https://transportup.com/headlines-breaking-news/helicopters-vs-evtols-how-will-going-electric-improve-aerial-mobility/

Helicopters vs eVTOLs: How will going electric improve aerial mobility?

21 September 2019 || 9 min read

eVTOLs have benefits that helicopters won't be able to compete with.



How will eVTOLs improve aerial mobility in ways that helicopters haven't?

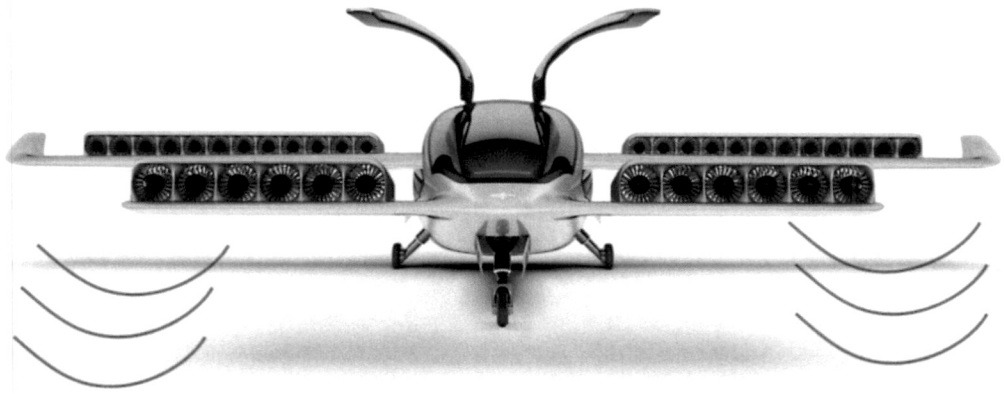
Helicopters are the world's current solution to aerial mobility: a time proven system that effectively transports people and goods short to medium distances, with vertical takeoff and landing capabilities to boot. Air taxi services utilizing helicopters have operated since the 1950's, New York Airways being one of the famed initial operators that was profitable until a crash in 1977 resulted in the company going defunct.

Today, companies like BLADE have successfully implemented shared-seat and private charter model air taxi services in locales such as New York, and other mobility companies like Uber have followed suit and launched their own platform, Uber Copter in mid-2019, also operating in New York City. The usage of helicopters for on-demand aerial mobility services extends beyond the United States – Voom operates Airbus Helicopters in Sao Paulo and Mexico City. All of these companies share a common intent, which Airbus' lists on their website:

By providing daily commuters with a more efficient transportation option, Voom addresses the challenges associated with traffic congestion in cities. At the same time, Voom enables Airbus to lay the groundwork for our longer-term vision of urban air mobility in which urban transport is powered by electric vertical take-off and landing (eVTOL) vehicles.

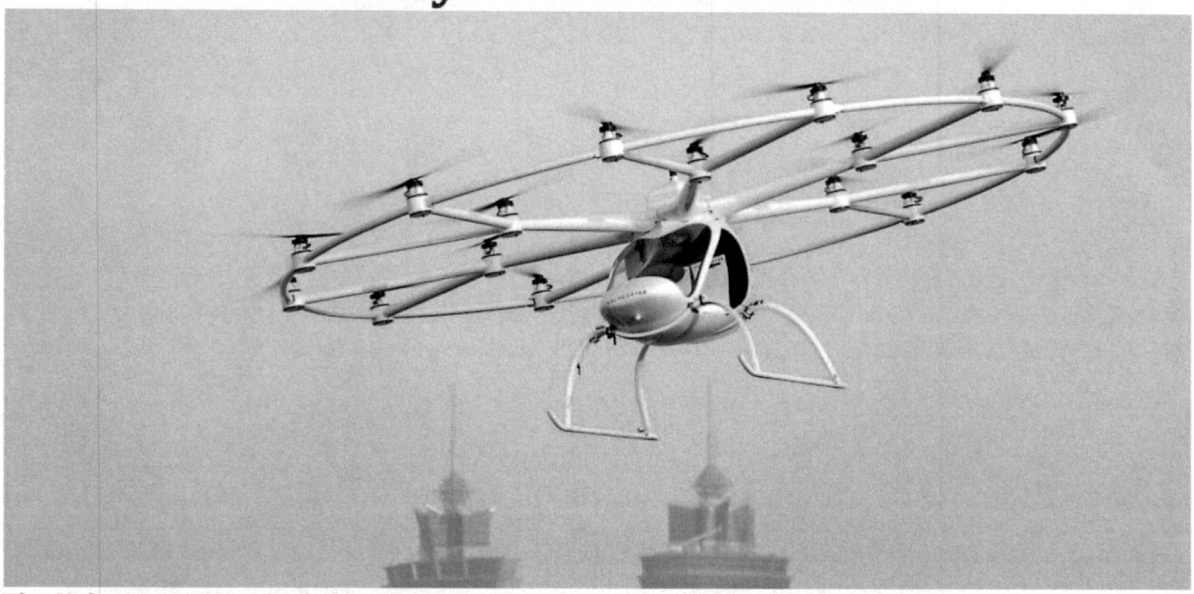
BLADE, Uber, Voom, and other companies intend on making the transition to eVTOLs when the time is right. But given the operational history and depth of knowledge in a proven system like the helicopter, why expend the extra effort to replace helicopters with an entirely new system?

Noise Pollution



One of the greatest obstacles to launching any aerial mobility service is noise and visual intrusions to the public. Many aerial mobility companies that intend on utilizing eVTOLs must overcome the hurdle of community acceptance. Fortunately, existing operators have accomplished this goal with an even more challenging (and louder) system – the helicopter. Among key aspects to reduce noise and visual pollution are electrification of the power plant (reduction in turbine noise emissions) and leverage original propulsion systems (smaller rotors) that output proportionally less noise than a singular rotor system like a helicopter. Resultantly, eVTOL OEM's prioritize noise impact reductions as a key feature of their designs and promote quieter skies as a major advantage for eVTOLs over traditional helicopters.

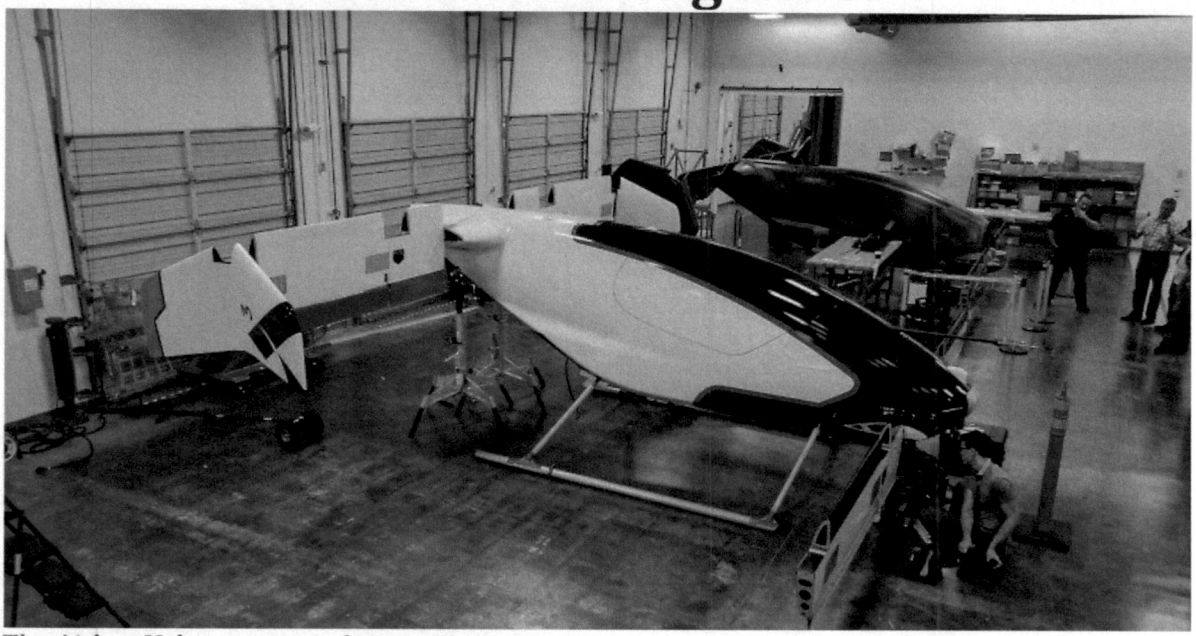
Safety Considerations



The Volocopter 2X, which features 18 rotors to reduce fan noise emissions during flight and mitigate single mode fan blade failure risk.

eVTOLs represent a step forward for vertical flight as designs progress away from single rotor to distributed propulsion solutions. Many eVTOLs use IDEP (Integrated distributed electric propulsion) employing several (sometimes up to 18) rotors for vertical lift. Rotor speed is independently controlled, thereby improving handling qualities and redundancies in the instance a single rotor should experience an anomaly. According to Uber Elevate's whitepaper, eVTOL developers claim to achieve levels of safety four times safer than that of helicopters (which equates to approximately double the current safety standards in autos). Additionally, the majority of helicopter accidents occur due to pilot or planning errors. With the advent of advanced autonomous flight control systems (updated with weather, air traffic information, and iterative flight path information) eVTOLs reduce risks associated with operator error. Even the initial piloted operations of eVTOLs will still be enhanced by the greater capabilities of flight control augmentation and situational awareness that accompanies vehicles designed for autonomous operation.

Manufacturing Costs



The Airbus Vahana, currently in prototype stage.

Manufacturing helicopters is complicated and expensive. While eVTOLs achieve similar levels of fuselage and materials complexity, many of their propulsion systems are plug-and-play: most eVTOL concepts use many of the same type of brushless DC electric motor for propulsion. While helicopters use turbines and transmissions to translate energy to thrust, electric motors driveshafts on eVTOLs are directly attached to fan blades, negating the need for transmissions. These manufacturing considerations also translate into MRO (Maintenance, Repair, and operations) architecture for aerial mobility. Helicopters require a complete overhaul of their turbine approximately every 2,000 flight hours. eVTOL motors will likely adhere to similar regulations, but in lieu of an expensive and time-consuming overhaul, electric motors would simply be removed and replaced in a few minutes.

Operational Expenses & Emissions



The Beta Technologies AVA, a fully electric eVTOL that began life as a Lancair.

The most direct benefit of eVTOLs over helicopters is electrification. Electric power (at the point of operation) is cheaper and cleaner than operating gas turbines. While mid -size helicopters typically consume 50 gallons of Jet-A per hour (or $200/hour of fuel assuming a nominal Jet-A price of $4/gallon). The predicted electricity costs for an eVTOL is approximately 8.2 cents per mile [Uber Elevate Whitepaper], and at a nominal speed of 50 miles/hour, equates to a whopping $4/hour for "fuel". In fact, for the same price as an hour of fuel for a helicopter, *an eVTOL could fly over 2,400 miles* (assuming recharging stops of course).

Additionally, electric operations reduce carbon emissions at the point of operation. While the electricity powering eVTOLs may not be 100% sustainably generated, electrification of aerial mobility (and aviation in general) will continue to grow as it has over the last 10 years – many examples of electric training aircraft, small commercial concepts, and hybrid systems are in operation around the world today.

Autonomous Operational System Architecture



At scale, eVTOLs intend to conduct aerial mobility operations autonomously, and integrated with airspace management systems to oversee the volume of air traffic in a highly populated urban area. Using these low altitude airspace management platforms such as AirMap and Boeing's Skygrid, the need for pilot and air traffic controller are eliminated. Most exciting, autonomous flights such as these have already occurred – EHang completed multiple passenger-carrying autonomous flights at the 2019 Northeast Asia expo in Changchun.
So when can we expect large-scale commercial operation of eVTOLs?

Although we won't see autonomous eVTOLs buzzing around the skies of LA, New York City, Tokyo, or London next year, progress is being made every day to enable commercial operations of electric vertical takeoff and landing aircraft. Helicopters currently serve as the gateway to lay operational framework, but studies such as one from Morgan Stanley's research arm estimate that eVTOL aerial mobility services could be valued at up to $1.5 Trillion by the year 2040.

Over 100 companies are developing eVTOL aircraft, and Uber claims that it will launch initial services within five years. Several of the world's major aircraft manufacturers including Airbus, Boeing, and Bell are also developing their own aircraft, many of which are already in the flight testing phase of development.
To learn more about the growing world of eVTOLs, aerial mobility, air taxis, and more, visit TransportUP's homepage at TransportUP.com

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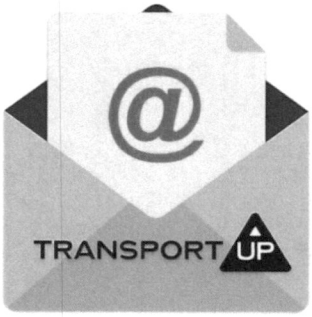
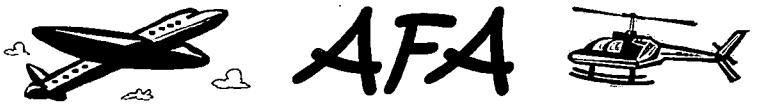


Listen to the TUP Podcast



Sources // Uber Elevate, EHang, Volocopter, Lilium, Airbus



Airport Planning and Design

December 6, 2023

Board of Commissioners
555 Court St NE, Suite 5232
Salem, OR 97301

RE: North Marion County Vertiport/Heliport Conditional Use Application:
Discussion of Need for Vertiport, Lack of Space at Aurora State Airport,
& Clustering of Related Businesses

Dear Honorable Commissioners:

This letter provides information concerning the need for the aviation uses, and why they are proposed at this site, for the conditional use application for the North Marion County Vertiport/Heliport to be located in Tax Parcels 800 and 900 Map 041W12B, 16.54 acre parcel at 22515 Airport Road NE, Aurora, Marion County. This letter also provides information about why there is not sufficient space at adjacent Aurora Airport for this use, and why it is advantageous for helicopter, vertiport, and heliport related businesses to be located near each other.

Heliport and airport planning and impact analysis is a professional expertise of mine and I practice it as an Oregon licensed civil engineer and architect. Over the past 38 years I have performed extensive work on heliport and airport master plans, noise reports, hangars, zone changes, conditional use permits, goal exceptions, and ALP Updates.

This application is for a "vertiport/heliport" and to clarify – a "vertiport" is the FAA's term for a newer version of a "heliport." The FAA has created design standards for vertiports which relate to the next generation of vertical takeoff aircraft like helicopters, but which will be dominated by multi-rotor electric powered aircraft.

These newer aircraft are being certified by FAA and over time are likely to become dominant in the vertical takeoff category of aircraft because of their lower energy needs, lower carbon footprint, and improved safety due to next generation guidance and control systems. The FAA has issued approach-departure path standards for vertiports and they have very similar standards to the FAA's guidance for heliports, so in reality vertiports are also designed to function as spaces for traditional helicopters as well as the next generation vehicles.

My planning, architecture, and engineering work has included design for the following heliports:

Portland Downtown Public Heliport OHSU Heliport Emanuel Hospital Heliport

Quinault Nation Heliport	Niagara Falls NY Heliport	Missoula MT Hosp. Heliport
Life Flight Astoria Astoria	HTS Heliport	Keiser Sunnyside Heliport
Providence Hospital Heliport	Life Flight Pendleton	Salem Hospital Heliport
Providence Portland Helistop	Life Flight The Dalles	Oregon Grad Center Heliport
Richmond WA Hosp Heliport	Astoria Hospital Heliport	Hermiston Hospital Heliport
PeaceHealth SW Medical Heliport	Westwood Heliport	Swan Island Heliport

and because heliports are a kind of airport, and airports also function as heliports for purpose of helicopter flight, I can mention that I have worked on the following Oregon airports:

Aurora	Pendleton	The Dalles
Astoria	Troutdale	Hillsboro
Portland International	Chiloquin	McDermitt
Independence	Florence	Renton
Madras	Hermiston	Boardman
Lexington	Lake County	Mulino
Albany	Condon	Wasco County
North Bend	Christmas Valley	Bend
Prineville	Baker City	Hood River

Need for North Marion County Vertiport/Heliport

Aircraft capable of vertical takeoff and landing are especially needed for public safety, so having sufficient facilities that allow an expansion of the use of this category of aircraft is vital for our state, Marion County, and local communities near the site. This site will be capable of serving a range of vertical takeoff and landing aircraft types, including:

1. Heavy Lift Helicopters: This site can accommodate heavy lift helicopters that are critical for fighting forest fires and for maintaining power lines as preventative measures during severe weather patterns. Two primary approach and departure paths are provided that are sized to allow use of these large helicopters, and the designated hangar areas are designed to be large enough to be capable of servicing these helicopters.

2. Emergency Medical Helicopters: This site can accommodate emergency medical helicopter services, such as provided by Life Flight Network and other providers. The medical helicopters are smaller than the heavy lift helicopters, thus they also are capable of using the approach-departures and the site areas.

3. Next Generation Vertical Takeoff Aircraft: This new facility is designed to serve the next generation of vertical takeoff and landing aircraft that have multiple main rotors and are electric powered. Thus, this new facility will have charging stations and refueling stations for these new generation aircraft, that will not be available at other heliports or airports. The approach-

departure paths are specifically designed to comply with the FAA's new standards for vertiports, which in turn are intended for this new generation of aircraft.

4. State of Oregon Department of Aviation Promoted Next Gen Aircraft: It should be noted that the State of Oregon has recently indicated intent to potentially purchase up to 126[1] of a new generation aircraft that qualify as using vertiports, with these new aircraft being intended to service rural areas for improved medical service. This site can be one in this part of Marion County for use by these aircraft as designated locations for maintenance, fueling, and electrical charging.

5. Size Parcel for Approach-Departure Paths: Each vertiport and/or heliport needs adequate site space such that from the designated departure point, the aircraft can gain sufficient altitude to clear adjacent power lines, adjacent buildings, and adjacent roads. The FAA provides standards for the slope of that cleared area, along with its width, such that it can be considered safe from an aeronautical standpoint.

   Even though vertical takeoff and landing aircraft have the ability to arrive and depart at quite steep slopes, the vertiport and/or heliport is intended to be useful at night, during rainstorms, during snow storms, and during windy and gusty environmental conditions. During those periods, the availability of a shallower approach provides increased margins of safety for the operation, and at times a flatter approach itself, for aircraft lift purposes, provides a safer approach. Therefore, the FAA designated approaches and departures are designed so that during adverse weather conditions the transportation system continues to function. Like for fixed wing aircraft, vertical takeoff and landing aircraft also function better during cool temperatures, and worse during high temperatures, due to the changing density of the air. Thus, conservative approach-departure paths promote reliable use during summer and winter.

   The site plan provided with this application shows the length and width of standard FAA required approaches and departure paths needed for a transportation facility like what is proposed. It makes graphically clear that a large acreage is needed, as is provided by this parcel.

6. Advantage of this Site being Adjacent to Farm Lands: Heliports are benefitted by being located adjacent to agricultural lands outside of a city, since it allows the flight paths needed for the aircraft to gain altitude to occur over the farmed areas, and not over an urban area. This minimizes the aircraft noise of the approaches and departures from affecting urban lands that have noise sensitive uses. The approaches and departures over the farmed lands also creates added aviation safety for those operations, since it provides a wide-open area with more room for maneuvering of the aircraft than would be provided over urban lands.

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[1] https://transportup.com/headlines-breaking-news/vehicles-manufactures/oregon-will-use-up-to-126-jump-evtol-aircraft-for-emergency-response/?utm_medium=email&utm_source=rasa_io&utm_campaign=newsletter (print copy attached as Exhibit A: "Oregon will use up to 126 Jump eVTOL aircraft for emergency response").

It is my professional opinion that a new vertiport site of approximately 10 to 20 acres in size is needed in the immediate area surrounding the Aurora Airport and its adjacent aircraft-related uses. As explained in more detail throughout this letter, my conclusion is based on the projected demand found in the 2012 Aurora Airport Master Plan analysis, development that has occurred since 2012, the interest in a vertiport facility expressed by near-by companies that rely on helicopter-based operations, the type of helicopters and vertical takeoff aircraft discussed above, and my years of experience designing heliports and airports summarized above. The proposed site meets these size requirements and in my opinion is ideally suited for the proposed use, but there may be other suitably sized properties within the immediate area that are suitable to the identified need.

In conclusion, this site provides for expansion of vertical takeoff and landing aircraft of all types. Thus, it likely can allow existing nearby vertical lift businesses to have space for expansion. In any case, just the existence of other nearby vertical lift businesses makes this site especially appropriate for the use, since these businesses function better by functioning as clusters, as will be expanded on below.

Lack of Space at Aurora State Airport

There is not any similar sized land available at adjacent Aurora Airport. In fact, Aurora Airport is essentially fully built out.

Since 1997, approximately a third of my professional work has been spent working with property owners, developers, and operators at the Aurora State Airport in my capacity as a consultant for multi-discipled development services ranging from master plans to building designs and aircraft apron layouts.

That work has included being consultant to Helicopter Transport Services to help them from January 1, 2012 to March 31, 2020, develop their 27-acre property for its full committed heavy lift use. During that eight-year period I have also assisted other airport operators in their work developing aviation properties of approximately 8 acres for a total of approximately 35 acres of airport related developed uses in this area.

Approximately 10 acres of additional airport-related development are currently under planning with committed leases by the State, and owned property, that are now creating detailed plans for development. Approximately 2.4 acres of that development is about to be completed.

The South End Airpark overall site has 12 percent of land available for development for three

hangars, but that land area is already committed for specific buildings for which contractor bids are being received and detailed plans being developed, for submittal for building permits. One of those projects (Hangar Foxtrot) is now in construction with steel being erected.

Of the estimated 39 acres of available developable land within the Aurora Airport in 2012 per the Master Plan analysis, there is now no significant area of land within the Airport available for development, except by the companies that already own their own land and have development plans already in place for their own purposes, or have already leased the land from the state and have development plans already in place for their own purposes.

The only remaining existing airport land areas that could conceivable be made available for future long-term hangar development by others, are State owned land used for parking of aircraft and tying them down in the open air. This could create perhaps one or two acres of new available land, but it is certain that the FAA would object to this, and not allow it to occur. This is because the airport is required to maintain a reasonable amount of aircraft tie-down areas for transient aircraft visiting this airport, so that the airport can be usable within the national system of airports.

It is my professional opinion that the 2012 estimated five-acre deficiency of available lands zoned for airport-related uses has already been used up, and the need now is equal to or greater than the 16 acres of the North Marion County Vertiport/Heliport proposed conditional use area. This is because of the fulfillment of the Helicopter Transport Services facility, the increased rate of development occurring in the prior eight years, and the types of aircraft served at the Aurora Airport which need larger sized hangars.

Clustering of Related Businesses

The importance of clustering of businesses, as an aspect to encourage and promote, has been recognized by the State of Oregon as a fundamental concept in planning for economic development for the state as a whole. This is based on the business clustering concepts developed by Harvard University professor Michael Porter[2] of the Harvard Business School and put into place by the creation of the Oregon Business Plan[3]. Aviation businesses are a key part of the Oregon Business Plan.

Vertiport and heliport businesses and services create a whole, unique transportation system for the

[2] https://www.isc.hbs.edu/about-michael-porter/Pages/default.aspx
[3] https://oregonbusinessplan.org/industry-clusters/

communities near that heliport. In this case, Helicopter Transport Systems is located next door, south, adjacent to this parcel with their own heliport, and Columbia Helicopters is located along Airport Road just one-half mile north, with their own heliport. In addition, on Aurora Airport (adjacent property to the west) there are other important helicopter companies: Life Flight Network (emergency medical), Wilson Construction (power line work), Winco Inc. (power line work). There are interactions and partnerships between these businesses at these heliports, that make it beneficial for them to locate near each other. This creates a cluster of aviation businesses that functionally share employees, skills, and even specialized machinery. Equally important they share an overlapping airspace governed by FAA with all takeoffs and landings occurring through the safety of the adjacent FAA control tower[4].

The aviation-related uses requested for this conditional uses are ones that have been approved by prior conditional use permits received from Marion County. With the existing uses authorized previously by Marion County around this site, these serve nearby communities very well. This has developed a strong group of aviation businesses that specialize in providing emergency services needed during earthquakes, windstorms, forest fire, and other emergencies. These are important services to encourage as they serve not just nearby communities, but all of the citizens of Marion County and of Oregon.

Respectfully submitted,

Aron Faegre

Aron Faegre, AIA, PE

Attachments
Exhibit A: Oregon will use up to 126 Jump eVTOL aircraft for emergency response

[4] The control tower functions during 7am to 8pm, the busy portion of the day, and after that individual aircraft maintain safe separation by FAA required radio communication directly between each aircraft and their systems.

TRANSPORT UP

The Latest News for Aerial Mobility

Vehicles/Manufactures

Oregon will use up to 126 Jump eVTOL aircraft for emergency response

03 December 2023 || 3 min read

Jump Aero, a California-based aircraft manufacturer, has partnered with the Oregon Department of Aviation to explore the integration of their JA1 Pulse Aircraft into the fabric of Oregon's emergency response ecosystem. The recently inked Memorandum of Understanding (MOU) marks a collaborative effort to redefine emergency medical services in rural Oregon, harnessing the speed and sustainability of the JA1 Pulse Aircraft.



The MOU anticipates the potential deployment of up to 126 JA1 Pulse aircraft to ensure swift access to trained professionals at emergency scenes, particularly in areas where the current response times exceed the desired standard of eight minutes due to vast distances and challenging terrains. The JA1 Pulse Aircraft is poised to significantly impact the lives of Oregon's residents and visitors alike.

This collaboration represents significant progress in Jump Aero's mission to provide rapid medical first response coverage to diverse regions. The Oregon Department of Aviation's commitment to exploring innovative solutions echoes their dedication to enhancing emergency services for all residents. Director Kenji Sugahara expressed anticipation about the partnership, stating, "We look forward to cultivating a long-term relationship with Jump Aero as we delve into providing rapid first response to our rural communities with the JA1 Pulse."

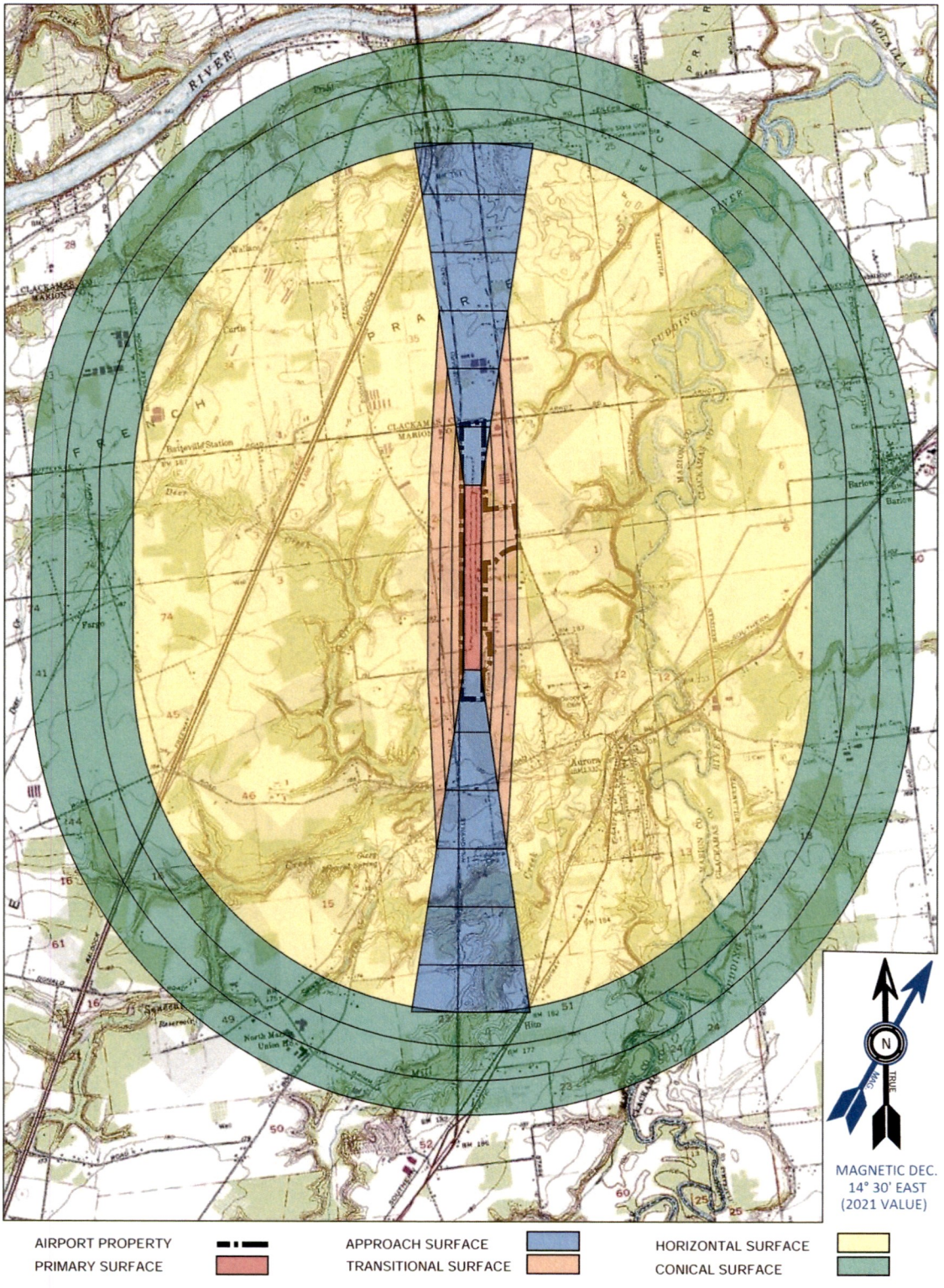
Oregon Department of Aviation's progressive stance, emphasizing the JA1 Pulse's potential to not only reduce emergency response times but also to elevate survival rates in rural communities. Dietrich enthused, "We are confident that the JA1 Pulse will emerge as a critical life-saving tool in Oregon, and we eagerly anticipate collaborating with first responders in Oregon and other partner regions."

Headquartered in Petaluma, California, Jump Aero specializes in electric vertical takeoff and landing (eVTOL) aircraft technology and their vision extends beyond innovation to revolutionizing emergency response times in rural areas. For detailed insights into Jump Aero and the JA1 Pulse aircraft, visit www.jumpaero.com.

Why it's important: The Oregon Department of Aviation (ODAV) takes center stage as a state agency dedicated to propelling the development of aviation within Oregon's transportation system while ensuring the safety of its airways. This collaboration with Jump Aero exemplifies the department's unwavering commitment to advancing emergency services in the state, marking a noteworthy stride toward a safer and more resilient state of Oregon.

Posted in: Vehicles/Manufactures

FIGURE 2-9: FAR PART 77 AIRSPACE



For Aurora State Airport, the approach surfaces for the runway extend 10,000 feet beyond each runway (beginning 200 beyond the runway end).

Source: Century West Engineering

Exhibit 32



NORTH MARION COUNTY VERTIPORT

ARON FAEGRE ARCHITECT
13200 FIELDING RD.
LAKE OSWEGO
OREGON
97034
503-680-1469

REGISTERED ARCHITECT
ARON FAEGRE
PORTLAND, OREGON
STATE OF OREGON

NORTH MARION COUNTY VERTIPORT
MASTER PLAN
AIRPORT ROAD - AURORA, OREGON

MASTER SITE PLAN

DATE 7-7-2023
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REVISIONS

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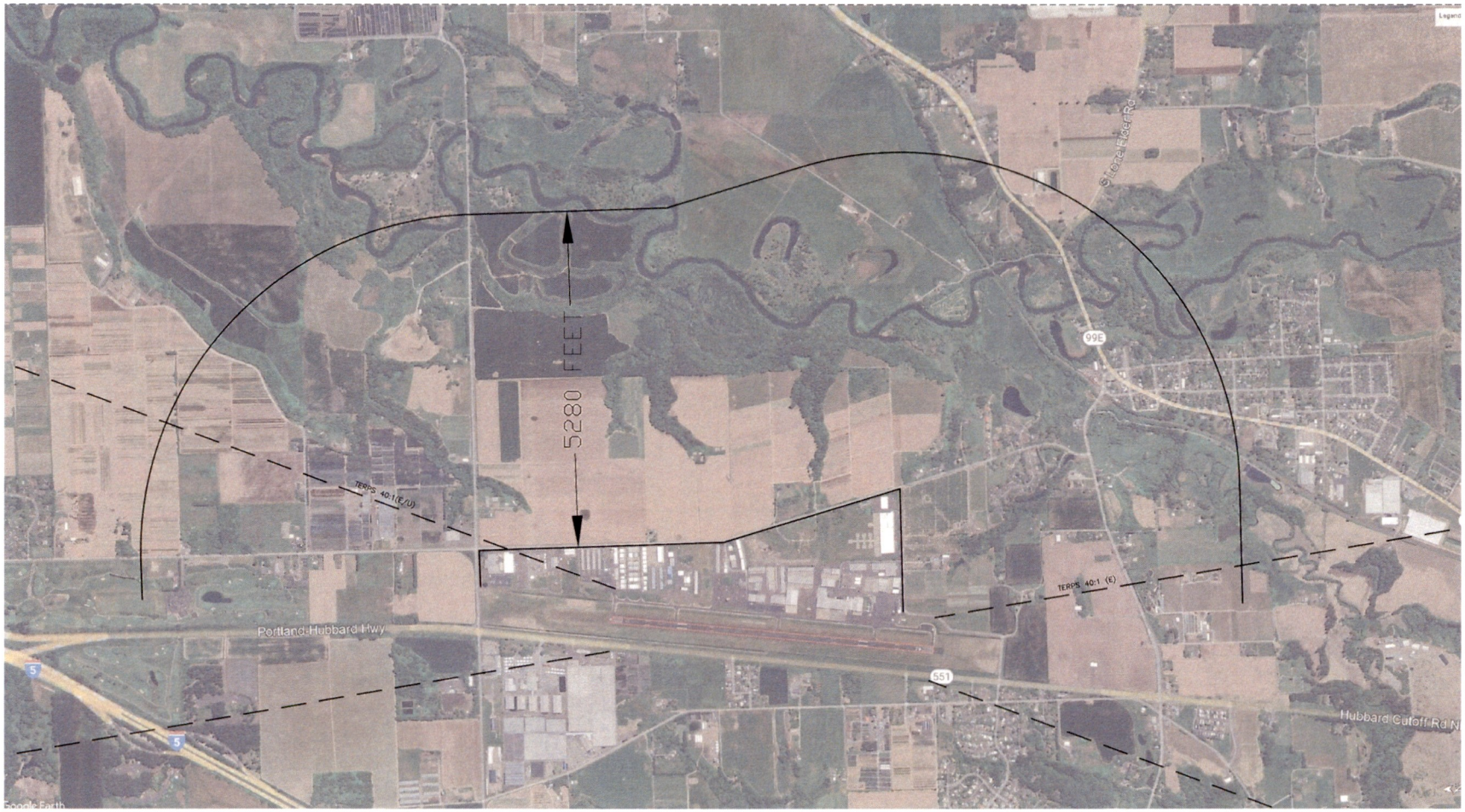
Exhibit 33



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NORTH MARION COUNTY VERTIPORT

ARON FAEGRE ARCHITECT
13200 FIELDING RD.
LAKE OSWEGO
OREGON
97034
503-680-1469

REGISTERED ARCHITECT
ARON FAEGRE
PORTLAND, OREGON
STATE OF OREGON

NORTH MARION COUNTY VERTIPORT
MASTER PLAN
AIRPORT ROAD - AURORA, OREGON

MASTER SITE PLAN

DATE 7-7-2023

DRAWN BY AF

REVISIONS

PAGE:
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23215 Airport Road NE
AURORA, OR 97002



FOR SALE

MACADAM FORBES
COMMERCIAL REAL ESTATE SERVICES

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joek@macadamforbes.com
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All of the information contained herein was obtained either from the owner or other parties we consider reliable. We have no reason to doubt its accuracy, however we do not guarantee it.

FOR SALE





PROPERTY DESCRIPTION

23215 Airport Road NE is a 6.41-acre land parcel with a 13,104 square foot metal warehouse property that has direct access to the runway. With a low site coverage ratio, the property provides the opportunity for a user or developer to build additional buildings or airplane hangars.

The property is on a private well and septic system, however, the site shares the drain field on the property to the south (23115 Airport Road NE, which the seller also owns). The seller will allow a new buyer to utilize the drain field but will require them to install their own on the subject property within 12 months after closing. On the north side of the subject property is an NW Natural easement to their substation, which is also located on the subject property.

The property is zoned Public, allowing for farm/forest uses and wireless/utility facilities. The zoning provides for several conditional uses, including airport-related commercial and industrial uses, churches/religious organizations, military training, and museum uses.

OFFERING SUMMARY

Sale Price:	$5,000,000
Property Taxes:	$10,571
Lot Size:	6.41 Acres
Building Size:	13,103 SF
Year Built:	1993

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FOR SALE





PROPERTY HIGHLIGHTS

- Rare opportunity to own fee simple ownership at the Aurora Airport
- Direct access to the runway
- Close proximity to Interstate 5
- Additional land to construct additional buildings



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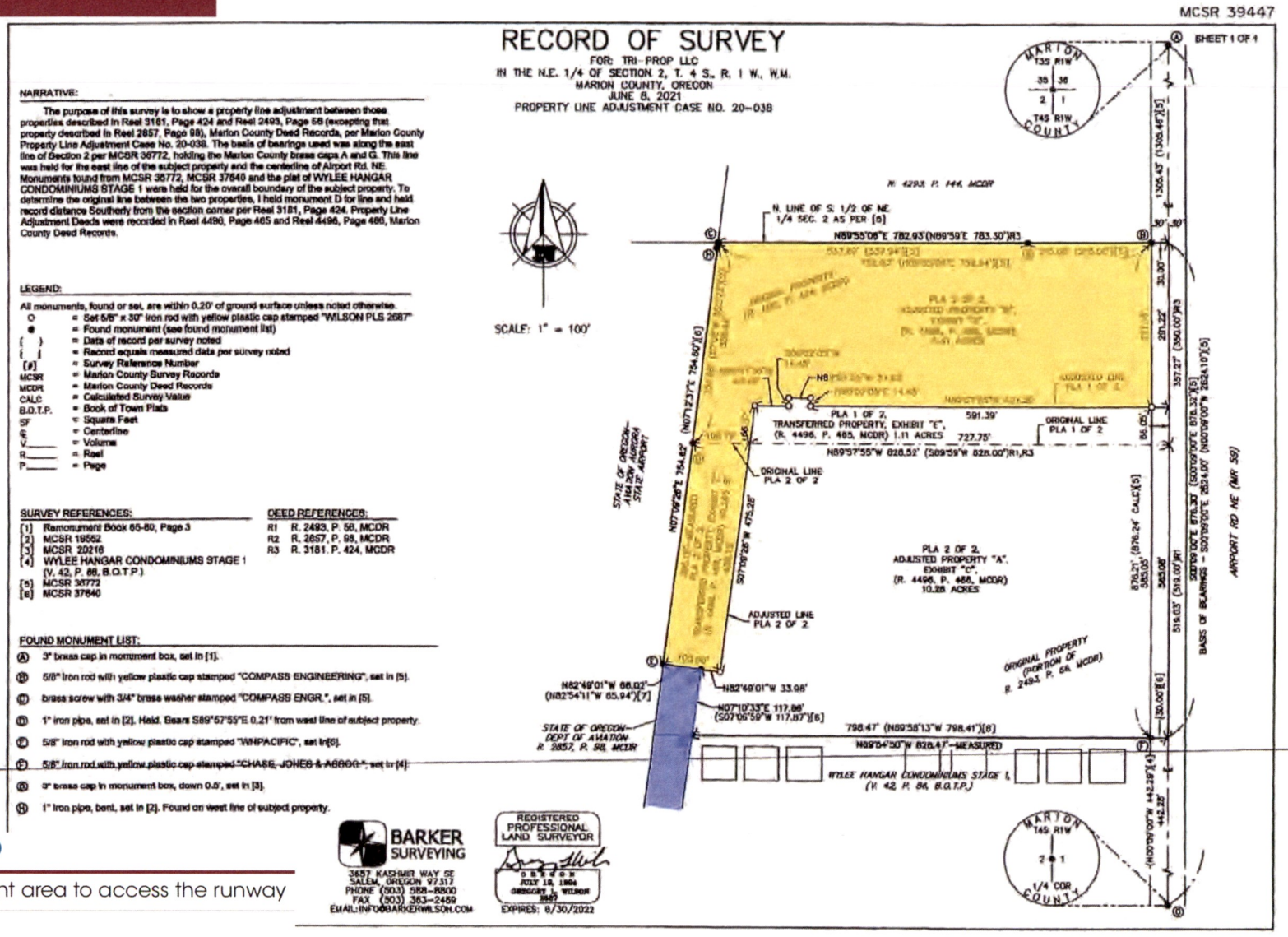

LEGEND

- Easement area to access the runway
- Site

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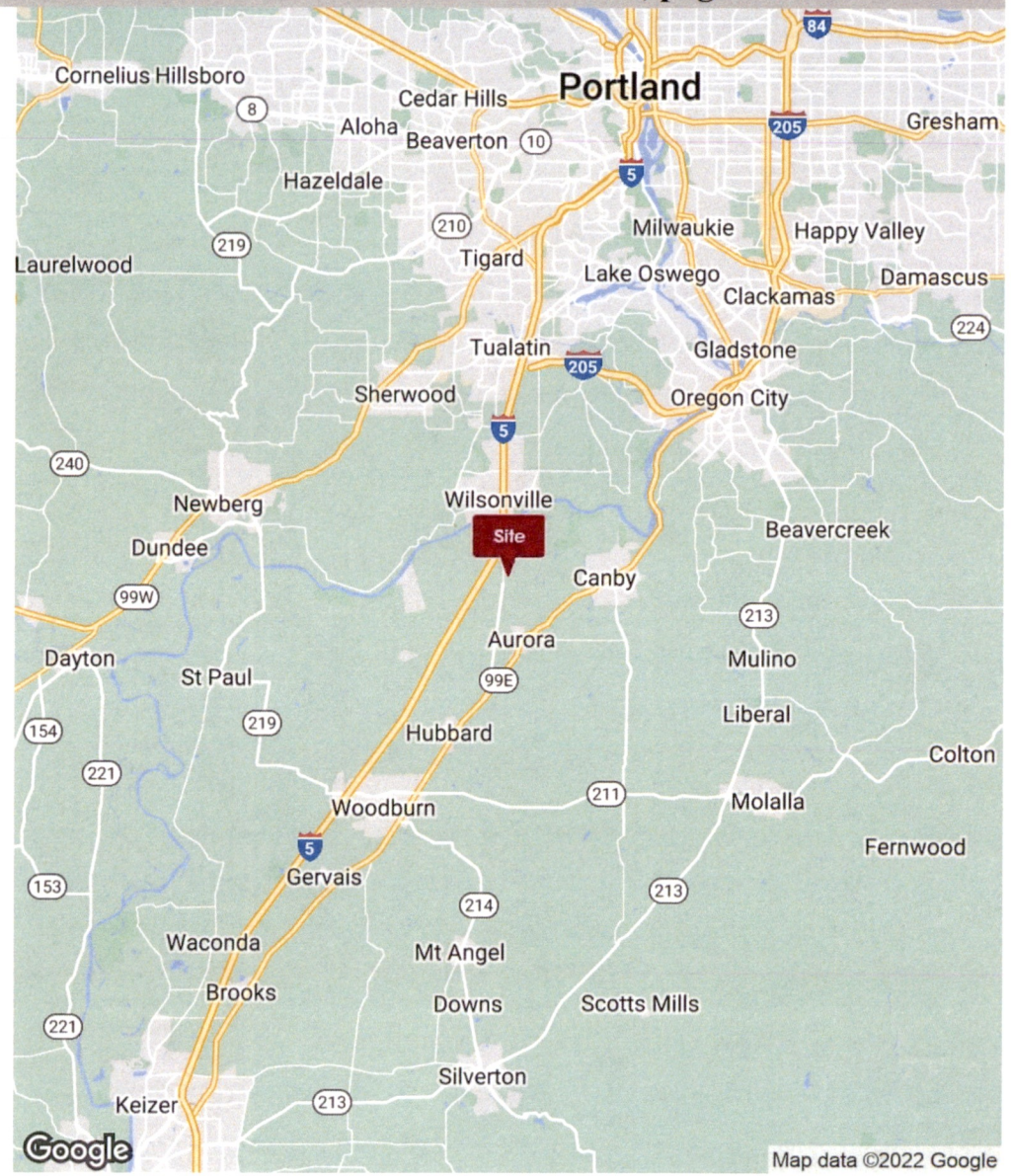
FOR SALE

23215 Airport Road NE, Aurora, OR 97002





DEMOGRAPHICS	1 MILE	3 MILES	5 MILES
Total population	605	8,088	47,389
Median age	41.5	49.2	40.6
Total households	196	3,601	18,760
Total persons per HH	3.1	2.2	2.5
Average HH income	$75,480	$93,711	$97,668
Average house value	$852,045	$592,128	$436,823

LOCATION OVERVIEW

Rare opportunity to acquire fee simple land located at the Aurora Airport just south of Wilsonville, Oregon. The property has access to Interstate 5 just 2 miles north and Interstate 205 is 8 miles away.

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Table of Corridor Properties

This table lists the properties within the designated corridor that might reasonably accommodate the proposed transportation facility.

Map Guide Red Dot Number	Map Number	Tax Lot #	Can Reasonably Accommodate?	Notes
1	TRS 03S 1W 36	100	No	103.73 acres, property lies in area zoned with Historic District (HD) / Historic Landmark (HL) overlay by Clackamas County.
		801	Maybe	66.06 acres; odd shaped parcel; portion to north may not comply with flight path threshold; portions to east encumbered by riparian area; may have sufficient area in east to develop transportation facility
		802	Maybe	23.88 acres; may be in the airport flight path
		900	Yes	33.72 acres; odd shaped, contains riparian way, adjacent to residential uses, but may have sufficient area for proposal
		1300	No	18.05 acres; but within riparian area and trees.
		Lots to north and east	No	Lots to north fail flight path threshold. Lots farther east located in flood hazard areas.
2	TRS 04S 1W 02A	400	No	6.21 acres; Minimally developed lot in P-zoned property. Fails size threshold, further reduced by 35-foot access easement further reducing site width.
2	TRS 04S 1W 02D			Map includes subject property. Other lots developed or owned by State of Oregon for development consistent with Airport Master Plan.

3	TRS 04S 1W 01	100	Yes	157.06 acres; significant portion in floodplain area for Pudding River. Appears to have sufficient area for 10-20 acre transportation facility.
		200	Yes	78.70 acres; vegetated riparian area in very south portion of parcel; northern portion appears sufficient for proposal
		300	Yes	76.62 acres; vegetated riparian area and buildings in north east portion of parcel; southern portion appears sufficient for proposal
		400	Yes	78.99 acres; buildings and vegetated riparian area in eastern portion of parcel
		500	No	87.63 acres; entire parcel within floodplain area
		600	Yes	37.35 acres; linear shaped parcel, 660 feet wide
		700	Yes	34.55 acres; linear shaped parcel, 660 feet wide
4	TRS 04S 1E 06		No	Clackamas County parcels to east of Pudding River – parcels within floodplain areas
5	TRS 04S 1W 11A	900	Yes if combined with TL 1200 in same ownership	9.51 acres;
		1000	No	3.07 acres; does not meet size threshold; developed with buildings; adjacent lot to east has riparian area, so cannot meet minimum threshold size even if combined with GL 1100.
		1100	No	8.86 acres; does not meet size threshold; southern half of property has riparian area so cannot meet minimum threshold size even if combined with TL 1000

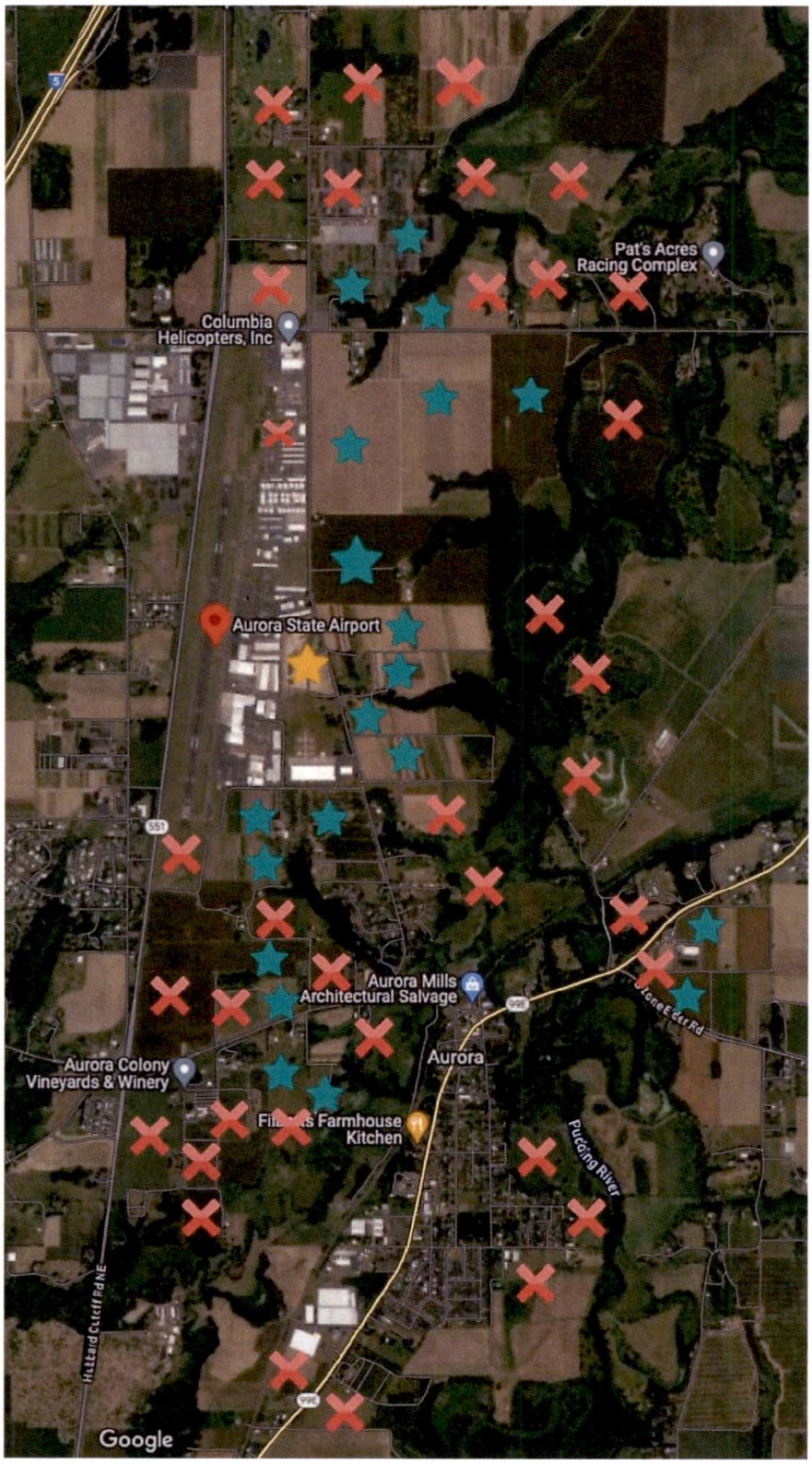
		1200	Yes if combined with either TL 900 or TL 1500 in same ownership	9.65 acres; western portions of property has riparian area on very east of property
		1500	Yes if combined with TL 1200 in same ownership	9.91 acres; very western portion of property has riparian area
5	TRS 04S 1W 11D	100	No	3.01 acres; does not meet size threshold; has riparian area on north end of property and owned by City of Aurora.
		200	No	32.71 acres; odd shaped lot; western portion lies within airport flight path; central part of lot is developed; eastern portion contains vegetated riparian areas.
		201	No	6.40 acres; cannot be effectively combined with adjacent lots due to existing development.
		202	No	0.58 acres; does not meet size threshold; adjacent to riparian area
		203	No	0.58 acres; does not meet size threshold; adjacent to riparian area
		700	No	Within airport flight path.
		701	Yes	15.9 acres. Adjacent to rural residential uses.
		1200	Yes	18.57 acres. Adjacent to rural residential uses.
		800, 900, 1000, 1100, 1300, 1400	No	Too small, developed with rural residential uses.
6	TRS 04S 1W 12	100	No	69.55 acres; odd shaped with heavily vegetated western portion, larger eastern portion within floodplain.
6	TRS 04S 1W 12B	100	Yes	12.77 acres; narrow site
		200	Yes	14.36 acres; narrow site, southern boundary partially impinged with riparian vegetation

		300	Yes	29.0 acres; northern boundary partially impinged with riparian vegetation
		500	Yes if combined with TL 800 in same ownership	6.75 acres
		600	Yes if combined with TL 700 in same ownership	5.77 acres
		700	Yes if combined with TL 600 in same ownership	6.91 acres
		800	Yes if combined with TL 500 in same ownership	8.23 acres
		900, 1000, 1100, 1200, 1300, 1400	No	Parcels do not meet size threshold. Cannot be consolidated due to existing development and vegetated riparian areas.
6	TRS 04S 1W 12 C	2400	Yes if combined with TL 2500 and TRS 04S 1W 12CB TL 1100	3.1 acres; inside City of Aurora UGB; adjacent on both sides to developed rural residential uses; within 500 feet of urban residential subdivisions.
		2500	Yes if combined with TL 2400 and TRS 04S 1W 12CB TL 1100	3.96 acres; inside City of Aurora UGB; adjacent on both sides to developed rural residential uses; within 600 feet of urban residential subdivisions.
		2600	No	34.94 acres; fails topography and obstruction thresholds for entire site.
		501-1900 and 2700	No	All sites too small and developed.
6	TRS 04S 1W 12CA	All properties	No	Properties within City of Aurora. Smaller lots developed with residential units; larger undeveloped areas are within the floodplain.

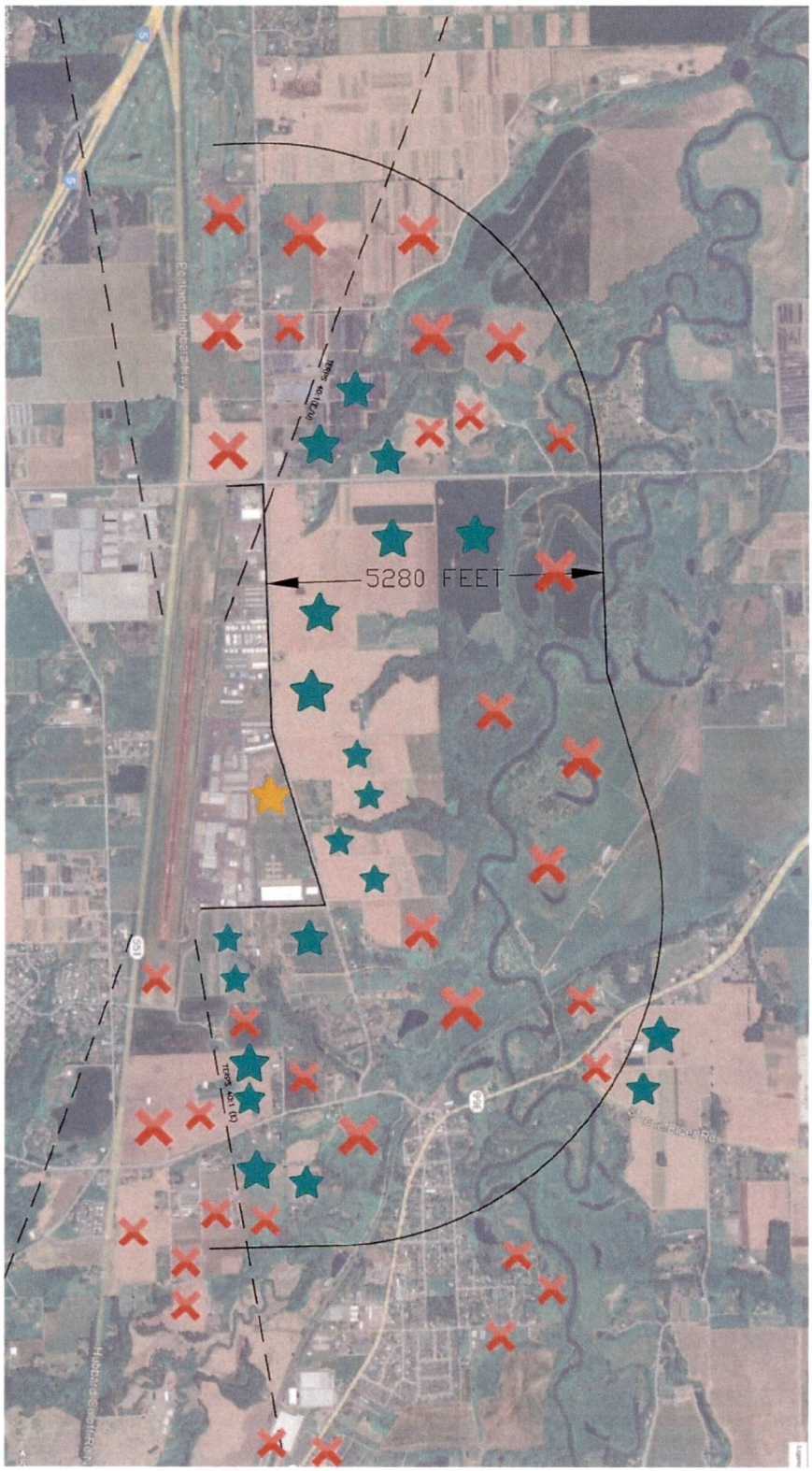
6	TRS 04S 1W 12CB	1100	Yes, if combined with TRS 04S 1W 12 C TL 2400 and	3.7 acres; inside City of Aurora UGB; adjacent on both sides to developed rural residential uses; within 300 feet of urban
			2500	residential subdivisions.
		All others	No	All remaining lots too small and unable to be combined to meet threshold, developed with urban residential uses or contains vegetated riparian areas.
7	T4S R1W Sec 7	3200	No	10 acres – bare minimum size, with extensive existing development and vegetation.
		3300	Yes	18 acres, fairly flat, partially within threshold area
		3400	Maybe	18 acres – some existing development, remainder flat and open, could be combined with adjacent TL 3900 (9 acres) or 3300 for flexibility. Partially within threshold area.
		All others	No	Clackamas County parcels to east of Pudding River. All lots either within flood zone, or too small and unable to be combined to meet minimum threshold due to development.
8	T4S R1W Sec 14A	100	Maybe	17.02 acres; western part maybe within airport flight path; adjacent to residential uses.
		500	No	26.25 acres; within airport flight path
		800	No	16.39 acres; within airport flight path; adjacent to residential uses.
		900	Yes	12.04 acres; near lower end of threshold size.
		1700	No	17.0 acres; within airport flight path.
		200, 300, 400, 500, 700, 1800	No	Too small, developed with residential uses, some in airport flight path.
		1000, 1100	No	Too small even if combined; encumbered with riparian vegetation and pond.

8	T4S R1W Sec 14D	All Other Lots	No	Parcels too small and developed; adjacent to noise sensitive uses
		800, 900, 1000	no	Although parcels are largely vacant and could be combined for adequate size, all three are within the protected flight path area. Also, near noise sensitive uses and traffic must run through City of Aurora to access target businesses.
9	T04 R1W Sec 13	All lots	No	All lots either within floodplain, or beyond threshold distance and outside the UGB.
9	T04 R1W Sec 13AB	All lots	No	Within City of Aurora City Limits; All lots too small and developed with urban residential uses.
9	T04 R1W Sec 13AC	All lots	No	All lots are beyond threshold distance. All lots are sub-sized and developed with urban residential development and cannot be consolidated to form threshold size. Larger lots (1-5 acres) are within floodplain.
9	T04 R1W Sec 13BA	All lots	No	Within City of Aurora City Limits; All lots beyond threshold distance, too small and developed with either commercial or urban residential uses.
9	T04 R1W Sec 13C	All other lots	No	Beyond threshold distance from target businesses.
		700	No	13.25 acres, but within protected flight path. Also beyond threshold distance, close to noise sensitive uses and traffic must run through City of Aurora to access target businesses.

Locations of Considered Properties

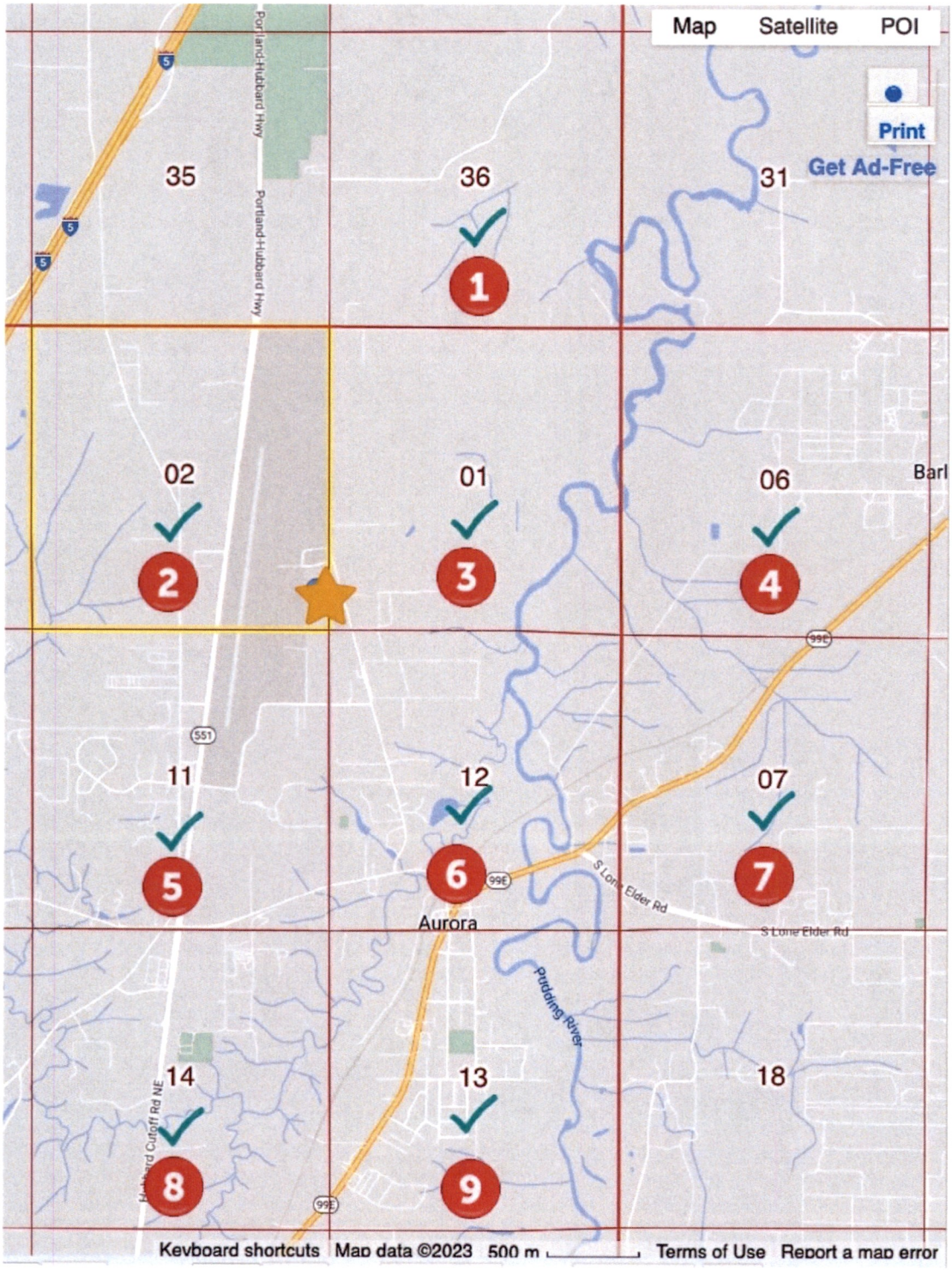


Locations of Considered Properties – Threshold Distance

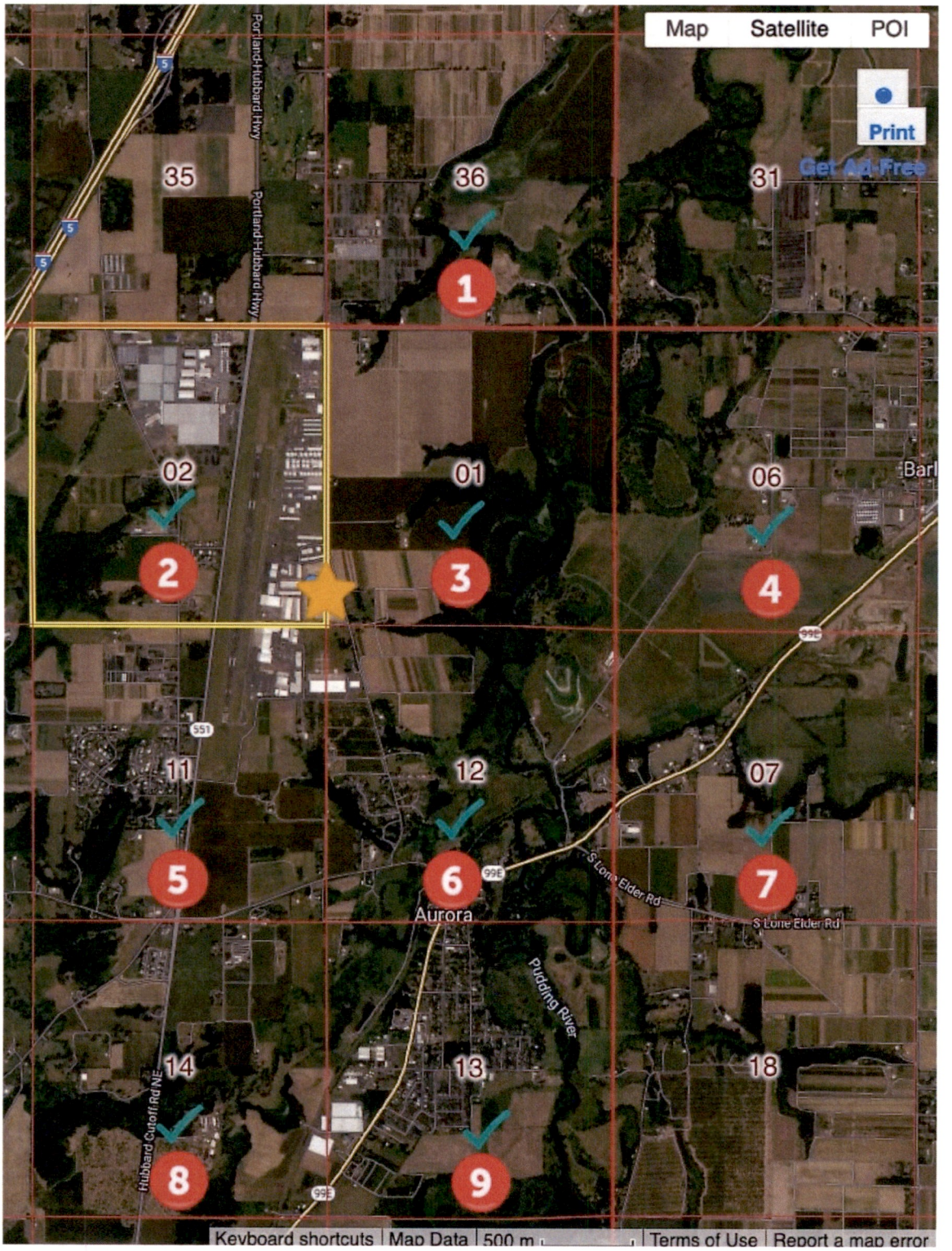


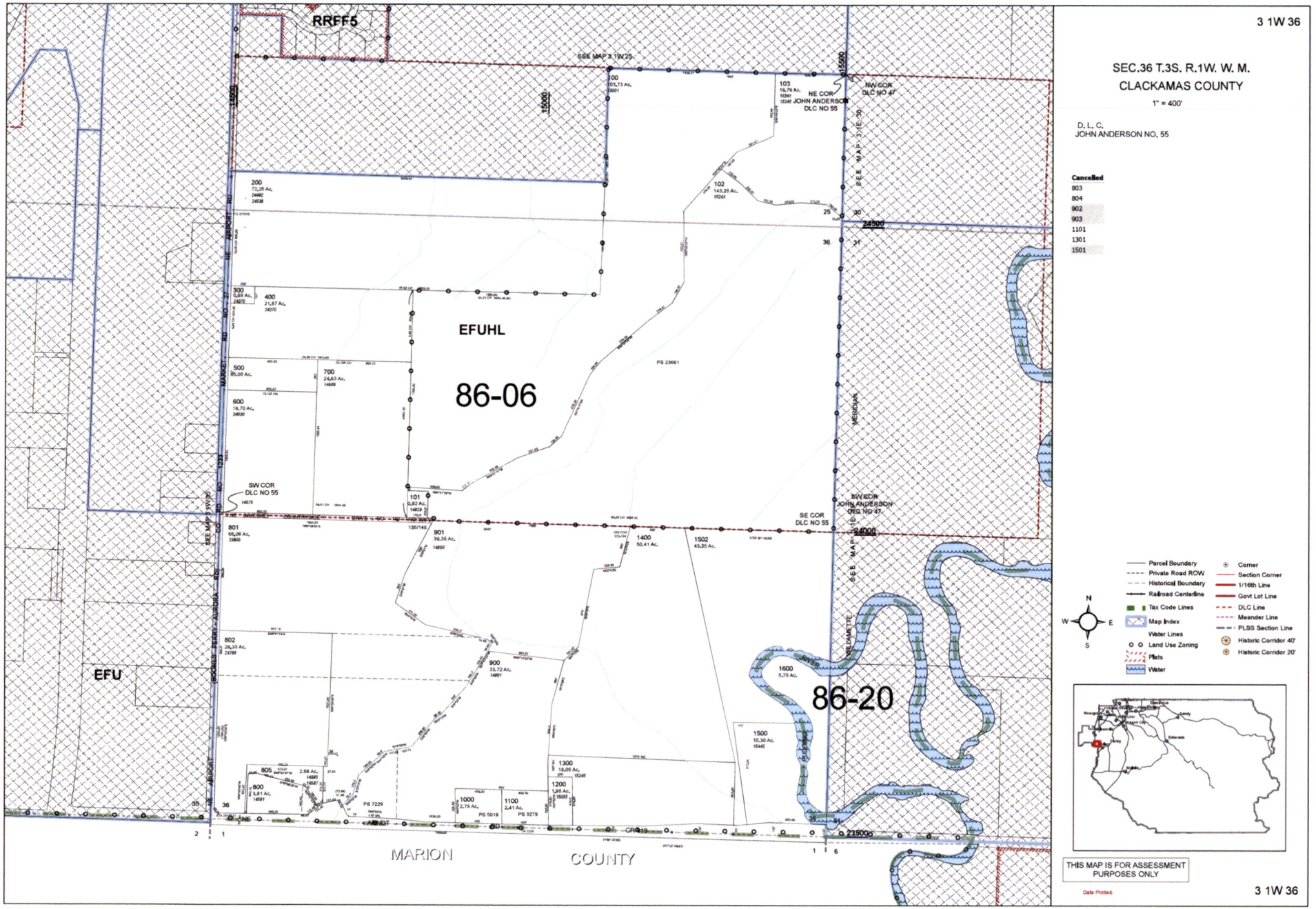
TRS Map Guide

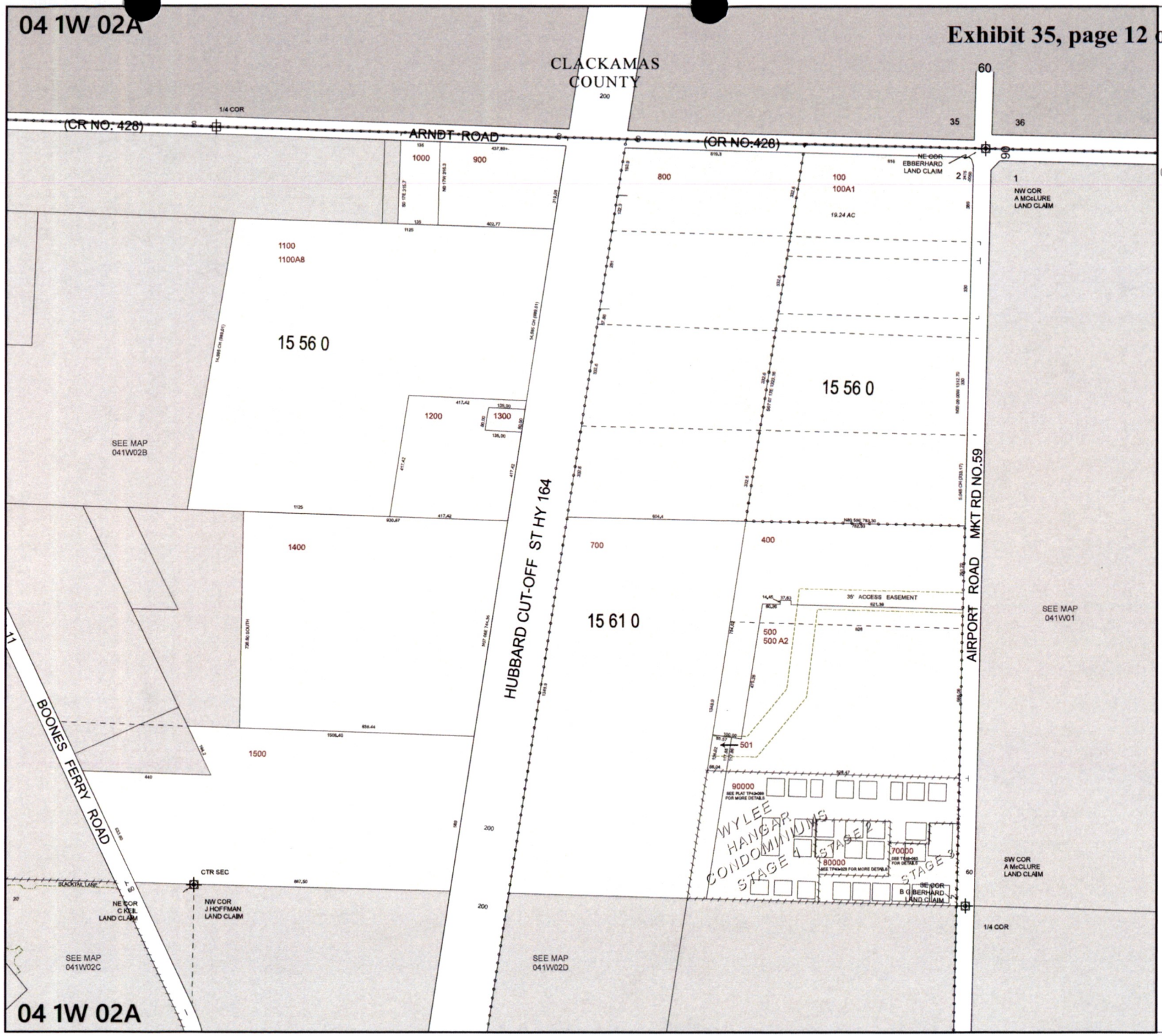
Map Base Map



Satellite Base Map




3 1W 36
SEC.36 T.3S. R.1W. W. M.
CLACKAMAS COUNTY
1" = 400'
D, L, C,
JOHN ANDERSON NO, 55
Cancelled
803
804
902
903
1101
1301
1501
RRFF5
EFUHL
86-06
EFU
86-20
SW COR DLC NO 55
NE COR JOHN ANDERSON DLC NO 55
NW COR DLC NO 47
SW COR JOHN ANDERSON DLC NO 47
SE COR DLC NO 55
MARION
COUNTY
Parcel Boundary
Private Road ROW
Historical Boundary
Railroad Centerline
Tax Code Lines
Map Index
Water Lines
Land Use Zoning
Plats
Water
Corner
Section Corner
1/16th Line
Govt Lot Line
DLC Line
Meander Line
PLSS Section Line
Historic Corridor 40'
Historic Corridor 20'
THIS MAP IS FOR ASSESSMENT PURPOSES ONLY
Date Printed:
3 1W 36



04 1W 02A



MARION COUNTY, OREGON

NE1/4 SEC2 T4S R1W W.M.

SCALE 1" = 200'

LEGEND

LINE TYPES

- Taxlot Boundary
- Historical Boundary
- Road Right-of-Way
- Easement
- Railroad Right-of-Way
- Railroad Centerline
- Private Road ROW
- Taxcode Line
- Subdivision/Plat Bndry
- Map Boundary
- Waterline - Taxlot Bndry
- Waterline - Non Bndry

CORNER TYPES

- 1/16TH Section Cor.
- 1/4 Section Cor.
- DLC Corner
- Section Corner (16, 15, 21, 22)

NUMBERS

Tax Code Number

00 00 0

Acreage

0.25 AC

All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW.

CANCELLED NUMBERS

200
300
600
601
1100A1
1100A2
1100A3
1100A5
1100A7

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Assessors Office
Cartography Dept

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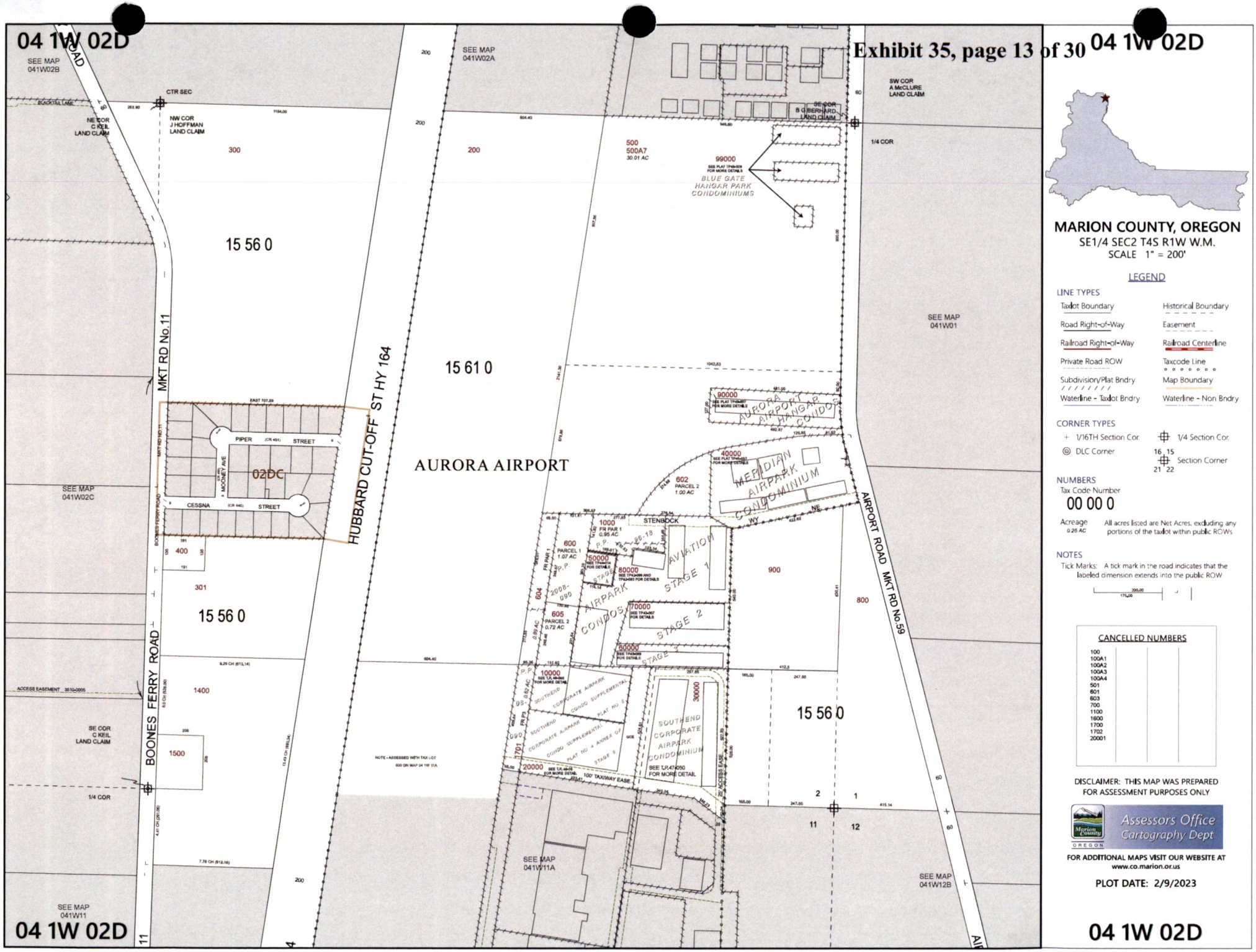
PLOT DATE: 7/16/2021

04 1W 02A



04 1W 02D

MARION COUNTY, OREGON

SE1/4 SEC2 T4S R1W W.M.

SCALE 1" = 200'

LEGEND

LINE TYPES

- Taxlot Boundary
- Historical Boundary
- Road Right-of-Way
- Easement
- Railroad Right-of-Way
- Railroad Centerline
- Private Road ROW
- Taxcode Line
- Subdivision/Plat Bndry
- Map Boundary
- Waterline - Taxlot Bndry
- Waterline - Non Bndry

CORNER TYPES

- 1/16TH Section Cor.
- 1/4 Section Cor.
- DLC Corner
- Section Corner (16, 15, 21, 22)

NUMBERS

Tax Code Number

00 00 0

Acreage 0.25 AC

All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW

200.00
175.00

CANCELLED NUMBERS

100
100A1
100A2
100A3
100A4
501
601
603
700
1100
1600
1700
1702
20001

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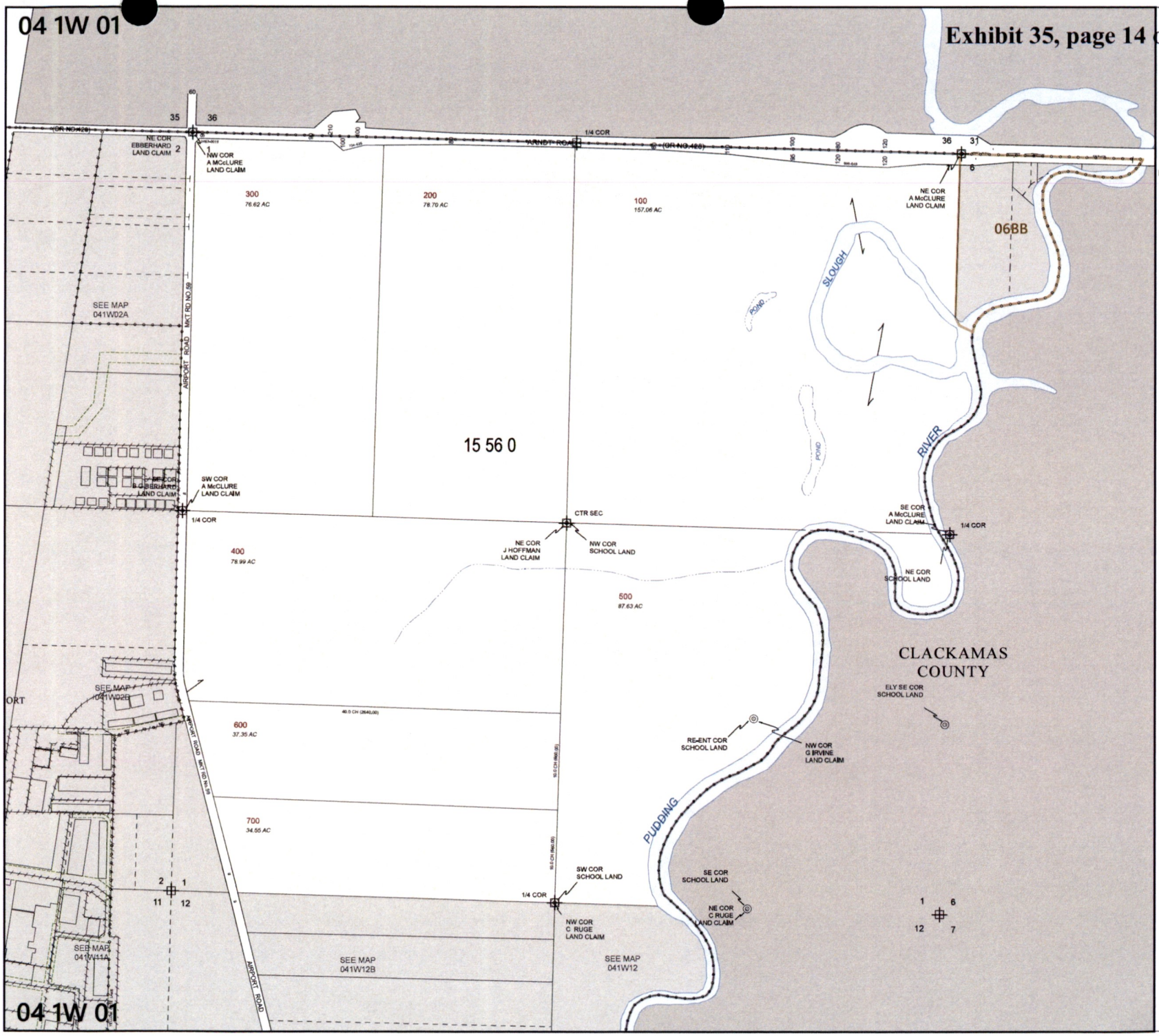
PLOT DATE: 2/9/2023

04 1W 02D

04 1W 01



04 1W 01



MARION COUNTY, OREGON

SEC 1 T4S R1W W.M.
SCALE 1" = 400'

LEGEND

LINE TYPES

- Taxlot Boundary
- Historical Boundary
- Road Right-of-Way
- Easement
- Railroad Right-of-Way
- Railroad Centerline
- Private Road ROW
- Taxcode Line
- Subdivision/Plat Bndry
- Map Boundary
- Waterline - Taxlot Bndry
- Waterline - Non Bndry

CORNER TYPES

- 1/16TH Section Cor.
- 1/4 Section Cor.
- DLC Corner
- Section Corner (16, 15, 21, 22)

NUMBERS

Tax Code Number
00 00 0

Acreage
0.25 AC

All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW

CANCELLED NUMBERS

400A1

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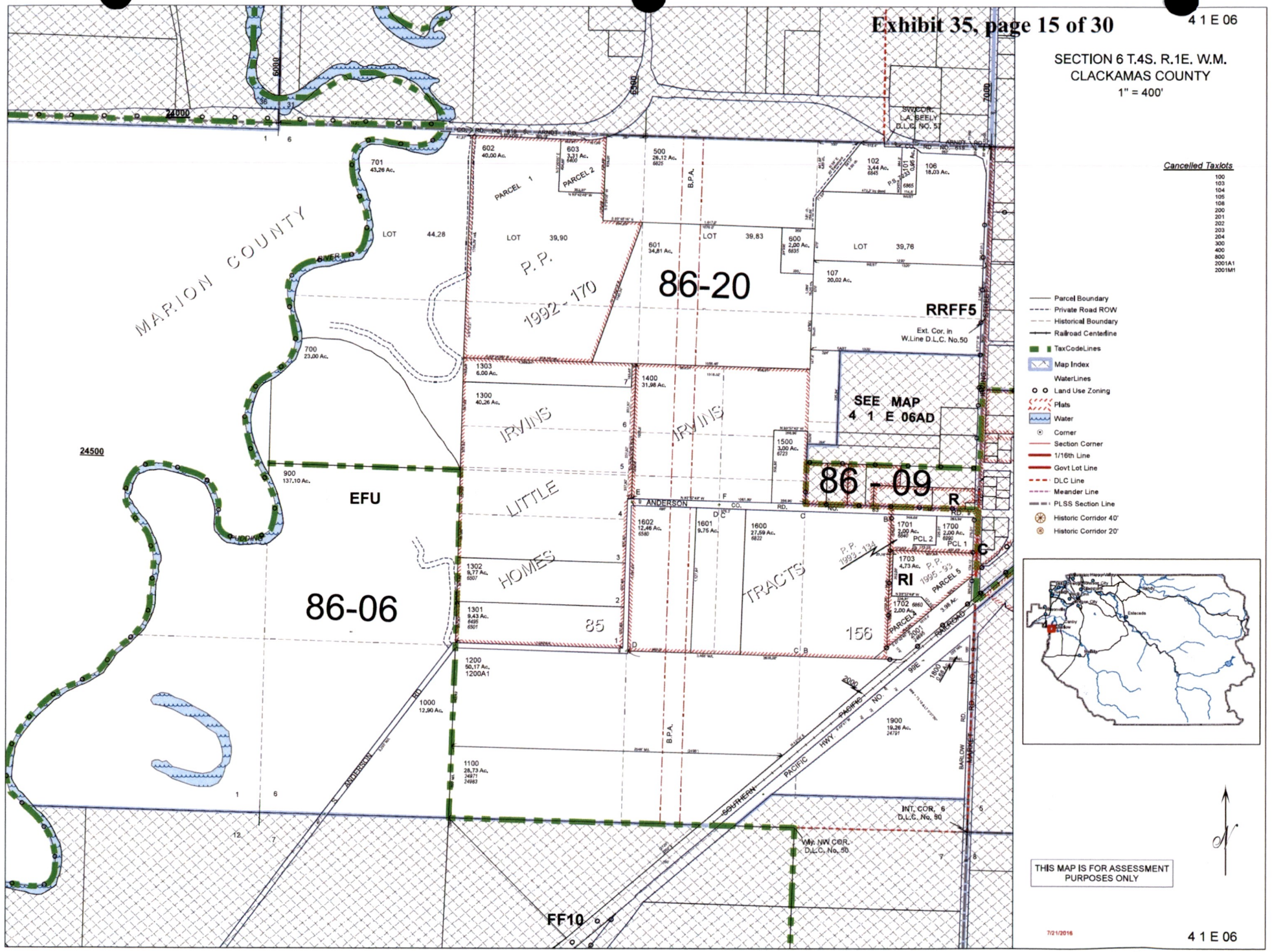
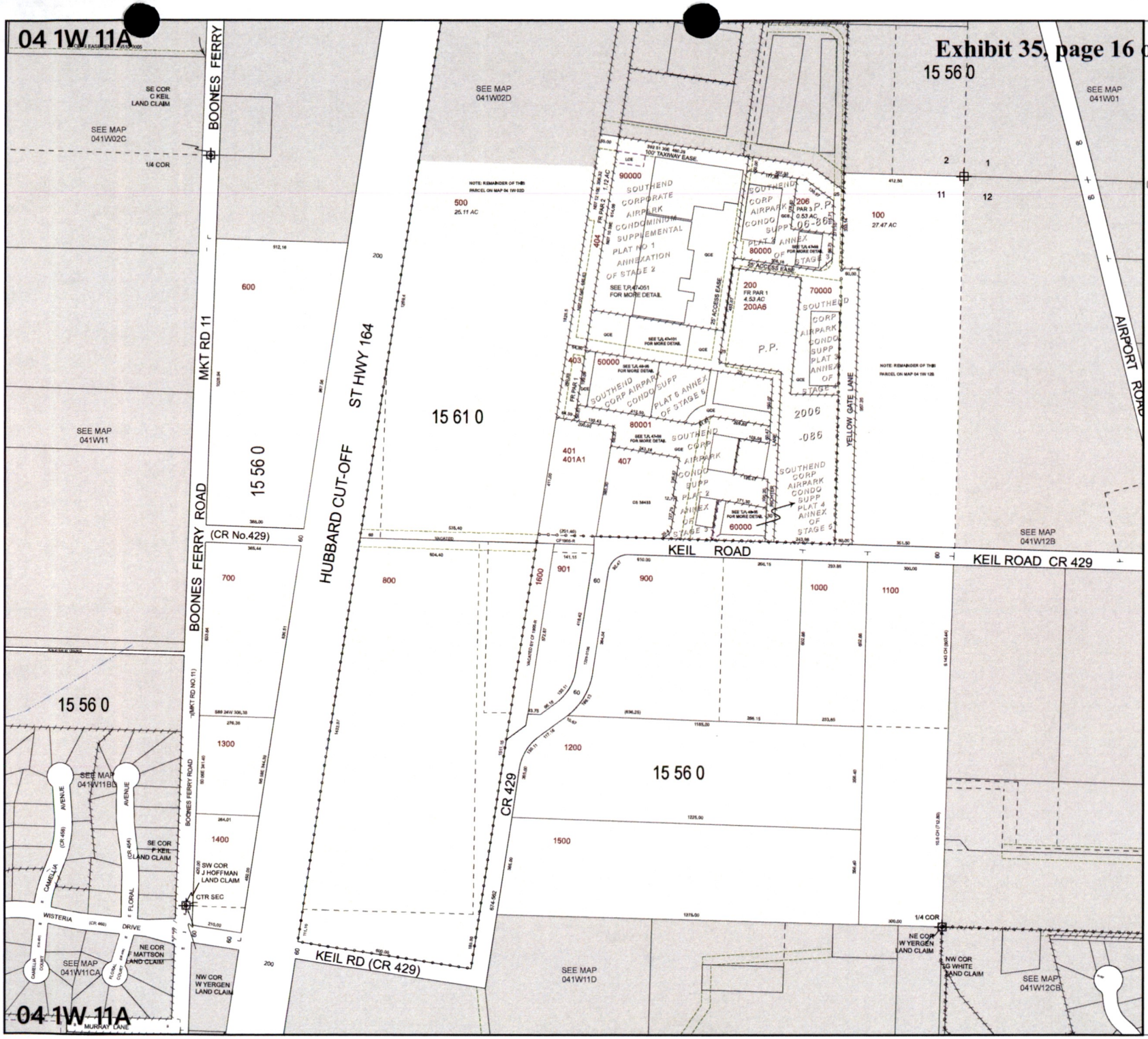
PLOT DATE: 10/16/2020

04 1W 01


4 1 E 06
SECTION 6 T.4S. R.1E. W.M.
CLACKAMAS COUNTY
1" = 400'
Cancelled Taxlots
100
103
104
105
108
200
201
202
203
204
300
400
800
2001A1
2001M1
Parcel Boundary
Private Road ROW
Historical Boundary
Railroad Centerline
TaxCodeLines
Map Index
WaterLines
Land Use Zoning
Plats
Water
Corner
Section Corner
1/16th Line
Govt Lot Line
DLC Line
Meander Line
PLSS Section Line
Historic Corridor 40'
Historic Corridor 20'
MARION COUNTY
86-20
86-06
86-09
EFU
RRFF5
RI
FF10
SEE MAP
4 1 E 06AD
IRVINS
LITTLE
HOMES
TRACTS
85
156
P.P. 1992-170
P.P. 1993-134
P.P. 1995-93
PARCEL 1
PARCEL 2
PARCEL 4
PARCEL 5
PCL 1
PCL 2
LOT 44.28
LOT 39.90
LOT 39.83
LOT 39.76
ANDERSON
SOUTHERN PACIFIC HWY. 99E
INT. COR. 6 D.L.C. No. 50
Wy. NW COR. D.L.C. No. 50
Ext. Cor. in W.Line D.L.C. No.50
SW.COR. L.A. SEELY D.L.C. NO. 57
24000
24500
THIS MAP IS FOR ASSESSMENT PURPOSES ONLY
7/21/2016
4 1 E 06



04 1W 11A



MARION COUNTY, OREGON

NE1/4 SEC11 T4S R1W W.M.
SCALE 1" = 200'

LEGEND

LINE TYPES

- Taxlot Boundary
- Historical Boundary
- Road Right-of-Way
- Easement
- Railroad Right-of-Way
- Railroad Centerline
- Private Road ROW
- Taxcode Line
- Subdivision/Plat Bndry
- Map Boundary
- Waterline - Taxlot Bndry
- Waterline - Non Bndry

CORNER TYPES

- 1/16TH Section Cor.
- 1/4 Section Cor.
- DLC Corner
- Section Corner (16 15 / 21 22)

NUMBERS

Tax Code Number
00 00 0

Acreage 0.25 AC — All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW

200.00
170.00

CANCELLED NUMBERS

101
200A1
200A2
200A5
201
202
203
204
207
300
400
401
402
405
406

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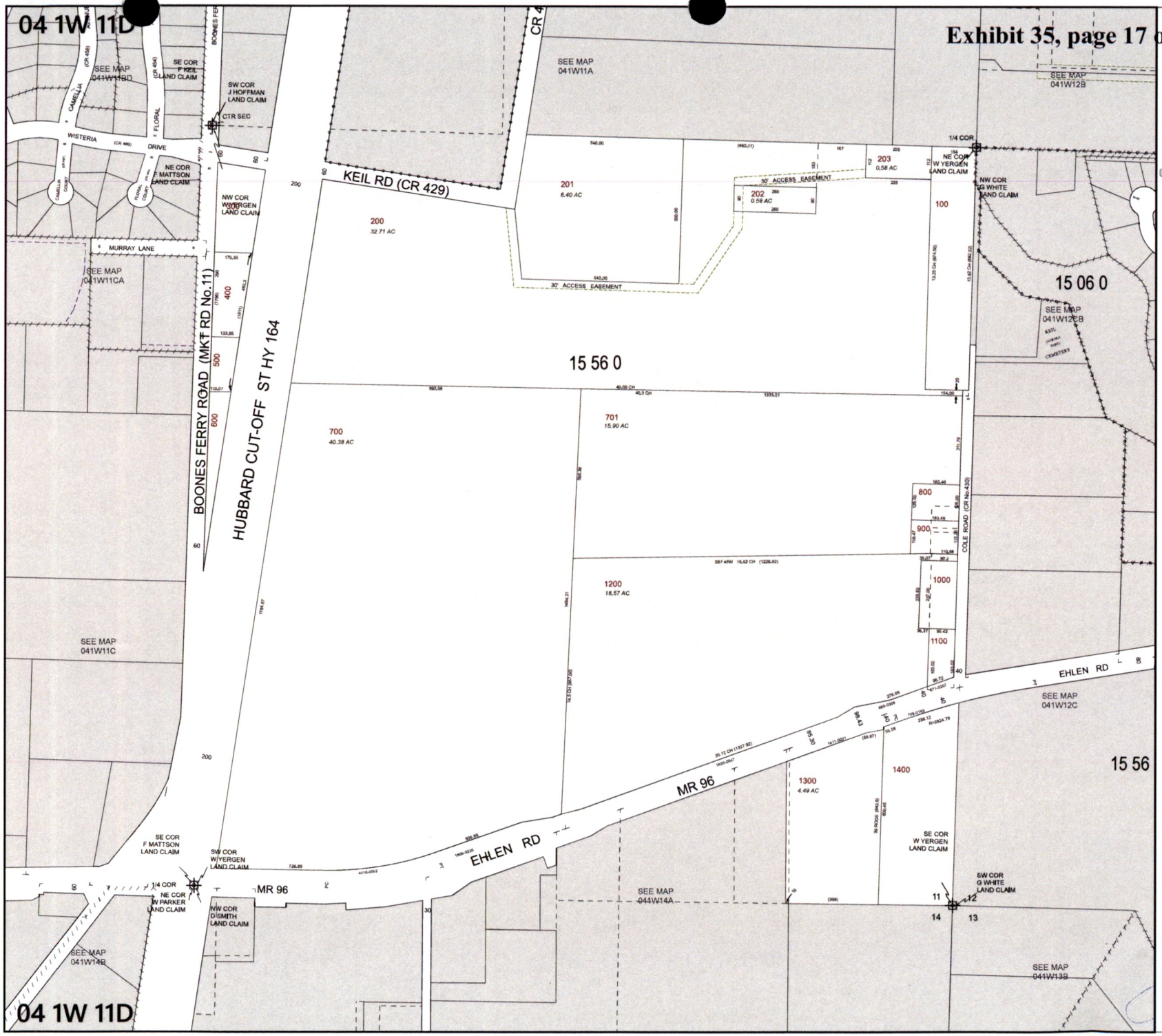
PLOT DATE: 4/1/2022

04 1W 11A

04 1W 11D



04 1W 11D

04 1W 11D



MARION COUNTY, OREGON

SE1/4 SEC11 T4S R1W W.M.

SCALE 1" = 200'

LEGEND

LINE TYPES

- Taxlot Boundary
- Historical Boundary
- Road Right-of-Way
- Easement
- Railroad Right-of-Way
- Railroad Centerline
- Private Road ROW
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CORNER TYPES

- 1/16TH Section Cor.
- 1/4 Section Cor.
- DLC Corner
- Section Corner (16, 15, 21, 22)

NUMBERS

Tax Code Number

00 00 0

Acreage

0.25 AC

All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW

CANCELLED NUMBERS

1101
1201
1401

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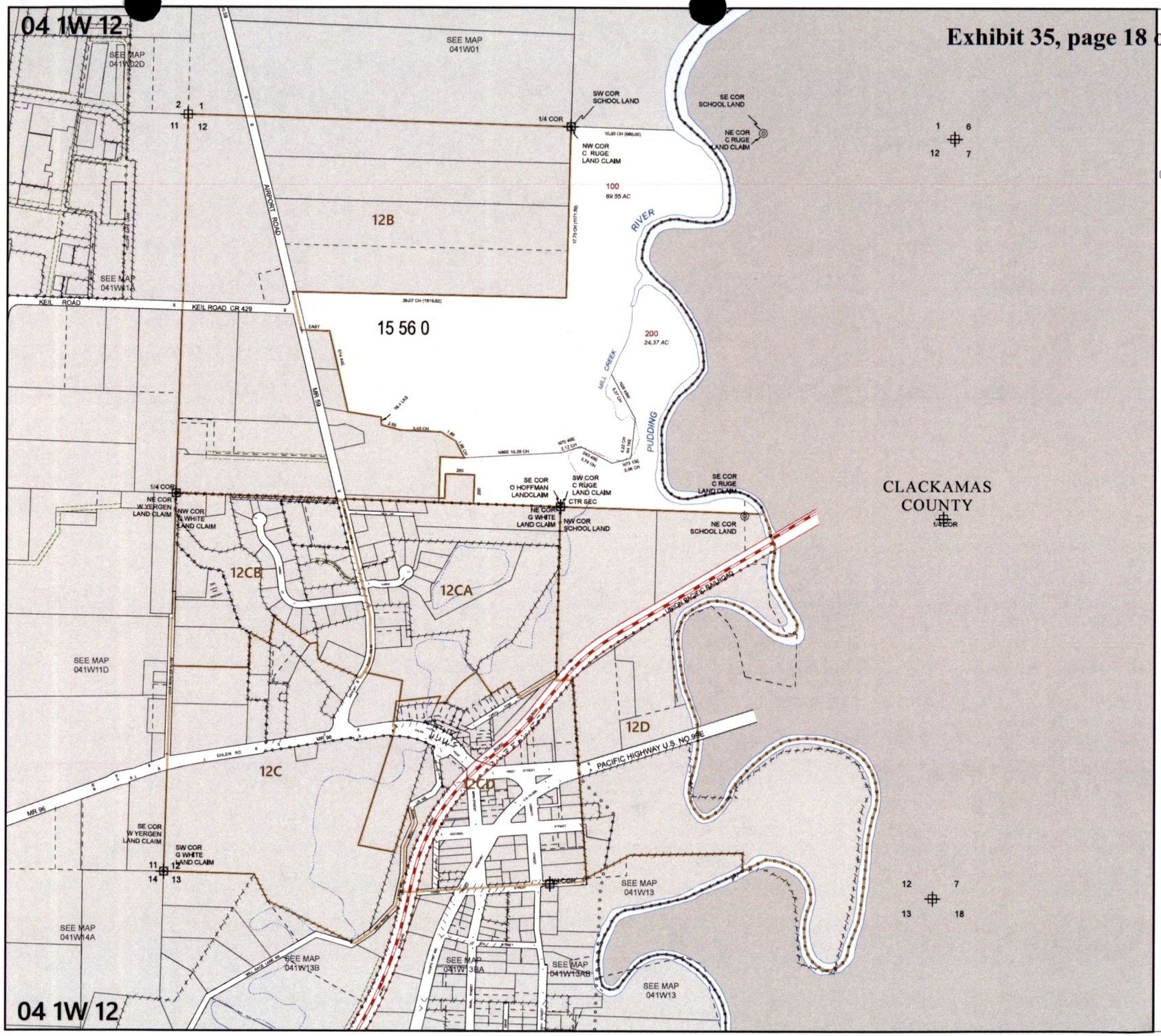
PLOT DATE: 3/16/2022

04 1W 11D



04 1W 12



MARION COUNTY, OREGON

SEC 12 T4S R1W W.M.
SCALE 1" = 400'

LEGEND

LINE TYPES

Taxlot Boundary	Historical Boundary
Road Right-of-Way	Easement
Railroad Right-of-Way	Railroad Centerline
Private Road ROW	Taxcode Line
Subdivision/Plat Bndry	Map Boundary
Waterline - Taxlot Bndry	Waterline - Non Bndry

CORNER TYPES

+ 1/16TH Section Cor.	1/4 Section Cor.
DLC Corner	16 15 / 21 22 Section Corner

NUMBERS

Tax Code Number

00 00 0

Acreage 0.26 AC

All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW

200.00
175.26

CANCELLED NUMBERS

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Assessors Office
Cartography Dept

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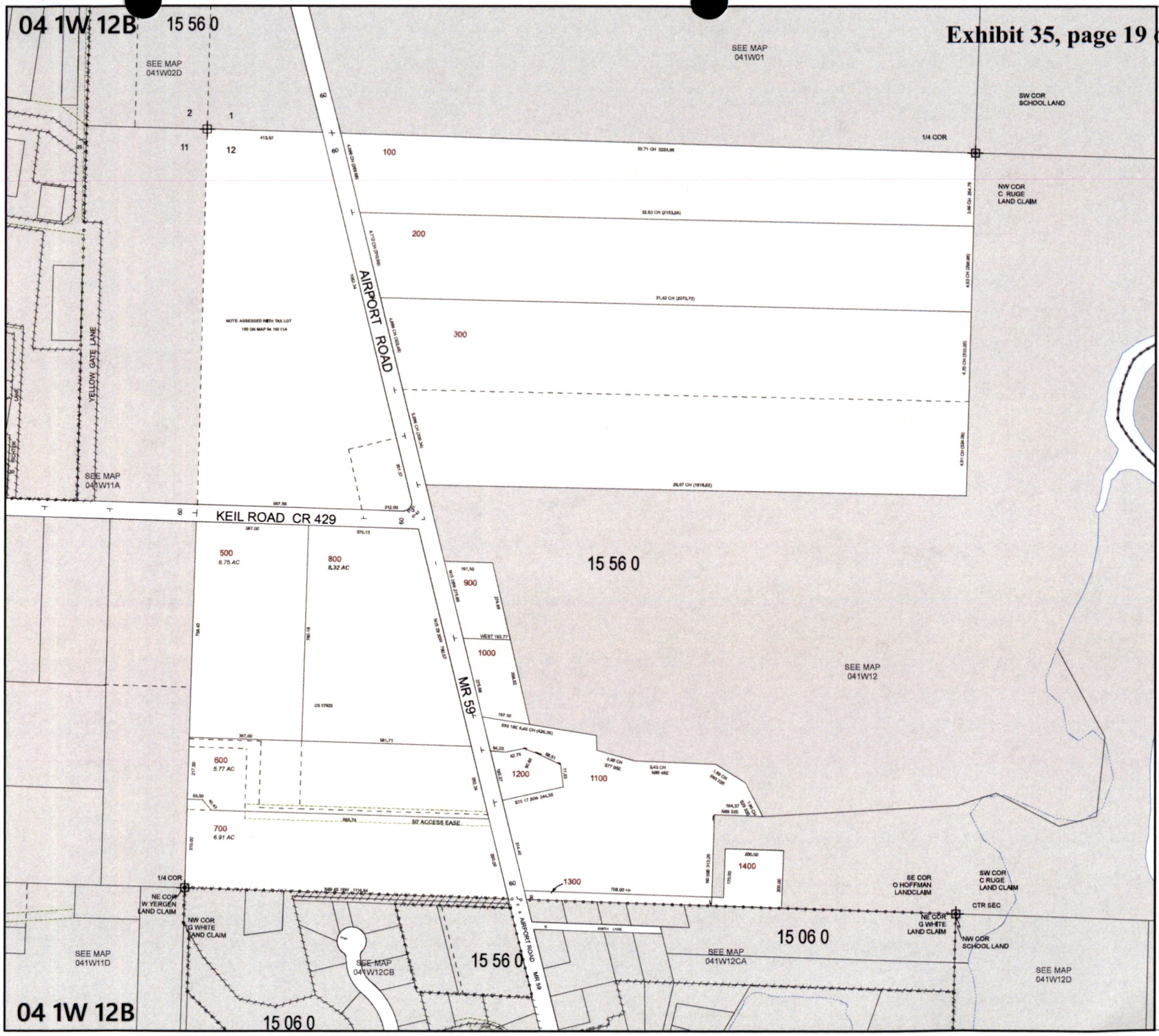
PLOT DATE: 10/16/2020

04 1W 12



04 1W 12B AURORA



MARION COUNTY, OREGON

NW1/4 SEC12 T4S R1W W.M.

SCALE 1" = 200'

LEGEND

LINE TYPES

- Taxlot Boundary
- Historical Boundary
- Road Right-of-Way
- Easement
- Railroad Right-of-Way
- Railroad Centerline
- Private Road ROW
- Taxcode Line
- Subdivision/Plat Bndry
- Map Boundary
- Waterline - Taxlot Bndry
- Waterline - Non Bndry

CORNER TYPES

- 1/16TH Section Cor.
- 1/4 Section Cor.
- DLC Corner
- Section Corner (16 15 / 21 22)

NUMBERS

Tax Code Number

00 00 0

Acreage 0.25 AC — All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW

200.00
170.00

CANCELLED NUMBERS

400
401

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Marion County OREGON — Assessors Office Cartography Dept

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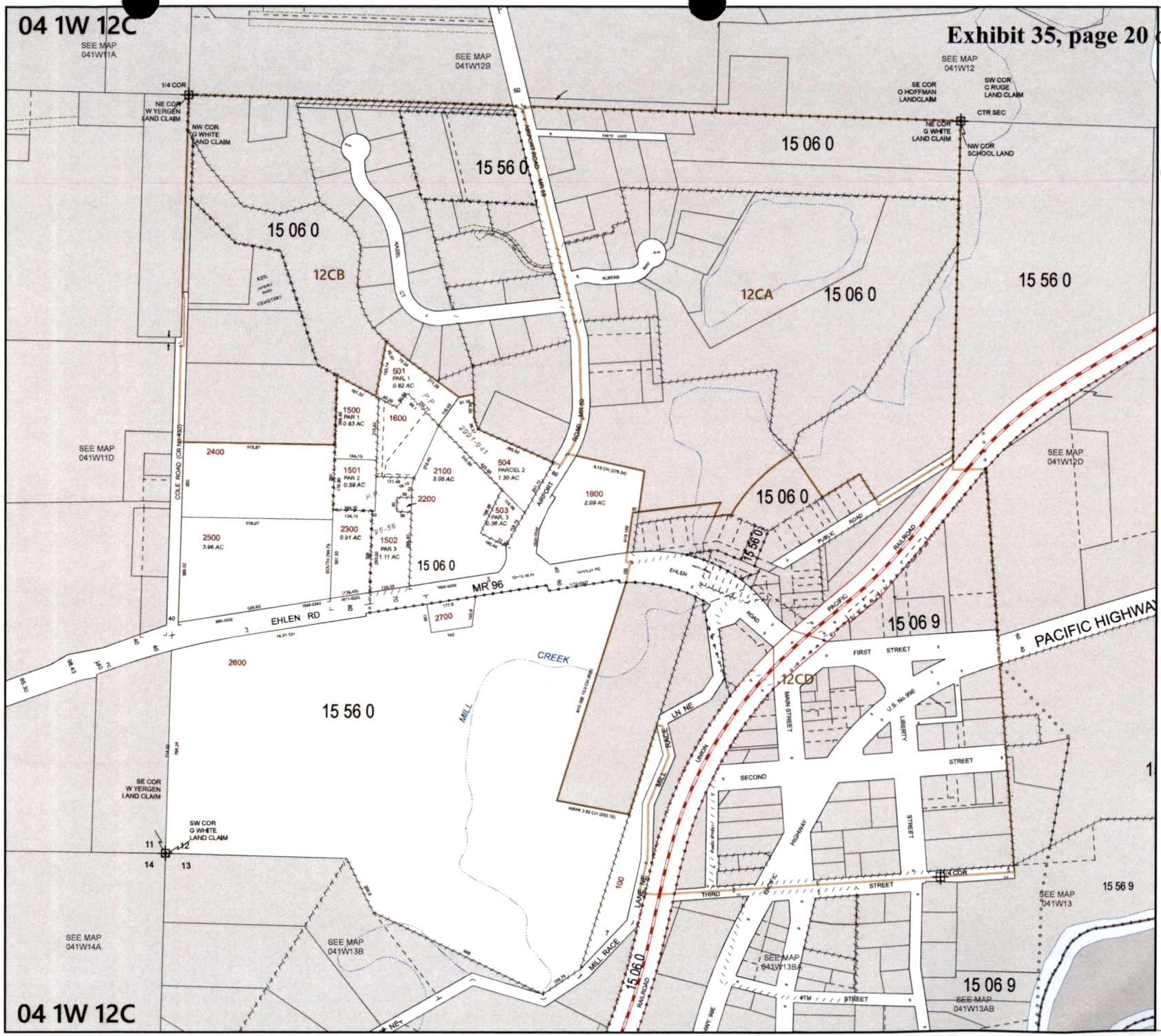
PLOT DATE: 10/16/2020

AURORA
04 1W 12B



04 1W 12C
AURORA



MARION COUNTY, OREGON
SW1/4 SEC12 T4S R1W W.M.
SCALE 1" = 200'

LEGEND

LINE TYPES

Taxlot Boundary	Historical Boundary
Road Right-of-Way	Easement
Railroad Right-of-Way	Railroad Centerline
Private Road ROW	Taxcode Line
Subdivision/Plat Bndry	Map Boundary
Waterline - Taxlot Bndry	Waterline - Non Bndry

CORNER TYPES

- 1/16TH Section Cor.
- 1/4 Section Cor.
- DLC Corner
- Section Corner (16, 15, 21, 22)

NUMBERS

Tax Code Number
00 00 0

Acreage
0.25 AC

All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW

CANCELLED NUMBERS

200
400
600
1200
1700
1901
2000
2501
2600H1
2600H2
2601
2602
2800

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Marion County OREGON — Assessors Office Cartography Dept

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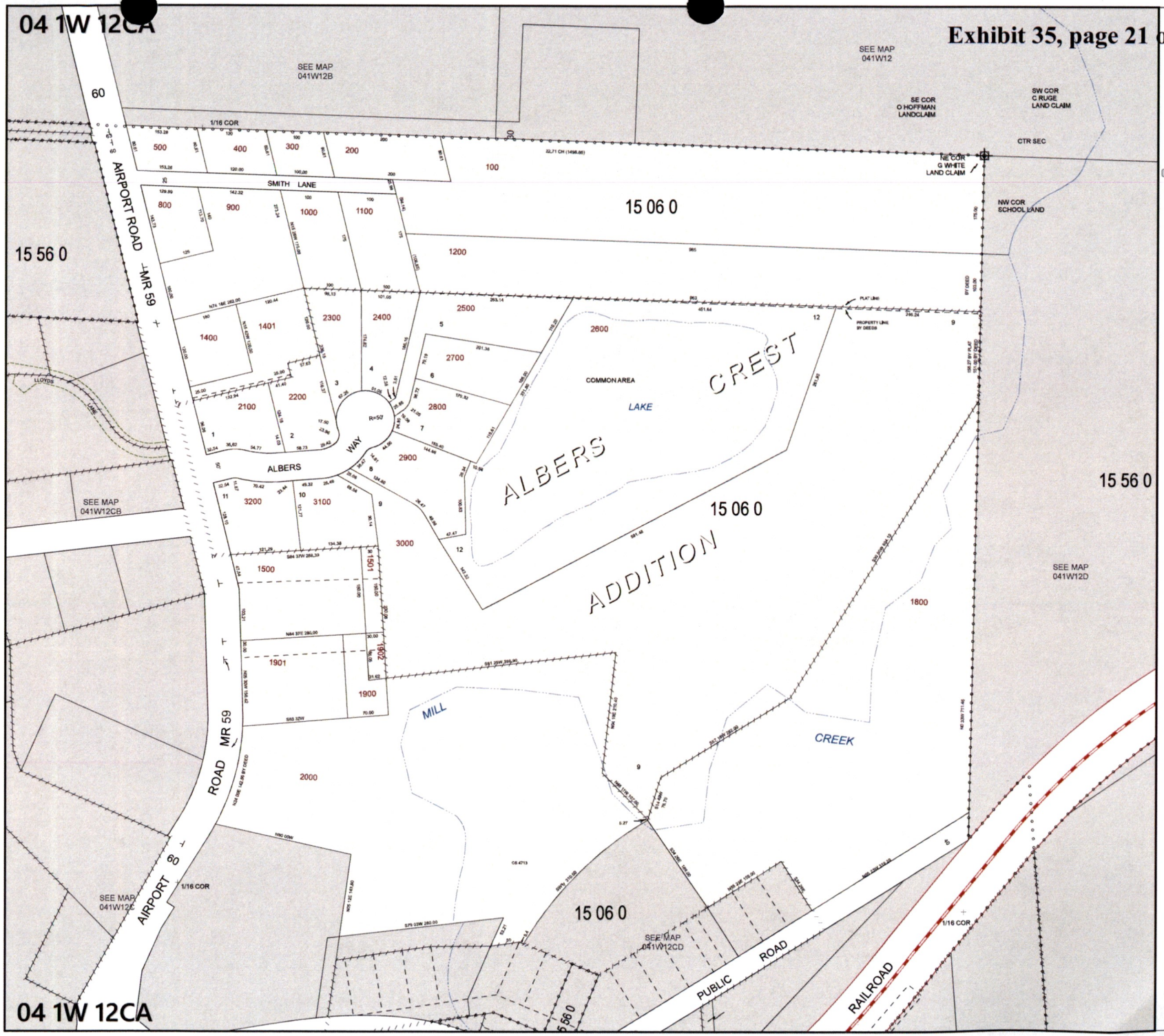
PLOT DATE: 10/16/2020

AURORA
04 1W 12C



04 1W 12CA
AURORA



MARION COUNTY, OREGON
NE1/4 SW1/4 SEC12 T4S R1W W.M.
SCALE 1" = 100'

LEGEND

LINE TYPES

Taxlot Boundary	Historical Boundary
Road Right-of-Way	Easement
Railroad Right-of-Way	Railroad Centerline
Private Road ROW	Taxcode Line
Subdivision/Plat Bndry	Map Boundary
Waterline - Taxlot Bndry	Waterline - Non Bndry

CORNER TYPES

- 1/16TH Section Cor.
- 1/4 Section Cor.
- DLC Corner
- Section Corner (16, 15, 21, 22)

NUMBERS

Tax Code Number
00 00 0

Acreage 0.25 AC

All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW

200.00
175.00

CANCELLED NUMBERS

600
700
1300
1301
1302
1600
1700
1701

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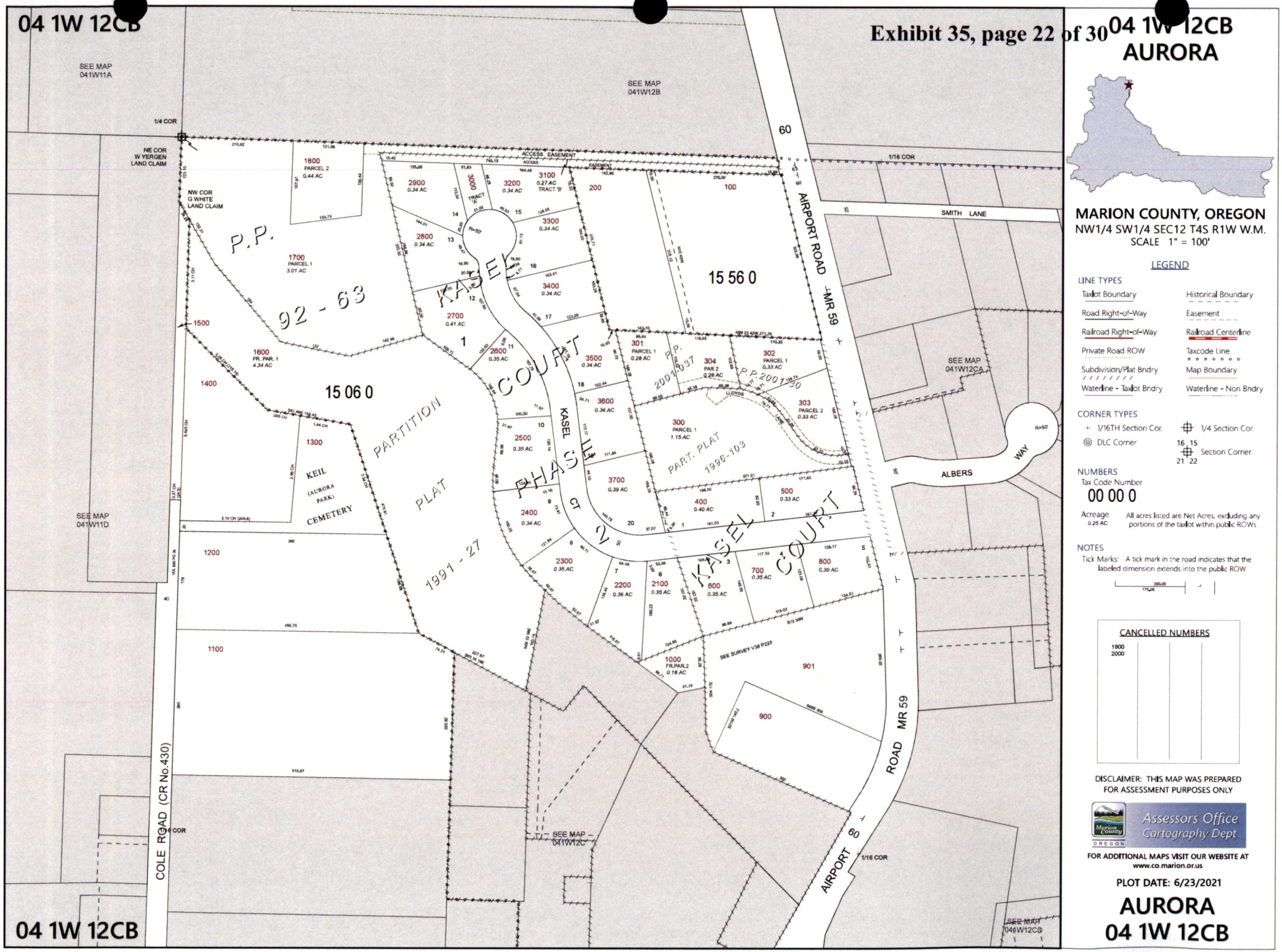
PLOT DATE: 10/16/2020

AURORA
04 1W 12CA



04 1W 12CB
AURORA

MARION COUNTY, OREGON
NW1/4 SW1/4 SEC12 T4S R1W W.M.
SCALE 1" = 100'

LEGEND

LINE TYPES

Taxlot Boundary	Historical Boundary
Road Right-of-Way	Easement
Railroad Right-of-Way	Railroad Centerline
Private Road ROW	Taxcode Line
Subdivision/Plat Bndry	Map Boundary
Waterline - Taxlot Bndry	Waterline - Non Bndry

CORNER TYPES

- + 1/16TH Section Cor.
- 1/4 Section Cor.
- DLC Corner
- 16 15 / 21 22 Section Corner

NUMBERS

Tax Code Number
00 00 0

Acreage 0.25 AC

All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW

200.00
175.00

CANCELLED NUMBERS

1900
2000

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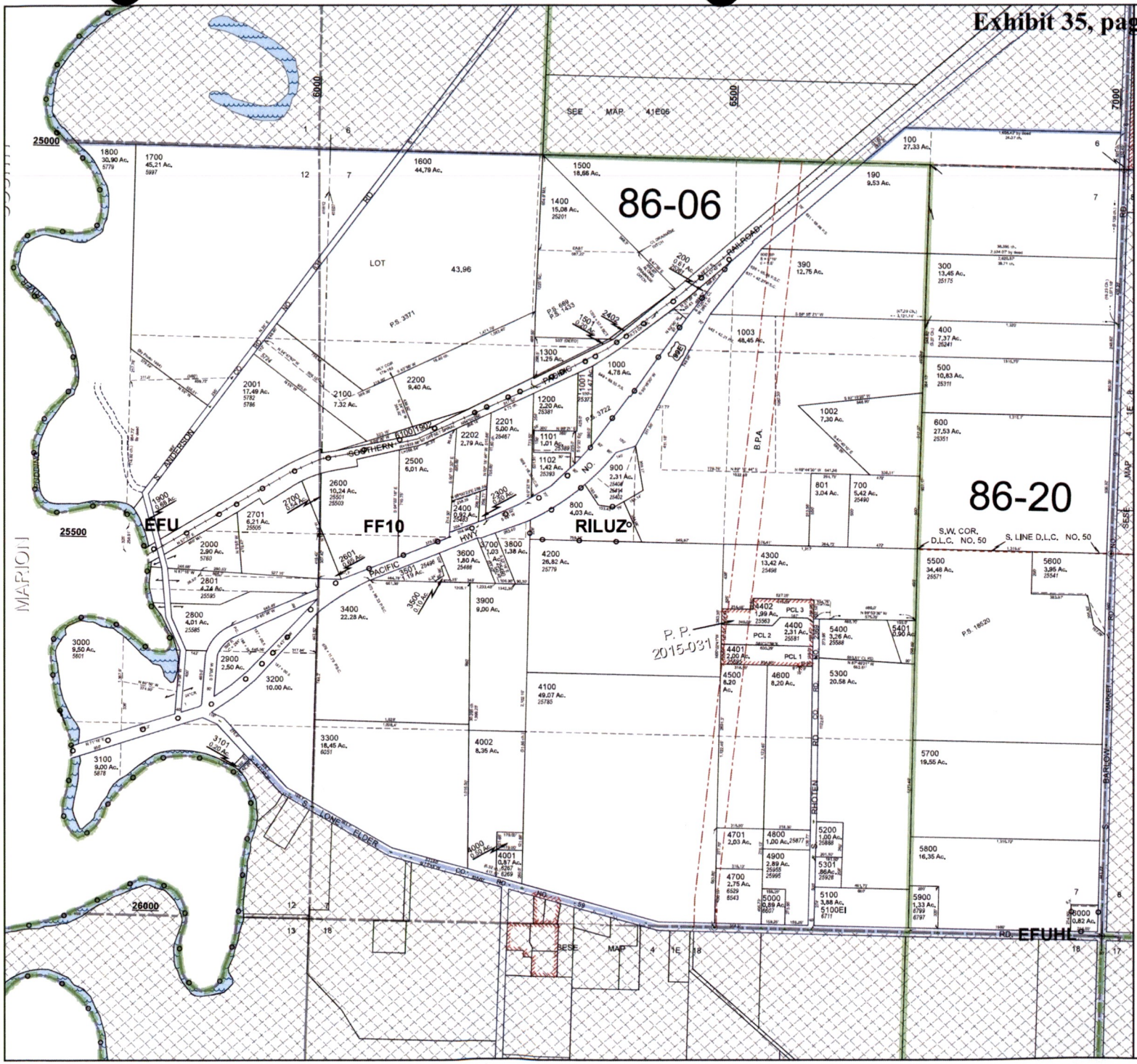
PLOT DATE: 6/23/2021

AURORA
04 1W 12CB



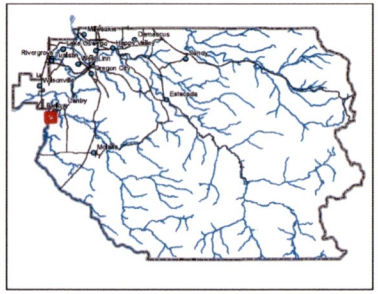
SECTION 7 T.4S. R.1E. W.M.
CLACKAMAS COUNTY
1" = 400'

D.L.C.
SAMUEL K. BARLOW NO. 50

Cancelled Taxlots

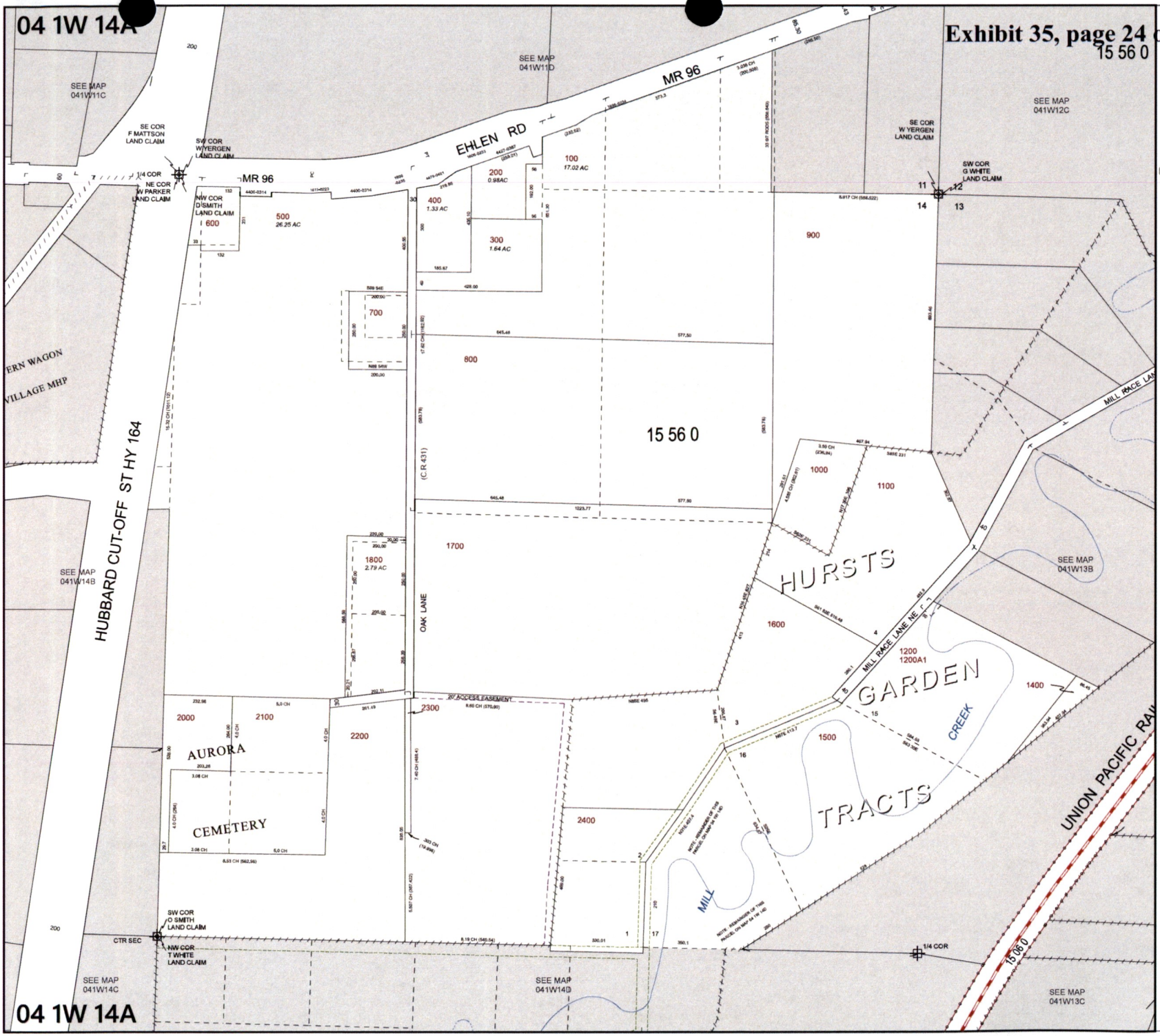
1004
1790
1670
2180
2091
2690
1100
1502
1680
1690
1901
2190
2201A1
2590

- Parcel Boundary
- Private Road ROW
- Historical Boundary
- Railroad Centerline
- Tax Code Lines
- Map Index
- Water Lines
- Land Use Zoning
- Plats
- Water
- Corner
- Section Corner
- 1/16th Line
- Govt Lot Line
- DLC Line
- Meander Line
- PLSS Section Line
- Historic Corridor 40'
- Historic Corridor 20'

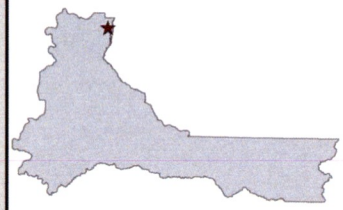


THIS MAP IS FOR ASSESSMENT PURPOSES ONLY

5/17/2022



04 1W 14A



MARION COUNTY, OREGON

NE1/4 SEC14 T4S R1W W.M.
SCALE 1" = 200'

LEGEND

LINE TYPES

Taxlot Boundary	Historical Boundary
Road Right-of-Way	Easement
Railroad Right-of-Way	Railroad Centerline
Private Road ROW	Taxcode Line
Subdivision/Plat Bndry	Map Boundary
Waterline - Taxlot Bndry	Waterline - Non Bndry

CORNER TYPES

+ 1/16TH Section Cor.	1/4 Section Cor.
DLC Corner	16 15 / 21 22 Section Corner

NUMBERS

Tax Code Number
00 00 0

Acreage
0.25 AC

All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW

200.00
175.00

CANCELLED NUMBERS

501
1300
1900

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Assessors Office
Cartography Dept

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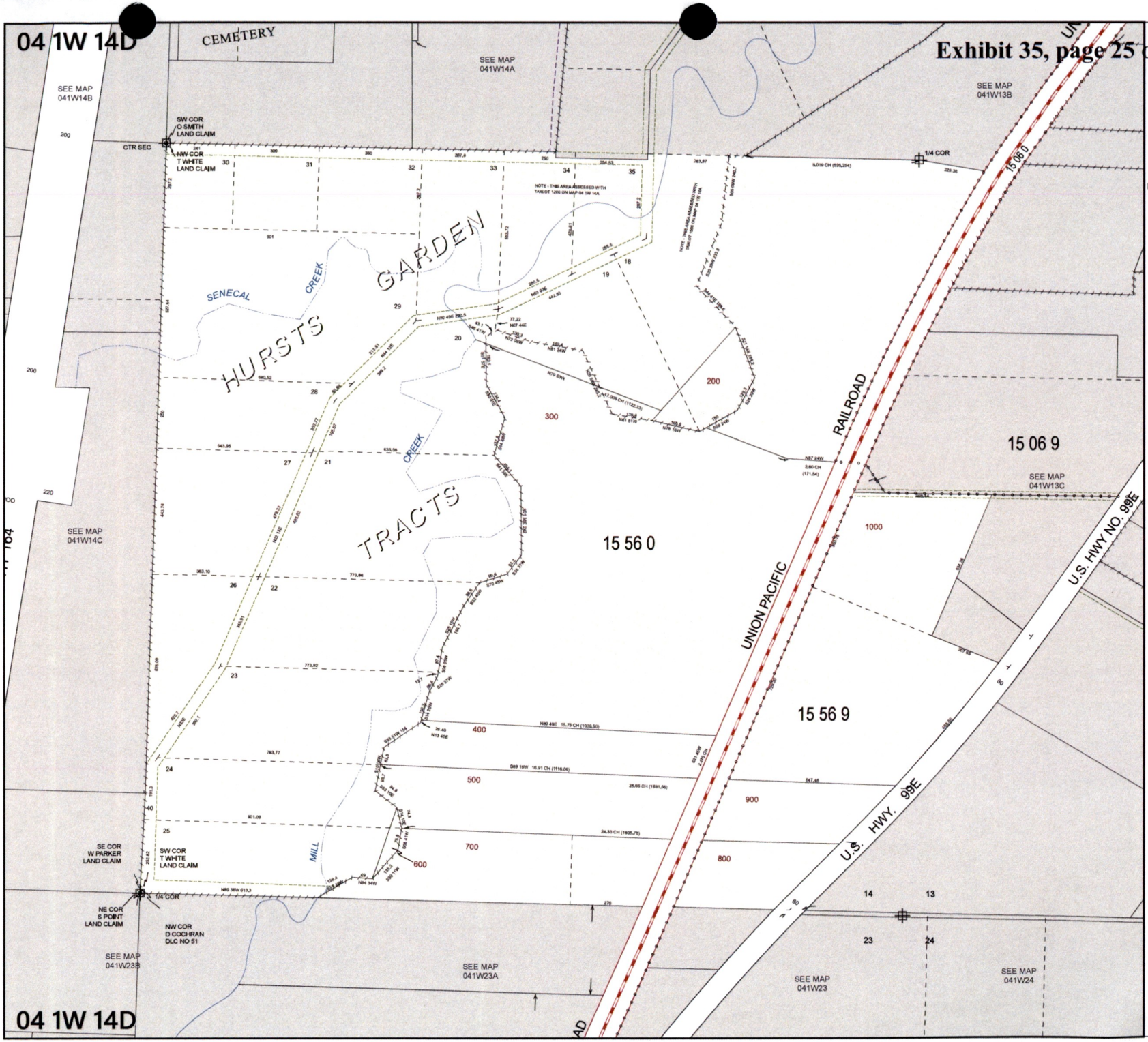
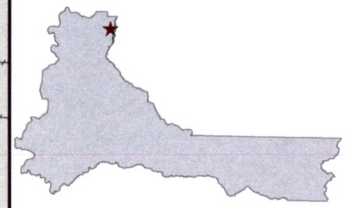
PLOT DATE: 7/12/2021

04 1W 14A



04 1W 14D AURORA



MARION COUNTY, OREGON

SE1/4 SEC14 T4S R1W W.M.
SCALE 1" = 200'

LEGEND

LINE TYPES

- Taxlot Boundary
- Historical Boundary
- Road Right-of-Way
- Easement
- Railroad Right-of-Way
- Railroad Centerline
- Private Road ROW
- Taxcode Line
- Subdivision/Plat Bndry
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CORNER TYPES

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- 1/4 Section Cor.
- DLC Corner
- 16 15 / 21 22 Section Corner

NUMBERS

Tax Code Number

00 00 0

Acreage 0.26 AC

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NOTES

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200.00
175.00

CANCELLED NUMBERS

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Marion County OREGON — Assessors Office Cartography Dept

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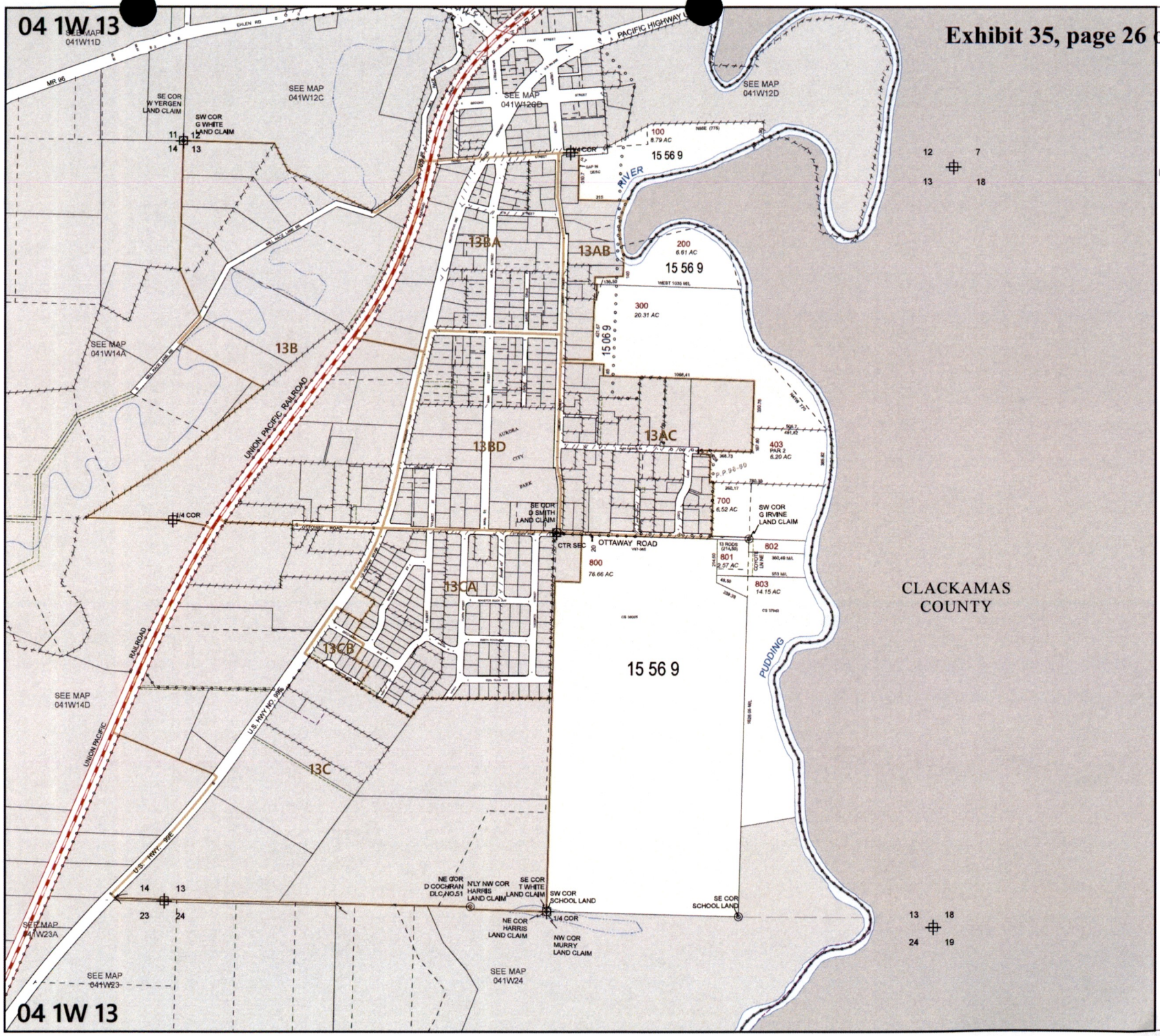
PLOT DATE: 12/30/2021

AURORA
04 1W 14D



04 1W 13
AURORA



MARION COUNTY, OREGON
SEC 13 T4S R1W W.M.
SCALE 1" = 400'

LEGEND

LINE TYPES

Taxlot Boundary	Historical Boundary
Road Right-of-Way	Easement
Railroad Right-of-Way	Railroad Centerline
Private Road ROW	Taxcode Line
Subdivision/Plat Bndry	Map Boundary
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CORNER TYPES

1/16TH Section Cor. | 1/4 Section Cor.
DLC Corner | Section Corner (16, 15, 21, 22)

NUMBERS

Tax Code Number
00 00 0

Acreage 0.25 AC — All acres listed are Net Acres, excluding any portions of the taxlot within public ROWs

NOTES

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200.00
175.00

CANCELLED NUMBERS

301
600

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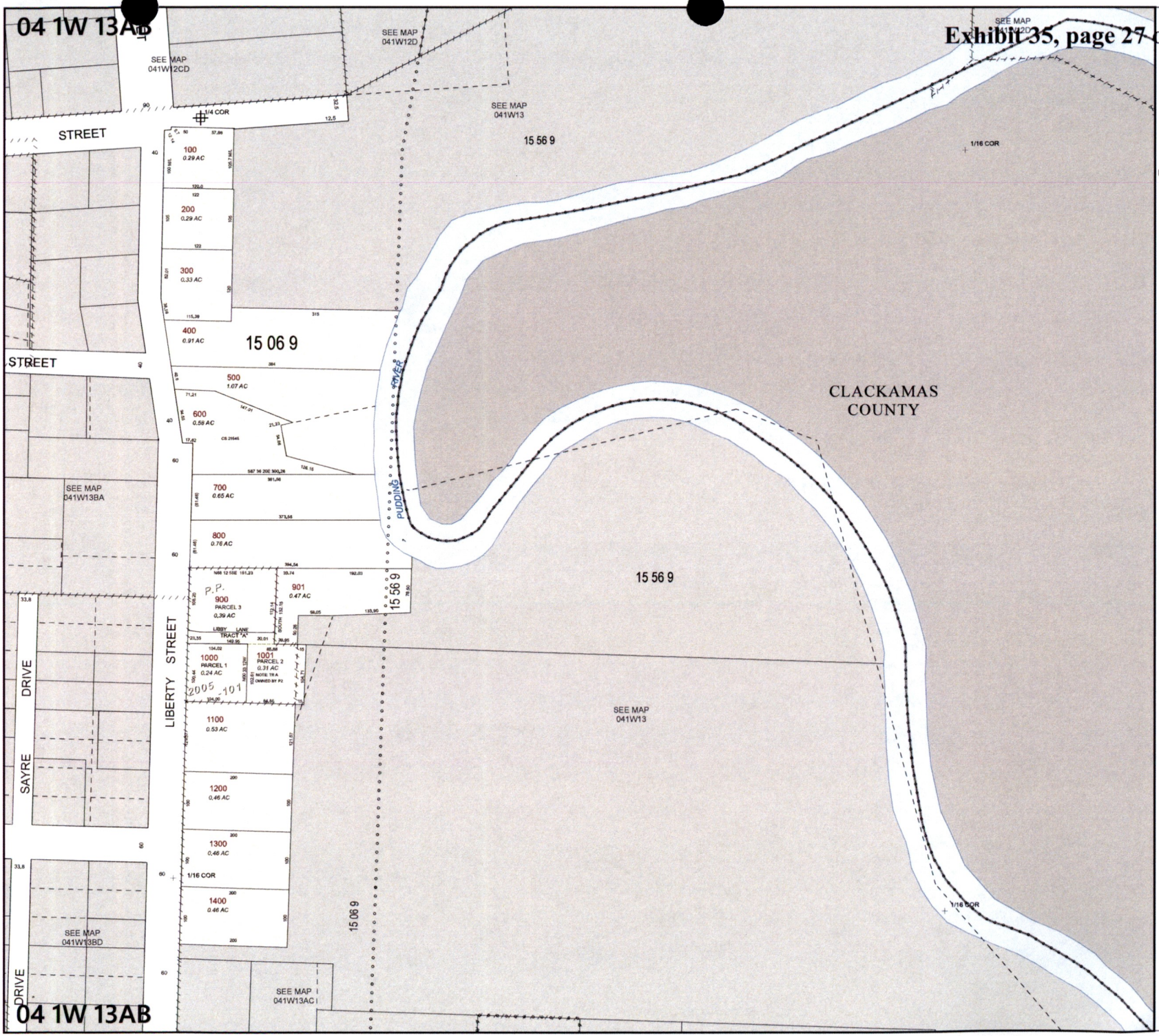
PLOT DATE: 10/16/2020

AURORA
04 1W 13



04 1W 13AB
AURORA



MARION COUNTY, OREGON
NW1/4 NE1/4 SEC13 T4S R1W W.M.
SCALE 1" = 100'

LEGEND

LINE TYPES

Taxlot Boundary	Historical Boundary
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200.00
175.00

CANCELLED NUMBERS

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Cartography Dept

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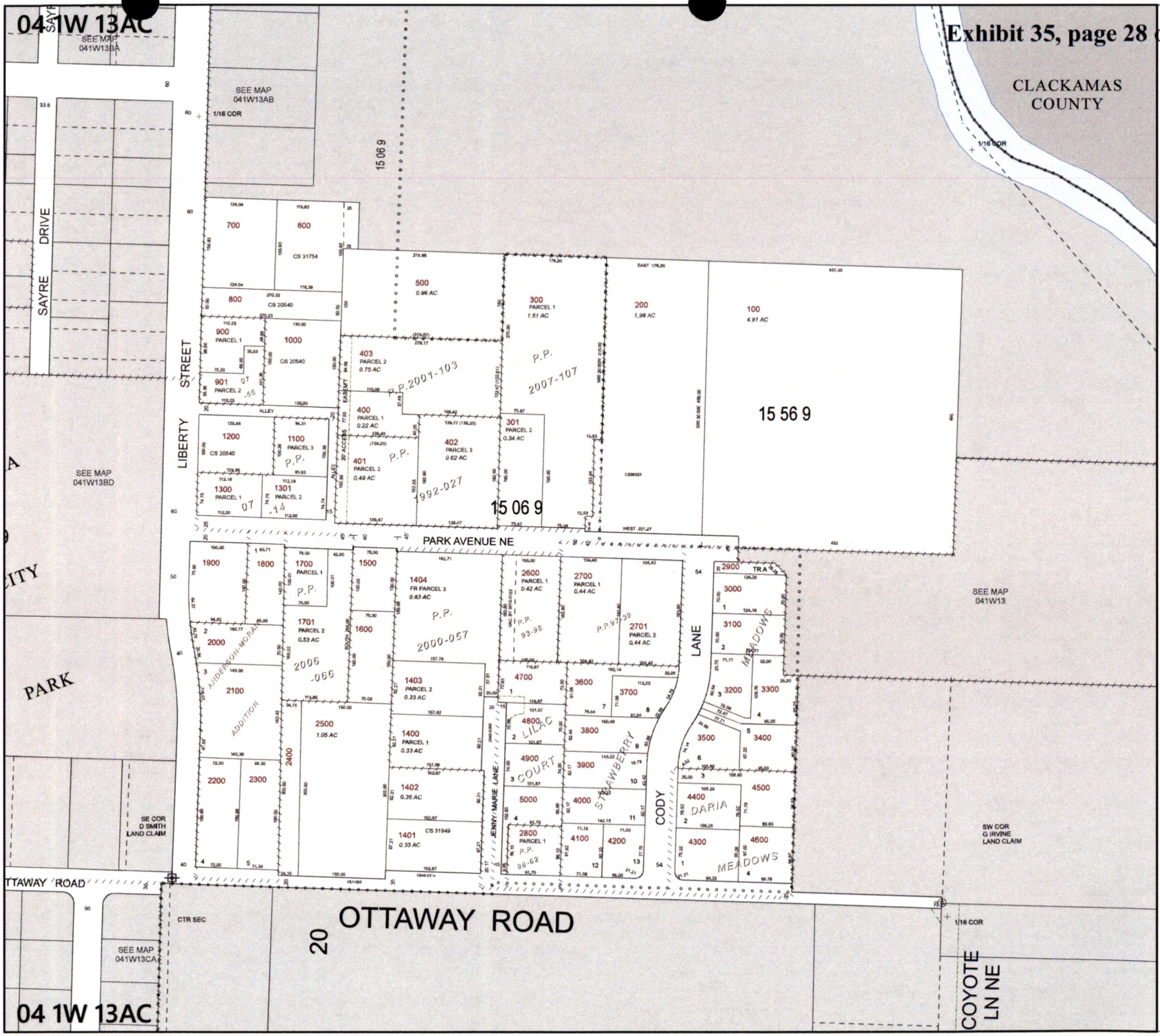
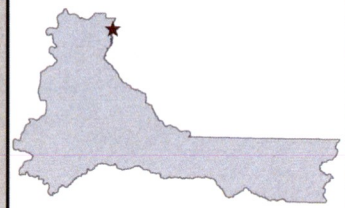
PLOT DATE: 10/16/2020

AURORA
04 1W 13AB



04 1W 13AC
AURORA



MARION COUNTY, OREGON
SW1/4 NE1/4 SEC13 T4S R1W W.M.
SCALE 1" = 100'

LEGEND

LINE TYPES

Taxlot Boundary	Historical Boundary
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DLC Corner	16 15 Section Corner 21 22

NUMBERS

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00 00 0

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200.00
175.00

CANCELLED NUMBERS

2801
2802
2803

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PLOT DATE: 10/16/2020

AURORA
04 1W 13AC



04 1W 13BA
AURORA



MARION COUNTY, OREGON
NE1/4 NW1/4 SEC13 T4S R1W W.M.
SCALE 1" = 100'

LEGEND

LINE TYPES

Taxlot Boundary	Historical Boundary
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200.00
175.00

CANCELLED NUMBERS

800L1
4300
5701
6301

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Cartography Dept

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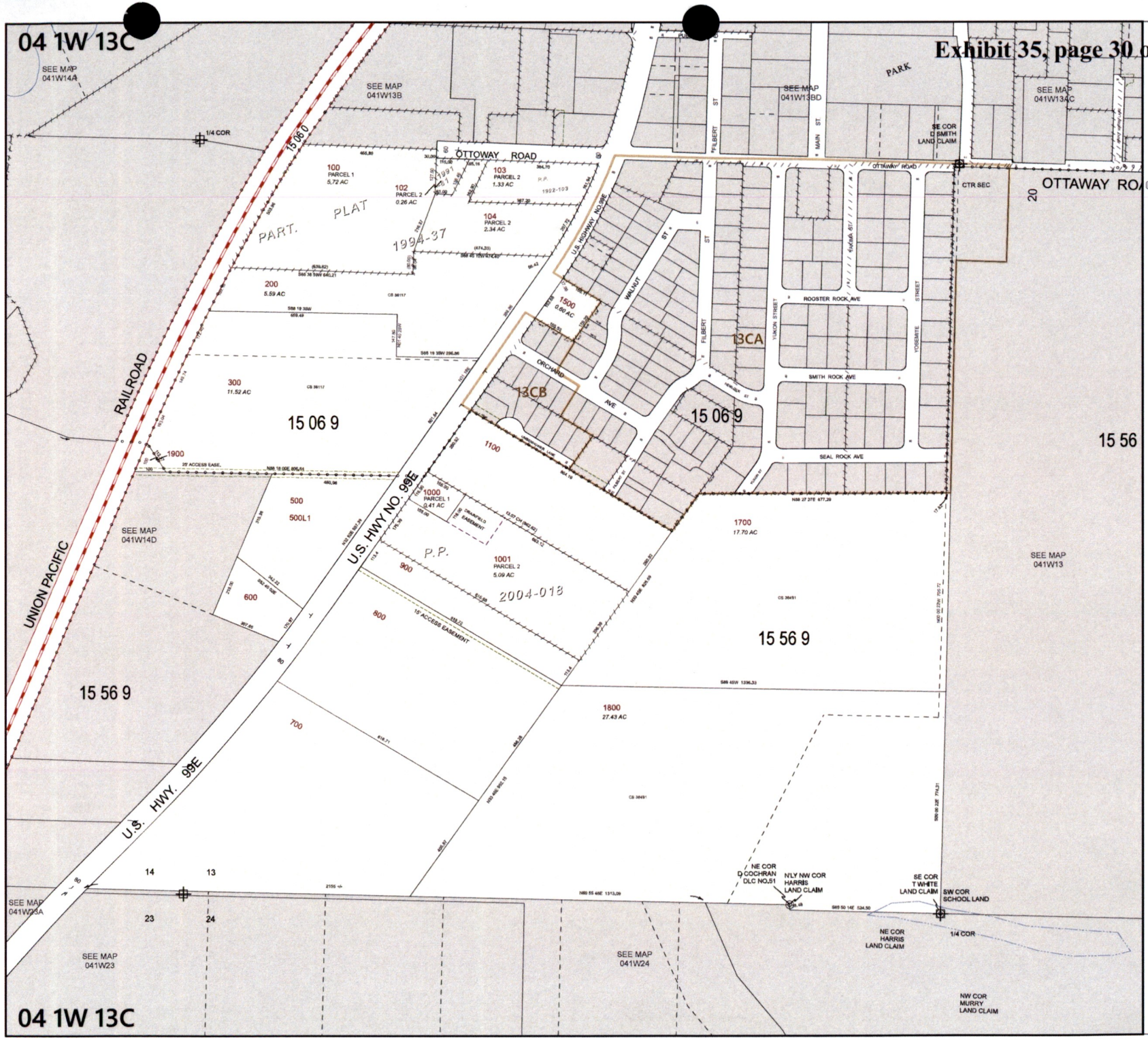
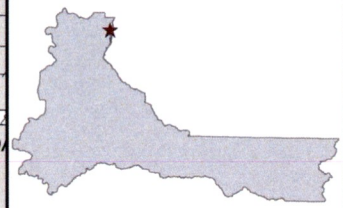
PLOT DATE:12/22/2022

AURORA
04 1W 13BA



04 1W 13C
AURORA



MARION COUNTY, OREGON
SW1/4 SEC13 T4S R1W W.M.
SCALE 1" = 200'

LEGEND

LINE TYPES

Taxlot Boundary	Historical Boundary
Road Right-of-Way	Easement
Railroad Right-of-Way	Railroad Centerline
Private Road ROW	Taxcode Line
Subdivision/Plat Bndry	Map Boundary
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CORNER TYPES

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- DLC Corner
- 16 15 / 21 22 Section Corner

NUMBERS

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00 00 0

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NOTES

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200.00
175.00

CANCELLED NUMBERS

101
201
400
1200
1201
1202
1300
1400
1600

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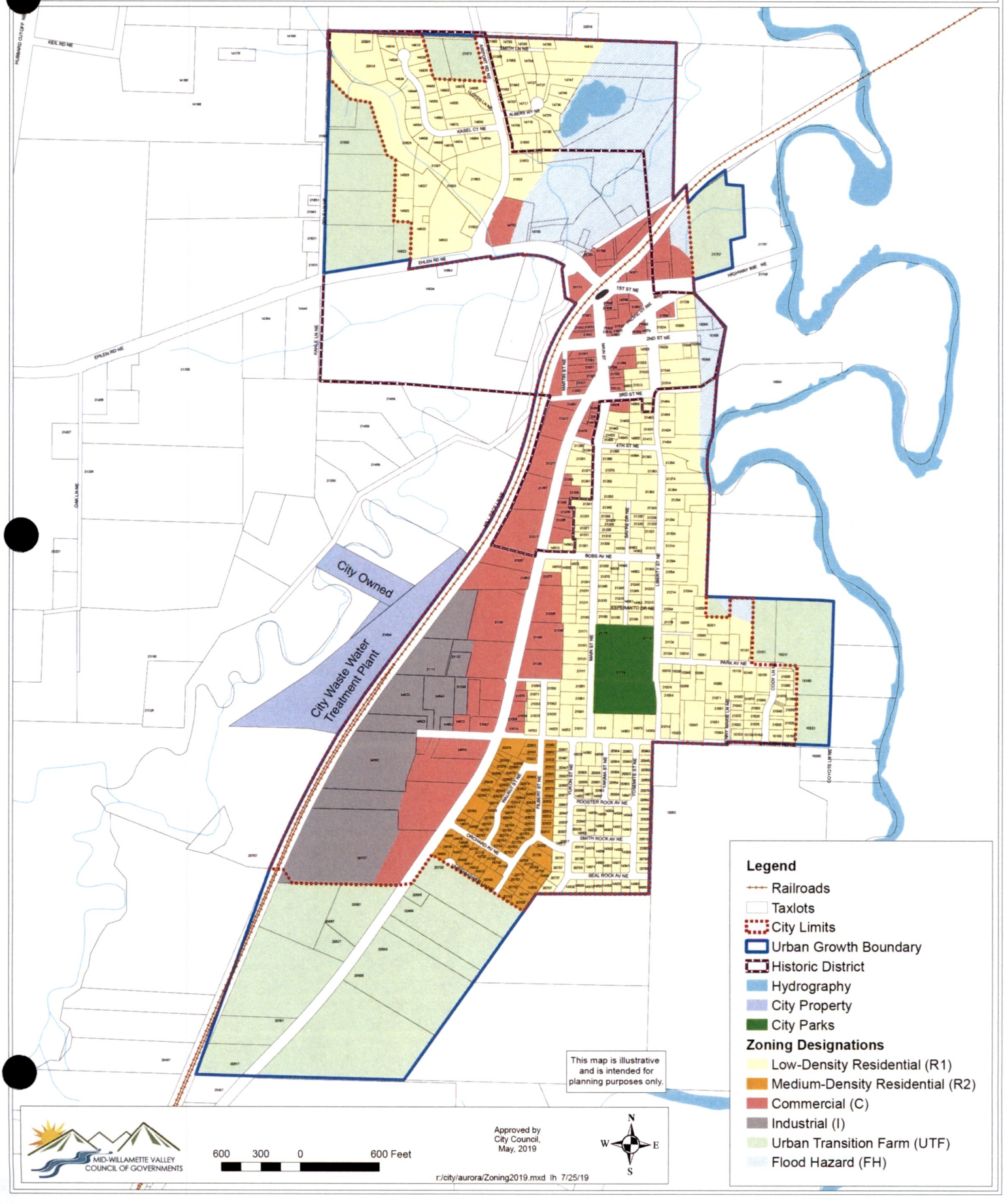
PLOT DATE: 12/30/2021

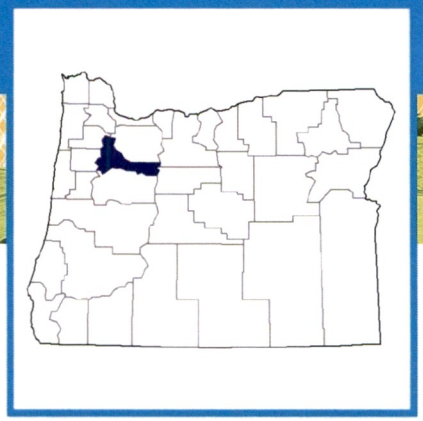
AURORA
04 1W 13C

City of Aurora Zoning Designations, 2019



2017 CENSUS OF AGRICULTURE *County Profile*





Marion County
Oregon

Total and Per Farm Overview, 2017 and change since 2012

	2017	% change since 2012
Number of farms	2,761	+8
Land in farms (acres)	288,671	+1
Average size of farm (acres)	105	-6
Total	($)	
Market value of products sold	701,580,000	+18
Government payments	1,995,000	+26
Farm-related income	28,582,000	+47
Total farm production expenses	613,394,000	+21
Net cash farm income	118,763,000	+9
Per farm average	($)	
Market value of products sold	254,104	+10
Government payments (average per farm receiving)	11,947	+89
Farm-related income	32,777	+47
Total farm production expenses	222,164	+13
Net cash farm income	43,015	+2

14 Percent of state agriculture sales

Share of Sales by Type (%)

Crops	86
Livestock, poultry, and products	14

Land in Farms by Use (%) [a]

Cropland	82
Pastureland	6
Woodland	7
Other	5

Acres irrigated: 102,576
36% of land in farms

Land Use Practices (% of farms)

No till	8
Reduced till	6
Intensive till	14
Cover crop	9

Farms by Value of Sales

	Number	Percent of Total [a]
Less than $2,500	1,273	46
$2,500 to $4,999	251	9
$5,000 to $9,999	283	10
$10,000 to $24,999	207	7
$25,000 to $49,999	168	6
$50,000 to $99,999	124	4
$100,000 or more	455	16

Farms by Size

	Number	Percent of Total [a]
1 to 9 acres	1,148	42
10 to 49 acres	945	34
50 to 179 acres	353	13
180 to 499 acres	169	6
500 to 999 acres	84	3
1,000 + acres	62	2

2017 CENSUS OF AGRICULTURE *County Profile*

Market Value of Agricultural Products Sold

	Sales ($1,000)	Rank in State [b]	Counties Producing Item	Rank in U.S. [b]	Counties Producing Item
Total	**701,580**	**1**	**36**	**55**	**3,077**
Crops	**603,365**	**1**	**36**	**23**	**3,073**
Grains, oilseeds, dry beans, dry peas	6,131	10	34	1,564	2,916
Tobacco	-	-	-	-	323
Cotton and cottonseed	-	-	-	-	647
Vegetables, melons, potatoes, sweet potatoes	69,478	4	36	48	2,821
Fruits, tree nuts, berries	92,162	2	35	45	2,748
Nursery, greenhouse, floriculture, sod	277,658	1	34	4	2,601
Cultivated Christmas trees, short rotation woody crops	19,729	3	24	4	1,384
Other crops and hay	138,207	1	36	6	3,040
Livestock, poultry, and products	**98,215**	**4**	**36**	**525**	**3,073**
Poultry and eggs	29,671	2	36	353	3,007
Cattle and calves	9,720	18	36	1,275	3,055
Milk from cows	48,421	3	27	166	1,892
Hogs and pigs	(D)	3	35	(D)	2,856
Sheep, goats, wool, mohair, milk	938	8	36	179	2,984
Horses, ponies, mules, burros, donkeys	1,016	5	35	185	2,970
Aquaculture	(D)	17	27	(D)	1,251
Other animals and animal products	7,780	1	34	23	2,878

Total Producers [c]	**5,066**
Sex	
Male	2,965
Female	2,101
Age	
<35	479
35 – 64	2,904
65 and older	1,683
Race	
American Indian/Alaska Native	34
Asian	66
Black or African American	1
Native Hawaiian/Pacific Islander	8
White	4,912
More than one race	45
Other characteristics	
Hispanic, Latino, Spanish origin	167
With military service	626
New and beginning farmers	1,401

Percent of farms that:

Have internet access	**85**
Farm organically	**1**
Sell directly to consumers	**16**
Hire farm labor	**31**
Are family farms	**96**

Top Crops in Acres [d]

Field/grass seed crops, all	79,536
Vegetables harvested, all	23,492
Forage (hay/haylage), all	18,657
Hazelnuts (Filberts)	16,366
Nursery stock crops	9,630

Livestock Inventory (Dec 31, 2017)

Broilers and other meat-type chickens	(D)
Cattle and calves	29,433
Goats	2,501
Hogs and pigs	1,104
Horses and ponies	2,496
Layers	(D)
Pullets	(D)
Sheep and lambs	5,947
Turkeys	1,863

See 2017 Census of Agriculture, U.S. Summary and State Data, for complete footnotes, explanations, definitions, commodity descriptions, and methodology.

[a] May not add to 100% due to rounding. [b] Among counties whose rank can be displayed. [c] Data collected for a maximum of four producers per farm. [d] Crop commodity names may be shortened; see full names at www.nass.usda.gov/go/cropnames.pdf. [e] Position below the line does not indicate rank. (D) Withheld to avoid disclosing data for individual operations. (NA) Not available. (Z) Less than half of the unit shown. (-) Represents zero.

USDA is an equal opportunity provider, employer, and lender.

EXHIBIT N

Aurora State Airport – Individual Airport Report

Economic Impact Analysis

The 2014 Update focuses on the Economic Impact Study that was completed as part of the Oregon Aviation Plan 2007. The Economic Impact Study Update (Update) was conducted to determine the value of the Oregon Aviation System. The Update includes fifty-seven Oregon airports listed in the National Plan of Integrated Airport Systems (NPAIS). The economic impact analysis of airports in Oregon was developed for each airport, measuring economic impacts of airport facilities, within regions and throughout the state. This study used the five regions of *ConnectOregon* to measure local/regional economic impacts of airports and for dependent non-aviation businesses.

Total economic impacts are the sum of on-airport economic activities, off-airport spending by visitors who arrive by air, and spin-off impacts (multiplier effect). Airport impacts are provided by region and state to show the contribution of each airport to the regional and state economies. In addition, aviation dependent impacts are provided by region to show the importance of airports in each region to non-aviation businesses. All impacts reported represent a base year of 2012. Each type of impact is defined in the following paragraphs.

On-Airport direct impacts represent economic activities that occur on airport grounds. Aviation related activities are those that would not occur without the airport, such as airlines, fixed base operators (FBO), government, and other tenants located at the airport or directly dependent on the airport. This category also includes airport management and other individuals employed directly by the airport, as well as retail and service operations for passengers, pilots, and other airport employees. In some cases, airports provide land or building space for companies that are not affiliated with aviation. These tenants are not related to the aviation mission of the airport, but are using the facility as a convenient and affordable business or industrial parks.

Off-Airport visitor spending (Direct Impacts) are expenditures made by air travelers who are visiting from outside the region, and occurs off the airport, in the regional economy. Visitor spending includes lodging, food, entertainment, retail purchases and ground transportation (retail purchases and on-airport car rentals are captured by on-airport impacts). Visitor spending is analyzed for commercial passengers as well as for general aviation pilots and passengers. Visitors flying into Oregon from another state or nation contribute to the airport's regional economy as well as to the state. However, passengers flying within Oregon, from one region to another, contribute to the region of their destination airport, but are not bringing additional money into Oregon. Therefore, in regions with air carrier airports, the direct impact of visitor spending for the region is higher than the impact of visitor spending for the state.

Airport dependent impacts represent area businesses that are dependent on an airport for incoming and outgoing, and for business travel. These businesses may relocate or suffer substantial loss if the airport were not available. This impact is not included in traditional economic impact methodology and is analyzed and reported by region for this study. Thus the economic dependence of a region on aviation represents the cumulative impacts of all airports within a region. The analysis is provided as an indicator of the importance of airports to regional economies.

EXHIBIT N

Spin-off impacts (Multiplier Affect) are calculated using impact multipliers, which are used to reflect the recycling of dollars through both the regional and state economy. A dollar spent in the economy does not disappear; rather, it continues to move through the local economy in successive rounds until it is incrementally exported from the community. As the expenditures described above are released into the economy, they circulate among other industry sectors, creating successive waves of additional economic benefit in the form of jobs, payroll, and output (expenditures). These successive rounds of spending are known as spin-off impacts, and help to represent the full impact of each dollar spent in a region. An example would be an airport employee spending his or her salary for housing, food, and other services. Spending occurring outside the area is considered economic leakage and is not reflected in the multiplier. Spin-off impacts are often reported as indirect and induced impacts. Indirect impacts reflect the purchase of goods and services by businesses. Induced impacts reflect worker making consumer purchases.

The project team analyzed the economic contributions of 57 airports under the jurisdiction of the Oregon Department of Aviation (ODA) that are part of the NPIAS. The Port of Portland commissioned a separate economic impact study of Portland International Airport which is included by reference. The sum of economic impacts derived from the 2012 Update and the 2011 Port of Portland study account for economic impacts generated by the NPIAS airports in Oregon.

Contribution of Airports to the Economy of Oregon

As shown in **Table 1**, NPIAS airports in Oregon contributed a total economic impact of $9.1 billion to the state economy, including $3.6 billion from NPIAS airports and $5.5 billion from Portland International Airport.

Additional study highlights include:

- Oregon's NPIAS airports (excluding PDX), including airport tenants, directly employ 7,700 people for aviation related activities and expend $495 million in wages. PDX supports an additional 16,300 jobs and $922 million in wages.
- Oregon's NPIAS airports' (excluding PDX) employees and tenants earned an average annual salary $64,500 per year for aviation activities, including jobs related to administrating and maintaining airport facilities, servicing air carriers and GA aircraft, and providing terminal services to passengers, as well as to air crews and other employees.
- 5,000 jobs across the state are directly attributed to visitor spending at Oregon's NPIAS airports (excluding PDX).
- Air cargo and business travel services directly contribute $8 billion to the state economy by enabling long distance business sales of goods and services produced in Oregon. The value of instate productivity supported by aviation supports more than 23,700 jobs to State residents.

EXHIBIT N

Aurora State Airport – Individual Airport Report

Table 1 2012 Economic Contribution of Airports to the Oregon Economy

	Jobs	Wages	Business Sales
Direct Effects of ODA On-Airport Aviation Activities and Visitor Spending			
On-Airport, including aviation-related tenants	7,677	$494,920,000	$1,680,058,000
Off-Airport: visitor spending	4,938	$102,187,000	$342,540,000
Subtotal of Direct Effects From ODA Airports	12,615	$597,107,000	$2,022,598,000
ODA Spin-off Effects of Supplier and Income Re-spending			
Due to On-Airport Aviation	11,193	$365,742,000	$1,351,803,000
Due to Visitor Spending	2,054	$80,250,000	$250,918,000
Subtotal of Spin-off Effects	13,247	$445,992,000	$1,602,721,000
Total ODA Airport Aviation Related Impacts	25,862	$1,043,099,000	$3,625,319,000
Portland International Airport Totals			
Airport Generated	16,308	$922,000,000	$3,725,000,000
Visitor Generated	35,963	$1,020,400,000	$1,752,700,000
Total Impact Portland International Airport	52,271	$1,942,500,000	$5,477,700,000
Grand Total – NPIAS Airports	**76,711**	**$2,811,790,000**	**$8,721,948,000**

Source: Airport and Tenant Surveys, EDR Group and Mead & Hunt Analyses, IMPLAN econometric package.
Note: Numbers may not add due to rounding.

EXHIBIT N

Aurora State Airport – Individual Airport Report

Comparisons of 2007 and 2012 Studies

The 2007 and 2012 studies bracketed the severe national downturn that began in late 2008, and for which the effects are still being felt in states and communities across the United States. From 2007-2012 the Oregon gross state product increased in real terms by 15% but worker earnings fell by 2% and the number of jobs fell by 3%. Together, these data indicate that productivity per job of Oregon workers has increased, meaning on average it takes more economic activity to create a job and generate wages to those who are working.

Significant economic changes are also seen in air cargo. The International Trade Administration of the U.S. Census Bureau traces annual value and metric tonnage of international air exports from point of origin as well as by airport. (Unfortunately, no such data set is available for domestic cargo shipments.) Tonnage has decreased by 27% for goods produced in Oregon and shipped from Oregon airports (primarily Portland International Airport), while the value of Oregon generated goods has increased by 63% in constant value. Thus, less production is needed to sustain overall value across commodities. For domestic cargo shipments, PDX reported 127,890 tons enplaned in 2007 and 91,480 tons in 2012, a decrease of 28%.

The scopes of the 2007 and 2012 studies have two major differences. The first difference is in the airports that are covered by the two studies. The 2007 study encompassed all 93 public use airports in the state of Oregon, other than those operated by the Port of Portland. In contrast the 2012 study is limited to 56 NPIAS airports (National Plan for Integrated Air Service; NPIAS designation is by the Federal Aviation Administration). Three airports, Wasco State Airport, Hillsboro Airport and Troutdale airport are part of the 2012 study but were not included in the 2007 effort. Thus, 53 airports are in common in the two studies.

The second difference is that on-airport impacts counted in the 2007 studies included both aviation related and non-aviation related tenants, although these were separated when impacts were reported. The 2012 study is limited to aviation related tenants. A comparison of the 2007 and 2012 studies is shown in **Table 2**.

Table 2 Aviation impact comparison: 2007 vs. 2012 (in 2012 dollars) for 53 NPIAS airports

Impact Type	Jobs		Wages (thousands)		Business Sales (thousands)	
	2007	2012	2007	2012	2007	2012
On Airport tenants	7,287	6,774	$301,970	$417,349	$953,175	$1,445,103
Off Airport Visitor Spending	6,945	4,434	$120,299	$89,221	$377,978	$304,029
Subtotal Direct Contribution	14,232	11,208	$422,269	$422,269	$1,331,153	$1,749,132
Tenant Spin Off	12,033	9,836	$352,319	$309,185	$1,018,264	$1,173,627
Visitor Spending Spin Off	3,153	1,845	$92,081	$70,353	$357,883	$223,355
Subtotal Spin Off	15,186	11,681	$444,400	$379,538	$1,376,148	$1,396,982
Total Aviation Impacts	29,418	22,889	$866,669	$886,108	$2,707,300	$3,146,114
Reliant/Dependent Impacts	**91,645**	**75,984**	**$4,211,110**	**$4,680,386**	**$17,446,481**	**$15,500,260**

EXHIBIT N

Aurora State Airport – Individual Airport Report

As shown is **Table 3**, it took 49% more business sales to generate a job in 2012 than in 2007, and workers were paid 31% more for the increase in productivity. For economic activities reliant on Oregon's NPIAS airports, labor productivity rose by 7% and wages were 34% higher, but as discussed above less cargo was moved and value per ton increased. Following **Table 3** is a summary entitled *Airport Role in Economy*, which illustrates the individual airport economic impact.

Table 3 Productivity analysis-change in wage and sales per job 2007 vs. 2012 (in 2012 dollars)

Impact Type	Wages per Job		Output per Job		% Change Wage	% Change Output
	2007	2012	2007	2012		
Total Aviation Related Impacts	$29,461	$38,713	$92,029	$137,451	31%	49%
Air Reliant/Dependent Impacts	$45,950	$61,597	$190,371	$203,994	34%	7%

EXHIBIT N

Aurora State Airport – Individual Airport Report

Oregon Aviation Plan 2014

Version OR 3.1 4/10/14

Airport Role in Economy

Airport: Aurora State
Airport Code:UAO

County: Marion

Region: Willamette Valley and Coast

Evaluated for Year: 2012

Activity Data

Total Commercial Operations:	0
Total Commercial Enplanements:	0
Total Commercial Visitors:	0
Total GA Operations:	39,225
Total GA Passengers:	117,675
Total GA Visitors:	117,675
Total Military Operations:	0

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On-going Contribution to the Regional and State Economies

	Jobs		Wages		Business Sales	
	Local	State	Local	State	Local	State
Direct Effects of On Airport Activities and Visitor Spending						
1. On Airport (incl. FBO and air related tenants)	1,087	1,087	$72,268,000	$72,268,000	$282,537,000	$282,537,000
2. Off-Airport: Visitor Spending	260	260	$5,476,000	$5,476,000	$18,474,000	$18,474,000
Total Direct	1,347	1,347	$77,744,000	$77,744,000	$301,011,000	$301,011,000
Spin-off Effects: Supplier and Income Re-spending						
3. Due to On Airport Aviation	1,623	1,901	$50,024,000	$66,793,000	$172,255,000	$231,899,000
4. Due to Visitor Spending	89	111	$3,196,000	$4,181,000	$9,654,000	$13,150,000
Total Spin-off	1,711	2,013	$53,220,000	$70,974,000	$181,909,000	$245,049,000
Total Airport Aviation Related Impacts	3,058	3,360	$130,964,000	$148,718,000	$482,920,000	$546,060,000
Total Airport Generated Impacts - Not Aviation						
5. On Airport Non-aviation Activities	0	0	$0	$0	$0	$0
6. Spin-offs due to Non-aviation Activities	0	0	$0	$0	$0	$0
Total Airport Non-aviation Impacts	0	0	$0	$0	$0	$0
Total Aviation and Non-aviation Related	3,058	3,360	$130,964,000	$148,718,000	$482,920,000	$546,060,000
Regional Off-Airport Aviation Dependent Business Activity						
7. Direct Business Activity	4,717	4,717	$310,238,000	$310,238,000	$1,319,304,000	$1,319,304,000
8. Spin-offs due to Dependent Activity	5,586	7,552	$222,057,000	$352,528,000	$629,692,000	$991,227,000
Total Off-airport Aviation Dependent Activity	10,303	12,270	$532,295,000	$662,766,000	$1,948,996,000	$2,310,531,000

Note: Regional Off-airport Aviation Dependent Business Activities account for business activity in the region that rely on aviation for business travel and cargo, and do not reflect a specific airport.

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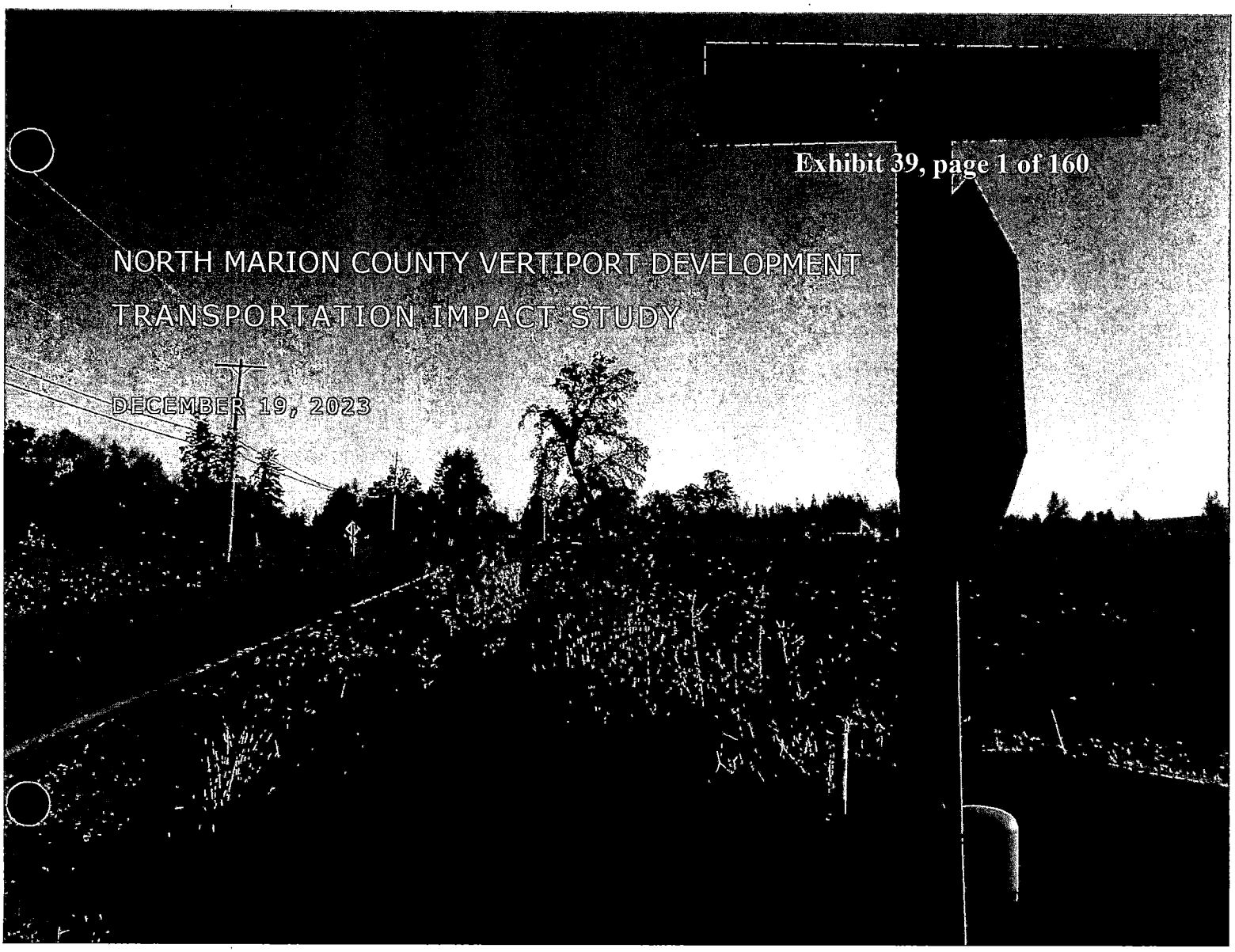

NORTH MARION COUNTY VERTIPORT DEVELOPMENT
TRANSPORTATION IMPACT STUDY

DECEMBER 19, 2023

PREPARED FOR:

TLM HOLDINGS

DOCUMENT DESCRIPTION

CLIENT	TLM Holdings
DKS Project Number	24239-000
Project Name	North Marion County Vertiport Development
Document Name	Transportation Impact Study

PREPARED BY DKS ASSOCIATES

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INTRODUCTION

This report documents a traffic assessment related to the impacts of a proposed development of vertiport-heliport services located on a currently vacant parcel adjacent to the Aurora State Airport in Marion County, Oregon. The development is a vertiport with tie downs and heliport hangars which include storage spaces and attached vertiport-heliport related office space and heliport shop spaces. The property is currently zoned Exclusive Farm Use (EFU), which allows for transportation facilities (like the proposed vertiport) as a conditional use.

Table 1 provides more details regarding the study area and characteristics of the proposed project.

TABLE 1: STUDY AREA AND PROPOSED PROJECT CHARACTERISTICS

STUDY AREA	
NUMBER OF INTERSECTIONS	7 existing intersections, 3 site access driveways
ANALYSIS PERIOD(S)	Weekday AM peak hour (peak hour between 7-9 AM) and PM peak hour (peak hour between 4-6 PM)
PROPOSED DEVELOPMENT	
SIZE AND LAND USE	vertiport-heliport tie-downs, hangars with storage spaces and attached vertiport-heliport office and heliport shop spaces
PROJECT TRIPS	38 AM peak hour trips, 38 PM peak hour trips, and 316 average weekday trips
VEHICLE ACCESS POINTS	Two access points along Airport Road and one access point on Stenbock Way
OTHER TRANSPORTATION FACILITIES	
PEDESTRIAN FACILITIES	No existing facilities
BICYCLE FACILITIES	Bicycle lanes along Arndt Road
TRANSIT FACILITIES	Route 3X SMART Transit stops at the Airport Road/Arndt Road intersection

The following chapters of this report document the existing conditions of the study area, including roadway classification, bicycle and pedestrian facilities, existing traffic operations, and existing safety conditions. The report then discusses the impact the proposed site plan will have on the surrounding transportation network and provides recommendations whether mitigation is required.

EXISTING CONDITIONS

This chapter details the existing study area conditions including the proposed site development, existing bicycle and pedestrian facilities, existing transit facilities, roadway network, future planned projects, existing traffic volumes and operations, and crash analysis. Supporting details are provided in the appendix.

STUDY AREA

The proposed development is located on the east edge of the Aurora State Airport, shown in Figure 1 and will include vertiport-heliport tie-downs, hangars with storage spaces and attached vertiport-heliport office and heliport shop spaces. There will be two access points to Airport Road and one access point to Stenbock Way. The following sections present a summary of the roadway network including the existing characteristics of the bicycle and pedestrian facilities, public transportation services, and any future planned projects in the study area.

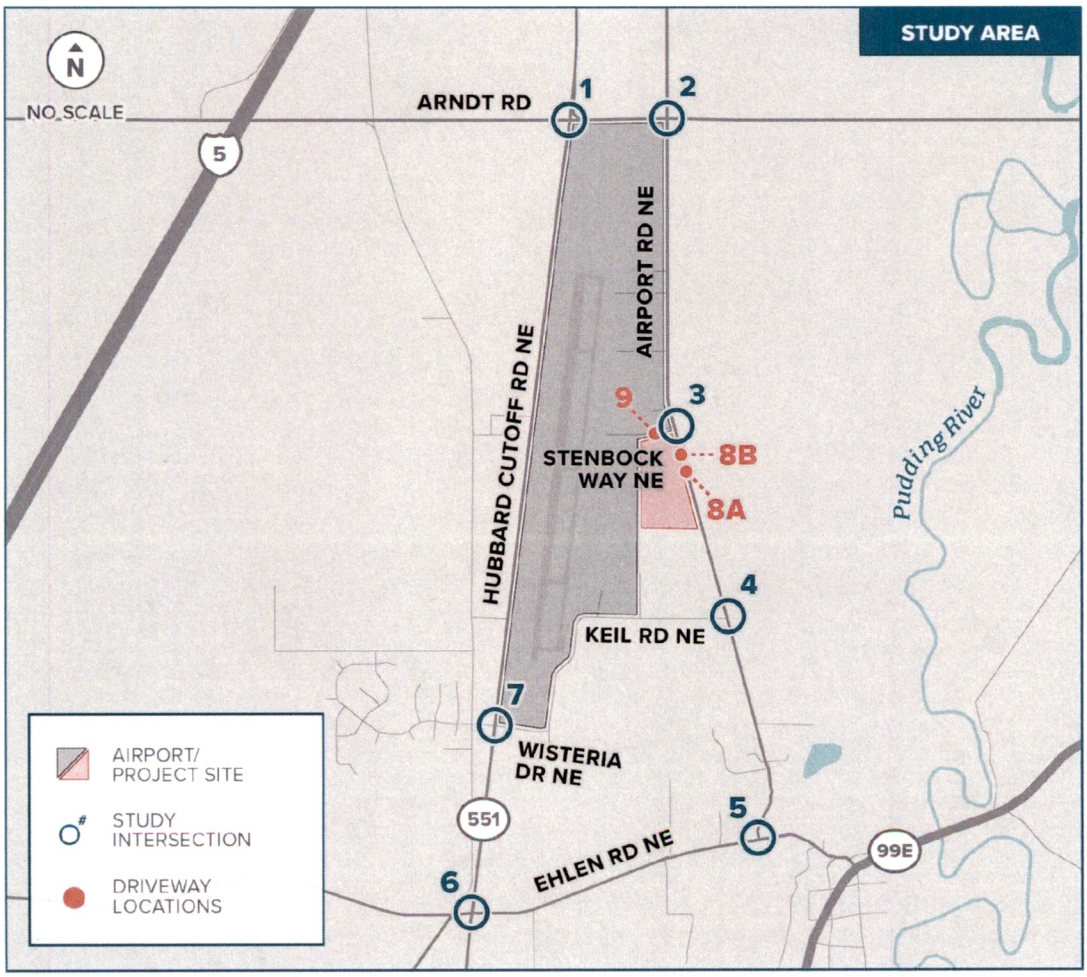

FIGURE 1: STUDY AREA

ROADWAY NETWORK

All of the roadways within the study area, except a small segment of Ehlen Road, are classified as rural roadways under either ODOT or Marion County jurisdiction. The above-mentioned short segment of Ehlen Road and the intersection of Airport Road/Ehlen Road are within the City of Aurora city limits and would be considered an urban roadway. However, both roadways are owned and maintained by Marion County, and the county's TSP and other standards shall govern the determination of transportation impacts and necessary mitigations at these locations.

The transportation characteristics of the roadways within the study area are shown in Table 2. The table includes the functional classification, number of travel lanes, posted speed, and facilities for bicyclists, pedestrians, and public transit. The functional classification specifies the purpose of the facility and is a determining factor of applicable cross-section, access spacing, and intersection performance standards.

TABLE 2: EXISTING STUDY AREA ROADWAY CHARACTERISTICS

ROADWAY	JURISDICTION	FUNCTIONAL CLASSIFICATION	LANES	POSTED SPEED	SIDEWALK	BIKE LANES	TRANSIT FACILITIES
OR 551	ODOT	State Highway - Rural Minor Arterial	2	55 mph	No	No [a]	None
ARNDT ROAD	Marion County	Rural Minor Arterial	4	45 mph	No	Yes	SMART 3X Bus Stop
AIRPORT ROAD	Marion County	Rural Major Collector	2	35/55 mph [b]	No	No	SMART 3X Bus Stop
KEIL ROAD	Marion County	Rural Minor Collector	2	35 mph	No	No	None
EHLEN ROAD	Marion County [c]	Rural Minor Arterial	2	35/45 mph [d]	No	No	None

[a] OR 551 has shoulders, approximately six feet, which are wide enough for bicycles.

[b] Airport Rd is 55 mph from Arndt Rd to just north of Smith Lane and 35 mph from just north of Smith Lane to Ehlen Rd.

[c] A short segment on the east end of Ehlen Road is within the Aurora City Limits and is classified as an urban roadway; However, the Marion County standards are still applicable and do not change based on this designation.

[d] Ehlen Road is 45 mph from OR 551 to Kahle Lane NE and 35 mph from Kahle Lane NE to just east of Airport Road NE.

The existing bicycle and pedestrian facilities near the proposed site include six foot bicycle lanes on Arndt Road east of OR 551. There is a short segment of sidewalk on each corner of the Arndt Road/Airport Road intersection. There is one transit stop within the project vicinity that is serviced by Route 3X (Canby) of the South Metro Area Regional Transit (SMART). The stop is located at Arndt Road/Airport Road and has headways of approximately 1-hour in the morning and evening peak weekday commute periods.

EXISTING TRAFFIC VOLUMES AND OPERATIONS

An analysis of the 2023 existing intersection operations was performed for the study intersections to ensure the transportation network meets Marion County and ODOT performance standards. Intersections are the focus of the analysis because they are the controlling bottlenecks of traffic flow and the ability of a roadway system to carry traffic efficiently is nearly always diminished in their vicinity.

Intersection operations were analyzed for the AM and PM peak hours. Turning movement counts were collected on September 19th, 2023, during the AM (7:00-9:00 a.m.) and PM (4:00-6:00 p.m.) peak periods at each of the following study intersections.

- Airport Road /Arndt Road
- Airport Road /Keil Road
- Airport Road /Ehlen Road
- Airport Road/Stenbock Way
- OR-551/Arndt Road
- OR-551/Keil Road
- OR-551/Ehlen Road

SEASONAL ADJUSTMENT FACTOR

The traffic count data collected in September 2023 represents a period where traffic volumes are lower than the average weekday conditions. Adjustments to ODOT facilities are required so that traffic volumes analyzed represent the 30th highest hour volume (30HV) as identified in the methodology from the ODOT Analysis Procedural Manual. To determine when the 30HV conditions occur, data is examined from Automatic Traffic Recorder (ATR) stations that record traffic highway volumes year-round. The Hubbard ATR #24-016 on OR-551 just south of Ehlen Road was deemed appropriate to utilize due to its proximity to the project site. The September traffic counts were adjusted to the peak month of August by a seasonal factor of 1.05 using volume data from 2016 through 2020.[1] The supporting ATR data and calculation is included in the appendix. The Seasonal Adjustment Factor was applied to the AM and PM peak hour volumes. The adjusted 2023 traffic volumes are shown in Figure 2 below.

[1] It should be noted that in 2021 there was an equipment outage from June through August and in 2022 there was construction near the ATR between May and August, so these years were not used in the Seasonal Adjustment Factor calculations.

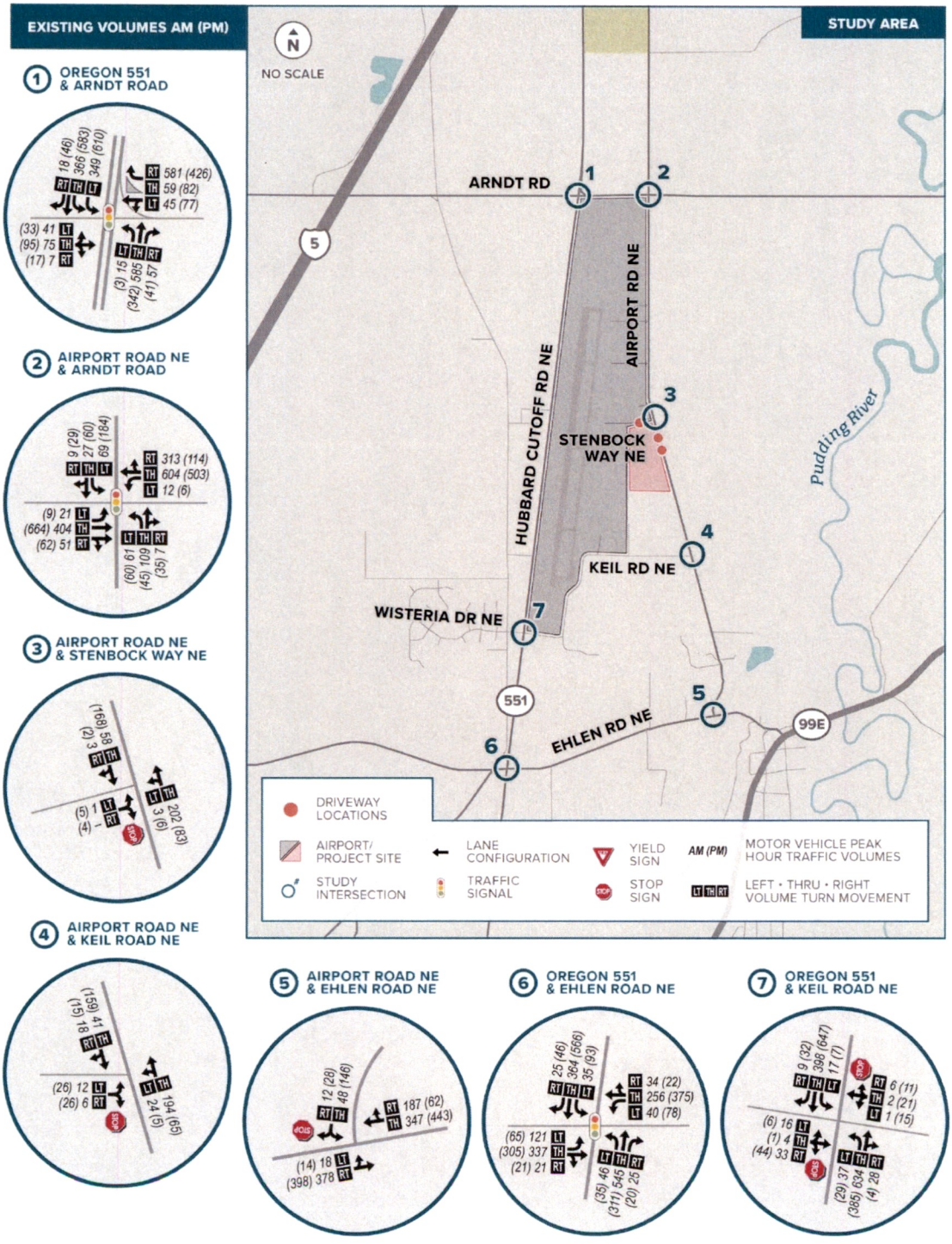

FIGURE 2: 2023 EXISTING CONDITIONS TRAFFIC VOLUMES

INTERSECTION PERFORMANCE MEASURES

Level of service (LOS) ratings and volume-to-capacity (v/c) ratios are two commonly used performance measures that provide a good representation of intersection operations. In addition, they are often incorporated into agency mobility standards.

- **Level of service (LOS):** A "report card" rating (A through F) based on the average delay experienced by vehicles at the intersection. LOS A, B, and C indicate conditions where traffic moves without significant delays over periods of peak hour travel demand. LOS D and LOS E are progressively worse operating conditions. LOS F represents conditions where average vehicle delay has become excessive and demand has exceeded capacity. This condition is typically evident in long queues and delays.
- **Volume-to-capacity (v/c) ratio:** A decimal representation (typically between 0.00 and 1.00) of the proportion of capacity that is being used at a turn movement, approach leg, or intersection. It is determined by dividing the peak hour traffic volume by the hourly capacity of a given intersection or movement. A lower ratio indicates smooth operations and minimal delays. As the ratio approaches 0.95, congestion increases and performance is reduced. If the ratio is greater than 1.00, the turn movement, approach leg, or intersection is oversaturated and usually results in excessive queues and long delays.

Marion County operations standards are outlined in the Marion County Traffic Impact Analysis (TIA) Requirements while ODOT mobility targets are outlined in the Oregon Highway Plan. All study intersections under Marion County jurisdiction require that unsignalized intersections maintain a Level of Service (LOS) of E or better.[2] Signalized intersections under Marion County jurisdiction[3] are required to maintain a LOS of D or better (all individual movements to maintain a LOS E or better) with a v/c ratio of 0.85 or less.[4] All signalized and unsignalized intersections under ODOT jurisdiction require a 0.70 or better v/c ratio for a regional highway in a rural area.[5]

EXISTING VEHICLE OPERATIONS

Existing study intersection operations were evaluated based on the Highway Capacity Manual (HCM) 6th Edition methodology for signalized and unsignalized intersections.[6] Specific parameters for ODOT and Marion County were applied based on the ODOT Analysis and Procedures Manual (APM) and Marion County Traffic Impact Analysis Requirements, respectively. Table 3 lists the

---

[2] Marion County standards for all-way stop intersections do not apply as there are no all-way stop intersections in the study area.

[3] A short segment of Ehlen Road is within the Aurora City Limits and UGB. However, the City of Aurora TSP defers to the Marion County operations standards as Marion County owns and maintains the roadway. (Aurora TSP, 2009, Table 3-2)

[4] TIA Requirements Policy and Procedures - Methodologies and Analysis Parameters. Marion County. 2015.

[5] Oregon Highway Plan Table 6. Oregon Department of Transportation. 2023.

[6] *Highway Capacity Manual, Sixth Edition | A Guide for Multimodal Mobility Analysis*, Transportation Research Board, Washington D.C., 2016.

study intersection's existing volume to capacity (v/c) ratio, delay, and LOS. As shown, under existing conditions, the OR-551/Ehlen Road intersection fails to meet ODOT's mobility target of v/c ≤ 0.70 for the AM and PM peak hours.

TABLE 3: 2023 EXISTING PEAK HOUR STUDY INTERSECTION OPERATIONS

INTERSECTION	JURIS-DICTION	MOBILITY TARGET/ OPERATING STANDARD	AM PEAK HOUR			PM PEAK HOUR		
			V/C	DELAY	LOS	V/C	DELAY	LOS
SIGNALIZED								
AIRPORT ROAD/ ARNDT ROAD	Marion County	0.85 v/c; LOS D	0.84	37.5	D	0.63	18.2	B
OR-551/ ARNDT ROAD	ODOT	0.70 v/c	0.69	21.6	C	0.62	19.8	B
OR-551/ EHLEN ROAD	ODOT	0.70 v/c	**0.75**	35.4	D	**0.79**	40.8	D
TWO-WAY STOP-CONTROLLED								
AIRPORT ROAD/ KEIL ROAD	Marion County	LOS E	0.03 EB	10.2	A/B	0.10 EB	10.4	A/B
AIRPORT ROAD/ EHLEN ROAD	Marion County	LOS E	0.23 SB	20.8	A/C	0.73 SB	46.6	A/E
OR-551/ KEIL ROAD	ODOT	0.70 v/c	0.27 SB	9.5	A/C	0.39 WB	45.4	A/E
AIRPORT ROAD/ STENBOCK WAY	Marion County	LOS E	0.01 EB	10.3	A/B	0.02 EB	10.4	A/B

Signalized Intersections:
v/c = Volume-to-Capacity Ratio of Intersection
Delay = Average Stopped Delay per Vehicle (sec)
LOS = Level of Service of Intersection

Two-Way Stop-Controlled Intersections:
v/c = Volume-to-Capacity Ratio of Worst Movement
Delay = Critical Movement Approach Delay (sec)
LOS = Level of Service of Major Street/Minor Street

Bold/Highlighted: Intersection fails to meet operating standards/mobility targets.

SAFETY ANALYSIS

The most recent five years (2017 - 2021) of available crash data for the study area was obtained from the Oregon Department of Transportation (ODOT) and was used to evaluate the safety performance of the study intersections. During the five-year study period, there were a total of 134 crashes with 106 crashes at the study intersections and 28 crashes along the study segments (Figure 3).

One fatal crash occurred in July 2021 involving a bicyclist that was struck from behind by a driver. This crash occurred along OR 551 between Arndt Road and Keil Road. There were five crashes in the study area that resulted in severe injuries, including one crash along the project site frontage. The crash occurred when a southbound driver ran off the road and into the ditch. The two primary types of collisions were rear-end (66 crashes) and turning (43 crashes) and the most common contributing factors were failure to avoid (42 crashes) or not yielding (34 crashes).

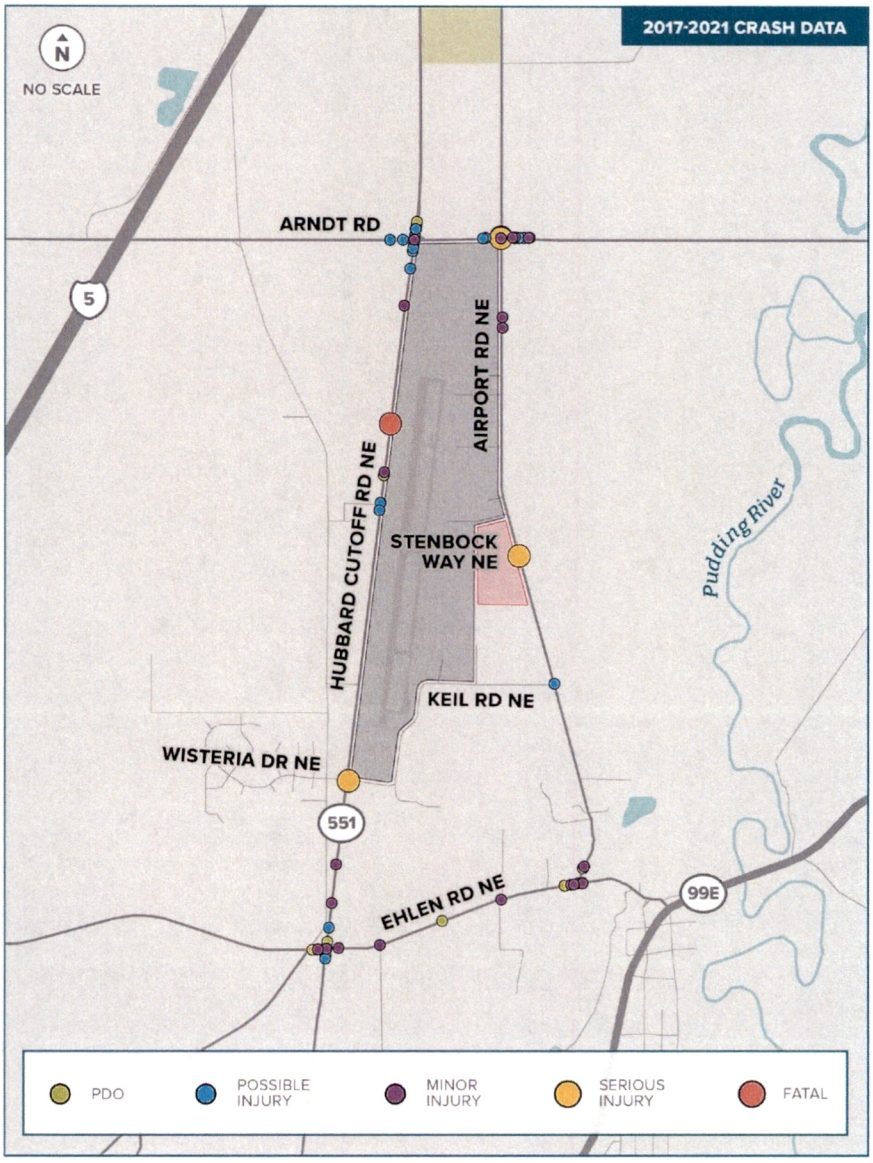

FIGURE 3: 2017 TO 2021 COLLISIONS

CRASH RATE

The total number of crashes observed at an intersection is typically related to the volume of traffic traveling through said intersection. Because of this relationship, a commonly used measure to evaluate the safety performance of an intersection is the intersection crash rate, which is the number of crashes per year per million entering vehicles (MEV). ODOT has developed a list of critical crash rates which represent the expected crash rate for different types of intersections across the state. If the calculated crash rate is higher than the corresponding ODOT critical

crash rate, this would indicate a potential safety concern and would warrant additional safety investigations.

As shown in Table 4, the three signalized intersections of Airport Road/Arndt Road, OR-551/Arndt Road, and OR-551/Ehlen Road had high crash rates that exceeds the ODOT Critical Crash Rate. As noted earlier, safety improvements were implemented in 2020 at the intersection of OR-551/Ehlen Road, the effects of which are not fully reflected in the crash rate yet.

TABLE 4: STUDY INTERSECTION CRASHES (2017-2021)

INTERSECTION	CRASH FREQUENCY (BY SEVERITY)				ADT	ODOT CRITICAL CRASH RATE	OBSERVED CRASH RATE
	FATAL	INJURY	PDO	TOTAL			
OR-551/ ARNDT ROAD	0	17	12	29	23,550	0.579	**0.675**
AIRPORT ROAD/ ARNDT ROAD	0	26	11	37	17,710	0.579	**1.145**
AIRPORT ROAD/ STENBOCK WAY	0	0	0	0	2,680	0.475	0.000
AIRPORT ROAD / KEIL ROAD	0	1	0	1	2,960	0.475	0.185
AIRPORT ROAD/ EHLEN ROAD	0	4	3	7	10,910	0.475	0.352
OR-551/ EHLEN ROAD	0	22	16	38	19,370	0.579	**1.075**
OR-551/ KEIL ROAD	0	2	0	2	12,020	1.080	0.091

[a] PDO = Property damage only
[b] Critical crash rates according to 90th Percentile rate from ODOT APM Exhibit 4-1
[c] Crash rate = average annual crashes per million entering vehicles (MEV); MEV estimates based on PM peak-hour traffic count

Bold/Highlighted: Intersection is over the critical crash rate.

SAFETY PRIORITY INDEX SYSTEM (SPIS)

The Safety Priority Index System (SPIS) is a ranking system developed by ODOT to identify potential safety problems on state highways. SPIS scores are developed based upon crash frequency, severity, and rate for a 0.10 mile or variable length segment along the state highway over a rolling three-year window (i.e., every year it is updated with the most recent three years).

A prioritized list of the top 15th percentile of statewide SPIS sites is created for each region, and the top 5th percentile are investigated by the five Region Traffic managers' offices. Based on the 2020 SPIS list, Airport Road/Arndt Road is in the top 95% percentile. OR-551/Ehlen Road is in the top 85th percentile. However, it should be noted that OR-551/Ehlen Road was recently reconfigured

in 2020 and included the addition of left turn lanes on the eastbound and westbound approaches. Because the SPIS data is based on crashes between 2017 – 2019, the recent safety improvements and their effects on safety at OR-551/Ehlen Road are not yet reflected in the current SPIS list.

RECOMMENDED SAFETY IMPROVEMENTS

Of the 29 crashes that occurred at the OR-551/Arndt Road intersection, the majority of crashes were rear-end crashes (16 crashes) or turning crashes (7 crashes). The most common cause for crashes here were "Failure to Avoid" (11 crashes) and "Improper Turning" (4 crashes). It is recommended that safety improvements such as advanced flashing signal ahead warning signage be installed at the OR-551/Arndt Road intersection, specifically in the northbound direction and eastbound direction, to address these crash patterns.

Of the 37 crashes that occurred at the Airport Road/Arndt Road intersection, two crashes resulted in severe injuries. The majority of crashes that occurred at this intersection were turning crashes (20 crashes) or rear-end crashes (11 crashes). The most common cause for crashes here were "Failure to Yield" (17 crashes) and "Failure to Avoid" (9 crashes). Both of the severe injury crashes occurred in the evening between 4PM – 6PM. It is recommended that safety improvements such as protected-permissive left turn phasing on the northbound and southbound approaches, advanced signal heads, and advanced signal warning signage be installed at the Airport Road/Arndt Road intersection to address these crash patterns.

PROJECT IMPACTS

The proposed development on the east edge of the Aurora State Airport is a "Vertiport." The proposed Vertiport is composed of verticopter/helicopter tie downs and hangars and charging stations. There are offices/shops shown on the proposed site plan. Shops are used for repairing and maintaining aircraft components. Offices are used for maintenance staff, inspectors, libraries of manuals, FAA required parts which must be secured at all times to ensure their provenance and chain of ownership is maintained, log books for aircraft and for each of their parts, offices for pilots, for pilot training, for weather data and flight planning, drone pilot work stations, if medical aero then offices for flight nurses and staff, training for same, dispatch offices, line person offices. Note, the verticopters/helicopters stored, maintained, and repaired at the proposed vertiport are the only ones using the facility.

To evaluate the impacts of the proposed development, the vehicle operations at the identified study intersections under future no-build and build conditions with the proposal were analyzed.

TRIP GENERATION

Trip generation is the method used to estimate the number of vehicles a development adds to site driveways and the adjacent roadway network during a specified period (i.e., such as the PM peak hour). Trip generation estimates are performed using trip rates surveyed at similar land uses, as provided by the Institute of Transportation Engineers (ITE).[7]

The site is proposed to include three different uses:

- Verticopter/helicopter tie downs and hangar space
- Verticopter/helicopter storage space
- Verticopter/helicopter offices and shops. The shops will be used for repairing and maintaining aircraft components. The offices will be used by maintenance staff, inspectors, and pilots.

There are three hangars and one headquarters building shown on the site plan.

- Hangar V is only for verticopter and helicopter storage and will not contain any office or shop space. Therefore, it is assumed to not generate any independent vehicle trips.
- Hangar W and Hangar X are proposed to house verticopter and helicopters as well as provide space for shops and offices. This combination of shop and office space is best matched by the Warehouse ITE Land Use (LU Code 150), which is described as "...primarily devoted to the storage of materials, but it may also include office and maintenance areas".
- The Vertiport Headquarters building will have a mix of traditional office space and shop space. For trip generation purposes, it was assumed that approximately 50% of the floorspace would be general office (ITE LU Code 710) and 50% would be verticopter-helicopter shops (ITE LU Code 150).

[7] *Trip Generation Manual, 11th Edition*, Institute of Transportation Engineers, 2021.

TABLE 5: BUILDING SQUARE FOOT BREAKDOWN BY USE

BUILDING	SIZE (SQUARE FEET)	BREAKDOWN OF USE	SIZE (SQUARE FEET)	TRIP GENERATION LAND USE CODE
HANGAR V	38,916	Verticopter and Helicopter Storage	38,916	None
HANGAR W	76,160	Verticopter and Helicopter Storage	32,000	None
		Shops/Offices	44,160	LU Code 150
HANGAR X	57,560	Verticopter and Helicopter Storage	32,000	None
		Shops/Offices	25,560	LU Code 150
VERTIPORT HEADQUARTERS	31,316	Office	15,658	LU Code 710
		Shops	15,658	LU Code 150

Based on the ITE manual, the proposed site is estimated to generate 316 average daily trips, 38 (32 in, 6 out) AM peak hour trips and 38 (8 in, 30 out) PM peak hour trips.

TABLE 6: TRIP GENERATION SUMMARY FOR PROPOSED DEVELOPMENT

LAND USE (ITE CODE)	TRIP GEN RATE [A]	UNITS	AM PEAK HOUR			PM PEAK HOUR			DAILY TRIPS
			IN	OUT	TOTAL	IN	OUT	TOTAL	
WAREHOUSE (150)	0.17 (0.18)	85.4 KSF	11	3	14	4	11	15	146
GENERAL OFFICE (710)	1.52 (1.44)	15.7 KSF	21	3	24	4	19	23	170
		TOTAL	**32**	**6**	**38**	**8**	**30**	**38**	**316**

Note:

A. XX (YY) = AM peak rate (PM peak rate) in trips per 1,000 square feet of gross floor area

B. KSF = 1,000 square feet

TRIP DISTRIBUTION

Trip distribution provides an estimation of where project-related trips would be coming from and going to within the study area. It is given as percentages at key gateways to the study area and is used to route project trips through the study intersections. The trip distribution, estimated using the existing traffic counts, is shown in Figure 4 on the following page.

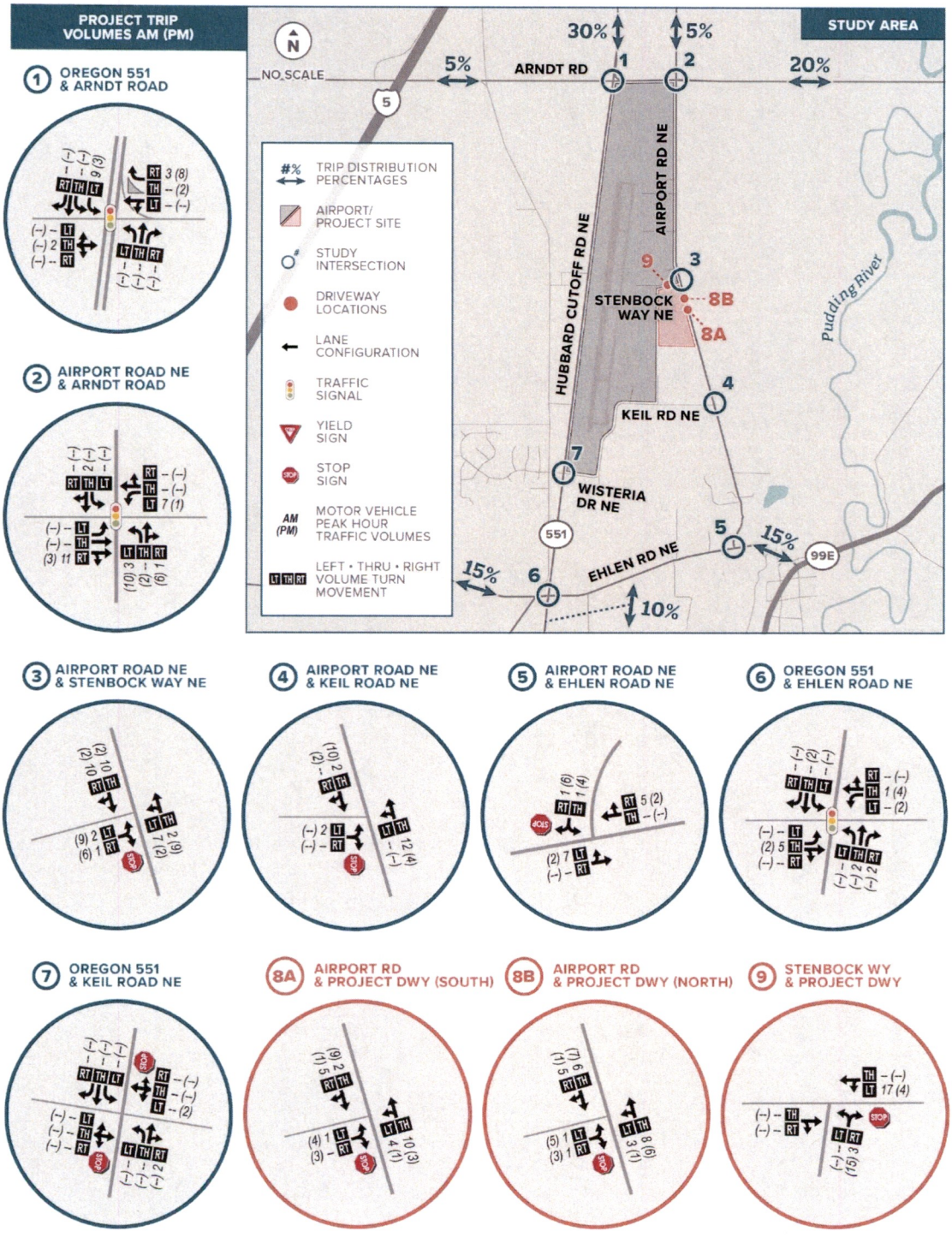

FIGURE 4: PROJECT TRIPS AND TRIP DISTRIBUTION

PROJECT IMPACT ANALYSIS

The following sections present the results of the future traffic operations analysis at each of the study intersections, with and without the proposed development.

FUTURE TRAFFIC VOLUMES

Future traffic volumes were estimated and used to analyze future intersection operations at the intersection for two future years: Year of Opening (2025) and Short-Term (2030). The future analysis scenarios include various combinations of three types of traffic: existing, background, and project. The background traffic includes the traffic that is expected to be added to the transportation system based on an increase in regional population and development.

A growth rate was calculated based on methodology from ODOT's Analysis Procedure Manual.[8] OR-551 is located outside of Aurora's urban growth boundary and using historical trends to estimate a growth rate was deemed applicable. Current and future traffic volumes on OR-551 near the site (mile posts 1.49 and 3.46) were gathered from ODOT's Future Volumes Table and an annual growth rate of 2.0% on OR-551 between Arndt Road and Ehlen Road was calculated. Supporting data is included in the appendix.

This growth rate was applied to all movements at the OR-551/Arndt Road and OR-551/Ehlen Road intersections, the north-south through movements at the OR-551/Keil Road intersection, and the east-west movements at the Arndt Road/Airport Road and Ehlen Road/Airport Road intersections. The growth rate was selectively applied to the study intersections to accurately model the expected background growth in traffic. It is anticipated that any growth on Airport Road in the future will be due to the expansion of the airport facilities.

PLANNED PROJECTS

All future traffic operations assumed completion of the following planned Marion County project:

> **Marion County Flashing Yellow Arrows:** Install flashing yellow arrows for all left turn movements at the Airport Road/Arndt Road intersection to allow for protective and permissive left turns. Optimized signal timing was assumed as part of this project.

OPENING YEAR (2025) ANALYSIS

Figure 5 and Figure 6 show the expected traffic volumes for the study area for the Opening Year 2025 No Build and Build (with proposed development).

[8] *Analysis Procedure Manual, Version 2,* Chapter 6: Future Year Forecasting, ODOT, Last updated November 2018.

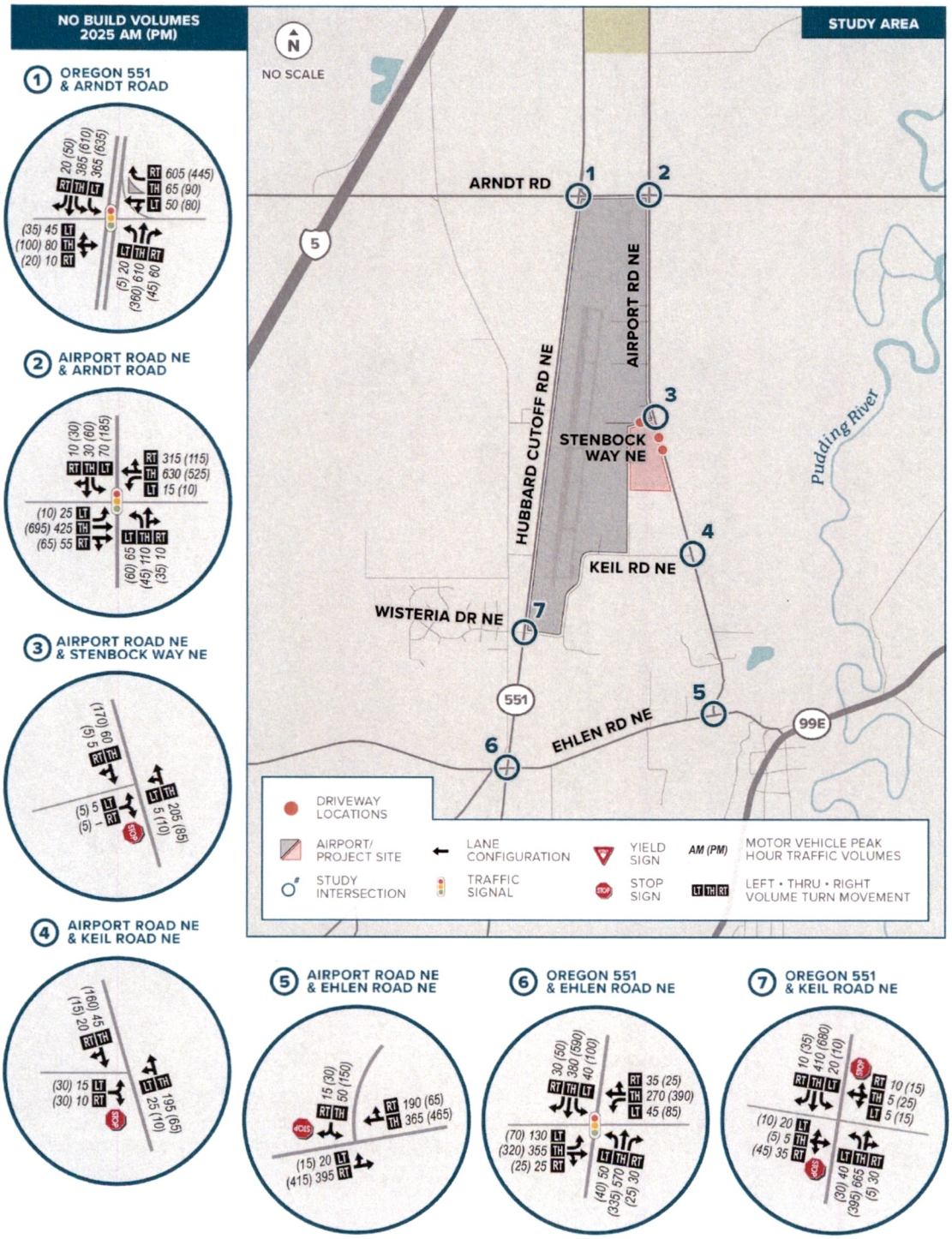

FIGURE 5: 2025 NO BUILD TRAFFIC VOLUMES

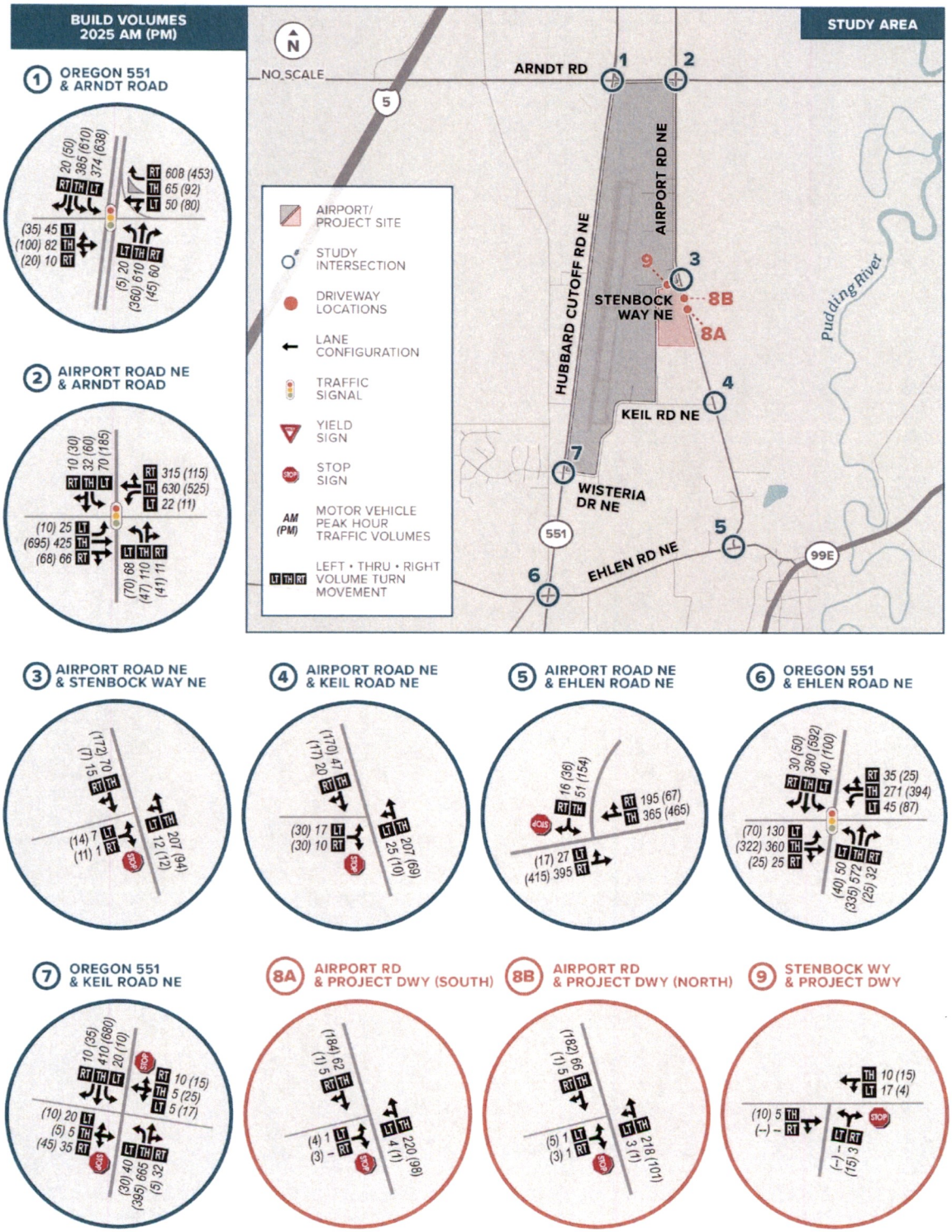

FIGURE 6: 2025 BUILD TRAFFIC VOLUMES

It is anticipated that the proposed development will be completed in 2025. Table 7 lists the 2025 No Build intersection operations and Table 8 lists the 2025 Build intersection operations. As shown, by 2025, all three signalized intersections will exceed the v/c mobility target in the No Build scenario. Additionally, the Airport Road / Ehlen Road intersection is projected to operate at LOS F, exceeding the Marion County LOS target. With the proposed development, the v/c at the three signals are projected to see no increase or a minimal increase in v/c ratio. At the Airport Road / Ehlen Road intersection, the LOS remains unchanged (LOS F on the minor street approaches). Mitigation measures are discussed in the *Mitigation Strategies* section.

TABLE 7: 2025 NO BUILD INTERSECTION OPERATIONS

INTERSECTION	JURIS-DICTION	MOBILITY TARGET/ OPERATING STANDARD	AM PEAK HOUR			PM PEAK HOUR		
			V/C	DELAY	LOS	V/C	DELAY	LOS
SIGNALIZED								
AIRPORT ROAD/ ARNDT ROAD	Marion County	0.85 v/c and LOS D	**0.95**	50.5	D	0.69	20.5	C
OR-551/ ARNDT ROAD	ODOT	0.70 v/c	**0.73**	23.7	C	0.66	21.9	C
OR-551/ EHLEN ROAD	ODOT	0.70 v/c	**0.79**	40.3	D	**0.83**	46.3	D
TWO-WAY STOP-CONTROLLED								
AIRPORT ROAD/ KEIL ROAD	Marion County	LOS E	0.04 EB	10.2	A/B	0.11 EB	10.6	A/B
AIRPORT ROAD/ EHLEN ROAD	Marion County	LOS E	0.26 SB	22.2	A/C	0.80 SB	58.2	A/**F**
OR-551/ KEIL ROAD	ODOT	0.70 v/c	0.33 EB	30.9	A/D	0.49 WB	55.0	A/F
AIRPORT ROAD/ STENBOCK WAY	Marion County	LOS E	0.01 EB	10.4	A/B	0.02 EB	10.4	A/B

Signalized Intersections:
v/c = Volume-to-Capacity Ratio of Intersection
Delay = Average Stopped Delay per Vehicle (sec)
LOS = Level of Service of Intersection

Two-Way Stop-Controlled Intersections:
v/c = Volume-to-Capacity Ratio of Worst Movement
Delay = Critical Movement Approach Delay (sec)
LOS = Level of Service of Major Street/Minor Street

Bold/Highlighted: Intersection fails to meet operating standards/mobility targets.

TABLE 8: 2025 BUILD INTERSECTION OPERATIONS

INTERSECTION	JURIS-DICTION	MOBILITY TARGET/ OPERATING STANDARD	AM PEAK HOUR [A]			PM PEAK HOUR [A]		
			V/C	DELAY	LOS	V/C	DELAY	LOS
SIGNALIZED								
AIRPORT ROAD/ ARNDT ROAD	Marion County	0.85 v/c and LOS D	**0.95 (+0.00)**	50.4 (-0.1)	D (-)	0.70 (+0.01)	21.3 (+2.9)	C (-)
OR-551/ ARNDT ROAD	ODOT	0.70 v/c	**0.74 (+0.01)**	24.1 (+0.4)	C (-)	0.66 (+0.00)	22.0 (+0.1)	C (-)
OR-551/ EHLEN ROAD	ODOT	0.70 v/c	**0.79 (+0.00)**	40.8 (+0.5)	D (-)	**0.83 (+0.00)**	47.1 (+0.8)	D (-)
TWO-WAY STOP-CONTROLLED								
AIRPORT ROAD/ KEIL ROAD	Marion County	LOS E	0.04 EB (+0.00)	10.4 (+0.2)	A/B (-/-)	0.11 EB (+0.00)	10.8 (+0.2)	A/B (-/-)
AIRPORT ROAD/ EHLEN ROAD	Marion County	LOS E	0.28 SB (+0.02)	23.1 (+0.9)	A/C (-/-)	0.85 SB (+0.05)	65.8 (+7.6)	A/**F** (-/-)
OR-551/ KEIL ROAD	ODOT	0.70 v/c	0.33 EB (+0.00)	31.3 (+0.4)	A/D (-/-)	0.52 WB (+0.03)	57.9 (+2.9)	A/F (-/-)
AIRPORT ROAD/ STENBOCK WAY	Marion County	LOS E	0.01 EB (+0.00)	10.5 (+0.1)	A/B (-/-)	0.05 EB (+0.03)	10.8 (+0.4)	A/B (-/-

Signalized Intersections:
v/c = Volume-to-Capacity Ratio of Intersection
Delay = Average Stopped Delay per Vehicle (sec)
LOS = Level of Service of Intersection

Two-Way Stop-Controlled Intersections:
v/c = Volume-to-Capacity Ratio of Worst Movement
Delay = Critical Movement Approach Delay (sec)
LOS = Level of Service of Major Street/Minor Street

Bold/Highlighted: Intersection fails to meet operating standards/mobility targets.

A. The number in parentheses represents the difference from No Build.

SHORT-TERM (2030) ANALYSIS

Figure 7 and Figure 8 show the expected traffic volumes for the study area for the Short-Term 2030 No Build and Build (with proposed development).

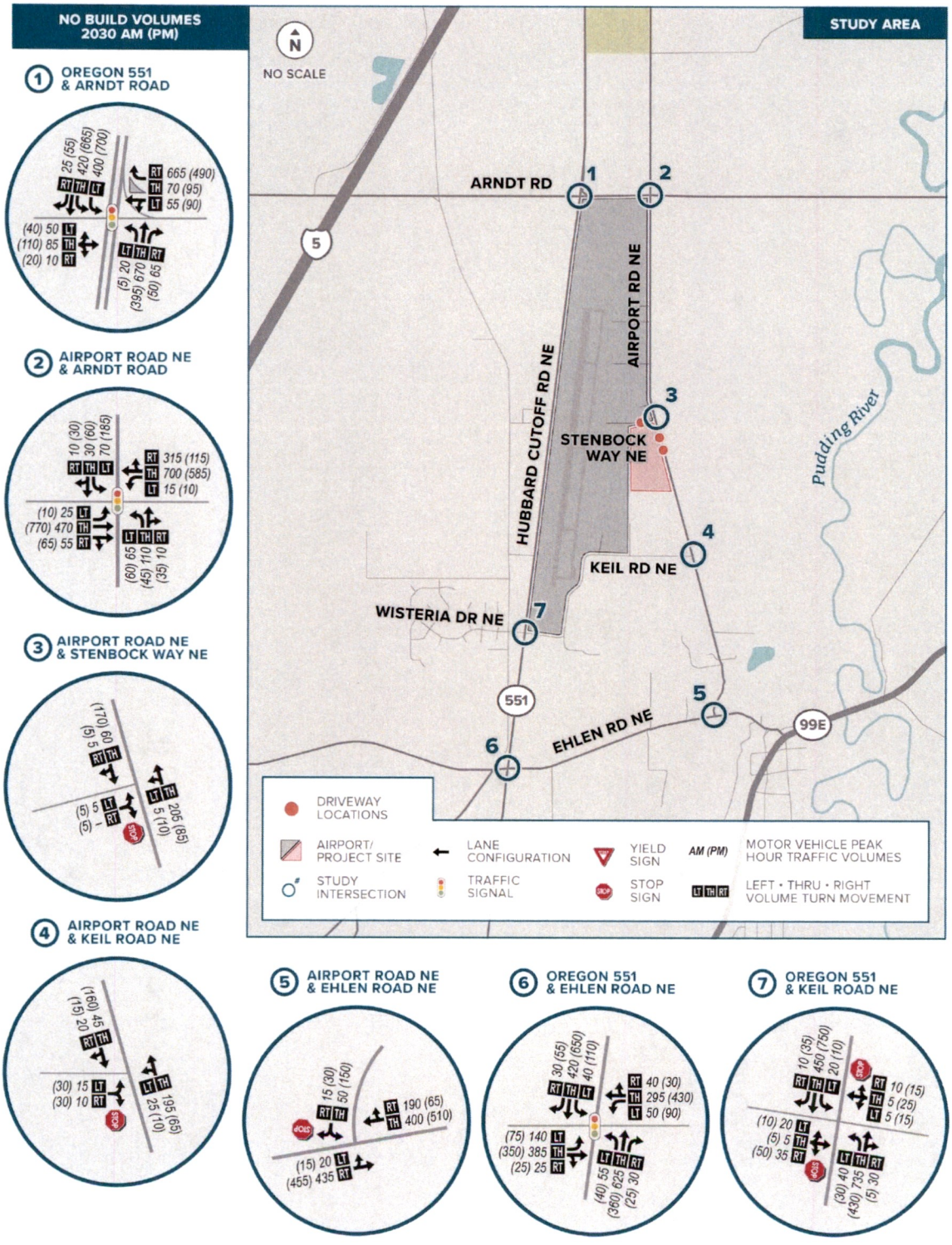

FIGURE 7: 2030 NO BUILD TRAFFIC VOLUMES

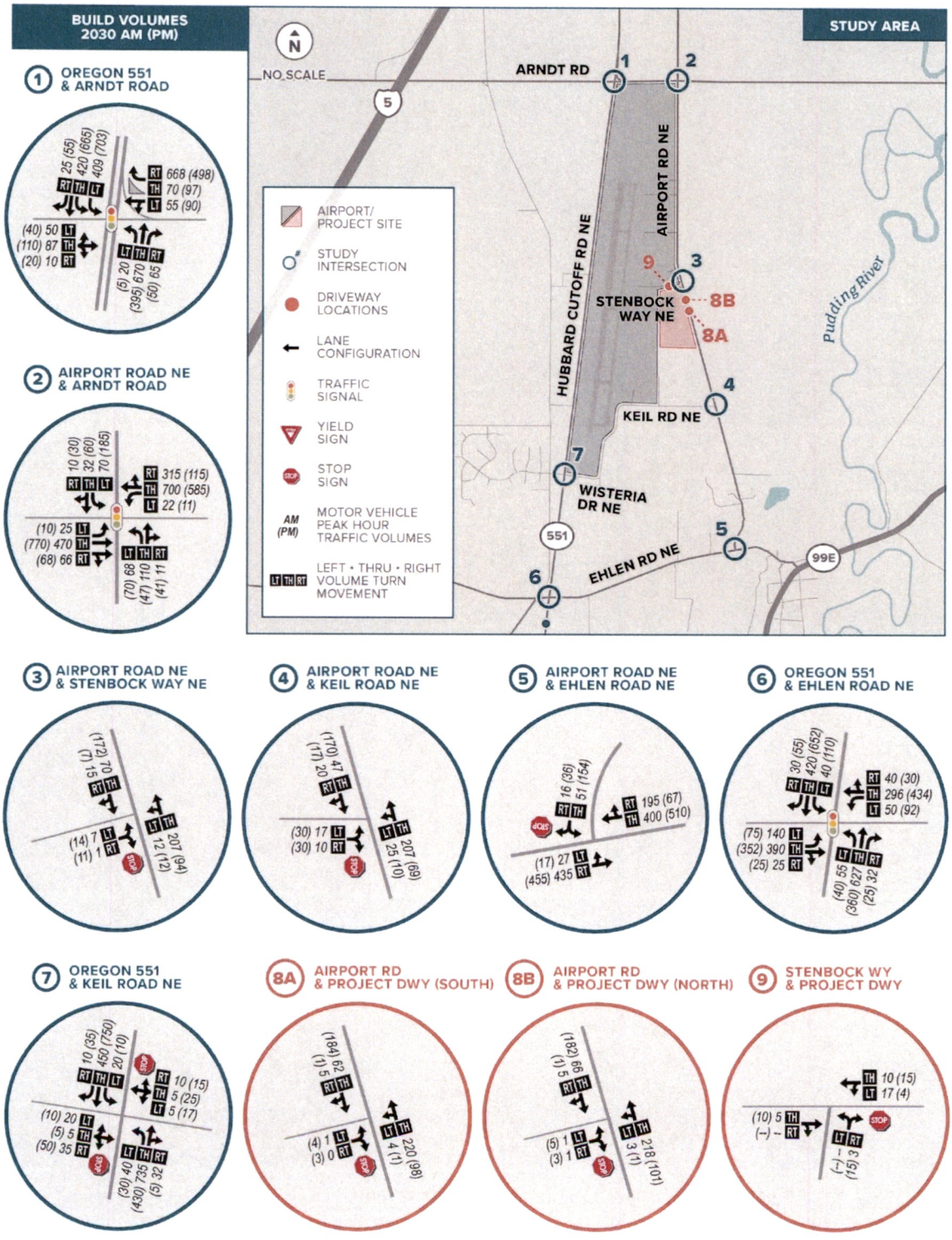

FIGURE 8: 2030 BUILD TRAFFIC VOLUMES

Table 9 lists the 2030 No Build intersection operations and Table 10 lists the 2030 Build intersection operations. As in 2025, the three signalized intersection and the intersection of Airport Road/Ehlen Road will exceed the applicable operating standards/mobility targets in both the No Build and Build scenarios in 2030. The additional traffic generated by the proposed project will increase the v/c by 0.01 or less at all signalized intersections, and the LOS at the Airport Road/Ehlen Road intersection will remain unchanged at LOS F. Mitigation measures that are proportional to the level of development being proposed will be required by both Marion County and ODOT, as discussed in the *Mitigation Strategies* section.

TABLE 9: 2030 NO BUILD INTERSECTION OPERATIONS

INTERSECTION	JURIS-DICTION	MOBILITY TARGET/ OPERATING STANDARD	AM PEAK HOUR			PM PEAK HOUR		
			V/C	DELAY	LOS	V/C	DELAY	LOS
SIGNALIZED								
AIRPORT ROAD/ ARNDT ROAD	Marion County	0.85 v/c and LOS D	**1.00**	**65.7**	**E**	0.73	21.5	C
OR-551/ ARNDT ROAD	ODOT	0.70 v/c	**0.81**	27.6	C	**0.72**	27.6	C
OR-551/ EHLEN ROAD	ODOT	0.70 v/c	**0.86**	48.8	D	**0.91**	59.5	E
TWO-WAY STOP-CONTROLLED								
AIRPORT ROAD/ KEIL ROAD	Marion County	LOS E	0.04 EB	10.2	A/B	0.11 EB	10.6	A/B
AIRPORT ROAD/ EHLEN ROAD	Marion County	LOS E	0.29 SB	25.1	A/D	0.92 SB	85.1	A/**F**
OR-551/ KEIL ROAD	ODOT	0.70 v/c	0.40 EB	39.0	A/E	0.61 WB	79.5	B/F
AIRPORT ROAD/ STENBOCK WAY	Marion County	LOS E	0.01 EB	10.4	A/B	0.02 EB	10.4	A/B

Signalized Intersections:
v/c = Volume-to-Capacity Ratio of Intersection
Delay = Average Stopped Delay per Vehicle (sec)
LOS = Level of Service of Intersection

Two-Way Stop-Controlled Intersections:
v/c = Volume-to-Capacity Ratio of Worst Movement
Delay = Critical Movement Approach Delay (sec)
LOS = Level of Service of Major Street/Minor Street

Bold/Highlighted: Intersection fails to meet operating standards/mobility targets.

TABLE 10: 2030 BUILD INTERSECTION OPERATIONS

INTERSECTION	JURIS-DICTION	MOBILITY TARGET/ OPERATING STANDARD	AM PEAK HOUR [A]			PM PEAK HOUR [A]		
			V/C	DELAY	LOS	V/C	DELAY	LOS
SIGNALIZED								
AIRPORT ROAD/ ARNDT ROAD	Marion County	0.85 v/c and LOS D	**1.00 (+0.00)**	**65.4 (-0.3)**	**E (-)**	0.74 (+0.01)	22.2 (+0.7)	C (-)
OR-551/ ARNDT ROAD	ODOT	0.70 v/c	**0.82 (+0.01)**	28.2 (+0.6)	C (-)	**0.72 (+0.00)**	27.8 (+0.2)	C (-)
OR-551/ EHLEN ROAD	ODOT	0.70 v/c	**0.86 (+0.00)**	49.3 (+0.5)	D (-)	**0.91 (+0.00)**	60.7 (+1.2)	E (-)
TWO-WAY STOP-CONTROLLED								
AIRPORT ROAD/ KEIL ROAD	Marion County	LOS E	0.04 EB (+0.00)	10.4 (+0.2)	A/B (-/-)	0.11 EB (+0.00)	10.8 (+0.2)	A/B (-/-
AIRPORT ROAD/ EHLEN ROAD	Marion County	LOS E	0.31 SB (+0.02)	26.3 (+1.2)	A/D (-/-)	0.97 SB (+0.05)	96.9 (+11.8)	A/**F** (-/-)
OR-551/ KEIL ROAD	ODOT	0.70 v/c	0.40 EB (+0.00)	39.4 (+0.4)	B/E (A/-)	0.64 WB (+0.03)	85.4 (+5.9)	B/F (-/-)
AIRPORT ROAD/ STENBOCK WAY	Marion County	LOS E	0.01 EB (+0.00)	10.5 (+0.1)	A/B (-/-)	0.05 EB (+0.03)	10.8 (+0.4)	A/B (-/-)

Signalized Intersections:
v/c = Volume-to-Capacity Ratio of Intersection
Delay = Average Stopped Delay per Vehicle (sec)
LOS = Level of Service of Intersection

Two-Way Stop-Controlled Intersections:
v/c = Volume-to-Capacity Ratio of Worst Movement
Delay = Critical Movement Approach Delay (sec)
LOS = Level of Service of Major Street/Minor Street

Bold/Highlighted: Intersection fails to meet operating standards/mobility targets.

A. The number in parentheses represents the difference from No Build.

MITIGATION STRATEGIES

As discussed in the traffic operations sections above, four of the study intersections do not meet the applicable Marion County operating standards or ODOT mobility targets under 2030 conditions (with and without the proposed project). The mitigation requirements vary by agency and are described below.

- **For Marion County intersections**, the developer is not required to construct the full mitigation to bring an intersection back to standards. Instead, the developer can contribute partial funds towards the mitigation, in proportion to the amount of traffic being generated.
- **For ODOT intersections**, the developer is required to construct the mitigation because ODOT has no mechanism for receiving or retaining private funds. However, the cost of the mitigation must be reasonable for the level of development. In cases where the cost of mitigating to standards is disproportionate to the development, construction of smaller-scale mitigations that provide an incremental operational or safety benefit may be accepted.

RECOMMENDED MITIGATIONS

AIRPORT ROAD/ARNDT ROAD (MARION COUNTY)

This intersection fails to meet the County's operating standard in the future 2030 No Build scenario. The proposed project does not degrade operations performance measures (the v/c ratio and LOS remain unchanged) with the addition of project-generated traffic. Therefore, the proposed project has no significant impact warranting mitigation.

TIS Mitigations to Standards: No mitigations are required.

AIRPORT ROAD/EHLEN ROAD (MARION COUNTY)

This intersection fails to meet the County's operating standard of LOS E in the future 2030 No Build scenarios. The proposed project does degrade operations performance measures (the LOS remains unchanged). Therefore, the proposed project has no significant impact warranting mitigation.

TIS Mitigations to Standards: No mitigations are required.

ARNDT ROAD/OR-551 (ODOT)

This intersection does not meet ODOT's mobility target under Existing 2023 conditions. The proposed project has a very minimal impact to the intersection, resulting in a maximum increase of 0.01 v/c ratio in 2030.

Calculated values for v/c ratios that are within 0.03 of the adopted target are considered to comply with the target, as reflected in the Oregon Highway Plan (OHP), Action 1F.5 regarding mobility targets and best traffic engineering practices. The reason is that transportation engineering is not an exact science and necessarily requires making educated assumptions that introduce a level of uncertainty to the analysis results and findings. Assumptions that result in v/c ratio within 0.03 of

the target is within the well-understood margin of error and so are considered to demonstrate compliance with the target. Therefore, the proposed project has no significant impact warranting mitigation.

TIS Mitigations to Standards: No mitigations are required.

EHLEN ROAD/OR-551 (ODOT)

This intersection fails to meet ODOT's mobility target in the future 2030 No Build scenario. The proposed project does not degrade operations performance measures (the v/c ratio remains unchanged) with the addition of project-generated traffic. Therefore, the proposed project has no significant impact warranting mitigation.

TIS Mitigations: No mitigations are required.

SITE PLAN REVIEW

The site plan includes approximately 102,916 square feet of proposed vertiport-heliport storage and hangar space and 101,036 square feet of proposed vertiport-heliport related office/shop space. The site plan also includes 277 proposed parking spaces located primarily along Airport Road. The site plan shows sufficient aisle width for parking maneuvers and a sufficient number of access points for emergency vehicle access.

PROJECT FRONTAGE

Frontage improvements along Airport Road will be required to bring the roadway to current Marion County design standards for Rural Major Collectors. The standard for Rural Major Collectors includes a minimum paved width of 22 feet, 5-foot gravel shoulders, and a minimum right-of-way width of 60 feet.

SITE ACCESS

Two access points are located along Airport Road, and one on Stenbock Way NE (private road). The spacing between the Airport Road access points is approximately 150 feet, which does not meet the Marion County access spacing standards for major collectors.[9] The southern access point along Airport Road is located near an existing driveway that leads to properties on the east side of Airport Way. It is recommended that the proposed access points be aligned with these driveways to avoid off-set intersections. The developer should coordinate with County staff and property owners. Based on preliminary observations, there are no sight distance restrictions at the existing driveway

[9] *Marion County Rural Transportation System Plan, 2005*. Table 10-1. Access spacing requirements between minor intersections or private access is 300 feet on major collector roadways.

or study intersections.[10] However, prior to occupancy, sight distance at any existing access points will need to be verified, documented, and stamped by a registered professional Civil or Traffic Engineer licensed in the State of Oregon.

Table 11 below shows the traffic operations at the three proposed project driveways for Opening Year (2025) and the Short-Term (2030) Build scenarios. It was assumed that 50 percent of the project trips would use the Stenbock Way driveway and the remainder evenly split between the two proposed driveways on Airport Road. As shown, the proposed driveways meet the Marion County operating standard.

TABLE 11: BUILD DRIVEWAY OPERATIONS

INTERSECTION	JURIS-DICTION	MOBILITY TARGET/ OPERATING STANDARD	AM PEAK HOUR			PM PEAK HOUR		
			V/C	DELAY	LOS	V/C	DELAY	LOS
OPENING YEAR (2025)								
AIRPORT ROAD / PROJECT DWY (NORTH)	Marion County	LOS E	0.00 EB	9.6	A/A	0.02 EB	10.8	A/B
AIRPORT ROAD / PROJECT DWY (SOUTH)	Marion County	LOS E	0.00 EB	9.6	A/A	0.02 EB	10.6	A/B
STENBOCK WAY / PROJECT DWY	Private	-	0.00 NB	8.4	A/A	0.02 NB	10.5	A/A
SHORT-TERM (2030)								
AIRPORT ROAD / PROJECT DWY (NORTH)	Marion County	LOS E	0.00 EB	9.6	A/A	0.02 EB	10.6	A/B
AIRPORT ROAD / PROJECT DWY (SOUTH)	Marion County	LOS E	0.00 EB	9.6	A/A	0.02 EB	10.5	A/B
STENBOCK WAY / PROJECT DWY	Private	-	0.00 NB	8.4	A/A	0.02 NB	8.5	A/A

Signalized Intersections:
v/c = Volume-to-Capacity Ratio of Intersection
Delay = Average Stopped Delay per Vehicle (sec)
LOS = Level of Service of Intersection

Two-Way Stop-Controlled Intersections:
v/c = Volume-to-Capacity Ratio of Worst Movement
Delay = Critical Movement Approach Delay (sec)
LOS = Level of Service of Major Street/Minor Street

[10] Preliminary sight distance evaluations were completed on August 2, 2017.

TURN LANE WARRANT ANALYSIS

Turn lane warrant analyses were performed for the proposed site access points along Airport Road using the criteria provided in the ODOT Analysis Procedures Manual[11] for left turn and right turn lanes. It was assumed that the vehicles turning into the project site would be split 50 percent to the Stenbock Way driveway and the remainder evenly split between the two proposed Airport Road access points.

Northbound left turn lanes were not warranted at the proposed site accesses on Airport Road or at Stenbock Way. Right turn lanes were also not warranted at the Stenbock Way intersection or either of the proposed site accesses. The results and supporting documentation can be found in the appendix.

CONDITIONAL USE EVALUATION

The proposed project is a conditional use under the current Marion County zoning of Exclusive Farm Use (EFU). Because the proposed project is a conditionally permitted land use under the EFU zoning, the site must show that it "will not force a significant change, or significantly increase the cost of, accepted farm or forest practices on surrounding lands devoted to farm or forest use."[12] To evaluate this criterion from a transportation perspective, a calculation of the added vehicle travel delay for key agricultural routes through the study area due to the project is provided below.

Two hypothetical routes for agricultural vehicles in the study area were identified to estimate any added vehicle delays that may be incurred by farmers engaged in accepted farming practices on surrounding lands as the result of the proposed project. The two hypothetical routes are shown in Figure 9.

The two hypothetical travel routes are between Smith Gardens on the west side of OR-551 and agricultural land just east of Airport Road. One route travels between the two sites via Arndt Road to the north and the other route travels via Keil Road to the south. The length of the routes and estimated increase in vehicle delays on both routes are shown in the following table.

[11] Chapter 12 Unsignalized Intersection Analysis, Analysis Procedures Manual, ODOT, 2023.

[12] Section 17.136.060, Marion County Zoning Code.

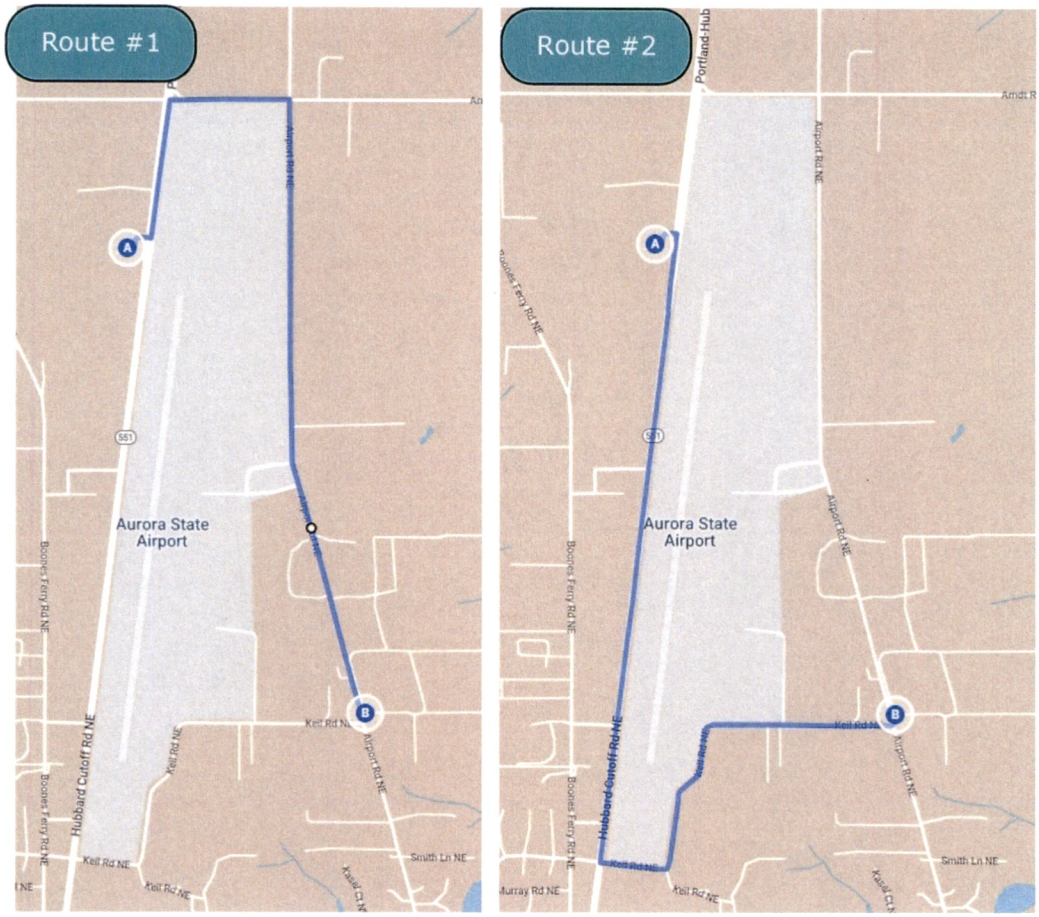

FIGURE 9: HYPOTHETICAL AGRICULTURAL ROUTES IN STUDY AREA

As shown, the added vehicle delay is minimal (<5 seconds or 2% increase). The additional traffic generated by the proposed conditional use would not impart a significant impact on the travel times experienced by agricultural vehicles in the vicinity of the project site, satisfying the approval criteria in the zoning code.

TABLE 12: ADDED VEHICLE DELAYS ON KEY AGRICULTURAL ROUTES

ROUTE	LENGTH (MILES)	APPROXIMATE TRAVEL TIME	VEHICLE DELAY ADDED TO ROUTE	
			AM PEAK HOUR	PM PEAK HOUR
Route #1 – via Arndt Road	1.8 miles	4-5 minutes	< 5 secs	< 5 secs
Route #2 – via Keil Road	2.1 miles	4-5 minutes	< 5 secs	< 5 secs

SUMMARY

The proposed North Marion County Vertiport will develop a vertiport-heliport transportation facility (a conditional use in EFU zones) consisting of vertiport-heliport tie downs, hangar storage space, maintenance and repair shops, and related offices, on a currently vacant parcel adjacent to the Aurora Airport in Marion County, Oregon. This traffic impact study evaluated the potential impacts of this project on the surrounding transportation network.

NO-BUILD CONDITIONS

- Four of the study intersections fail to meet applicable operating standards or mobility targets in the No-Build condition, including OR-551/Arndt Road, Airport Road/Arndt Road, OR-551/Ehlen Road, and Airport Road/Ehlen Road.
- Two study intersections (Airport Road/Arndt Road and OR-551/Arndt Road) have existing safety deficiencies based on historical safety performance.

PROJECT IMPACTS

- The proposed vertiport is expected to generate 316 average daily trips, 38(32 in, 6 out) AM peak hour trips and 38 (8 in, 30 out) PM peak hour trips.
- The three site driveways (two on Airport Road, one on Stenbock Way) will operate acceptably. There are no sight distance constraints at the proposed driveway locations and turn lanes are not warranted.
- The same four study intersections that fail to meet applicable operating standards or mobility targets under No-Build conditions will continue to fail under Build conditions. However, the addition of project-generated trips will not degrade operations according to the performance standards. Therefore, the project has no significant impact and no mitigations are required.
- The proposed development is not expected to cause a significant adverse impact on the surrounding agricultural operations based on an assessment of travel times in the vicinity of the project site. Hypothetical routes for agricultural vehicles are expected to see an increase in travel time of less than five seconds during peak hours.

RECOMMENDED MITIGATIONS

- **Airport Road Frontage Improvements:** Half-street frontage improvements along Airport Road are required to meet current design standards for rural major collector roadways. The standard for Rural Major Collectors includes a minimum paved width of 22 feet, 5-foot gravel shoulders, and a minimum right-of-way width of 60 feet.
- No other mitigations are needed to meet Marion County or ODOT requirements.

TRANSPORTATION PLANNING RULE

We are advised that it is legally unclear whether the provisions of the Transportation Planning Rule (TPR) apply, apart from those expressly specified as applicable per OAR 660-012-0070. Because of this uncertainty, we are asked to apply other potentially applicable provisions of the TPR as a precaution only, without conceding they apply. Accordingly, we address the provisions of the TPR other than OAR 660-012-0070 as a precaution only, without taking any position about whether they apply here.

The requirements of Oregon Administrative Rule (OAR) 660-012-0060, the Transportation Planning Rule (TPR), must be met for proposed comprehensive plan zoning amendments. The intent of the TPR (OAR 660-12-0060) is to ensure that future land use and traffic growth is consistent with transportation system planning and does not create a significant effect on the surrounding transportation system beyond currently allowed uses.

The definition of a "significant effect" varies by jurisdiction and no such definition is provided in the Marion County code currently. According to the Oregon Highway Plan (OHP)[13], a net increase of **less than 400 daily trips** does not qualify as a significant effect. While the OHP is not applicable to County roads, it provides a reasonable estimate of a significant effect for TPR analysis purposes.

Based on the trip generation estimate presented in Table 6, the trip generation for the proposed conditional use is **316 daily trips**. Therefore, under this proposed development, it can be concluded that the comprehensive plan map amendment would not have a significant effect on the transportation system and therefore, this conditional use complies with the TPR requirements.

[13] 1999 Oregon Highway Plan, Action 1F.5, Pages 80-81.

APPENDIX

DKS

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SECTION 1. TRAFFIC COUNT DATA

ALL TRAFFIC DATA SERVICES
(303) 216-2439
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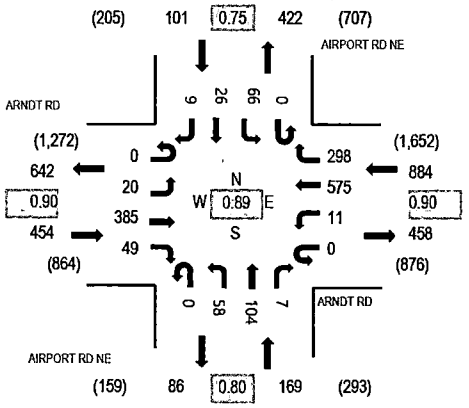
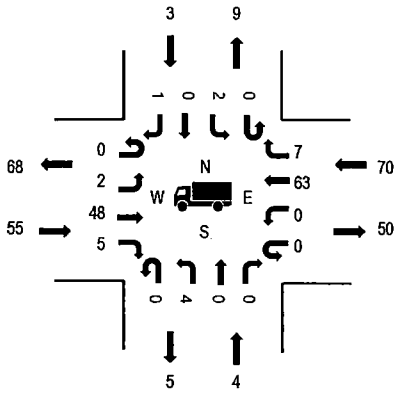
Location: 1 AIRPORT RD NE & ARNDT RD AM
Date: Tuesday, September 19, 2023
Peak Hour: 07:00 AM - 08:00 AM
Peak 15-Minutes: 07:25 AM - 07:40 AM

Peak Hour

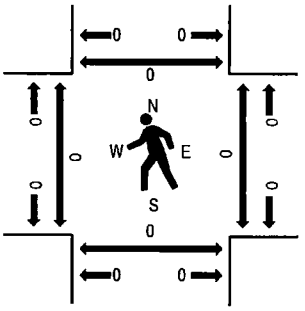
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	12.1%	0.90
WB	7.9%	0.90
NB	2.4%	0.80
SB	3.0%	0.75
All	8.2%	0.89

Traffic Counts - Motorized Vehicles

Interval Start Time	ARNDT RD Eastbound				ARNDT RD Westbound				AIRPORT RD NE Northbound				AIRPORT RD NE Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
7:00 AM	0	1	28	3	0	1	52	20	0	8	6	0	0	2	1	1	123	1,608
7:05 AM	0	1	27	1	0	0	67	22	0	2	5	1	0	3	4	0	133	1,591
7:10 AM	0	1	23	1	0	1	41	25	0	9	11	0	0	5	1	0	118	1,593
7:15 AM	0	0	28	2	0	3	42	26	0	1	10	2	0	3	2	0	119	1,598
7:20 AM	0	2	44	6	0	0	59	27	0	3	15	2	0	1	1	1	161	1,596
7:25 AM	0	1	36	7	0	2	50	24	0	6	11	0	0	12	3	1	153	1,561
7:30 AM	0	3	18	8	0	2	53	18	0	6	9	0	0	7	5	2	131	1,519
7:35 AM	0	1	48	5	0	0	56	37	0	4	9	0	0	7	1	1	169	1,501
7:40 AM	0	2	38	4	0	1	41	36	0	7	4	0	0	4	2	0	139	1,454
7:45 AM	0	4	23	6	0	1	42	32	0	4	10	0	0	6	4	2	134	1,452
7:50 AM	0	1	41	2	0	0	34	19	0	1	5	0	0	8	2	0	113	1,432
7:55 AM	0	3	31	4	0	0	38	12	0	7	9	2	0	8	0	1	115	1,414
8:00 AM	0	4	28	2	0	1	37	20	0	0	2	1	0	9	1	1	106	1,406
8:05 AM	0	2	29	4	0	1	51	19	0	8	10	1	0	8	1	1	135	
8:10 AM	0	3	30	4	0	1	55	23	0	3	1	0	0	1	1	1	123	
8:15 AM	0	2	25	2	0	1	38	21	0	3	11	0	0	8	4	2	117	
8:20 AM	0	3	23	6	0	1	56	20	0	7	7	0	0	2	1	0	126	
8:25 AM	0	0	30	6	0	2	45	8	0	5	8	1	0	2	3	1	111	
8:30 AM	0	1	34	2	0	0	40	12	0	5	10	1	0	8	0	0	113	
8:35 AM	0	3	25	6	0	2	58	15	0	2	4	0	0	6	1	0	122	
8:40 AM	0	2	33	2	0	0	55	21	0	7	2	1	0	11	3	0	137	
8:45 AM	0	2	35	4	0	0	44	13	0	1	6	0	0	5	2	2	114	
8:50 AM	0	4	24	2	0	1	43	9	0	4	1	1	0	4	1	1	95	
8:55 AM	0	1	24	3	0	0	45	10	0	6	5	0	0	8	2	3	107	
Count Total	0	47	725	92	0	21	1,142	489	0	109	171	13	0	138	46	21	3,014	
Peak Hour	0	20	385	49	0	11	575	298	0	58	104	7	0	66	26	9	1,608	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
7:00 AM	2	0	8	0	10	7:00 AM	0	0	0	0	0	7:00 AM	0	0	0	0	0
7:05 AM	1	0	7	0	8	7:05 AM	0	0	0	0	0	7:05 AM	0	0	0	0	0
7:10 AM	4	1	3	0	8	7:10 AM	0	0	0	1	1	7:10 AM	0	0	0	0	0
7:15 AM	5	0	7	0	12	7:15 AM	0	0	0	0	0	7:15 AM	0	0	0	0	0
7:20 AM	6	0	2	0	8	7:20 AM	0	0	0	0	0	7:20 AM	0	0	0	0	0
7:25 AM	6	0	11	2	19	7:25 AM	0	0	0	0	0	7:25 AM	0	0	0	0	0
7:30 AM	4	2	6	1	13	7:30 AM	0	0	0	0	0	7:30 AM	0	0	0	0	0
7:35 AM	10	0	3	0	13	7:35 AM	0	0	0	0	0	7:35 AM	0	0	0	0	0
7:40 AM	7	0	4	0	11	7:40 AM	0	0	0	0	0	7:40 AM	0	0	0	0	0
7:45 AM	6	1	6	0	13	7:45 AM	0	0	0	0	0	7:45 AM	0	0	0	0	0
7:50 AM	3	0	7	0	10	7:50 AM	0	0	0	0	0	7:50 AM	0	0	0	0	0
7:55 AM	1	0	6	0	7	7:55 AM	0	0	0	0	0	7:55 AM	0	0	0	0	0
8:00 AM	5	0	10	2	17	8:00 AM	0	0	0	0	0	8:00 AM	0	0	0	0	0
8:05 AM	1	1	4	0	6	8:05 AM	0	0	0	0	0	8:05 AM	0	0	0	0	0
8:10 AM	3	0	7	1	11	8:10 AM	0	0	0	0	0	8:10 AM	0	0	0	0	0
8:15 AM	3	0	1	3	7	8:15 AM	0	0	0	0	0	8:15 AM	0	0	0	0	0
8:20 AM	5	0	6	0	11	8:20 AM	0	0	0	0	0	8:20 AM	0	0	0	0	0
8:25 AM	2	0	7	1	10	8:25 AM	0	0	0	0	0	8:25 AM	0	0	0	0	0
8:30 AM	5	1	5	1	12	8:30 AM	0	0	0	0	0	8:30 AM	0	0	0	0	0
8:35 AM	6	0	13	1	20	8:35 AM	0	0	0	0	0	8:35 AM	0	0	0	0	0
8:40 AM	7	2	4	1	14	8:40 AM	0	0	0	0	0	8:40 AM	0	0	0	0	0
8:45 AM	10	0	5	0	15	8:45 AM	0	0	0	0	0	8:45 AM	0	0	0	0	0
8:50 AM	5	0	9	0	14	8:50 AM	0	0	0	0	0	8:50 AM	0	0	0	0	0
8:55 AM	6	0	2	1	9	8:55 AM	0	0	0	0	0	8:55 AM	0	0	0	0	0
Count Total	113	8	143	14	278	Count Total	0	0	0	1	1	Count Total	0	0	0	0	0
Peak Hour	55	4	70	3	132	Peak Hour	0	0	0	1	1	Peak Hour	0	0	0	0	0

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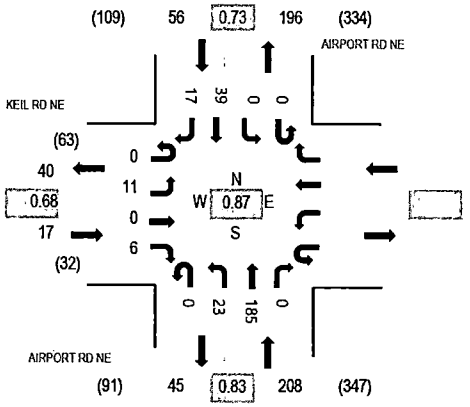
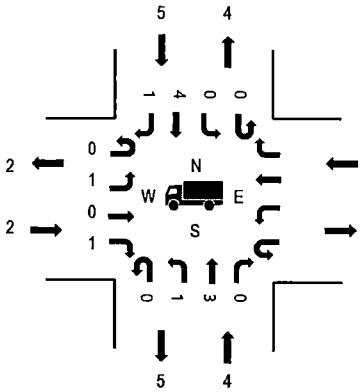
Location: 2 AIRPORT RD NE & KEIL RD NE AM
Date: Tuesday, September 19, 2023
Peak Hour: 07:00 AM - 08:00 AM
Peak 15-Minutes: 07:25 AM - 07:40 AM

Peak Hour

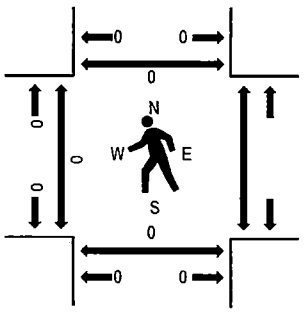
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	11.8%	0.68
WB		
NB	1.9%	0.83
SB	8.9%	0.73
All	3.9%	0.87

Traffic Counts - Motorized Vehicles

Interval Start Time	KEIL RD NE Eastbound				Westbound				AIRPORT RD NE Northbound				AIRPORT RD NE Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
7:00 AM	0	3	0	2					0	1	14	0	0	0	4	2	26	281
7:05 AM	0	1	0	0					0	1	16	0	0	0	4	3	25	280
7:10 AM	0	0	0	0					0	2	10	0	0	0	1	1	14	276
7:15 AM	0	0	0	0					0	4	25	0	0	0	2	1	32	271
7:20 AM	0	1	0	0					0	1	11	0	0	0	3	0	16	264
7:25 AM	0	1	0	0					0	1	21	0	0	0	5	2	30	270
7:30 AM	0	1	0	0					0	3	14	0	0	0	8	3	29	258
7:35 AM	0	1	0	2					0	3	13	0	0	0	2	1	22	250
7:40 AM	0	0	0	2					0	0	25	0	0	0	2	1	30	243
7:45 AM	0	0	0	0					0	2	9	0	0	0	4	1	16	224
7:50 AM	0	2	0	0					0	2	16	0	0	0	3	1	24	221
7:55 AM	0	1	0	0					0	3	11	0	0	0	1	1	17	210
8:00 AM	0	2	0	2					0	2	15	0	0	0	2	2	25	207
8:05 AM	0	1	0	1					0	0	13	0	0	0	4	2	21	
8:10 AM	0	0	0	1					0	1	5	0	0	0	1	1	9	
8:15 AM	0	1	0	0					0	1	16	0	0	0	5	2	25	
8:20 AM	0	0	0	0					0	1	14	0	0	0	6	1	22	
8:25 AM	0	1	0	0					0	1	9	0	0	0	2	0	13	
8:30 AM	0	2	0	0					0	3	19	0	0	0	2	0	26	
8:35 AM	0	1	0	0					0	0	10	0	0	0	4	0	15	
8:40 AM	0	1	0	0					0	2	4	0	0	0	4	0	11	
8:45 AM	0	0	0	0					0	0	9	0	0	0	3	1	13	
8:50 AM	0	2	0	0					0	0	7	0	0	0	3	1	13	
8:55 AM	0	0	0	0					0	1	6	0	0	0	6	1	14	
Count Total	0	22	0	10					0	35	312	0	0	0	81	28	488	
Peak Hour	0	11	0	6					0	23	185	0	0	0	39	17	281	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

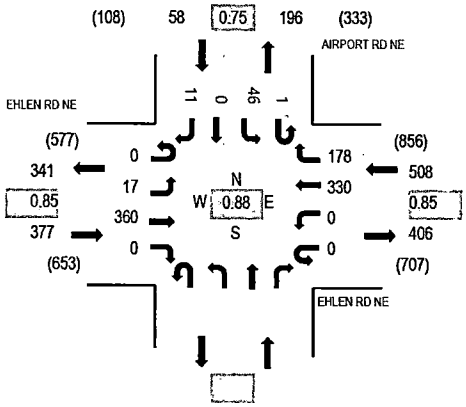
Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
7:00 AM	0	0		1	1	7:00 AM	0	0		0	0	7:00 AM	0	0		0	0
7:05 AM	0	0		0	0	7:05 AM	0	0		0	0	7:05 AM	0	0		0	0
7:10 AM	0	1		0	1	7:10 AM	0	0		0	0	7:10 AM	0	0		0	0
7:15 AM	0	0		1	1	7:15 AM	0	0		1	1	7:15 AM	0	0		0	0
7:20 AM	0	0		0	0	7:20 AM	0	0		0	0	7:20 AM	0	0		0	0
7:25 AM	0	1		2	3	7:25 AM	0	0		0	0	7:25 AM	0	0		0	0
7:30 AM	1	1		1	3	7:30 AM	0	0		0	0	7:30 AM	0	0		0	0
7:35 AM	1	0		0	1	7:35 AM	0	0		0	0	7:35 AM	0	0		0	0
7:40 AM	0	0		0	0	7:40 AM	0	0		0	0	7:40 AM	0	0		0	0
7:45 AM	0	0		0	0	7:45 AM	0	0		0	0	7:45 AM	0	0		0	0
7:50 AM	0	0		0	0	7:50 AM	0	0		0	0	7:50 AM	0	0		0	0
7:55 AM	0	1		0	1	7:55 AM	0	0		0	0	7:55 AM	0	0		0	0
8:00 AM	0	1		0	1	8:00 AM	0	0		0	0	8:00 AM	0	0		0	0
8:05 AM	0	0		1	1	8:05 AM	0	0		0	0	8:05 AM	0	0		0	0
8:10 AM	1	0		0	1	8:10 AM	0	0		0	0	8:10 AM	0	0		0	0
8:15 AM	0	1		0	1	8:15 AM	0	0		0	0	8:15 AM	0	0		0	0
8:20 AM	0	0		2	2	8:20 AM	0	0		0	0	8:20 AM	0	0		0	0
8:25 AM	0	2		0	2	8:25 AM	0	0		0	0	8:25 AM	1	0		0	1
8:30 AM	1	1		0	2	8:30 AM	0	0		0	0	8:30 AM	0	0		0	0
8:35 AM	0	0		0	0	8:35 AM	0	0		0	0	8:35 AM	0	0		0	0
8:40 AM	0	0		0	0	8:40 AM	0	0		0	0	8:40 AM	0	0		0	0
8:45 AM	0	0		0	0	8:45 AM	0	0		0	0	8:45 AM	0	0		0	0
8:50 AM	1	0		0	1	8:50 AM	0	0		0	0	8:50 AM	0	0		0	0
8:55 AM	0	0		1	1	8:55 AM	0	0		0	0	8:55 AM	0	0		0	0
Count Total	5	9		9	23	Count Total	0	0		1	1	Count Total	1	0		0	1
Peak Hour	2	4		5	11	Peak Hour	0	0		1	1	Peak Hour	0	0		0	0

ALL TRAFFIC DATA SERVICES
(303) 216-2439
www.alltrafficdata.net

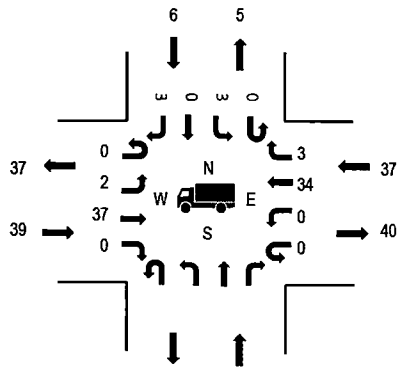
Location: 3 AIRPORT RD NE & EHLEN RD NE AM
Date: Tuesday, September 19, 2023
Peak Hour: 07:15 AM - 08:15 AM
Peak 15-Minutes: 07:25 AM - 07:40 AM

Peak Hour

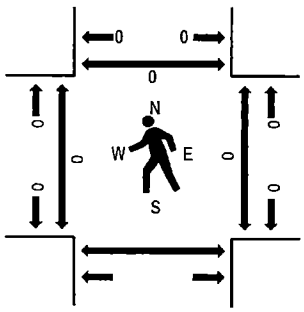
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	10.3%	0.85
WB	7.3%	0.85
NB		
SB	10.3%	0.75
All	8.7%	0.88

Traffic Counts - Motorized Vehicles

Interval Start Time	EHLEN RD NE Eastbound				EHLEN RD NE Westbound				Northbound				AIRPORT RD NE Southbound					Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total	
7:00 AM	0	1	32	0	0	0	21	11					0	7	0	0	72	905
7:05 AM	0	0	21	0	0	0	19	23					0	4	0	0	67	922
7:10 AM	0	3	19	0	0	0	5	3					0	1	0	1	32	906
7:15 AM	0	0	32	0	0	0	41	26					0	3	0	1	103	943
7:20 AM	0	1	22	0	0	0	26	15					0	2	0	3	69	894
7:25 AM	0	4	36	0	0	0	28	14					0	3	0	1	86	880
7:30 AM	0	2	39	0	0	0	34	11					0	8	0	1	95	862
7:35 AM	0	1	26	0	0	0	35	19					0	5	0	1	87	820
7:40 AM	0	5	29	0	0	0	17	21					0	3	0	2	77	781
7:45 AM	0	0	33	0	0	0	30	8					0	6	0	0	77	780
7:50 AM	0	2	44	0	0	0	17	13					0	3	0	0	79	749
7:55 AM	0	0	32	0	0	0	15	12					0	2	0	0	61	720
8:00 AM	0	0	28	0	0	0	33	21					1	5	0	1	89	712
8:05 AM	0	1	14	0	0	0	23	8					0	4	0	1	51	
8:10 AM	0	1	25	0	0	0	31	10					0	2	0	0	69	
8:15 AM	0	1	19	0	0	0	18	12					0	4	0	0	54	
8:20 AM	0	1	15	0	0	0	16	16					0	5	0	2	55	
8:25 AM	0	4	33	0	0	0	14	14					0	2	0	1	68	
8:30 AM	0	1	10	0	0	0	28	11					0	2	0	1	53	
8:35 AM	0	0	23	0	0	0	16	6					0	2	0	1	48	
8:40 AM	0	4	25	0	0	0	33	8					0	6	0	0	76	
8:45 AM	0	0	20	0	0	0	22	3					0	0	0	1	46	
8:50 AM	0	0	25	0	0	0	13	7					0	4	0	1	50	
8:55 AM	0	1	18	0	0	0	22	7					0	4	0	1	53	
Count Total	0	33	620	0	0	0	557	299					1	87	0	20	1,617	
Peak Hour	0	17	360	0	0	0	330	178					1	46	0	11	943	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
7:00 AM	6		3	1	10	7:00 AM	0		0	0	0	7:00 AM	0		0	0	0
7:05 AM	1		1	0	2	7:05 AM	0		0	0	0	7:05 AM	0		0	0	0
7:10 AM	3		2	0	5	7:10 AM	0		0	0	0	7:10 AM	0		0	0	0
7:15 AM	5		1	0	6	7:15 AM	0		0	0	0	7:15 AM	0		0	0	0
7:20 AM	2		4	0	6	7:20 AM	0		0	0	0	7:20 AM	0		0	0	0
7:25 AM	6		3	0	9	7:25 AM	0		0	0	0	7:25 AM	0		0	0	0
7:30 AM	3		1	2	6	7:30 AM	0		0	0	0	7:30 AM	0		0	0	0
7:35 AM	1		3	2	6	7:35 AM	0		0	0	0	7:35 AM	0		0	0	0
7:40 AM	2		1	0	3	7:40 AM	0		0	0	0	7:40 AM	0		0	0	0
7:45 AM	3		5	0	8	7:45 AM	0		0	0	0	7:45 AM	0		0	0	0
7:50 AM	5		3	0	8	7:50 AM	0		0	0	0	7:50 AM	0		0	0	0
7:55 AM	4		4	0	8	7:55 AM	0		0	0	0	7:55 AM	0		0	0	0
8:00 AM	2		3	0	5	8:00 AM	0		0	0	0	8:00 AM	0		0	0	0
8:05 AM	3		4	1	8	8:05 AM	0		0	0	0	8:05 AM	0		0	0	0
8:10 AM	3		5	1	9	8:10 AM	0		0	0	0	8:10 AM	0		0	0	0
8:15 AM	3		3	0	6	8:15 AM	0		0	0	0	8:15 AM	0		0	0	0
8:20 AM	2		3	2	7	8:20 AM	0		0	0	0	8:20 AM	0		0	0	0
8:25 AM	2		2	0	4	8:25 AM	0		0	0	0	8:25 AM	0		0	0	0
8:30 AM	1		3	0	4	8:30 AM	0		0	0	0	8:30 AM	0		0	0	0
8:35 AM	5		0	0	5	8:35 AM	0		0	0	0	8:35 AM	0		0	0	0
8:40 AM	5		4	0	9	8:40 AM	0		0	0	0	8:40 AM	0		0	0	0
8:45 AM	3		2	1	6	8:45 AM	0		0	0	0	8:45 AM	0		0	0	0
8:50 AM	3		1	0	4	8:50 AM	0		0	0	0	8:50 AM	0		0	0	0
8:55 AM	6		4	1	11	8:55 AM	0		0	0	0	8:55 AM	0		0	0	0
Count Total	79		65	11	155	Count Total	0		0	0	0	Count Total	0		0	0	0
Peak Hour	39		37	6	82	Peak Hour	0		0	0	0	Peak Hour	0		0	0	0

ALL TRAFFIC DATA SERVICES
(303) 216-2439
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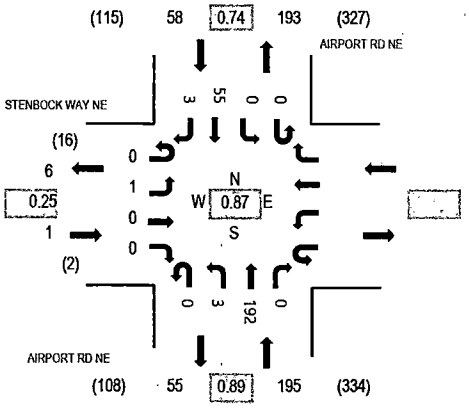
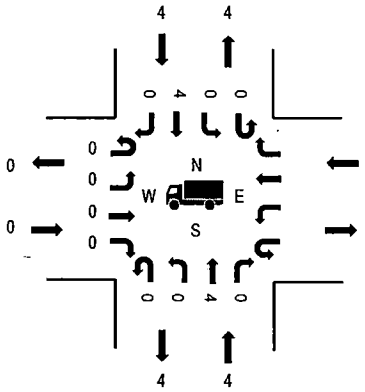
Location: 4 AIRPORT RD NE & STENBOCK WAY NE AM
Date: Tuesday, September 19, 2023
Peak Hour: 07:00 AM - 08:00 AM
Peak 15-Minutes: 07:25 AM - 07:40 AM

Peak Hour

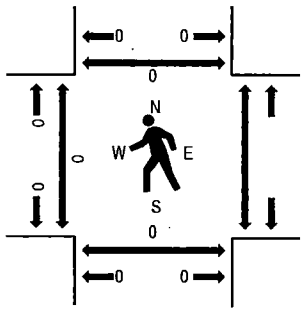
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	0.0%	0.25
WB		
NB	2.1%	0.89
SB	6.9%	0.74
All	3.1%	0.87

Traffic Counts - Motorized Vehicles

Interval Start Time	STENBOCK WAY NE Eastbound U-Turn	Left	Thru	Right	Westbound U-Turn	Left	Thru	Right	AIRPORT RD NE Northbound U-Turn	Left	Thru	Right	AIRPORT RD NE Southbound U-Turn	Left	Thru	Right	Total	Rolling Hour
7:00 AM	0	0	0	0					0	0	16	0	0	0	7	0	23	254
7:05 AM	0	0	0	0					0	0	17	0	0	0	8	0	25	247
7:10 AM	0	0	0	0					0	0	11	0	0	0	0	0	11	245
7:15 AM	0	0	0	0					0	0	21	0	0	0	2	1	24	243
7:20 AM	0	1	0	0					0	0	13	0	0	0	3	0	17	240
7:25 AM	0	0	0	0					0	0	21	0	0	0	9	0	30	245
7:30 AM	0	0	0	0					0	0	16	0	0	0	8	0	24	231
7:35 AM	0	0	0	0					0	0	15	0	0	0	4	0	19	230
7:40 AM	0	0	0	0					0	3	16	0	0	0	4	0	23	229
7:45 AM	0	0	0	0					0	0	17	0	0	0	5	1	23	216
7:50 AM	0	0	0	0					0	0	18	0	0	0	3	0	21	207
7:55 AM	0	0	0	0					0	0	11	0	0	0	2	1	14	193
8:00 AM	0	0	0	0					0	1	12	0	0	0	3	0	16	197
8:05 AM	0	0	0	0					0	0	17	0	0	0	6	0	23	
8:10 AM	0	0	0	0					0	2	4	0	0	0	3	0	9	
8:15 AM	0	0	0	0					0	0	15	0	0	0	6	0	21	
8:20 AM	0	0	0	0					0	0	15	0	0	0	6	1	22	
8:25 AM	0	0	0	0					0	0	11	0	0	0	3	2	16	
8:30 AM	0	0	0	0					0	2	19	0	0	0	2	0	23	
8:35 AM	0	0	0	0					0	0	12	0	0	0	6	0	18	
8:40 AM	0	0	0	0					0	0	5	0	0	0	3	2	10	
8:45 AM	0	0	0	0					0	0	9	0	0	0	5	0	14	
8:50 AM	0	0	0	0					0	0	4	0	0	0	3	0	7	
8:55 AM	0	0	0	1					0	0	11	0	0	0	6	0	18	
Count Total	0	1	0	1					0	8	326	0	0	0	107	8	451	
Peak Hour	0	1	0	0					0	3	192	0	0	0	55	3	254	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
7:00 AM	0	0		0	0	7:00 AM	0	0		0	0	7:00 AM	0	0		0	0
7:05 AM	0	0		0	0	7:05 AM	0	0		0	0	7:05 AM	0	0		0	0
7:10 AM	0	1		0	1	7:10 AM	0	0		1	1	7:10 AM	0	0		0	0
7:15 AM	0	0		1	1	7:15 AM	0	0		0	0	7:15 AM	0	0		0	0
7:20 AM	0	0		0	0	7:20 AM	0	0		0	0	7:20 AM	0	0		0	0
7:25 AM	0	0		2	2	7:25 AM	0	0		0	0	7:25 AM	0	0		0	0
7:30 AM	0	2		0	2	7:30 AM	0	0		0	0	7:30 AM	0	0		0	0
7:35 AM	0	0		1	1	7:35 AM	0	0		0	0	7:35 AM	0	0		0	0
7:40 AM	0	0		0	0	7:40 AM	0	0		0	0	7:40 AM	0	0		0	0
7:45 AM	0	1		0	1	7:45 AM	0	0		0	0	7:45 AM	0	0		0	0
7:50 AM	0	0		0	0	7:50 AM	0	0		0	0	7:50 AM	0	0		0	0
7:55 AM	0	0		0	0	7:55 AM	0	0		0	0	7:55 AM	0	0		0	0
8:00 AM	0	1		0	1	8:00 AM	0	0		0	0	8:00 AM	0	0		0	0
8:05 AM	0	0		1	1	8:05 AM	0	0		0	0	8:05 AM	0	0		0	0
8:10 AM	0	0		0	0	8:10 AM	0	0		0	0	8:10 AM	0	0		0	0
8:15 AM	0	0		0	0	8:15 AM	0	0		0	0	8:15 AM	0	0		0	0
8:20 AM	0	0		1	1	8:20 AM	0	0		0	0	8:20 AM	0	0		0	0
8:25 AM	0	2		0	2	8:25 AM	0	0		0	0	8:25 AM	0	0		0	0
8:30 AM	0	1		1	2	8:30 AM	0	0		0	0	8:30 AM	0	0		0	0
8:35 AM	0	1		1	2	8:35 AM	0	0		0	0	8:35 AM	0	0		0	0
8:40 AM	0	0		0	0	8:40 AM	0	0		0	0	8:40 AM	0	0		0	0
8:45 AM	0	0		0	0	8:45 AM	0	0		0	0	8:45 AM	0	0		0	0
8:50 AM	0	0		0	0	8:50 AM	0	0		0	0	8:50 AM	0	0		0	0
8:55 AM	0	1		1	2	8:55 AM	0	0		0	0	8:55 AM	0	0		0	0
Count Total	0	10		9	19	Count Total	0	0		1	1	Count Total	0	0		0	0
Peak Hour	0	4		4	8	Peak Hour	0	0		1	1	Peak Hour	0	0		0	0

ALL TRAFFIC DATA SERVICES
(303) 216-2439
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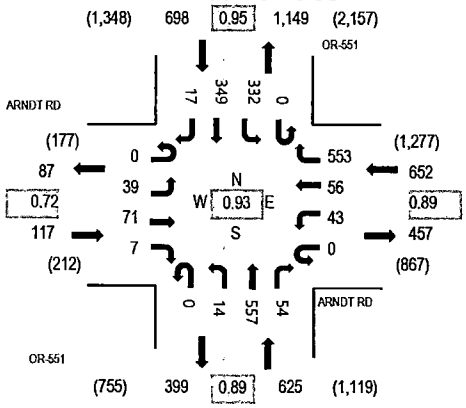
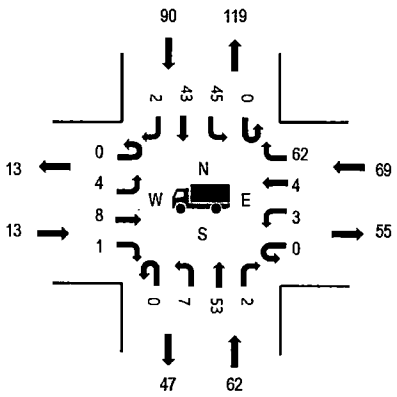
Location: 5 OR-551 & ARNDT RD AM
Date: Tuesday, September 19, 2023
Peak Hour: 07:00 AM - 08:00 AM
Peak 15-Minutes: 07:15 AM - 07:30 AM

Peak Hour

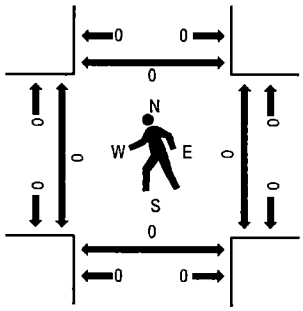
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	11.1%	0.72
WB	10.6%	0.89
NB	9.9%	0.89
SB	12.9%	0.95
All	11.2%	0.93

Traffic Counts - Motorized Vehicles

Interval Start Time	ARNDT RD Eastbound				ARNDT RD Westbound				OR-551 Northbound				OR-551 Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
7:00 AM	0	1	4	1	0	7	6	56	0	1	28	3	0	25	28	3	163	2,092
7:05 AM	0	2	2	0	0	2	3	58	0	2	47	5	0	26	35	1	183	2,077
7:10 AM	0	1	4	1	0	2	4	45	0	1	60	1	0	14	29	2	164	2,064
7:15 AM	0	1	9	0	0	3	4	44	0	1	52	3	0	26	30	2	175	2,066
7:20 AM	0	5	1	1	0	3	4	54	0	0	55	3	0	40	36	0	202	2,040
7:25 AM	0	4	8	1	0	4	5	48	0	3	54	5	0	29	22	3	186	2,010
7:30 AM	0	3	13	1	0	6	7	50	0	1	38	5	0	24	27	0	175	1,969
7:35 AM	0	4	7	2	0	4	3	48	0	0	33	2	0	34	26	0	163	1,927
7:40 AM	0	0	6	0	0	1	7	44	0	1	59	5	0	34	26	1	184	1,893
7:45 AM	0	5	9	0	0	4	3	44	0	3	52	8	0	25	32	1	186	1,883
7:50 AM	0	6	5	0	0	4	3	29	0	1	41	6	0	29	29	2	155	1,870
7:55 AM	0	7	3	0	0	3	7	33	0	0	38	8	0	26	29	2	156	1,869
8:00 AM	0	2	2	0	0	5	5	33	0	0	31	4	0	33	30	3	148	1,864
8:05 AM	0	2	3	0	0	5	1	49	0	2	50	4	0	20	32	2	170	
8:10 AM	0	5	4	1	0	6	3	46	0	3	35	2	0	33	26	2	166	
8:15 AM	0	4	8	0	0	6	4	41	0	1	35	2	0	22	24	2	149	
8:20 AM	0	2	5	2	0	5	2	51	0	1	43	5	0	24	30	2	172	
8:25 AM	0	5	4	1	0	2	3	41	0	0	32	2	0	27	25	3	145	
8:30 AM	0	5	3	1	0	3	6	45	0	0	16	4	0	34	13	3	133	
8:35 AM	0	3	2	0	0	2	4	49	0	0	18	1	0	26	21	3	129	
8:40 AM	0	2	3	4	0	1	2	52	0	0	44	3	0	32	23	8	174	
8:45 AM	0	1	4	2	0	4	6	40	0	1	48	4	0	32	29	2	173	
8:50 AM	0	1	4	1	0	8	2	40	0	0	55	6	0	20	15	2	154	
8:55 AM	0	3	6	0	0	2	7	44	0	2	35	5	0	17	27	3	151	
Count Total	0	74	119	19	0	92	101	1,084	0	24	999	96	0	652	644	52	3,956	
Peak Hour	0	39	71	7	0	43	56	553	0	14	557	54	0	332	349	17	2,092	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

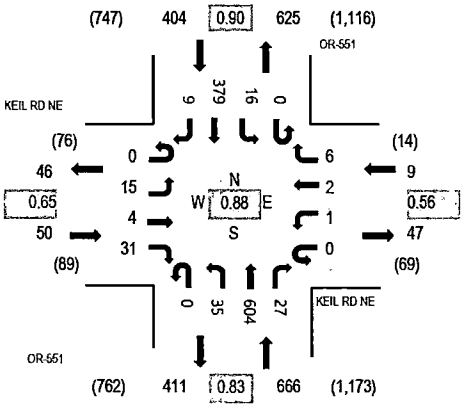
Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
7:00 AM	0	4	8	3	15	7:00 AM	0	0	0	0	0	7:00 AM	0	0	0	0	0
7:05 AM	0	5	6	5	16	7:05 AM	0	0	0	0	0	7:05 AM	0	0	0	0	0
7:10 AM	0	7	4	4	15	7:10 AM	0	0	0	0	0	7:10 AM	0	0	0	0	0
7:15 AM	2	5	7	5	19	7:15 AM	0	0	0	0	0	7:15 AM	0	0	0	0	0
7:20 AM	0	4	2	11	17	7:20 AM	0	0	0	0	0	7:20 AM	0	0	0	0	0
7:25 AM	2	7	11	5	25	7:25 AM	0	0	0	0	0	7:25 AM	0	0	0	0	0
7:30 AM	1	6	7	13	27	7:30 AM	0	0	0	0	0	7:30 AM	0	0	0	0	0
7:35 AM	2	3	5	11	21	7:35 AM	0	0	0	0	0	7:35 AM	0	0	0	0	0
7:40 AM	2	7	4	11	24	7:40 AM	0	0	0	0	0	7:40 AM	0	0	0	0	0
7:45 AM	1	4	6	8	19	7:45 AM	0	0	0	0	0	7:45 AM	0	0	0	0	0
7:50 AM	1	5	3	8	17	7:50 AM	0	0	0	0	0	7:50 AM	0	0	0	0	0
7:55 AM	2	5	6	6	19	7:55 AM	0	0	0	0	0	7:55 AM	0	0	0	0	0
8:00 AM	0	2	9	6	17	8:00 AM	0	0	0	0	0	8:00 AM	0	0	0	0	0
8:05 AM	1	6	4	12	23	8:05 AM	0	0	0	0	0	8:05 AM	0	0	0	0	0
8:10 AM	3	4	7	5	19	8:10 AM	0	0	0	0	0	8:10 AM	0	0	0	0	0
8:15 AM	5	4	5	6	20	8:15 AM	0	0	0	0	0	8:15 AM	0	0	0	0	0
8:20 AM	3	2	5	7	17	8:20 AM	0	0	0	0	0	8:20 AM	0	0	0	0	0
8:25 AM	1	5	4	7	17	8:25 AM	0	0	0	0	0	8:25 AM	0	0	0	0	0
8:30 AM	4	4	8	6	22	8:30 AM	0	0	0	0	0	8:30 AM	0	0	0	0	0
8:35 AM	0	4	12	9	25	8:35 AM	0	0	0	0	0	8:35 AM	0	0	0	0	0
8:40 AM	3	5	6	11	25	8:40 AM	0	0	0	0	0	8:40 AM	0	0	0	0	0
8:45 AM	2	4	5	14	25	8:45 AM	0	0	0	0	0	8:45 AM	0	0	0	0	0
8:50 AM	1	6	7	5	19	8:50 AM	0	0	0	0	0	8:50 AM	0	0	0	0	0
8:55 AM	1	4	4	12	21	8:55 AM	0	0	0	0	0	8:55 AM	0	0	0	0	0
Count Total	37	112	145	190	484	Count Total	0	0	0	0	0	Count Total	0	0	0	0	0
Peak Hour	13	62	69	90	234	Peak Hour	0	0	0	0	0	Peak Hour	0	0	0	0	0

ALL TRAFFIC DATA SERVICES
(303) 216-2439
www.alltrafficdata.net

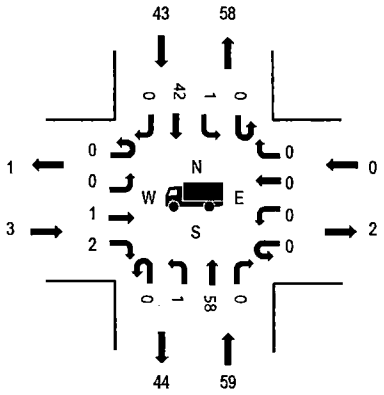
Location: 6 OR-551 & KEIL RD NE AM
Date: Tuesday, September 19, 2023
Peak Hour: 07:05 AM - 08:05 AM
Peak 15-Minutes: 07:10 AM - 07:25 AM

Peak Hour

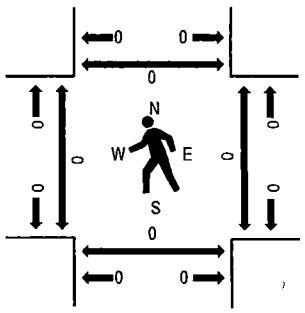
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	6.0%	0.65
WB	0.0%	0.56
NB	8.9%	0.83
SB	10.6%	0.90
All	9.3%	0.88

Traffic Counts - Motorized Vehicles

Interval Start Time	KEIL RD NE Eastbound				KEIL RD NE Westbound				OR-551 Northbound				OR-551 Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
7:00 AM	0	1	2	0	0	0	0	1	0	6	43	2	0	2	26	0	83	1,121
7:05 AM	0	1	1	2	0	0	0	1	0	3	45	3	0	4	33	2	95	1,129
7:10 AM	0	0	0	1	0	0	1	2	0	6	68	2	0	1	32	0	113	1,118
7:15 AM	0	4	0	2	0	0	0	0	0	5	50	2	0	1	36	0	100	1,099
7:20 AM	0	1	0	3	0	0	0	0	0	4	63	2	0	3	29	1	106	1,066
7:25 AM	0	3	1	2	0	0	0	2	0	1	53	2	0	0	37	0	101	1,033
7:30 AM	0	1	0	3	0	0	0	0	0	0	30	1	0	0	24	0	59	1,000
7:35 AM	0	0	0	1	0	0	0	0	0	1	52	2	0	0	43	0	99	989
7:40 AM	0	1	0	4	0	0	0	1	0	2	54	3	0	2	20	0	87	936
7:45 AM	0	1	1	8	0	0	0	0	0	6	56	2	0	1	36	1	112	932
7:50 AM	0	1	0	4	0	0	0	0	0	0	56	2	0	1	26	3	93	918
7:55 AM	0	0	1	0	0	0	0	0	0	3	35	3	0	0	31	0	73	920
8:00 AM	0	2	0	1	0	1	1	0	0	4	42	3	0	3	32	2	91	902
8:05 AM	0	1	1	1	0	0	1	0	0	1	51	1	0	1	25	1	84	
8:10 AM	0	0	0	4	0	0	0	0	0	0	39	1	0	0	48	2	94	
8:15 AM	0	1	0	4	0	0	0	0	0	1	39	1	0	0	17	4	67	
8:20 AM	0	3	0	1	0	0	0	0	0	0	40	0	0	1	25	3	73	
8:25 AM	0	1	1	2	0	0	0	0	0	2	26	1	0	0	35	0	68	
8:30 AM	0	1	0	3	0	1	0	0	0	1	16	1	0	0	25	0	48	
8:35 AM	0	0	0	1	0	0	0	0	0	1	22	0	0	0	22	0	46	
8:40 AM	0	2	0	1	0	0	0	0	0	0	59	1	0	0	20	0	83	
8:45 AM	0	2	0	3	0	0	0	1	0	3	55	2	0	0	32	0	98	
8:50 AM	0	1	0	1	0	0	0	0	0	0	53	3	1	0	36	0	95	
8:55 AM	0	0	0	1	0	1	0	0	0	3	32	1	0	0	16	1	55	
Count Total	0	28	8	53	0	3	3	8	0	53	1,079	41	1	20	706	20	2,023	
Peak Hour	0	15	4	31	0	1	2	6	0	35	604	27	0	16	379	9	1,129	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
7:00 AM	2	5	0	2	9	7:00 AM	0	0	0	0	0	7:00 AM	0	0	0	0	0
7:05 AM	1	5	0	4	10	7:05 AM	0	0	0	0	0	7:05 AM	0	0	0	0	0
7:10 AM	0	7	0	0	7	7:10 AM	0	0	0	0	0	7:10 AM	0	0	0	0	0
7:15 AM	1	3	0	3	7	7:15 AM	0	0	1	0	1	7:15 AM	0	0	0	0	0
7:20 AM	1	5	0	2	8	7:20 AM	0	0	0	0	0	7:20 AM	0	0	0	0	0
7:25 AM	0	7	0	3	10	7:25 AM	0	0	0	0	0	7:25 AM	0	0	0	0	0
7:30 AM	0	2	0	4	6	7:30 AM	0	0	0	0	0	7:30 AM	0	0	0	0	0
7:35 AM	0	7	0	10	17	7:35 AM	0	0	0	0	0	7:35 AM	0	0	0	0	0
7:40 AM	0	7	0	4	11	7:40 AM	0	0	0	0	0	7:40 AM	0	0	0	0	0
7:45 AM	0	6	0	3	9	7:45 AM	0	0	0	0	0	7:45 AM	0	0	0	0	0
7:50 AM	0	4	0	3	7	7:50 AM	0	0	0	0	0	7:50 AM	0	0	0	0	0
7:55 AM	0	3	0	4	7	7:55 AM	0	0	0	0	0	7:55 AM	0	0	0	0	0
8:00 AM	0	3	0	3	6	8:00 AM	0	0	0	0	0	8:00 AM	0	0	0	0	0
8:05 AM	0	4	0	2	6	8:05 AM	0	0	0	0	0	8:05 AM	0	0	0	0	0
8:10 AM	1	3	0	10	14	8:10 AM	0	0	0	0	0	8:10 AM	0	0	0	1	1
8:15 AM	0	2	0	1	3	8:15 AM	0	0	0	0	0	8:15 AM	0	0	0	0	0
8:20 AM	0	3	0	8	11	8:20 AM	0	0	0	0	0	8:20 AM	0	0	0	0	0
8:25 AM	0	7	0	4	11	8:25 AM	0	0	0	0	0	8:25 AM	0	0	0	0	0
8:30 AM	2	6	1	8	17	8:30 AM	0	0	0	0	0	8:30 AM	0	0	0	0	0
8:35 AM	0	2	0	3	5	8:35 AM	0	0	0	0	0	8:35 AM	0	0	0	0	0
8:40 AM	0	5	0	6	11	8:40 AM	0	0	0	0	0	8:40 AM	0	0	0	0	0
8:45 AM	0	8	0	6	14	8:45 AM	0	0	0	0	0	8:45 AM	0	0	0	1	1
8:50 AM	0	3	0	7	10	8:50 AM	0	0	0	0	0	8:50 AM	0	0	0	0	0
8:55 AM	0	8	0	3	11	8:55 AM	0	0	0	0	0	8:55 AM	0	0	0	0	0
Count Total	8	115	1	103	227	Count Total	0	0	1	0	1	Count Total	0	0	0	2	2
Peak Hour	3	59	0	43	105	Peak Hour	0	0	1	0	1	Peak Hour	0	0	0	0	0

ALL TRAFFIC DATA SERVICES
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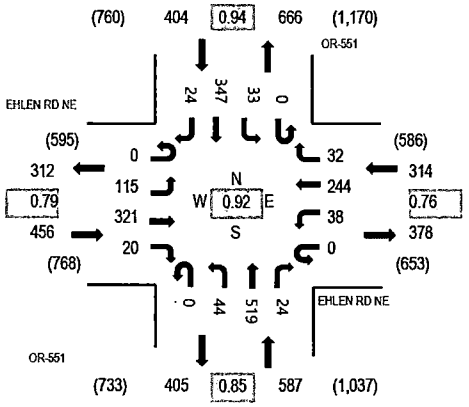
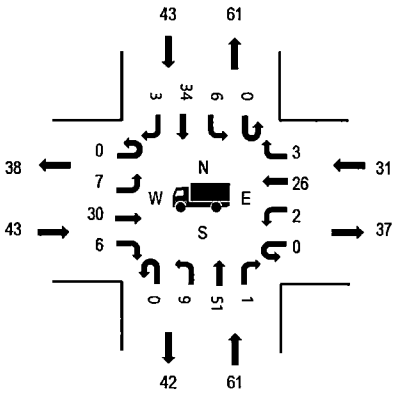
Location: 7 OR-551 & EHLEN RD NE AM
Date: Tuesday, September 19, 2023
Peak Hour: 07:00 AM - 08:00 AM
Peak 15-Minutes: 07:40 AM - 07:55 AM

Peak Hour

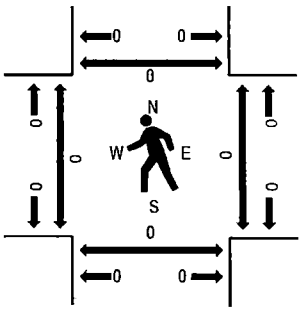
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	9.4%	0.79
WB	9.9%	0.76
NB	10.4%	0.85
SB	10.6%	0.94
All	10.1%	0.92

Traffic Counts - Motorized Vehicles

Interval Start Time	EHLEN RD NE Eastbound				EHLEN RD NE Westbound				OR-551 Northbound				OR-551 Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
7:00 AM	0	11	16	3	0	3	15	2	0	4	46	1	0	4	24	2	131	1,761
7:05 AM	0	8	17	3	0	1	15	1	0	1	46	2	0	2	31	1	128	1,747
7:10 AM	0	8	26	3	0	4	10	0	0	3	50	2	0	0	30	0	136	1,746
7:15 AM	0	9	25	2	0	2	27	5	0	5	43	0	0	3	32	2	155	1,742
7:20 AM	0	9	14	0	0	1	16	1	0	4	63	3	0	4	32	2	149	1,712
7:25 AM	0	10	32	1	0	6	23	3	0	5	38	2	0	4	23	3	150	1,671
7:30 AM	0	6	35	2	0	3	41	3	0	4	17	2	0	3	30	1	147	1,633
7:35 AM	0	8	21	2	0	4	20	8	0	4	55	3	0	3	31	4	163	1,556
7:40 AM	0	9	30	1	0	6	25	2	0	4	50	2	0	2	31	1	163	1,480
7:45 AM	0	9	35	3	0	3	21	1	0	5	40	0	0	3	20	2	142	1,451
7:50 AM	0	11	36	0	0	2	15	5	0	3	48	4	0	3	42	3	172	1,457
7:55 AM	0	17	34	0	0	3	16	1	0	2	23	3	0	2	21	3	125	1,425
8:00 AM	0	8	16	1	0	0	8	1	0	3	41	3	0	5	22	9	117	1,390
8:05 AM	0	11	14	0	0	8	22	3	0	4	34	0	0	1	29	1	127	
8:10 AM	0	7	23	0	0	0	30	4	0	4	28	0	0	6	28	2	132	
8:15 AM	0	7	12	3	0	0	22	1	0	5	42	2	0	3	28	0	125	
8:20 AM	0	7	23	5	0	8	14	2	0	1	23	1	0	4	17	3	108	
8:25 AM	0	8	17	2	0	2	15	2	0	3	21	0	0	12	27	3	112	
8:30 AM	0	1	4	4	0	4	11	3	0	0	13	2	0	3	24	1	70	
8:35 AM	0	3	20	1	0	3	16	2	0	1	20	1	0	4	16	0	87	
8:40 AM	0	14	25	2	0	3	12	3	0	5	44	6	0	1	16	3	134	
8:45 AM	0	11	14	1	0	2	35	2	0	5	41	4	0	3	25	5	148	
8:50 AM	0	4	19	4	0	1	11	3	0	5	54	0	0	6	25	8	140	
8:55 AM	0	5	15	1	0	1	15	3	0	1	28	5	0	1	15	0	90	
Count Total	0	201	523	44	0	70	455	61	0	81	908	48	0	82	619	59	3,151	
Peak Hour	0	115	321	20	0	38	244	32	0	44	519	24	0	33	347	24	1,761	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
7:00 AM	4	3	3	2	12	7:00 AM	0	0	0	0	0	7:00 AM	0	0	0	0	0
7:05 AM	2	4	1	3	10	7:05 AM	0	0	0	0	0	7:05 AM	0	0	0	0	0
7:10 AM	5	8	0	1	14	7:10 AM	0	0	0	0	0	7:10 AM	0	0	0	0	0
7:15 AM	4	3	3	4	14	7:15 AM	0	0	0	0	0	7:15 AM	0	0	0	0	0
7:20 AM	0	8	0	3	11	7:20 AM	0	0	0	0	0	7:20 AM	0	0	0	0	0
7:25 AM	3	6	5	3	17	7:25 AM	0	0	0	0	0	7:25 AM	0	0	0	0	0
7:30 AM	3	2	3	3	11	7:30 AM	0	0	0	0	0	7:30 AM	0	0	0	0	0
7:35 AM	3	8	2	10	23	7:35 AM	0	0	0	0	0	7:35 AM	0	0	0	0	0
7:40 AM	4	6	3	4	17	7:40 AM	0	0	0	0	0	7:40 AM	0	0	0	0	0
7:45 AM	5	8	4	4	21	7:45 AM	0	0	0	0	0	7:45 AM	0	0	0	0	0
7:50 AM	6	2	3	3	14	7:50 AM	0	0	0	0	0	7:50 AM	0	0	0	0	0
7:55 AM	4	3	4	3	14	7:55 AM	0	0	0	0	0	7:55 AM	0	0	0	0	0
8:00 AM	2	4	1	3	10	8:00 AM	0	0	0	0	0	8:00 AM	0	0	0	0	0
8:05 AM	4	6	3	3	16	8:05 AM	0	0	0	0	0	8:05 AM	0	0	0	0	0
8:10 AM	1	5	5	10	21	8:10 AM	0	0	0	0	0	8:10 AM	0	0	0	0	0
8:15 AM	2	5	6	1	14	8:15 AM	0	0	0	0	0	8:15 AM	0	0	0	0	0
8:20 AM	3	2	2	7	14	8:20 AM	0	0	0	0	0	8:20 AM	0	0	0	0	0
8:25 AM	2	6	2	6	16	8:25 AM	0	0	0	0	0	8:25 AM	0	0	0	0	0
8:30 AM	1	6	0	10	17	8:30 AM	0	0	0	0	0	8:30 AM	0	0	0	0	0
8:35 AM	7	0	3	1	11	8:35 AM	0	0	0	0	0	8:35 AM	0	0	0	0	0
8:40 AM	6	7	0	7	20	8:40 AM	0	0	0	0	0	8:40 AM	0	0	0	0	0
8:45 AM	5	7	5	7	24	8:45 AM	0	0	0	0	0	8:45 AM	0	0	0	0	0
8:50 AM	3	3	1	7	14	8:50 AM	0	0	0	0	0	8:50 AM	0	0	0	0	0
8:55 AM	4	11	5	2	22	8:55 AM	0	0	0	0	0	8:55 AM	0	0	0	0	0
Count Total	83	123	64	107	377	Count Total	0	0	0	0	0	Count Total	0	0	0	0	0
Peak Hour	43	61	31	43	178	Peak Hour	0	0	0	0	0	Peak Hour	0	0	0	0	0

ALL TRAFFIC DATA SERVICES
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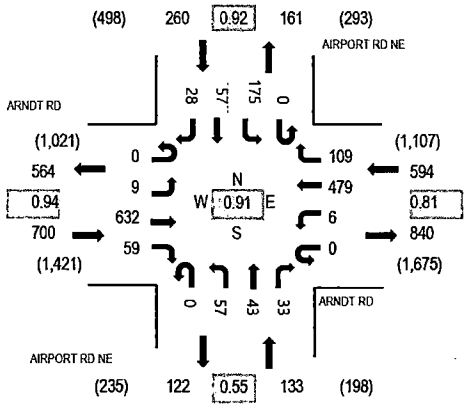
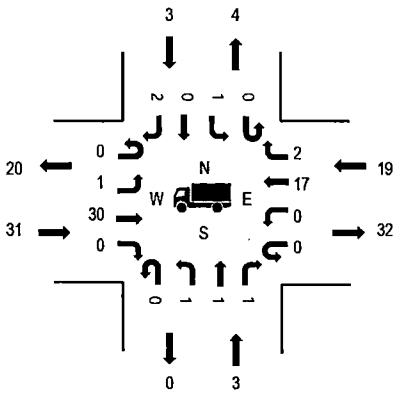
Location: 1 AIRPORT RD NE & ARNDT RD PM
Date: Tuesday, September 19, 2023
Peak Hour: 04:20 PM - 05:20 PM
Peak 15-Minutes: 05:05 PM - 05:20 PM

Peak Hour

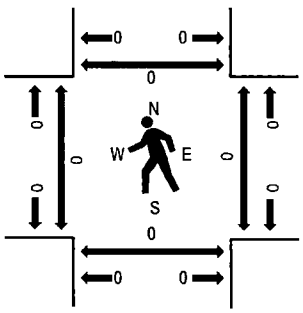
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	4.4%	0.94
WB	3.2%	0.81
NB	2.3%	0.55
SB	1.2%	0.92
All	3.3%	0.91

Traffic Counts - Motorized Vehicles

Interval Start Time	ARNDT RD Eastbound				ARNDT RD Westbound				AIRPORT RD NE Northbound				AIRPORT RD NE Southbound					Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total	
4:00 PM	0	1	65	3	0	0	36	9	0	1	1	3	0	21	5	1	146	1,679
4:05 PM	0	1	52	5	0	0	40	18	0	5	3	2	0	11	5	2	144	1,655
4:10 PM	0	1	57	3	0	1	39	12	0	2	0	2	0	12	1	4	134	1,670
4:15 PM	0	3	56	6	0	0	37	6	0	5	6	3	0	20	6	5	153	1,686
4:20 PM	0	0	54	6	0	1	50	8	0	4	2	1	0	17	4	0	147	1,687
4:25 PM	0	2	60	3	0	0	34	10	0	2	3	1	0	14	5	0	134	1,670
4:30 PM	0	0	42	2	0	1	30	4	0	6	1	8	0	14	7	2	117	1,672
4:35 PM	0	0	57	5	0	0	39	9	0	11	11	11	0	6	6	6	161	1,681
4:40 PM	0	1	49	7	0	0	46	9	0	4	5	5	0	12	6	2	146	1,643
4:45 PM	0	2	52	6	0	0	37	8	0	4	3	1	0	18	5	1	137	1,610
4:50 PM	0	0	49	5	0	0	33	6	0	4	4	0	0	16	1	3	121	1,600
4:55 PM	0	0	58	10	0	0	42	9	0	2	3	0	0	9	5	1	139	1,598
5:00 PM	0	3	52	5	0	1	26	8	0	5	2	1	0	15	4	0	122	1,545
5:05 PM	0	1	49	3	0	2	56	15	0	5	3	1	0	15	5	4	159	
5:10 PM	0	0	56	6	0	1	37	13	0	4	2	3	0	18	5	5	150	
5:15 PM	0	0	54	1	0	0	49	10	0	6	4	1	0	21	4	4	154	
5:20 PM	0	0	60	7	0	0	41	5	0	0	1	0	0	8	5	3	130	
5:25 PM	0	1	64	6	0	1	31	8	0	1	3	1	0	14	6	0	136	
5:30 PM	0	0	48	2	0	1	39	10	0	3	0	1	0	13	9	0	126	
5:35 PM	0	1	55	4	0	0	34	9	0	1	0	0	0	13	4	2	123	
5:40 PM	0	1	56	6	0	0	25	6	0	1	2	1	0	11	3	1	113	
5:45 PM	0	0	58	2	0	1	32	4	0	2	1	2	0	20	3	2	127	
5:50 PM	0	1	54	4	0	1	28	6	0	3	4	1	0	11	5	1	119	
5:55 PM	0	1	32	5	0	1	26	6	0	3	1	0	0	8	2	1	86	
Count Total	0	20	1,289	112	0	12	887	208	0	84	65	49	0	337	111	50	3,224	
Peak Hour	0	9	632	59	0	6	479	109	0	57	43	33	0	175	57	28	1,687	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

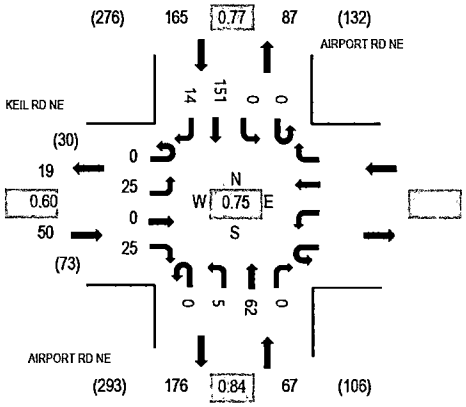
Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
4:00 PM	4	0	3	2	9	4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0
4:05 PM	1	2	4	2	9	4:05 PM	0	0	0	0	0	4:05 PM	0	0	0	0	0
4:10 PM	6	0	1	0	7	4:10 PM	0	0	0	0	0	4:10 PM	0	0	0	0	0
4:15 PM	2	0	1	3	6	4:15 PM	0	0	0	0	0	4:15 PM	0	0	0	0	0
4:20 PM	4	0	2	0	6	4:20 PM	0	0	0	0	0	4:20 PM	0	0	0	0	0
4:25 PM	3	0	2	0	5	4:25 PM	0	0	0	0	0	4:25 PM	0	0	0	0	0
4:30 PM	1	1	0	0	2	4:30 PM	0	0	0	0	0	4:30 PM	0	0	0	0	0
4:35 PM	1	1	3	0	5	4:35 PM	0	1	0	0	1	4:35 PM	0	0	0	0	0
4:40 PM	3	0	0	0	3	4:40 PM	0	0	0	0	0	4:40 PM	0	0	0	0	0
4:45 PM	5	0	0	0	5	4:45 PM	0	0	0	0	0	4:45 PM	0	0	0	0	0
4:50 PM	1	1	4	0	6	4:50 PM	0	0	0	0	0	4:50 PM	0	0	1	0	1
4:55 PM	3	0	3	0	6	4:55 PM	0	0	0	0	0	4:55 PM	0	0	0	0	0
5:00 PM	2	0	0	0	2	5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0
5:05 PM	6	0	2	0	8	5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0
5:10 PM	1	0	2	1	4	5:10 PM	0	0	0	0	0	5:10 PM	0	0	0	0	0
5:15 PM	1	0	1	2	4	5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0
5:20 PM	1	0	2	1	4	5:20 PM	0	0	0	0	0	5:20 PM	0	0	0	0	0
5:25 PM	2	0	1	0	3	5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0
5:30 PM	2	0	4	0	6	5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0
5:35 PM	2	0	1	0	3	5:35 PM	0	0	0	0	0	5:35 PM	0	0	0	0	0
5:40 PM	1	0	0	0	1	5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0
5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0
5:50 PM	1	0	1	0	2	5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0
5:55 PM	2	1	0	0	3	5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0
Count Total	55	6	37	11	109	Count Total	0	1	0	0	1	Count Total	0	0	1	0	1
Peak Hour	31	3	19	3	56	Peak Hour	0	1	0	0	1	Peak Hour	0	0	1	0	1

ALL TRAFFIC DATA SERVICES
(303) 216-2439
www.alltrafficdata.net

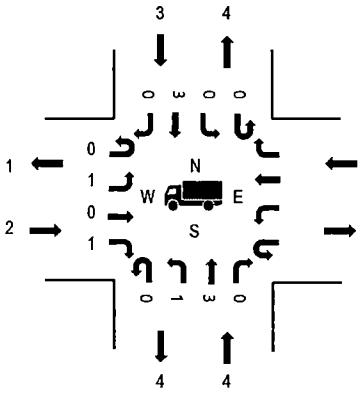
Location: 2 AIRPORT RD NE & KEIL RD NE PM
Date: Tuesday, September 19, 2023
Peak Hour: 04:15 PM - 05:15 PM
Peak 15-Minutes: 04:30 PM - 04:45 PM

Peak Hour

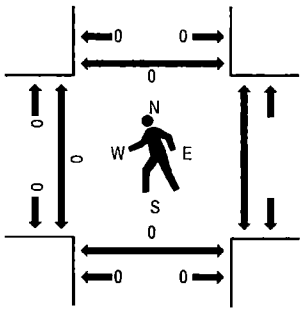
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	4.0%	0.60
WB		
NB	6.0%	0.84
SB	1.8%	0.77
All	3.2%	0.75

Traffic Counts - Motorized Vehicles

Interval Start Time	KEIL RD NE Eastbound				Westbound				AIRPORT RD NE Northbound				AIRPORT RD NE Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
4:00 PM	0	3	0	2					0	0	5	0	0	0	8	0	18	270
4:05 PM	0	1	0	1					0	1	2	0	0	0	14	0	19	274
4:10 PM	0	1	0	2					0	0	2	0	0	0	9	1	15	273
4:15 PM	0	3	0	4					0	2	8	0	0	0	12	1	30	282
4:20 PM	0	1	0	4					0	0	2	0	0	0	17	1	25	263
4:25 PM	0	1	0	0					0	1	3	0	0	0	5	1	11	255
4:30 PM	0	3	0	4					0	0	7	0	0	0	21	1	36	254
4:35 PM	0	5	0	4					0	0	9	0	0	0	15	4	37	237
4:40 PM	0	4	0	1					0	0	3	0	0	0	11	2	21	208
4:45 PM	0	0	0	1					0	0	7	0	0	0	15	2	25	204
4:50 PM	0	1	0	0					0	1	4	0	0	0	10	0	16	192
4:55 PM	0	0	0	2					0	0	3	0	0	0	12	0	17	191
5:00 PM	0	2	0	1					0	0	7	0	0	0	11	1	22	185
5:05 PM	0	2	0	3					0	0	4	0	0	0	8	1	18	
5:10 PM	0	3	0	1					0	1	5	0	0	0	14	0	24	
5:15 PM	0	1	0	1					0	0	3	0	0	0	5	1	11	
5:20 PM	0	0	0	0					0	2	4	0	0	0	11	0	17	
5:25 PM	0	0	0	0					0	0	1	0	0	0	9	0	10	
5:30 PM	0	1	0	0					0	1	2	0	0	0	12	3	19	
5:35 PM	0	0	0	2					0	0	0	0	0	0	6	0	8	
5:40 PM	0	0	0	2					0	0	2	0	0	0	12	1	17	
5:45 PM	0	1	0	1					0	1	5	0	0	0	5	0	13	
5:50 PM	0	2	0	0					0	0	5	0	0	0	8	0	15	
5:55 PM	0	1	0	1					0	0	3	0	0	0	6	0	11	
Count Total	0	36	0	37					0	10	96	0	0	0	256	20	455	
Peak Hour	0	25	0	25					0	5	62	0	0	0	151	14	282	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
4:00 PM	1	2		0	3	4:00 PM	0	0		0	0	4:00 PM	0	0		0	0
4:05 PM	0	1		0	1	4:05 PM	0	0		0	0	4:05 PM	0	0		0	0
4:10 PM	0	0		1	1	4:10 PM	0	0		0	0	4:10 PM	0	0		0	0
4:15 PM	1	1		2	4	4:15 PM	0	0		0	0	4:15 PM	0	0		0	0
4:20 PM	1	0		1	2	4:20 PM	0	0		0	0	4:20 PM	0	0		0	0
4:25 PM	0	0		0	0	4:25 PM	0	0		0	0	4:25 PM	0	0		0	0
4:30 PM	0	2		0	2	4:30 PM	1	0		0	1	4:30 PM	0	0		0	0
4:35 PM	0	0		0	0	4:35 PM	0	0		0	0	4:35 PM	0	0		0	0
4:40 PM	0	0		0	0	4:40 PM	0	0		0	0	4:40 PM	0	0		0	0
4:45 PM	0	1		0	1	4:45 PM	0	1		0	1	4:45 PM	0	0		0	0
4:50 PM	0	0		0	0	4:50 PM	0	0		0	0	4:50 PM	0	0		0	0
4:55 PM	0	0		0	0	4:55 PM	0	0		0	0	4:55 PM	0	0		0	0
5:00 PM	0	0		0	0	5:00 PM	0	0		0	0	5:00 PM	0	0		0	0
5:05 PM	0	0		0	0	5:05 PM	0	0		0	0	5:05 PM	0	0		0	0
5:10 PM	0	0		0	0	5:10 PM	0	0		0	0	5:10 PM	0	0		0	0
5:15 PM	0	0		0	0	5:15 PM	0	0		0	0	5:15 PM	0	0		0	0
5:20 PM	0	0		1	1	5:20 PM	0	0		0	0	5:20 PM	0	0		0	0
5:25 PM	0	0		0	0	5:25 PM	0	0		0	0	5:25 PM	0	0		0	0
5:30 PM	0	0		1	1	5:30 PM	0	0		0	0	5:30 PM	0	0		0	0
5:35 PM	0	0		0	0	5:35 PM	0	0		0	0	5:35 PM	0	0		0	0
5:40 PM	0	0		0	0	5:40 PM	0	0		0	0	5:40 PM	0	0		0	0
5:45 PM	0	0		0	0	5:45 PM	0	0		0	0	5:45 PM	0	0		0	0
5:50 PM	0	0		0	0	5:50 PM	0	0		0	0	5:50 PM	0	0		0	0
5:55 PM	0	1		0	1	5:55 PM	0	0		0	0	5:55 PM	0	0		0	0
Count Total	3	8		6	17	Count Total	1	1		0	2	Count Total	0	0		0	0
Peak Hour	2	4		3	9	Peak Hour	1	1		0	2	Peak Hour	0	0		0	0

ALL TRAFFIC DATA SERVICES
(303) 216-2439
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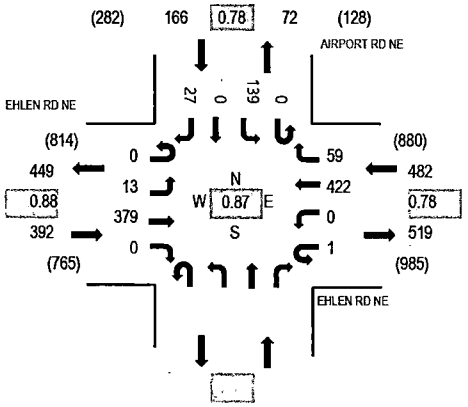
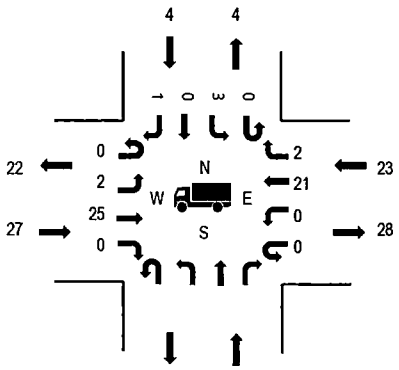
Location: 3 AIRPORT RD NE & EHLEN RD NE PM
Date: Tuesday, September 19, 2023
Peak Hour: 04:05 PM - 05:05 PM
Peak 15-Minutes: 04:05 PM - 04:20 PM

Peak Hour

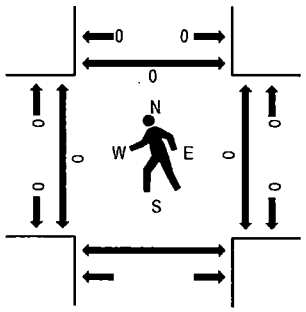
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	6.9%	0.88
WB	4.8%	0.78
NB		
SB	2.4%	0.78
All	5.2%	0.87

Traffic Counts - Motorized Vehicles

Interval Start Time	EHLEN RD NE Eastbound				EHLEN RD NE Westbound				Northbound				AIRPORT RD NE Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
4:00 PM	0	3	40	0	0	0	25	6					0	6	0	0	80	1,039
4:05 PM	0	3	28	0	0	0	54	4					0	15	0	1	105	1,040
4:10 PM	0	1	38	0	1	0	43	7					0	11	0	2	98	1,028
4:15 PM	0	1	34	0	0	0	39	6					0	12	0	3	95	1,015
4:20 PM	0	0	40	0	0	0	34	1					0	14	0	5	94	984
4:25 PM	0	2	33	0	0	0	30	5					0	5	0	1	76	965
4:30 PM	0	1	39	0	0	0	37	6					0	12	0	8	103	971
4:35 PM	0	1	29	0	0	0	39	6					0	17	0	3	95	939
4:40 PM	0	1	31	0	0	0	32	2					0	11	0	2	79	920
4:45 PM	0	1	23	0	0	0	31	4					0	12	0	0	71	904
4:50 PM	0	1	22	0	0	0	34	7					0	7	0	1	72	894
4:55 PM	0	0	36	0	0	0	17	5					0	13	0	0	71	897
5:00 PM	0	1	31	0	0	0	32	6					0	10	0	1	81	888
5:05 PM	0	0	38	0	0	0	34	5					0	9	0	2	88	
5:10 PM	0	1	29	0	0	0	38	6					0	12	0	4	90	
5:15 PM	0	3	22	0	0	0	30	4					0	5	0	0	64	
5:20 PM	0	0	33	0	0	0	26	5					0	11	0	0	75	
5:25 PM	0	0	34	0	0	0	38	1					0	9	0	0	82	
5:30 PM	0	2	27	0	0	0	28	1					0	12	0	1	71	
5:35 PM	0	0	29	0	0	0	38	2					0	7	0	0	76	
5:40 PM	0	1	28	0	0	0	16	1					0	14	0	3	63	
5:45 PM	0	2	23	0	0	0	26	5					0	5	0	0	61	
5:50 PM	0	0	27	0	0	0	35	5					0	8	0	0	75	
5:55 PM	0	0	31	0	0	0	20	3					0	7	0	1	62	
Count Total	0	25	740	0	1	0	776	103					0	244	0	38	1,927	
Peak Hour	0	13	379	0	1	0	422	59					0	139	0	27	1,040	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
4:00 PM	2		5	1	8	4:00 PM	0		0	0	0	4:00 PM	0		0	0	0
4:05 PM	1		4	0	5	4:05 PM	0		0	0	0	4:05 PM	0		0	0	0
4:10 PM	4		2	0	6	4:10 PM	0		0	0	0	4:10 PM	0		0	0	0
4:15 PM	0		0	2	2	4:15 PM	0		0	0	0	4:15 PM	0		0	0	0
4:20 PM	2		2	2	6	4:20 PM	1		0	0	1	4:20 PM	0		0	0	0
4:25 PM	3		2	0	5	4:25 PM	0		0	0	0	4:25 PM	0		0	0	0
4:30 PM	5		4	0	9	4:30 PM	0		1	0	1	4:30 PM	0		0	1	1
4:35 PM	2		0	0	2	4:35 PM	0		0	0	0	4:35 PM	0		0	0	0
4:40 PM	2		4	0	6	4:40 PM	0		0	0	0	4:40 PM	0		0	0	0
4:45 PM	2		1	0	3	4:45 PM	0		0	0	0	4:45 PM	0		0	0	0
4:50 PM	1		2	0	3	4:50 PM	0		0	0	0	4:50 PM	0		0	0	0
4:55 PM	4		0	0	4	4:55 PM	0		0	0	0	4:55 PM	0		0	0	0
5:00 PM	1		2	0	3	5:00 PM	0		0	0	0	5:00 PM	0		0	0	0
5:05 PM	5		0	0	5	5:05 PM	0		0	0	0	5:05 PM	0		0	0	0
5:10 PM	0		0	0	0	5:10 PM	0		0	0	0	5:10 PM	0		0	0	0
5:15 PM	5		1	0	6	5:15 PM	0		0	0	0	5:15 PM	0		0	0	0
5:20 PM	1		0	1	2	5:20 PM	0		0	0	0	5:20 PM	0		0	0	0
5:25 PM	3		1	0	4	5:25 PM	0		0	0	0	5:25 PM	0		0	0	0
5:30 PM	0		0	1	1	5:30 PM	0		0	0	0	5:30 PM	0		0	0	0
5:35 PM	3		0	0	3	5:35 PM	0		0	0	0	5:35 PM	0		0	0	0
5:40 PM	2		0	0	2	5:40 PM	0		0	0	0	5:40 PM	0		0	0	0
5:45 PM	3		0	0	3	5:45 PM	0		0	0	0	5:45 PM	0		0	0	0
5:50 PM	0		2	0	2	5:50 PM	0		0	0	0	5:50 PM	0		0	0	0
5:55 PM	3		1	0	4	5:55 PM	0		0	0	0	5:55 PM	0		0	0	0
Count Total	54		33	7	94	Count Total	1		1	0	2	Count Total	0		0	1	1
Peak Hour	27		23	4	54	Peak Hour	1		1	0	2	Peak Hour	0		0	1	1

ALL TRAFFIC DATA SERVICES
(303) 216-2439
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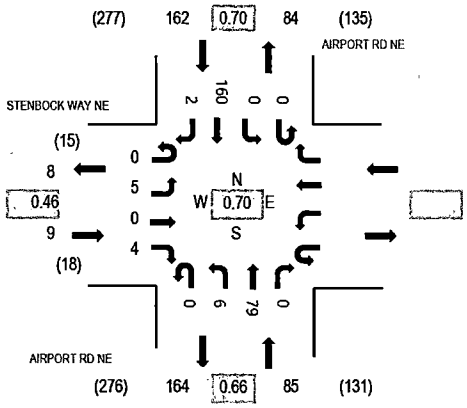
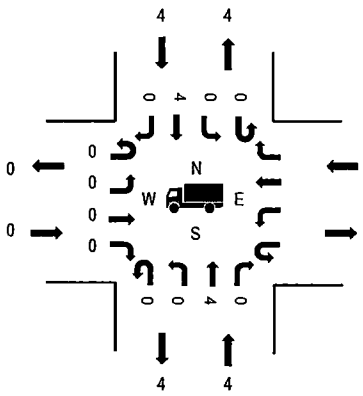
Location: 4 AIRPORT RD NE & STENBOCK WAY NE PM
Date: Tuesday, September 19, 2023
Peak Hour: 04:15 PM - 05:15 PM
Peak 15-Minutes: 04:30 PM - 04:45 PM

Peak Hour

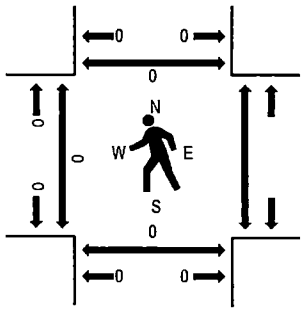
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	0.0%	0.46
WB		
NB	4.7%	0.66
SB	2.5%	0.70
All	3.1%	0.70

Traffic Counts - Motorized Vehicles

Interval Start Time	STENBOCK WAY NE Eastbound				STENBOCK WAY NE Westbound				AIRPORT RD NE Northbound				AIRPORT RD NE Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
4:00 PM	0	0	0	0					0	0	6	0	0	0	7	0	13	250
4:05 PM	0	1	0	1					0	0	4	0	0	0	13	0	19	255
4:10 PM	0	2	0	1					0	0	4	0	0	0	9	0	16	252
4:15 PM	0	0	0	2					0	0	8	0	0	0	13	0	23	256
4:20 PM	0	0	0	1					0	1	4	0	0	0	14	1	21	243
4:25 PM	0	0	0	0					0	0	4	0	0	0	6	0	10	236
4:30 PM	0	0	0	0					0	1	6	0	0	0	22	0	29	243
4:35 PM	0	2	0	0					0	2	14	0	0	0	21	0	39	229
4:40 PM	0	0	0	0					0	1	7	0	0	0	14	1	23	200
4:45 PM	0	0	0	1					0	0	8	0	0	0	14	0	23	193
4:50 PM	0	1	0	0					0	0	4	0	0	0	9	0	14	182
4:55 PM	0	1	0	0					0	0	4	0	0	0	15	0	20	186
5:00 PM	0	0	0	0					0	0	8	0	0	0	10	0	18	176
5:05 PM	0	0	0	0					0	1	5	0	0	0	10	0	16	
5:10 PM	0	1	0	0					0	0	7	0	0	0	12	0	20	
5:15 PM	0	0	0	0					0	0	5	0	0	0	5	0	10	
5:20 PM	0	0	0	0					0	0	3	0	0	0	11	0	14	
5:25 PM	0	0	0	0					0	0	2	0	0	0	14	1	17	
5:30 PM	0	1	0	1					0	0	3	0	0	0	10	0	15	
5:35 PM	0	1	0	0					0	0	0	0	0	0	8	1	10	
5:40 PM	0	0	0	1					0	0	2	0	0	0	11	2	16	
5:45 PM	0	0	0	0					0	0	5	0	0	0	5	2	12	
5:50 PM	0	0	0	0					0	0	8	0	0	0	10	0	18	
5:55 PM	0	0	0	0					0	0	4	0	0	0	5	1	10	
Count Total	0	10	0	8					0	6	125	0	0	0	268	9	426	
Peak Hour	0	5	0	4					0	6	79	0	0	0	160	2	256	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

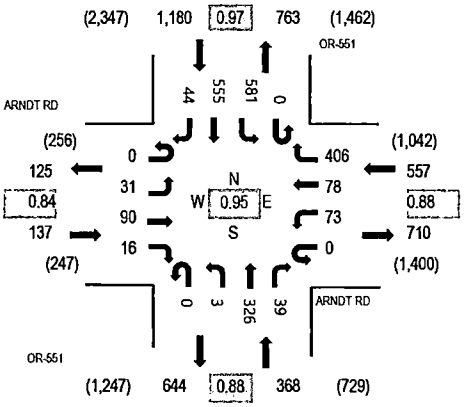
Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
4:00 PM	0	2		0	2	4:00 PM	0	0		0	0	4:00 PM	0	0		0	0
4:05 PM	0	0		0	0	4:05 PM	0	0		0	0	4:05 PM	0	0		0	0
4:10 PM	0	0		1	1	4:10 PM	0	0		0	0	4:10 PM	0	0		0	0
4:15 PM	0	0		2	2	4:15 PM	0	0		0	0	4:15 PM	0	0		0	0
4:20 PM	0	0		2	2	4:20 PM	0	0		0	0	4:20 PM	0	0		0	0
4:25 PM	0	0		0	0	4:25 PM	0	0		0	0	4:25 PM	0	0		0	0
4:30 PM	0	2		0	2	4:30 PM	0	0		0	0	4:30 PM	0	0		0	0
4:35 PM	0	0		0	0	4:35 PM	0	1		0	1	4:35 PM	0	0		0	0
4:40 PM	0	0		0	0	4:40 PM	0	0		0	0	4:40 PM	0	0		0	0
4:45 PM	0	2		0	2	4:45 PM	0	1		0	1	4:45 PM	0	0		0	0
4:50 PM	0	0		0	0	4:50 PM	0	0		0	0	4:50 PM	0	0		0	0
4:55 PM	0	0		0	0	4:55 PM	0	0		0	0	4:55 PM	0	0		0	0
5:00 PM	0	0		0	0	5:00 PM	0	0		0	0	5:00 PM	0	0		0	0
5:05 PM	0	0		0	0	5:05 PM	0	0		0	0	5:05 PM	0	0		0	0
5:10 PM	0	0		0	0	5:10 PM	0	0		0	0	5:10 PM	0	0		0	0
5:15 PM	0	0		0	0	5:15 PM	0	0		0	0	5:15 PM	0	0		0	0
5:20 PM	0	0		1	1	5:20 PM	0	0		0	0	5:20 PM	0	0		0	0
5:25 PM	0	0		0	0	5:25 PM	0	0		0	0	5:25 PM	0	0		0	0
5:30 PM	0	0		1	1	5:30 PM	0	0		0	0	5:30 PM	0	0		0	0
5:35 PM	0	0		0	0	5:35 PM	0	0		0	0	5:35 PM	0	0		0	0
5:40 PM	0	0		0	0	5:40 PM	0	0		0	0	5:40 PM	0	0		0	0
5:45 PM	0	0		0	0	5:45 PM	0	0		0	0	5:45 PM	0	0		0	0
5:50 PM	0	0		0	0	5:50 PM	0	0		0	0	5:50 PM	0	0		0	0
5:55 PM	0	1		0	1	5:55 PM	0	0		0	0	5:55 PM	0	0		0	0
Count Total	0	7		7	14	Count Total	0	2		0	2	Count Total	0	0		0	0
Peak Hour	0	4		4	8	Peak Hour	0	2		0	2	Peak Hour	0	0		0	0

ALL TRAFFIC DATA SERVICES
(303) 216-2439
www.alltrafficdata.net

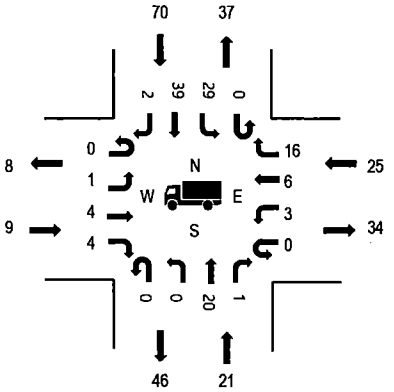
Location: 5 OR-551 & ARNDT RD PM
Date: Tuesday, September 19, 2023
Peak Hour: 04:00 PM - 05:00 PM
Peak 15-Minutes: 04:05 PM - 04:20 PM

Peak Hour

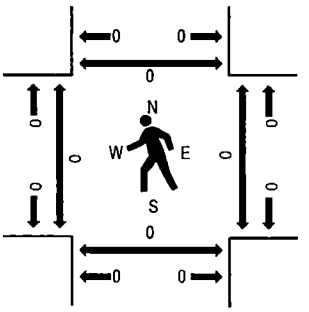
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	6.6%	0.84
WB	4.5%	0.88
NB	5.7%	0.88
SB	5.9%	0.97
All	5.6%	0.95

Traffic Counts - Motorized Vehicles

Interval Start Time	ARNDT RD Eastbound				ARNDT RD Westbound				OR-551 Northbound				OR-551 Southbound					Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	Total	
4:00 PM	0	3	12	1	0	3	3	35	0	0	9	1	0	62	45	5	179	2,242
4:05 PM	0	1	3	4	0	6	9	31	0	1	34	5	0	46	58	2	200	2,224
4:10 PM	0	3	13	1	0	11	5	32	0	0	17	4	0	39	51	4	180	2,217
4:15 PM	0	3	6	2	0	8	4	35	0	1	43	6	0	50	45	6	209	2,233
4:20 PM	0	2	9	2	0	5	6	40	0	0	29	3	0	47	50	5	198	2,233
4:25 PM	0	0	6	2	0	5	4	32	0	0	27	3	0	60	39	4	182	2,209
4:30 PM	0	5	2	2	0	6	4	29	0	0	27	1	0	32	51	5	164	2,205
4:35 PM	0	3	8	0	0	11	7	37	0	0	27	1	0	52	40	1	187	2,217
4:40 PM	0	2	7	0	0	4	9	42	0	0	26	6	0	51	38	2	187	2,208
4:45 PM	0	6	8	2	0	4	10	32	0	0	25	4	0	42	36	1	170	2,171
4:50 PM	0	1	10	0	0	6	4	28	0	1	34	1	0	59	55	6	205	2,208
4:55 PM	0	2	6	0	0	4	13	33	0	0	28	4	0	41	47	3	181	2,159
5:00 PM	0	0	11	0	0	2	6	25	0	0	20	7	0	45	41	4	161	2,123
5:05 PM	0	5	7	0	0	6	13	40	0	2	35	5	0	42	33	5	193	
5:10 PM	0	2	6	1	0	6	6	36	0	1	28	1	0	53	52	4	196	
5:15 PM	0	4	7	3	0	6	5	45	0	0	26	1	0	57	49	6	209	
5:20 PM	0	2	5	3	0	7	13	28	0	1	20	2	0	49	40	4	174	
5:25 PM	0	0	10	2	0	2	6	21	0	0	28	3	0	57	46	3	178	
5:30 PM	0	1	2	0	0	4	3	40	0	1	21	1	0	53	47	3	176	
5:35 PM	0	2	6	0	0	3	5	30	0	0	26	6	0	50	48	2	178	
5:40 PM	0	0	3	1	0	4	6	20	0	1	21	2	0	48	40	4	150	
5:45 PM	0	1	3	0	0	3	5	27	0	5	40	2	0	57	61	3	207	
5:50 PM	0	4	8	0	0	2	5	26	0	0	12	3	0	50	46	0	156	
5:55 PM	0	3	6	2	0	1	4	24	0	2	36	2	0	20	42	3	145	
Count Total	0	55	164	28	0	119	155	768	0	16	639	74	0	1,162	1,100	85	4,365	
Peak Hour	0	31	90	16	0	73	78	406	0	3	326	39	0	581	555	44	2,242	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

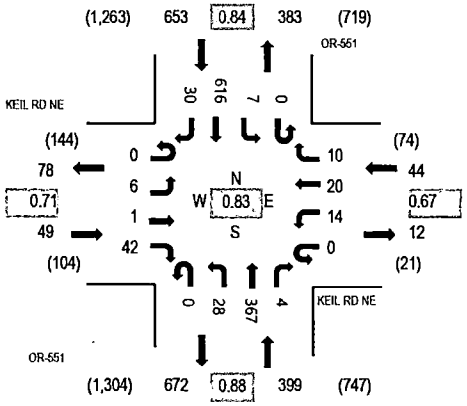
Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
4:00 PM	1	1	2	4	8	4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0
4:05 PM	1	6	5	9	21	4:05 PM	0	0	0	0	0	4:05 PM	0	0	0	0	0
4:10 PM	1	2	2	8	13	4:10 PM	0	0	0	0	0	4:10 PM	0	0	0	0	0
4:15 PM	0	4	2	6	12	4:15 PM	0	0	0	0	0	4:15 PM	0	0	0	0	0
4:20 PM	0	0	1	8	9	4:20 PM	0	0	0	0	0	4:20 PM	0	0	0	0	0
4:25 PM	2	2	2	4	10	4:25 PM	0	0	0	0	0	4:25 PM	0	0	0	0	0
4:30 PM	1	1	0	7	9	4:30 PM	0	0	0	0	0	4:30 PM	0	0	0	0	0
4:35 PM	0	2	3	3	8	4:35 PM	0	0	0	0	0	4:35 PM	0	0	0	0	0
4:40 PM	1	0	0	4	5	4:40 PM	0	0	0	0	0	4:40 PM	0	0	0	0	0
4:45 PM	2	3	0	9	14	4:45 PM	0	0	0	0	0	4:45 PM	0	0	0	0	0
4:50 PM	0	0	4	3	7	4:50 PM	0	0	0	0	0	4:50 PM	0	0	0	0	0
4:55 PM	0	0	4	5	9	4:55 PM	0	0	0	0	0	4:55 PM	0	0	0	0	0
5:00 PM	0	3	0	4	7	5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0
5:05 PM	0	1	1	13	15	5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0
5:10 PM	0	1	2	5	8	5:10 PM	0	0	0	0	0	5:10 PM	0	0	0	0	0
5:15 PM	2	0	3	2	7	5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0
5:20 PM	1	1	1	2	5	5:20 PM	0	0	0	0	0	5:20 PM	0	0	0	0	0
5:25 PM	0	1	2	3	6	5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0
5:30 PM	0	3	3	4	10	5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0
5:35 PM	1	1	2	2	6	5:35 PM	0	0	0	0	0	5:35 PM	0	0	0	0	0
5:40 PM	0	1	0	7	8	5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0
5:45 PM	0	2	0	2	4	5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0
5:50 PM	0	1	1	4	6	5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0
5:55 PM	0	2	1	2	5	5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0
Count Total	13	38	41	120	212	Count Total	0	0	0	0	0	Count Total	0	0	0	0	0
Peak Hour	9	21	25	70	125	Peak Hour	0	0	0	0	0	Peak Hour	0	0	0	0	0

ALL TRAFFIC DATA SERVICES
(303) 216-2439
www.alltrafficdata.net

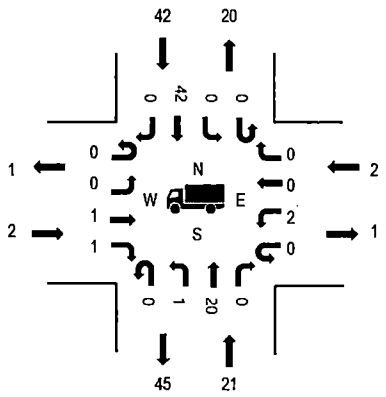
Location: 6 OR-551 & KEIL RD NE PM
Date: Tuesday, September 19, 2023
Peak Hour: 04:05 PM - 05:05 PM
Peak 15-Minutes: 04:05 PM - 04:20 PM

Peak Hour

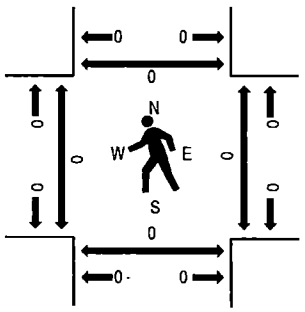
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	4.1%	0.71
WB	4.5%	0.67
NB	5.3%	0.88
SB	6.4%	0.84
All	5.9%	0.83

Traffic Counts - Motorized Vehicles

Interval Start Time	KEIL RD NE Eastbound				KEIL RD NE Westbound				OR-551 Northbound				OR-551 Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
4:00 PM	0	1	0	7	0	2	2	0	0	2	21	0	0	0	49	4	88	1,135
4:05 PM	0	0	1	4	0	1	1	1	0	1	31	1	0	0	73	1	115	1,145
4:10 PM	0	2	0	12	0	0	3	2	0	0	43	0	0	0	59	3	124	1,123
4:15 PM	0	0	0	6	0	1	1	0	0	1	38	1	0	4	53	2	107	1,070
4:20 PM	0	1	0	3	0	1	2	1	0	4	23	0	0	0	48	4	87	1,070
4:25 PM	0	0	0	0	0	0	3	1	0	1	20	0	0	0	49	4	78	1,063
4:30 PM	0	0	0	1	0	0	2	0	0	2	24	0	0	2	46	3	80	1,070
4:35 PM	0	0	0	1	0	5	4	0	0	2	28	1	0	0	52	4	97	1,063
4:40 PM	0	0	0	5	0	1	2	2	0	0	30	0	0	0	43	3	86	1,054
4:45 PM	0	2	0	2	0	2	1	2	0	5	42	1	0	0	40	1	98	1,062
4:50 PM	0	1	0	1	0	1	0	0	0	2	22	0	0	0	54	4	85	1,057
4:55 PM	0	0	0	0	0	0	0	0	0	7	33	0	0	0	49	1	90	1,072
5:00 PM	0	0	0	7	0	2	1	1	0	3	33	0	0	1	50	0	98	1,053
5:05 PM	0	0	0	2	0	3	5	2	0	2	37	1	0	0	39	2	93	
5:10 PM	0	2	0	3	0	0	1	1	0	3	16	0	0	0	44	1	71	
5:15 PM	0	0	0	3	0	0	2	1	0	5	32	0	0	0	59	5	107	
5:20 PM	0	0	0	2	0	1	0	0	0	2	24	0	0	0	51	0	80	
5:25 PM	0	0	0	3	0	0	0	2	0	0	30	0	0	1	47	2	85	
5:30 PM	0	2	0	3	0	1	1	0	0	2	22	1	0	0	39	2	73	
5:35 PM	0	0	1	2	0	0	1	0	0	0	24	1	0	0	56	3	88	
5:40 PM	0	1	0	4	0	0	1	1	0	2	40	1	0	0	44	0	94	
5:45 PM	0	0	0	4	0	0	0	0	0	2	27	1	0	1	55	3	93	
5:50 PM	0	3	0	5	0	0	1	1	0	2	27	0	0	0	57	4	100	
5:55 PM	0	1	0	6	0	1	0	0	0	3	18	0	0	1	40	1	71	
Count Total	0	16	2	86	0	22	34	18	0	53	685	9	0	10	1,196	57	2,188	
Peak Hour	0	6	1	42	0	14	20	10	0	28	367	4	0	7	616	30	1,145	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

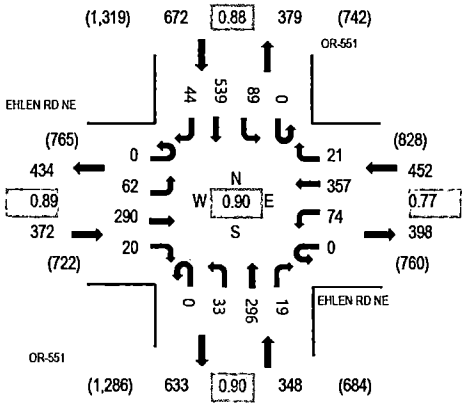
Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
4:00 PM	0	5	0	3	8	4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0
4:05 PM	1	2	0	4	7	4:05 PM	0	0	1	0	1	4:05 PM	0	0	0	0	0
4:10 PM	0	4	0	5	9	4:10 PM	0	0	0	0	0	4:10 PM	0	0	0	0	0
4:15 PM	0	2	1	6	9	4:15 PM	0	0	0	0	0	4:15 PM	0	0	0	0	0
4:20 PM	0	2	0	4	6	4:20 PM	0	0	0	0	0	4:20 PM	0	0	0	0	0
4:25 PM	0	0	0	4	4	4:25 PM	0	1	0	0	1	4:25 PM	0	0	0	0	0
4:30 PM	1	2	0	6	9	4:30 PM	0	0	0	0	0	4:30 PM	0	0	0	0	0
4:35 PM	0	2	0	3	5	4:35 PM	0	0	0	0	0	4:35 PM	0	0	0	0	0
4:40 PM	0	0	0	1	1	4:40 PM	0	0	0	0	0	4:40 PM	0	0	0	0	0
4:45 PM	0	3	1	3	7	4:45 PM	0	0	0	0	0	4:45 PM	0	0	0	0	0
4:50 PM	0	0	0	3	3	4:50 PM	0	0	0	0	0	4:50 PM	0	0	0	0	0
4:55 PM	0	2	0	2	4	4:55 PM	0	0	0	0	0	4:55 PM	0	0	0	0	0
5:00 PM	0	2	0	1	3	5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0
5:05 PM	0	0	0	7	7	5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0
5:10 PM	0	1	0	3	4	5:10 PM	0	0	0	0	0	5:10 PM	0	0	0	0	0
5:15 PM	0	1	0	1	2	5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0
5:20 PM	0	3	0	3	6	5:20 PM	0	0	0	0	0	5:20 PM	0	0	0	0	0
5:25 PM	0	3	0	1	4	5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0
5:30 PM	0	1	0	1	2	5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0
5:35 PM	0	0	0	1	1	5:35 PM	0	0	0	0	0	5:35 PM	0	0	0	0	0
5:40 PM	1	2	0	4	7	5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0
5:45 PM	0	1	0	4	5	5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0
5:50 PM	0	4	0	3	7	5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0
5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0
Count Total	3	42	2	73	120	Count Total	0	1	1	0	2	Count Total	0	0	0	0	0
Peak Hour	2	21	2	42	67	Peak Hour	0	1	1	0	2	Peak Hour	0	0	0	0	0

ALL TRAFFIC DATA SERVICES
(303) 216-2439
www.alltrafficdata.net

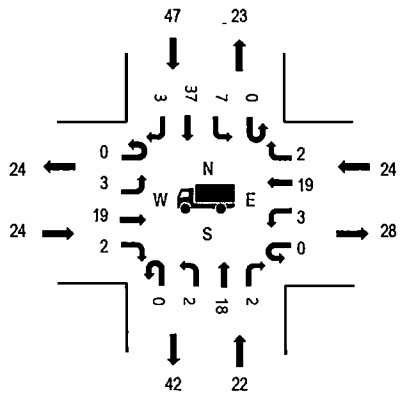
Location: 7 OR-551 & EHLEN RD NE PM
Date: Tuesday, September 19, 2023
Peak Hour: 04:00 PM - 05:00 PM
Peak 15-Minutes: 04:10 PM - 04:25 PM

Peak Hour

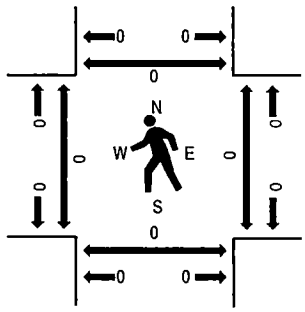
Motorized Vehicles



Heavy Vehicles



Pedestrians



Note: Total study counts contained in parentheses.

	HV%	PHF
EB	6.5%	0.89
WB	5.3%	0.77
NB	6.3%	0.90
SB	7.0%	0.88
All	6.3%	0.90

Traffic Counts - Motorized Vehicles

Interval Start Time	EHLEN RD NE Eastbound				EHLEN RD NE Westbound				OR-551 Northbound				OR-551 Southbound				Total	Rolling Hour
	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right	U-Turn	Left	Thru	Right		
4:00 PM	0	0	30	4	0	7	26	2	0	3	18	0	0	15	50	7	162	1,844
4:05 PM	0	6	19	0	0	4	21	1	0	4	29	1	0	7	52	2	146	1,844
4:10 PM	0	8	28	4	0	6	46	3	0	3	29	2	0	9	42	2	177	1,844
4:15 PM	0	7	25	3	0	12	35	2	0	2	31	1	0	9	49	2	178	1,803
4:20 PM	0	2	34	1	0	7	34	4	0	1	19	1	0	4	52	0	159	1,774
4:25 PM	0	4	20	1	0	4	26	0	0	3	20	7	0	10	61	4	160	1,764
4:30 PM	0	4	33	2	0	4	30	3	0	5	20	0	0	6	42	5	154	1,748
4:35 PM	0	8	19	1	0	5	41	0	0	2	29	1	0	8	41	8	163	1,716
4:40 PM	0	13	24	2	0	8	31	0	0	1	19	3	0	4	36	1	142	1,690
4:45 PM	0	2	21	0	0	4	28	4	0	1	31	2	0	5	37	4	139	1,703
4:50 PM	0	2	25	2	0	6	17	1	0	1	21	0	0	4	39	4	122	1,686
4:55 PM	0	6	17	0	0	7	22	1	0	7	30	1	0	8	38	5	142	1,713
5:00 PM	0	10	20	0	0	2	18	0	0	3	40	0	0	11	57	1	162	1,709
5:05 PM	0	5	29	3	0	9	35	1	0	0	22	5	0	6	27	4	146	
5:10 PM	0	3	20	3	0	4	22	1	0	0	25	0	0	6	50	2	136	
5:15 PM	0	6	16	5	0	4	39	1	0	1	21	3	0	7	44	2	149	
5:20 PM	0	2	22	4	0	4	22	0	0	2	26	1	0	10	51	5	149	
5:25 PM	0	2	38	2	0	6	27	1	0	3	21	0	0	7	34	3	144	
5:30 PM	0	3	13	1	0	6	22	1	0	2	25	1	0	6	39	3	122	
5:35 PM	0	5	22	4	0	6	19	2	0	0	22	1	0	7	48	1	137	
5:40 PM	0	8	24	5	0	10	20	2	0	3	32	4	0	2	45	0	155	
5:45 PM	0	4	17	3	0	6	17	1	0	0	17	1	0	6	46	4	122	
5:50 PM	0	3	22	3	0	14	22	2	0	1	26	1	0	7	46	2	149	
5:55 PM	0	4	19	0	0	11	19	0	0	6	19	2	0	6	51	1	138	
Count Total	0	117	552	53	0	156	639	33	0	54	592	38	0	170	1,077	72	3,553	
Peak Hour	0	62	290	20	0	74	357	21	0	33	296	19	0	89	539	44	1,844	

Traffic Counts - Heavy Vehicles, Bicycles on Road, and Pedestrians/Bicycles on Crosswalk

Interval Start Time	Heavy Vehicles					Interval Start Time	Bicycles on Roadway					Interval Start Time	Pedestrians/Bicycles on Crosswalk				
	EB	NB	WB	SB	Total		EB	NB	WB	SB	Total		EB	NB	WB	SB	Total
4:00 PM	3	4	1	3	11	4:00 PM	0	0	0	0	0	4:00 PM	0	0	0	0	0
4:05 PM	1	4	3	0	8	4:05 PM	0	1	0	0	1	4:05 PM	0	0	0	0	0
4:10 PM	3	1	3	9	16	4:10 PM	0	0	0	0	0	4:10 PM	0	0	0	0	0
4:15 PM	1	1	1	3	6	4:15 PM	0	0	0	0	0	4:15 PM	0	0	0	0	0
4:20 PM	2	1	4	7	14	4:20 PM	1	0	0	0	1	4:20 PM	0	0	0	0	0
4:25 PM	1	2	2	4	9	4:25 PM	1	0	0	0	1	4:25 PM	0	0	0	0	0
4:30 PM	3	2	3	7	15	4:30 PM	0	0	1	0	1	4:30 PM	0	0	0	0	0
4:35 PM	2	1	1	3	7	4:35 PM	0	0	0	0	0	4:35 PM	0	0	0	0	0
4:40 PM	2	2	3	2	9	4:40 PM	0	0	0	0	0	4:40 PM	0	0	0	0	0
4:45 PM	2	1	1	3	7	4:45 PM	0	0	0	0	0	4:45 PM	0	0	0	0	0
4:50 PM	2	0	2	4	8	4:50 PM	0	0	0	0	0	4:50 PM	0	0	0	0	0
4:55 PM	2	3	0	2	7	4:55 PM	0	0	0	0	0	4:55 PM	0	0	0	0	0
5:00 PM	2	3	1	1	7	5:00 PM	0	0	0	0	0	5:00 PM	0	0	0	0	0
5:05 PM	3	0	1	3	7	5:05 PM	0	0	0	0	0	5:05 PM	0	0	0	0	0
5:10 PM	0	1	0	5	6	5:10 PM	0	0	0	0	0	5:10 PM	0	0	0	0	0
5:15 PM	5	0	1	2	8	5:15 PM	0	0	0	0	0	5:15 PM	0	0	0	0	0
5:20 PM	0	3	0	3	6	5:20 PM	0	0	0	0	0	5:20 PM	0	0	0	0	0
5:25 PM	3	3	0	2	8	5:25 PM	0	0	0	0	0	5:25 PM	0	0	0	0	0
5:30 PM	1	1	1	1	4	5:30 PM	0	0	0	0	0	5:30 PM	0	0	0	0	0
5:35 PM	4	0	0	1	5	5:35 PM	0	0	0	0	0	5:35 PM	0	0	0	0	0
5:40 PM	1	3	0	4	8	5:40 PM	0	0	0	0	0	5:40 PM	0	0	0	0	0
5:45 PM	2	1	0	5	8	5:45 PM	0	0	0	0	0	5:45 PM	0	0	0	0	0
5:50 PM	0	4	1	1	6	5:50 PM	0	0	0	0	0	5:50 PM	0	0	0	0	0
5:55 PM	3	0	1	2	6	5:55 PM	0	0	0	0	0	5:55 PM	0	0	0	0	0
Count Total	48	41	30	77	196	Count Total	2	1	1	0	4	Count Total	0	0	0	0	0
Peak Hour	24	22	24	47	117	Peak Hour	2	1	1	0	4	Peak Hour	0	0	0	0	0

SECTION 2. SEASONAL ADJUSTMENT FACTOR CALCULATIONS

Seasonal Adjustment Factor Calculations Using ATR #24-016

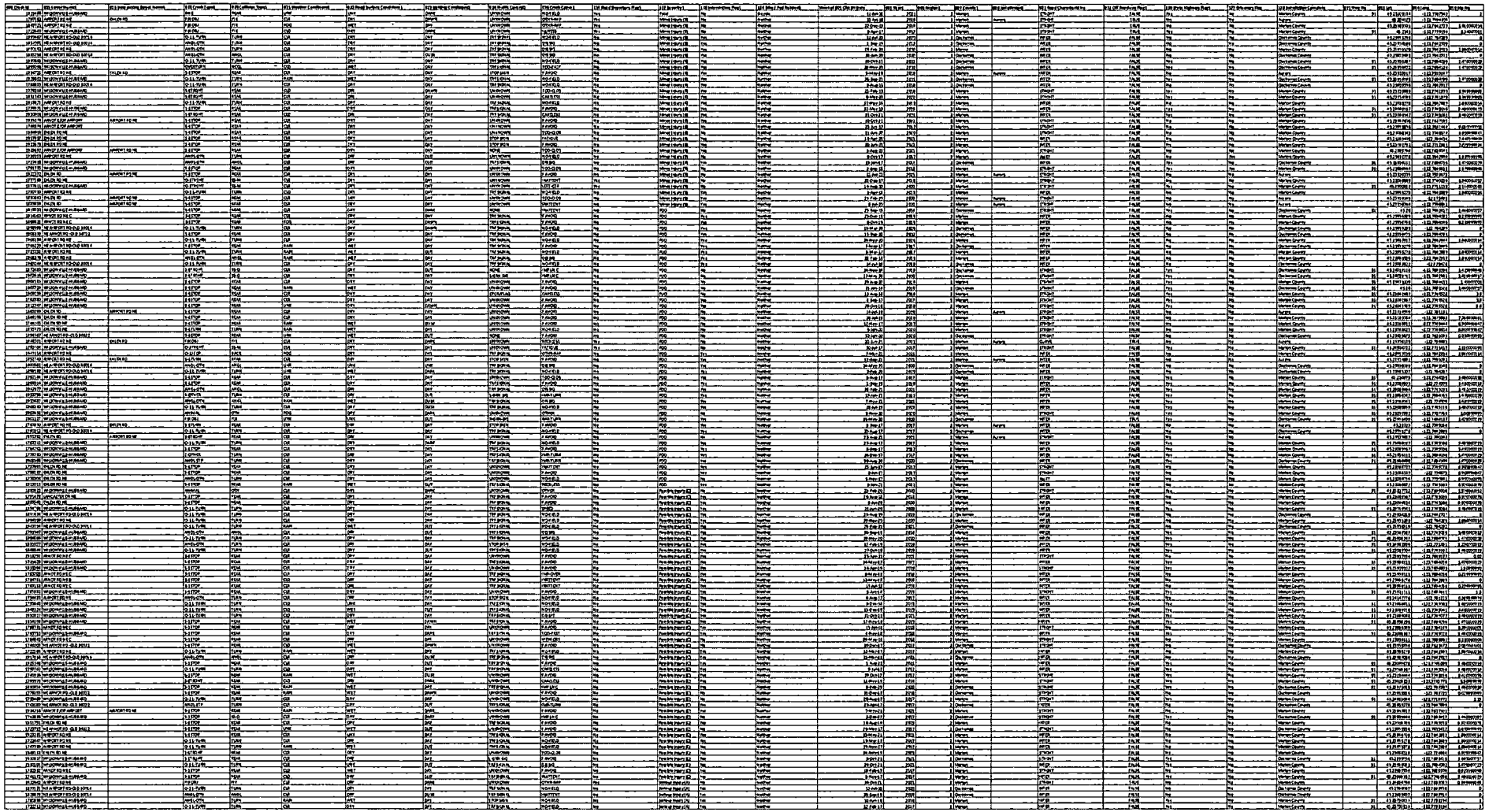
		2022	2021	2020	2019	2018	2017	2016	
Weekday Traffic	Peak Month (August)	See Comments Below		10174	10715	10332	11053	9848	
	Count Count (Sept)			9538	10332	10211	10232	9472	
Percent ADT	Peak Month (August)			118	112	109	121	111	114
	Count Count (Sept)			111	108	107	112	107	109
				1.06	1.04	1.02	1.08	1.04	

Seasonal Adjustment
1.05

Comments:
2021 - Equipment outage Jun - August
2022 - Construction from May - Aug, volumes were estimated for those months

Note: Remove highest and lowest values

SECTION 3: CRASH DATA



SECTION 4: GROWTH RATE CALCULATIONS

Future Highway Volumes Table (ODOT)

HWY	MP	DIR	HS	Description	2019	2021	2022	2042	RSQ	RSQ	Growth Rate	
051	1.49	1		South of Arndt Road, Clackamas-Marion County Line [0.02 mile]		13400		17600	0.8889	0.8889	1.49%	
051	3.46	1		North of Ehlen Road [0.02 mile]		11800		15700	0.8431	0.8431	1.57%	
											1.53%	**Average, Round up to 2%**

Growth Rate = (Future Volume - Existing Volume)/Existing Volume
(Future Year - Existing Year)

SECTION 5: HCM REPORTS - EXISTING 2023 AM AND PM

HCM 6th Signalized Intersection Summary
1: Airport Road & Arndt Road

Existing (2023) - S.A. AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	20	385	49	11	575	298	58	104	7	66	26	9
Future Volume (veh/h)	20	385	49	11	575	298	58	104	7	66	26	9
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		0.98	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1586	1586	1586	1641	1641	1641	1723	1723	1723	1709	1709	1709
Adj Flow Rate, veh/h	24	454	58	13	678	352	68	123	8	78	31	11
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Percent Heavy Veh, %	12	12	12	8	8	8	2	2	2	3	3	3
Cap, veh/h	69	1784	227	57	660	343	283	278	18	207	208	74
Arrive On Green	0.05	0.66	0.64	0.04	0.65	0.63	0.17	0.17	0.15	0.17	0.17	0.15
Sat Flow, veh/h	1511	2690	342	1563	1009	524	1365	1600	104	1249	1197	425
Grp Volume(v), veh/h	24	253	259	13	0	1030	68	0	131	78	0	42
Grp Sat Flow(s),veh/h/ln	1511	1507	1525	1563	0	1533	1365	0	1704	1249	0	1621
Q Serve(g_s), s	1.5	6.5	6.6	0.8	0.0	62.0	4.2	0.0	6.5	5.7	0.0	2.1
Cycle Q Clear(g_c), s	1.5	6.5	6.6	0.8	0.0	62.0	6.3	0.0	6.5	12.2	0.0	2.1
Prop In Lane	1.00		0.22	1.00		0.34	1.00		0.06	1.00		0.26
Lane Grp Cap(c), veh/h	69	999	1011	57	0	1002	283	0	296	207	0	282
V/C Ratio(X)	0.35	0.25	0.26	0.23	0.00	1.03	0.24	0.00	0.44	0.38	0.00	0.15
Avail Cap(c_a), veh/h	350	999	1011	363	0	1002	506	0	575	411	0	547
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	43.9	6.5	6.6	44.4	0.0	16.8	35.9	0.0	35.1	40.5	0.0	33.4
Incr Delay (d2), s/veh	2.2	0.4	0.4	1.5	0.0	35.7	0.3	0.0	0.8	0.8	0.0	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.6	1.7	1.8	0.3	0.0	26.4	1.4	0.0	2.6	1.7	0.0	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	46.1	6.9	7.0	45.9	0.0	52.5	36.2	0.0	35.9	41.3	0.0	33.6
LnGrp LOS	D	A	A	D	A	F	D	A	D	D	A	C
Approach Vol, veh/h		536			1043			199			120	
Approach Delay, s/veh		8.7			52.4			36.0			38.6	
Approach LOS		A			D			D			D	

Timer - Assigned Phs		2	3	4		6	7	8				
Phs Duration (G+Y+Rc), s		20.5	8.3	66.0		20.5	7.4	66.9				
Change Period (Y+Rc), s		6.0	6.0	6.0		6.0	6.0	6.0				
Max Green Setting (Gmax), s		30.0	20.0	60.0		30.0	20.0	60.0				
Max Q Clear Time (g_c+I1), s		14.2	3.5	64.0		8.5	2.8	8.6				
Green Ext Time (p_c), s		0.3	0.0	0.0		0.6	0.0	18.0				

Intersection Summary	
HCM 6th Ctrl Delay	37.5
HCM 6th LOS	D

Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	11	6	23	185	39	17
Future Vol, veh/h	11	6	23	185	39	17
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	12	12	2	2	9	9
Mvmt Flow	13	7	28	223	47	21

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	337	58	68	0	-	0
Stage 1	58	-	-	-	-	-
Stage 2	279	-	-	-	-	-
Critical Hdwy	6.52	6.32	4.12	-	-	-
Critical Hdwy Stg 1	5.52	-	-	-	-	-
Critical Hdwy Stg 2	5.52	-	-	-	-	-
Follow-up Hdwy	3.608	3.408	2.218	-	-	-
Pot Cap-1 Maneuver	639	981	1533	-	-	-
Stage 1	940	-	-	-	-	-
Stage 2	746	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	626	981	1533	-	-	-
Mov Cap-2 Maneuver	626	-	-	-	-	-
Stage 1	920	-	-	-	-	-
Stage 2	746	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.2	0.8	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1533	-	718	-	-
HCM Lane V/C Ratio	0.018	-	0.029	-	-
HCM Control Delay (s)	7.4	0	10.2	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	17	360	330	178	46	11
Future Vol, veh/h	17	360	330	178	46	11
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	9	9	9	9	9	9
Mvmt Flow	20	430	394	212	55	13

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	606	0	-	0	970	500
Stage 1	-	-	-	-	500	-
Stage 2	-	-	-	-	470	-
Critical Hdwy	4.19	-	-	-	6.49	6.29
Critical Hdwy Stg 1	-	-	-	-	5.49	-
Critical Hdwy Stg 2	-	-	-	-	5.49	-
Follow-up Hdwy	2.281	-	-	-	3.581	3.381
Pot Cap-1 Maneuver	939	-	-	-	273	557
Stage 1	-	-	-	-	595	-
Stage 2	-	-	-	-	615	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	939	-	-	-	265	557
Mov Cap-2 Maneuver	-	-	-	-	265	-
Stage 1	-	-	-	-	578	-
Stage 2	-	-	-	-	615	-

Approach	EB	WB	SB
HCM Control Delay, s	0.4	0	20.8
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	939	-	-	-	295
HCM Lane V/C Ratio	0.022	-	-	-	0.231
HCM Control Delay (s)	8.9	0	-	-	20.8
HCM Lane LOS	A	A	-	-	C
HCM 95th %tile Q(veh)	0.1	-	-	-	0.9

HCM 6th Signalized Intersection Summary
4: OR 551 & Arndt Road

Existing (2023) - S.A. AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	39	71	7	43	56	553	14	557	54	332	349	17
Future Volume (veh/h)	39	71	7	43	56	553	14	557	54	332	349	17
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adj Flow Rate, veh/h	44	80	8	49	63	0	16	629	61	375	394	19
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	11	11	11	11	11	11	11	11	11	11	11	11
Cap, veh/h	105	134	12	122	119		36	912	773	487	1138	944
Arrive On Green	0.11	0.13	0.11	0.11	0.13	0.00	0.02	0.57	0.57	0.16	0.71	0.71
Sat Flow, veh/h	388	1006	90	491	888	1356	1524	1600	1356	2956	1600	1328
Grp Volume(v), veh/h	132	0	0	112	0	0	16	629	61	375	394	19
Grp Sat Flow(s),veh/h/ln	1484	0	0	1379	0	1356	1524	1600	1356	1478	1600	1328
Q Serve(g_s), s	0.7	0.0	0.0	0.0	0.0	0.0	0.9	25.4	1.8	11.1	8.6	0.4
Cycle Q Clear(g_c), s	7.8	0.0	0.0	7.1	0.0	0.0	0.9	25.4	1.8	11.1	8.6	0.4
Prop In Lane	0.33		0.06	0.44		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	218	0	0	211	0		36	912	773	487	1138	944
V/C Ratio(X)	0.60	0.00	0.00	0.53	0.00		0.44	0.69	0.08	0.77	0.35	0.02
Avail Cap(c_a), veh/h	549	0	0	532	0		259	1089	923	1152	1138	944
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	37.9	0.0	0.0	37.6	0.0	0.0	43.9	13.9	8.8	36.4	5.0	3.9
Incr Delay (d2), s/veh	2.0	0.0	0.0	2.1	0.0	0.0	6.2	1.8	0.1	1.9	0.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.8	0.0	0.0	2.5	0.0	0.0	0.4	7.6	0.5	3.8	1.8	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	39.9	0.0	0.0	39.7	0.0	0.0	50.0	15.7	8.9	38.3	5.3	3.9
LnGrp LOS	D	A	A	D	A		D	B	A	D	A	A
Approach Vol, veh/h		132			112			706			788	
Approach Delay, s/veh		39.9			39.7			15.9			21.0	
Approach LOS		D			D			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.2	68.8		16.2	19.0	55.9		16.2				
Change Period (Y+Rc), s	4.5	6.0		6.0	4.5	6.0		6.0				
Max Green Setting (Gmax), s	15.0	60.0		31.0	35.0	60.0		31.0				
Max Q Clear Time (g_c+I1), s	2.9	10.6		9.1	13.1	27.4		9.8				
Green Ext Time (p_c), s	0.0	16.6		0.4	1.5	22.5		0.4				

Intersection Summary	
HCM 6th Ctrl Delay	21.6
HCM 6th LOS	C

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	1.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↰	↑		↰	↑	↱
Traffic Vol, veh/h	15	4	31	1	2	6	35	604	27	16	379	9
Future Vol, veh/h	15	4	31	1	2	6	35	604	27	16	379	9
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	500	-	160
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	9	9	9	9	9	9	9	9	9	9	9	9
Mvmt Flow	18	5	37	1	2	7	42	721	32	19	452	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1316	1327	452	1338	1322	737	463	0	0	753	0	0
Stage 1	490	490	-	821	821	-	-	-	-	-	-	-
Stage 2	826	837	-	517	501	-	-	-	-	-	-	-
Critical Hdwy	7.19	6.59	6.29	7.19	6.59	6.29	4.19	-	-	4.19	-	-
Critical Hdwy Stg 1	6.19	5.59	-	6.19	5.59	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.19	5.59	-	6.19	5.59	-	-	-	-	-	-	-
Follow-up Hdwy	3.581	4.081	3.381	3.581	4.081	3.381	2.281	-	-	2.281	-	-
Pot Cap-1 Maneuver	130	150	593	126	151	407	1062	-	-	826	-	-
Stage 1	547	537	-	359	379	-	-	-	-	-	-	-
Stage 2	356	372	-	529	531	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	120	141	593	110	142	407	1062	-	-	826	-	-
Mov Cap-2 Maneuver	120	141	-	110	142	-	-	-	-	-	-	-
Stage 1	525	525	-	345	364	-	-	-	-	-	-	-
Stage 2	334	357	-	480	519	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	24.6	20.9	0.4	0.4
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1062	-	-	243	237	826	-	-
HCM Lane V/C Ratio	0.039	-	-	0.246	0.045	0.023	-	-
HCM Control Delay (s)	8.5	-	-	24.6	20.9	9.5	-	-
HCM Lane LOS	A	-	-	C	C	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.9	0.1	0.1	-	-

HCM 6th Signalized Intersection Summary
6: OR 551 & Ehlen Road

Existing (2023) - S.A. AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	115	321	20	38	244	32	44	519	24	33	347	24
Future Volume (veh/h)	115	321	20	38	244	32	44	519	24	33	347	24
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614
Adj Flow Rate, veh/h	131	366	23	43	278	37	50	592	27	38	396	27
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	10	10	10	10	10	10	10	10	10	10	10	10
Cap, veh/h	159	453	28	53	324	43	61	779	660	45	762	646
Arrive On Green	0.10	0.30	0.29	0.03	0.23	0.22	0.04	0.48	0.48	0.03	0.47	0.47
Sat Flow, veh/h	1537	1502	94	1537	1394	186	1537	1614	1367	1537	1614	1367
Grp Volume(v), veh/h	131	0	389	43	0	315	50	592	27	38	396	27
Grp Sat Flow(s),veh/h/ln	1537	0	1597	1537	0	1580	1537	1614	1367	1537	1614	1367
Q Serve(g_s), s	8.8	0.0	23.7	2.9	0.0	20.2	3.4	31.6	1.1	2.6	18.1	1.1
Cycle Q Clear(g_c), s	8.8	0.0	23.7	2.9	0.0	20.2	3.4	31.6	1.1	2.6	18.1	1.1
Prop In Lane	1.00		0.06	1.00		0.12	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	159	0	482	53	0	367	61	779	660	45	762	646
V/C Ratio(X)	0.82	0.00	0.81	0.82	0.00	0.86	0.81	0.76	0.04	0.84	0.52	0.04
Avail Cap(c_a), veh/h	510	0	551	510	0	546	292	949	804	292	949	804
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	46.3	0.0	34.0	50.6	0.0	38.9	50.2	22.3	14.4	50.9	19.5	15.0
Incr Delay (d2), s/veh	7.6	0.0	7.3	19.9	0.0	7.7	17.1	3.4	0.0	24.8	0.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.5	0.0	9.4	1.4	0.0	8.2	1.5	11.1	0.3	1.3	6.2	0.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	53.9	0.0	41.3	70.4	0.0	46.6	67.3	25.7	14.4	75.7	20.2	15.0
LnGrp LOS	D	A	D	E	A	D	E	C	B	E	C	B
Approach Vol, veh/h		520			358			669			461	
Approach Delay, s/veh		44.5			49.5			28.3			24.5	
Approach LOS		D			D			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.2	53.8	14.9	28.5	7.1	54.9	7.6	35.8
Change Period (Y+Rc), s	4.0	6.0	4.0	* 5.4	4.0	6.0	4.0	* 5.4
Max Green Setting (Gmax), s	20.0	60.0	35.0	* 35	20.0	60.0	35.0	* 35
Max Q Clear Time (g_c+I1), s	5.4	20.1	10.8	22.2	4.6	33.6	4.9	25.7
Green Ext Time (p_c), s	0.1	12.4	0.4	0.9	0.0	15.3	0.1	0.9

Intersection Summary	
HCM 6th Ctrl Delay	35.4
HCM 6th LOS	D

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	0.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	1	0	3	192	55	3
Future Vol, veh/h	1	0	3	192	55	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	0	0	2	2	7	7
Mvmt Flow	1	0	4	232	66	4

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	308	68	70	0	-	0
Stage 1	68	-	-	-	-	-
Stage 2	240	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.12	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.218	-	-	-
Pot Cap-1 Maneuver	688	1001	1531	-	-	-
Stage 1	960	-	-	-	-	-
Stage 2	805	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	686	1001	1531	-	-	-
Mov Cap-2 Maneuver	686	-	-	-	-	-
Stage 1	957	-	-	-	-	-
Stage 2	805	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.3	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1531	-	686	-	-
HCM Lane V/C Ratio	0.002	-	0.002	-	-
HCM Control Delay (s)	7.4	0	10.3	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

HCM 6th Signalized Intersection Summary
1: Airport Road & Arndt Road

Existing (2023) - S.A. PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	9	632	59	6	479	109	57	43	33	175	57	28
Future Volume (veh/h)	9	632	59	6	479	109	57	43	33	175	57	28
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709
Adj Flow Rate, veh/h	10	729	68	7	553	126	66	50	38	202	66	32
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	57	1765	165	51	787	179	334	220	167	342	268	130
Arrive On Green	0.03	0.59	0.57	0.03	0.58	0.56	0.25	0.25	0.22	0.25	0.25	0.22
Sat Flow, veh/h	1628	3002	280	1628	1347	307	1287	895	681	1299	1087	527
Grp Volume(v), veh/h	10	394	403	7	0	679	66	0	88	202	0	98
Grp Sat Flow(s),veh/h/ln	1628	1624	1659	1628	0	1653	1287	0	1576	1299	0	1614
Q Serve(g_s), s	0.5	11.8	11.9	0.4	0.0	25.9	3.9	0.0	4.0	13.1	0.0	4.4
Cycle Q Clear(g_c), s	0.5	11.8	11.9	0.4	0.0	25.9	8.2	0.0	4.0	17.1	0.0	4.4
Prop In Lane	1.00		0.17	1.00		0.19	1.00		0.43	1.00		0.33
Lane Grp Cap(c), veh/h	57	954	975	51	0	966	334	0	388	342	0	397
V/C Ratio(X)	0.18	0.41	0.41	0.14	0.00	0.70	0.20	0.00	0.23	0.59	0.00	0.25
Avail Cap(c_a), veh/h	402	1130	1155	402	0	1151	480	0	566	489	0	580
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	41.7	10.0	10.1	42.0	0.0	13.2	30.3	0.0	27.2	33.7	0.0	27.2
Incr Delay (d2), s/veh	1.1	0.9	0.9	0.9	0.0	4.3	0.2	0.0	0.2	1.2	0.0	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.2	3.7	3.8	0.2	0.0	9.0	1.1	0.0	1.4	3.9	0.0	1.6
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	42.8	10.9	11.0	42.8	0.0	17.5	30.5	0.0	27.4	34.9	0.0	27.5
LnGrp LOS	D	B	B	D	A	B	C	A	C	C	A	C
Approach Vol, veh/h		807			686			154			300	
Approach Delay, s/veh		11.4			17.7			28.7			32.4	
Approach LOS		B			B			C			C	

Timer - Assigned Phs	2	3	4	6	7	8
Phs Duration (G+Y+Rc), s	25.9	7.1	56.0	25.9	6.8	56.3
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0
Max Green Setting (Gmax), s	30.0	20.0	60.0	30.0	20.0	60.0
Max Q Clear Time (g_c+I1), s	19.1	2.5	27.9	10.2	2.4	13.9
Green Ext Time (p_c), s	0.8	0.0	22.1	0.5	0.0	28.0

Intersection Summary	
HCM 6th Ctrl Delay	18.2
HCM 6th LOS	B

Intersection	
Int Delay, s/veh	2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	25	25	5	62	151	14
Future Vol, veh/h	25	25	5	62	151	14
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	75	75	75	75	75	75
Heavy Vehicles, %	4	4	6	6	2	2
Mvmt Flow	35	35	7	87	211	20

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	322	221	231	0	-	0
Stage 1	221	-	-	-	-	-
Stage 2	101	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.16	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.254	-	-	-
Pot Cap-1 Maneuver	668	814	1314	-	-	-
Stage 1	811	-	-	-	-	-
Stage 2	918	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	664	814	1314	-	-	-
Mov Cap-2 Maneuver	664	-	-	-	-	-
Stage 1	806	-	-	-	-	-
Stage 2	918	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.4	0.6	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1314	-	731	-	-
HCM Lane V/C Ratio	0.005	-	0.096	-	-
HCM Control Delay (s)	7.8	0	10.4	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.3	-	-

Intersection	
Int Delay, s/veh	7.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		⋔	
Traffic Vol, veh/h	13	379	422	59	139	27
Future Vol, veh/h	13	379	422	59	139	27
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	7	7	5	5	2	2
Mvmt Flow	16	457	509	71	168	33

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	580	0	-	0	1034	545
Stage 1	-	-	-	-	545	-
Stage 2	-	-	-	-	489	-
Critical Hdwy	4.17	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.263	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	970	-	-	-	257	538
Stage 1	-	-	-	-	581	-
Stage 2	-	-	-	-	616	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	970	-	-	-	251	538
Mov Cap-2 Maneuver	-	-	-	-	251	-
Stage 1	-	-	-	-	568	-
Stage 2	-	-	-	-	616	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	46.6
HCM LOS			E

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	970	-	-	-	275
HCM Lane V/C Ratio	0.016	-	-	-	0.729
HCM Control Delay (s)	8.8	0	-	-	46.6
HCM Lane LOS	A	A	-	-	E
HCM 95th %tile Q(veh)	0	-	-	-	5.2

HCM 6th Signalized Intersection Summary
4: OR 551 & Arndt Road

Existing (2023) - S.A. PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	31	90	16	73	78	406	3	326	39	581	555	44
Future Volume (veh/h)	31	90	16	73	78	406	3	326	39	581	555	44
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668
Adj Flow Rate, veh/h	34	99	18	81	86	0	3	360	43	642	613	49
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	6	6	6	6	6	6	6	6	6	6	6	6
Cap, veh/h	99	201	33	175	141		17	684	580	802	1101	933
Arrive On Green	0.15	0.17	0.15	0.15	0.17	0.00	0.01	0.41	0.41	0.26	0.66	0.66
Sat Flow, veh/h	239	1155	189	609	806	1414	1589	1668	1414	3082	1668	1414
Grp Volume(v), veh/h	151	0	0	167	0	0	3	360	43	642	613	49
Grp Sat Flow(s),veh/h/ln	1583	0	0	1415	0	1414	1589	1668	1414	1541	1668	1414
Q Serve(g_s), s	0.0	0.0	0.0	2.0	0.0	0.0	0.1	12.5	1.4	15.0	15.3	0.9
Cycle Q Clear(g_c), s	6.8	0.0	0.0	8.8	0.0	0.0	0.1	12.5	1.4	15.0	15.3	0.9
Prop In Lane	0.23		0.12	0.49		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	292	0	0	279	0		17	684	580	802	1101	933
V/C Ratio(X)	0.52	0.00	0.00	0.60	0.00		0.18	0.53	0.07	0.80	0.56	0.05
Avail Cap(c_a), veh/h	678	0	0	639	0		319	1338	1134	1416	1338	1134
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	29.4	0.0	0.0	30.4	0.0	0.0	37.9	17.1	13.9	26.7	7.1	4.6
Incr Delay (d2), s/veh	1.1	0.0	0.0	2.0	0.0	0.0	3.8	0.9	0.1	1.4	0.6	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	0.0	0.0	3.0	0.0	0.0	0.1	4.1	0.4	5.0	3.4	0.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	30.5	0.0	0.0	32.4	0.0	0.0	41.7	18.0	13.9	28.1	7.7	4.7
LnGrp LOS	C	A	A	C	A		D	B	B	C	A	A
Approach Vol, veh/h		151			167			406			1304	
Approach Delay, s/veh		30.5			32.4			17.8			17.6	
Approach LOS		C			C			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	4.8	55.0		17.5	24.1	35.7		17.5				
Change Period (Y+Rc), s	4.5	6.0		6.0	4.5	6.0		6.0				
Max Green Setting (Gmax), s	15.0	60.0		31.0	35.0	60.0		31.0				
Max Q Clear Time (g_c+I1), s	2.1	17.3		10.8	17.0	14.5		8.8				
Green Ext Time (p_c), s	0.0	25.7		0.7	2.6	15.2		0.5				

Intersection Summary	
HCM 6th Ctrl Delay	19.8
HCM 6th LOS	B

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↰	↑		↰	↑	↱
Traffic Vol, veh/h	6	1	42	14	20	10	28	367	4	7	616	30
Future Vol, veh/h	6	1	42	14	20	10	28	367	4	7	616	30
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	500	-	160
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	6	6	6	6	6	6	6	6	6	6	6	6
Mvmt Flow	8	1	53	18	25	13	35	464	5	9	779	38

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1353	1336	779	1380	1372	467	817	0	0	469	0	0
Stage 1	797	797	-	537	537	-	-	-	-	-	-	-
Stage 2	556	539	-	843	835	-	-	-	-	-	-	-
Critical Hdwy	7.16	6.56	6.26	7.16	6.56	6.26	4.16	-	-	4.16	-	-
Critical Hdwy Stg 1	6.16	5.56	-	6.16	5.56	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.16	5.56	-	6.16	5.56	-	-	-	-	-	-	-
Follow-up Hdwy	3.554	4.054	3.354	3.554	4.054	3.354	2.254	-	-	2.254	-	-
Pot Cap-1 Maneuver	124	151	390	119	143	588	794	-	-	1072	-	-
Stage 1	374	393	-	521	516	-	-	-	-	-	-	-
Stage 2	508	515	-	353	377	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	100	143	390	98	136	588	794	-	-	1072	-	-
Mov Cap-2 Maneuver	100	143	-	98	136	-	-	-	-	-	-	-
Stage 1	358	390	-	498	493	-	-	-	-	-	-	-
Stage 2	451	492	-	301	374	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	21.4	45.4	0.7	0.1
HCM LOS	C	E		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	794	-	-	281	143	1072	-	-
HCM Lane V/C Ratio	0.045	-	-	0.221	0.389	0.008	-	-
HCM Control Delay (s)	9.7	-	-	21.4	45.4	8.4	-	-
HCM Lane LOS	A	-	-	C	E	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	0.8	1.7	0	-	-

HCM 6th Signalized Intersection Summary
6: OR 551 & Ehlen Road

Existing (2023) - S.A. PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	62	290	20	74	357	21	33	296	19	89	539	44
Future Volume (veh/h)	62	290	20	74	357	21	33	296	19	89	539	44
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668
Adj Flow Rate, veh/h	72	338	23	86	416	24	38	345	22	104	629	51
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	6	6	6	6	6	6	6	6	6	6	6
Cap, veh/h	91	435	30	108	457	26	46	714	605	127	799	677
Arrive On Green	0.06	0.28	0.27	0.07	0.29	0.28	0.03	0.43	0.43	0.08	0.48	0.48
Sat Flow, veh/h	1589	1542	105	1589	1560	90	1589	1668	1414	1589	1668	1414
Grp Volume(v), veh/h	72	0	361	86	0	440	38	345	22	104	629	51
Grp Sat Flow(s),veh/h/ln	1589	0	1647	1589	0	1650	1589	1668	1414	1589	1668	1414
Q Serve(g_s), s	5.1	0.0	22.8	6.0	0.0	29.1	2.7	16.9	1.0	7.3	35.7	2.2
Cycle Q Clear(g_c), s	5.1	0.0	22.8	6.0	0.0	29.1	2.7	16.9	1.0	7.3	35.7	2.2
Prop In Lane	1.00		0.06	1.00		0.05	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	91	0	465	108	0	483	46	714	605	127	799	677
V/C Ratio(X)	0.79	0.00	0.78	0.79	0.00	0.91	0.82	0.48	0.04	0.82	0.79	0.08
Avail Cap(c_a), veh/h	492	0	530	492	0	531	281	915	775	281	915	775
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	52.6	0.0	37.4	51.9	0.0	38.6	54.6	23.3	18.8	51.2	24.7	15.9
Incr Delay (d2), s/veh	10.7	0.0	5.9	9.3	0.0	18.4	22.1	0.7	0.0	9.3	4.5	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.2	0.0	9.3	2.6	0.0	13.7	1.3	6.2	0.3	3.1	13.5	0.7
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	63.3	0.0	43.3	61.1	0.0	57.0	76.7	24.0	18.8	60.5	29.2	16.0
LnGrp LOS	E	A	D	E	A	E	E	C	B	E	C	B
Approach Vol, veh/h		433			526			405			784	
Approach Delay, s/veh		46.6			57.7			28.7			32.5	
Approach LOS		D			E			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	7.3	58.1	10.5	37.1	13.0	52.4	11.7	35.9
Change Period (Y+Rc), s	4.0	6.0	4.0	* 5.4	4.0	6.0	4.0	* 5.4
Max Green Setting (Gmax), s	20.0	60.0	35.0	* 35	20.0	60.0	35.0	* 35
Max Q Clear Time (g_c+I1), s	4.7	37.7	7.1	31.1	9.3	18.9	8.0	24.8
Green Ext Time (p_c), s	0.1	14.5	0.2	0.7	0.1	10.6	0.2	0.9

Intersection Summary	
HCM 6th Ctrl Delay	40.8
HCM 6th LOS	D

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	4	6	79	160	2
Future Vol, veh/h	5	4	6	79	160	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	70	70	70	70	70	70
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	8	6	9	119	240	3

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	379	242	243	0	-	0
Stage 1	242	-	-	-	-	-
Stage 2	137	-	-	-	-	-
Critical Hdwy	6.43	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.527	3.327	2.227	-	-	-
Pot Cap-1 Maneuver	621	794	1317	-	-	-
Stage 1	796	-	-	-	-	-
Stage 2	887	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	617	794	1317	-	-	-
Mov Cap-2 Maneuver	617	-	-	-	-	-
Stage 1	790	-	-	-	-	-
Stage 2	887	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.4	0.5	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1317	-	685	-	-
HCM Lane V/C Ratio	0.007	-	0.02	-	-
HCM Control Delay (s)	7.8	0	10.4	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

SECTION 6: HCM REPORTS - OPENING YEAR 2025 NO BUILD AM AND PM

HCM 6th Signalized Intersection Summary
1: Airport Road & Arndt Road

Opening Year (2025) AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	25	425	55	15	630	315	65	110	10	70	30	10
Future Volume (veh/h)	25	425	55	15	630	315	65	110	10	70	30	10
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		0.98	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1586	1586	1586	1641	1641	1641	1723	1723	1723	1709	1709	1709
Adj Flow Rate, veh/h	28	478	62	17	708	354	73	124	11	79	34	11
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Percent Heavy Veh, %	12	12	12	8	8	8	2	2	2	3	3	3
Cap, veh/h	122	1746	226	586	659	329	293	175	16	219	143	46
Arrive On Green	0.04	0.65	0.63	0.03	0.64	0.63	0.07	0.11	0.10	0.07	0.12	0.10
Sat Flow, veh/h	1511	2684	347	1563	1024	512	1641	1559	138	1628	1229	397
Grp Volume(v), veh/h	28	267	273	17	0	1062	73	0	135	79	0	45
Grp Sat Flow(s),veh/h/ln	1511	1507	1524	1563	0	1536	1641	0	1698	1628	0	1626
Q Serve(g_s), s	0.7	9.1	9.3	0.4	0.0	78.0	4.6	0.0	9.3	5.1	0.0	3.1
Cycle Q Clear(g_c), s	0.7	9.1	9.3	0.4	0.0	78.0	4.6	0.0	9.3	5.1	0.0	3.1
Prop In Lane	1.00		0.23	1.00		0.33	1.00		0.08	1.00		0.24
Lane Grp Cap(c), veh/h	122	980	991	586	0	988	293	0	190	219	0	189
V/C Ratio(X)	0.23	0.27	0.27	0.03	0.00	1.07	0.25	0.00	0.71	0.36	0.00	0.24
Avail Cap(c_a), veh/h	159	980	991	636	0	988	332	0	364	251	0	349
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	31.2	9.0	9.1	6.7	0.0	21.9	42.8	0.0	52.0	42.9	0.0	48.9
Incr Delay (d2), s/veh	0.7	0.5	0.5	0.0	0.0	51.0	0.3	0.0	3.6	0.7	0.0	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	2.8	2.9	0.1	0.0	37.6	1.8	0.0	4.0	2.0	0.0	1.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	31.9	9.5	9.6	6.7	0.0	72.9	43.1	0.0	55.6	43.7	0.0	49.4
LnGrp LOS	C	A	A	A	A	F	D	A	E	D	A	D
Approach Vol, veh/h		568			1079			208			124	
Approach Delay, s/veh		10.6			71.9			51.2			45.7	
Approach LOS		B			E			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	12.1	18.1	9.1	82.0	12.6	17.6	8.2	82.9
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Green Setting (Gmax), s	9.0	24.0	6.0	76.0	9.0	24.0	6.0	76.0
Max Q Clear Time (g_c+I1), s	6.6	5.1	2.7	80.0	7.1	11.3	2.4	11.3
Green Ext Time (p_c), s	0.0	0.1	0.0	0.0	0.0	0.3	0.0	20.9

Intersection Summary	
HCM 6th Ctrl Delay	50.5
HCM 6th LOS	D

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	15	10	25	195	45	20
Future Vol, veh/h	15	10	25	195	45	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	12	12	2	2	9	9
Mvmt Flow	17	11	29	224	52	23

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	346	64	75	0	-	0
Stage 1	64	-	-	-	-	-
Stage 2	282	-	-	-	-	-
Critical Hdwy	6.52	6.32	4.12	-	-	-
Critical Hdwy Stg 1	5.52	-	-	-	-	-
Critical Hdwy Stg 2	5.52	-	-	-	-	-
Follow-up Hdwy	3.608	3.408	2.218	-	-	-
Pot Cap-1 Maneuver	631	973	1524	-	-	-
Stage 1	934	-	-	-	-	-
Stage 2	743	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	617	973	1524	-	-	-
Mov Cap-2 Maneuver	617	-	-	-	-	-
Stage 1	913	-	-	-	-	-
Stage 2	743	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.2	0.8	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1524	-	723	-	-
HCM Lane V/C Ratio	0.019	-	0.04	-	-
HCM Control Delay (s)	7.4	0	10.2	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection	
Int Delay, s/veh	1.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	20	395	365	190	50	15
Future Vol, veh/h	20	395	365	190	50	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	9	9	9	9	9	9
Mvmt Flow	23	449	415	216	57	17

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	631	0	-	0	1018	523
Stage 1	-	-	-	-	523	-
Stage 2	-	-	-	-	495	-
Critical Hdwy	4.19	-	-	-	6.49	6.29
Critical Hdwy Stg 1	-	-	-	-	5.49	-
Critical Hdwy Stg 2	-	-	-	-	5.49	-
Follow-up Hdwy	2.281	-	-	-	3.581	3.381
Pot Cap-1 Maneuver	919	-	-	-	255	540
Stage 1	-	-	-	-	581	-
Stage 2	-	-	-	-	598	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	919	-	-	-	247	540
Mov Cap-2 Maneuver	-	-	-	-	247	-
Stage 1	-	-	-	-	562	-
Stage 2	-	-	-	-	598	-

Approach	EB	WB	SB
HCM Control Delay, s	0.4	0	22.2
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	919	-	-	-	282
HCM Lane V/C Ratio	0.025	-	-	-	0.262
HCM Control Delay (s)	9	0	-	-	22.2
HCM Lane LOS	A	A	-	-	C
HCM 95th %tile Q(veh)	0.1	-	-	-	1

HCM 6th Signalized Intersection Summary
4: OR 551 & Arndt Road

Opening Year (2025) AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	45	80	10	50	65	605	20	610	60	365	385	20
Future Volume (veh/h)	45	80	10	50	65	605	20	610	60	365	385	20
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adj Flow Rate, veh/h	48	86	11	54	70	0	22	656	65	392	414	22
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	11	11	11	11	11	11	11	11	11	11	11	11
Cap, veh/h	103	137	16	120	121		43	901	763	498	1125	934
Arrive On Green	0.12	0.14	0.12	0.12	0.14	0.00	0.03	0.56	0.56	0.17	0.70	0.70
Sat Flow, veh/h	370	951	108	464	839	1356	1524	1600	1356	2956	1600	1328
Grp Volume(v), veh/h	145	0	0	124	0	0	22	656	65	392	414	22
Grp Sat Flow(s),veh/h/ln	1429	0	0	1303	0	1356	1524	1600	1356	1478	1600	1328
Q Serve(g_s), s	0.5	0.0	0.0	0.0	0.0	0.0	1.4	29.4	2.1	12.3	10.0	0.5
Cycle Q Clear(g_c), s	9.6	0.0	0.0	9.0	0.0	0.0	1.4	29.4	2.1	12.3	10.0	0.5
Prop In Lane	0.33		0.08	0.44		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	226	0	0	215	0		43	901	763	498	1125	934
V/C Ratio(X)	0.64	0.00	0.00	0.58	0.00		0.51	0.73	0.09	0.79	0.37	0.02
Avail Cap(c_a), veh/h	510	0	0	490	0		244	1025	869	1085	1125	934
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	39.8	0.0	0.0	39.5	0.0	0.0	46.3	15.7	9.7	38.5	5.7	4.3
Incr Delay (d2), s/veh	2.2	0.0	0.0	2.4	0.0	0.0	6.8	2.6	0.1	2.1	0.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.3	0.0	0.0	2.9	0.0	0.0	0.6	9.2	0.5	4.3	2.3	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	42.0	0.0	0.0	41.9	0.0	0.0	53.2	18.3	9.8	40.6	6.0	4.3
LnGrp LOS	D	A	A	D	A		D	B	A	D	A	A
Approach Vol, veh/h		145			124			743			828	
Approach Delay, s/veh		42.0			41.9			18.6			22.4	
Approach LOS		D			D			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.7	72.0		18.0	20.3	58.5		18.0				
Change Period (Y+Rc), s	4.5	6.0		6.0	4.5	6.0		6.0				
Max Green Setting (Gmax), s	15.0	60.0		31.0	35.0	60.0		31.0				
Max Q Clear Time (g_c+I1), s	3.4	12.0		11.0	14.3	31.4		11.6				
Green Ext Time (p_c), s	0.0	17.4		0.5	1.5	21.1		0.4				

Intersection Summary												
HCM 6th Ctrl Delay			23.7									
HCM 6th LOS			C									

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	2.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↰	↑		↰	↑	↱
Traffic Vol, veh/h	20	5	35	5	5	10	40	665	30	20	410	10
Future Vol, veh/h	20	5	35	5	5	10	40	665	30	20	410	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	500	-	160
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	9	9	9	9	9	9	9	9	9	9	9	9
Mvmt Flow	23	6	40	6	6	11	45	756	34	23	466	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1384	1392	466	1404	1386	773	477	0	0	790	0	0
Stage 1	512	512	-	863	863	-	-	-	-	-	-	-
Stage 2	872	880	-	541	523	-	-	-	-	-	-	-
Critical Hdwy	7.19	6.59	6.29	7.19	6.59	6.29	4.19	-	-	4.19	-	-
Critical Hdwy Stg 1	6.19	5.59	-	6.19	5.59	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.19	5.59	-	6.19	5.59	-	-	-	-	-	-	-
Follow-up Hdwy	3.581	4.081	3.381	3.581	4.081	3.381	2.281	-	-	2.281	-	-
Pot Cap-1 Maneuver	117	137	582	113	138	388	1050	-	-	800	-	-
Stage 1	532	525	-	340	362	-	-	-	-	-	-	-
Stage 2	336	356	-	513	519	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	104	127	582	96	128	388	1050	-	-	800	-	-
Mov Cap-2 Maneuver	104	127	-	96	128	-	-	-	-	-	-	-
Stage 1	509	510	-	325	346	-	-	-	-	-	-	-
Stage 2	307	341	-	459	504	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	30.9	29.3	0.5	0.4
HCM LOS	D	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1050	-	-	206	171	800	-	-
HCM Lane V/C Ratio	0.043	-	-	0.331	0.133	0.028	-	-
HCM Control Delay (s)	8.6	-	-	30.9	29.3	9.6	-	-
HCM Lane LOS	A	-	-	D	D	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1.4	0.4	0.1	-	-

HCM 6th Signalized Intersection Summary
6: OR 551 & Ehlen Road

Opening Year (2025) AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	355	25	45	270	35	50	570	30	40	380	30
Future Volume (veh/h)	130	355	25	45	270	35	50	570	30	40	380	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614
Adj Flow Rate, veh/h	141	386	27	49	293	38	54	620	33	43	413	33
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	10	10	10	10	10	10	10	10	10	10	10	10
Cap, veh/h	169	460	32	61	334	43	67	771	653	52	755	640
Arrive On Green	0.11	0.31	0.30	0.04	0.24	0.23	0.04	0.48	0.48	0.03	0.47	0.47
Sat Flow, veh/h	1537	1490	104	1537	1399	181	1537	1614	1367	1537	1614	1367
Grp Volume(v), veh/h	141	0	413	49	0	331	54	620	33	43	413	33
Grp Sat Flow(s),veh/h/ln	1537	0	1595	1537	0	1581	1537	1614	1367	1537	1614	1367
Q Serve(g_s), s	10.3	0.0	27.7	3.6	0.0	23.1	4.0	37.3	1.5	3.2	20.9	1.5
Cycle Q Clear(g_c), s	10.3	0.0	27.7	3.6	0.0	23.1	4.0	37.3	1.5	3.2	20.9	1.5
Prop In Lane	1.00		0.07	1.00		0.11	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	169	0	493	61	0	378	67	771	653	52	755	640
V/C Ratio(X)	0.84	0.00	0.84	0.80	0.00	0.88	0.81	0.80	0.05	0.82	0.55	0.05
Avail Cap(c_a), veh/h	470	0	507	470	0	503	268	874	741	268	874	741
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	50.0	0.0	36.9	54.5	0.0	42.0	54.3	25.4	16.0	55.0	21.8	16.6
Incr Delay (d2), s/veh	7.9	0.0	11.3	16.5	0.0	11.9	15.4	5.4	0.0	20.5	0.9	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.1	0.0	11.6	1.6	0.0	9.9	1.8	13.8	0.4	1.5	7.3	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	57.9	0.0	48.2	71.0	0.0	53.9	69.7	30.8	16.0	75.5	22.6	16.6
LnGrp LOS	E	A	D	E	A	D	E	C	B	E	C	B
Approach Vol, veh/h		554			380			707			489	
Approach Delay, s/veh		50.7			56.1			33.0			26.9	
Approach LOS		D			E			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.0	57.6	16.6	31.3	7.9	58.7	8.5	39.4
Change Period (Y+Rc), s	4.0	6.0	4.0	* 5.4	4.0	6.0	4.0	* 5.4
Max Green Setting (Gmax), s	20.0	60.0	35.0	* 35	20.0	60.0	35.0	* 35
Max Q Clear Time (g_c+I1), s	6.0	22.9	12.3	25.1	5.2	39.3	5.6	29.7
Green Ext Time (p_c), s	0.1	12.6	0.4	0.9	0.0	13.4	0.1	0.7

Intersection Summary	
HCM 6th Ctrl Delay	40.3
HCM 6th LOS	D

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	0	5	205	60	5
Future Vol, veh/h	5	0	5	205	60	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	0	0	2	2	7	7
Mvmt Flow	6	0	6	236	69	6

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	320	72	75	0	-	0
Stage 1	72	-	-	-	-	-
Stage 2	248	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.12	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.218	-	-	-
Pot Cap-1 Maneuver	678	996	1524	-	-	-
Stage 1	956	-	-	-	-	-
Stage 2	798	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	675	996	1524	-	-	-
Mov Cap-2 Maneuver	675	-	-	-	-	-
Stage 1	951	-	-	-	-	-
Stage 2	798	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.4	0.2	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1524	-	675	-	-
HCM Lane V/C Ratio	0.004	-	0.009	-	-
HCM Control Delay (s)	7.4	0	10.4	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

HCM 6th Signalized Intersection Summary
1: Airport Road & Arndt Road

Opening Year (2025) PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	695	65	10	525	115	60	45	35	185	60	30
Future Volume (veh/h)	10	695	65	10	525	115	60	45	35	185	60	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709
Adj Flow Rate, veh/h	11	764	71	11	577	126	66	49	38	203	66	33
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	356	1819	169	431	823	180	283	84	65	302	147	73
Arrive On Green	0.03	0.61	0.59	0.03	0.61	0.59	0.07	0.09	0.07	0.11	0.14	0.12
Sat Flow, veh/h	1628	3003	279	1628	1359	297	1628	886	687	1628	1075	537
Grp Volume(v), veh/h	11	413	422	11	0	703	66	0	87	203	0	99
Grp Sat Flow(s),veh/h/ln	1628	1624	1659	1628	0	1655	1628	0	1573	1628	0	1612
Q Serve(g_s), s	0.2	13.6	13.7	0.2	0.0	29.6	3.6	0.0	5.4	11.0	0.0	5.7
Cycle Q Clear(g_c), s	0.2	13.6	13.7	0.2	0.0	29.6	3.6	0.0	5.4	11.0	0.0	5.7
Prop In Lane	1.00		0.17	1.00		0.18	1.00		0.44	1.00		0.33
Lane Grp Cap(c), veh/h	356	983	1004	431	0	1002	283	0	149	302	0	220
V/C Ratio(X)	0.03	0.42	0.42	0.03	0.00	0.70	0.23	0.00	0.58	0.67	0.00	0.45
Avail Cap(c_a), veh/h	479	1204	1230	555	0	1227	351	0	404	302	0	414
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	11.1	10.6	10.7	7.6	0.0	13.8	37.1	0.0	44.3	35.3	0.0	40.5
Incr Delay (d2), s/veh	0.0	0.9	0.9	0.0	0.0	4.1	0.3	0.0	2.7	5.3	0.0	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	4.4	4.6	0.1	0.0	10.5	1.4	0.0	2.1	4.6	0.0	2.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	11.1	11.5	11.6	7.6	0.0	17.9	37.4	0.0	47.0	40.6	0.0	41.5
LnGrp LOS	B	B	B	A	A	B	D	A	D	D	A	D
Approach Vol, veh/h		846			714			153			302	
Approach Delay, s/veh		11.5			17.8			42.9			40.9	
Approach LOS		B			B			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	10.7	17.8	7.3	65.3	15.0	13.6	7.3	65.3
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Green Setting (Gmax), s	9.0	24.0	9.0	73.0	9.0	24.0	9.0	73.0
Max Q Clear Time (g_c+I1), s	5.6	7.7	2.2	31.6	13.0	7.4	2.2	15.7
Green Ext Time (p_c), s	0.0	0.2	0.0	27.7	0.0	0.2	0.0	33.7

Intersection Summary	
HCM 6th Ctrl Delay	20.5
HCM 6th LOS	C

Intersection	
Int Delay, s/veh	2.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	30	30	10	65	160	15
Future Vol, veh/h	30	30	10	65	160	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	75	75	75	75	75	75
Heavy Vehicles, %	4	4	6	6	2	2
Mvmt Flow	40	40	13	87	213	20

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	336	223	233	0	-	0
Stage 1	223	-	-	-	-	-
Stage 2	113	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.16	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.254	-	-	-
Pot Cap-1 Maneuver	655	812	1311	-	-	-
Stage 1	809	-	-	-	-	-
Stage 2	907	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	648	812	1311	-	-	-
Mov Cap-2 Maneuver	648	-	-	-	-	-
Stage 1	801	-	-	-	-	-
Stage 2	907	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.6	1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1311	-	721	-	-
HCM Lane V/C Ratio	0.01	-	0.111	-	-
HCM Control Delay (s)	7.8	0	10.6	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.4	-	-

Intersection	
Int Delay, s/veh	9.3

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	15	415	465	65	150	30
Future Vol, veh/h	15	415	465	65	150	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	7	7	5	5	2	2
Mvmt Flow	17	477	534	75	172	34

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	609	0	-	0	1083	572
Stage 1	-	-	-	-	572	-
Stage 2	-	-	-	-	511	-
Critical Hdwy	4.17	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.263	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	946	-	-	-	240	520
Stage 1	-	-	-	-	565	-
Stage 2	-	-	-	-	602	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	946	-	-	-	234	520
Mov Cap-2 Maneuver	-	-	-	-	234	-
Stage 1	-	-	-	-	551	-
Stage 2	-	-	-	-	602	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	58.2
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	946	-	-	-	258
HCM Lane V/C Ratio	0.018	-	-	-	0.802
HCM Control Delay (s)	8.9	0	-	-	58.2
HCM Lane LOS	A	A	-	-	F
HCM 95th %tile Q(veh)	0.1	-	-	-	6.2

HCM 6th Signalized Intersection Summary
4: OR 551 & Arndt Road

Opening Year (2025) PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	35	100	20	80	90	445	5	360	45	635	610	50
Future Volume (veh/h)	35	100	20	80	90	445	5	360	45	635	610	50
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668
Adj Flow Rate, veh/h	37	105	21	84	95	0	5	379	47	668	642	53
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	6	6	6	6	6	6	6	6	6	6	6	6
Cap, veh/h	96	205	37	167	147		20	682	578	814	1101	933
Arrive On Green	0.16	0.18	0.16	0.16	0.18	0.00	0.01	0.41	0.41	0.26	0.66	0.66
Sat Flow, veh/h	237	1111	199	566	793	1414	1589	1668	1414	3082	1668	1414
Grp Volume(v), veh/h	163	0	0	179	0	0	5	379	47	668	642	53
Grp Sat Flow(s),veh/h/ln	1548	0	0	1359	0	1414	1589	1668	1414	1541	1668	1414
Q Serve(g_s), s	0.0	0.0	0.0	2.7	0.0	0.0	0.3	14.6	1.7	17.1	17.9	1.1
Cycle Q Clear(g_c), s	8.1	0.0	0.0	10.8	0.0	0.0	0.3	14.6	1.7	17.1	17.9	1.1
Prop In Lane	0.23		0.13	0.47		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	302	0	0	282	0		20	682	578	814	1101	933
V/C Ratio(X)	0.54	0.00	0.00	0.64	0.00		0.25	0.56	0.08	0.82	0.58	0.06
Avail Cap(c_a), veh/h	617	0	0	577	0		292	1228	1041	1299	1228	1041
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	31.5	0.0	0.0	32.8	0.0	0.0	41.2	19.1	15.2	29.1	7.9	5.1
Incr Delay (d2), s/veh	1.1	0.0	0.0	2.4	0.0	0.0	4.8	1.0	0.1	1.8	0.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.0	0.0	0.0	3.6	0.0	0.0	0.1	5.0	0.5	5.8	4.4	0.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	32.7	0.0	0.0	35.2	0.0	0.0	46.0	20.1	15.3	30.9	8.7	5.1
LnGrp LOS	C	A	A	D	A		D	C	B	C	A	A
Approach Vol, veh/h		163			179			431			1363	
Approach Delay, s/veh		32.7			35.2			19.9			19.4	
Approach LOS		C			D			B			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	5.1	59.6		19.6	26.2	38.4		19.6				
Change Period (Y+Rc), s	4.5	6.0		6.0	4.5	6.0		6.0				
Max Green Setting (Gmax), s	15.0	60.0		31.0	35.0	60.0		31.0				
Max Q Clear Time (g_c+I1), s	2.3	19.9		12.8	19.1	16.6		10.1				
Green Ext Time (p_c), s	0.0	25.9		0.7	2.6	15.8		0.5				

Intersection Summary	
HCM 6th Ctrl Delay	21.9
HCM 6th LOS	C

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	4.1

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↰	↱		↰	↑	↱
Traffic Vol, veh/h	10	5	45	15	25	15	30	395	5	10	680	35
Future Vol, veh/h	10	5	45	15	25	15	30	395	5	10	680	35
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	500	-	160
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	6	6	6	6	6	6	6	6	6	6	6	6
Mvmt Flow	12	6	54	18	30	18	36	476	6	12	819	42

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1418	1397	819	1445	1436	479	861	0	0	482	0	0
Stage 1	843	843	-	551	551	-	-	-	-	-	-	-
Stage 2	575	554	-	894	885	-	-	-	-	-	-	-
Critical Hdwy	7.16	6.56	6.26	7.16	6.56	6.26	4.16	-	-	4.16	-	-
Critical Hdwy Stg 1	6.16	5.56	-	6.16	5.56	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.16	5.56	-	6.16	5.56	-	-	-	-	-	-	-
Follow-up Hdwy	3.554	4.054	3.354	3.554	4.054	3.354	2.254	-	-	2.254	-	-
Pot Cap-1 Maneuver	112	138	369	107	131	579	764	-	-	1060	-	-
Stage 1	353	374	-	512	509	-	-	-	-	-	-	-
Stage 2	496	507	-	330	358	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	84	130	369	84	124	579	764	-	-	1060	-	-
Mov Cap-2 Maneuver	84	130	-	84	124	-	-	-	-	-	-	-
Stage 1	336	370	-	488	485	-	-	-	-	-	-	-
Stage 2	429	483	-	274	354	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	30	55	0.7	0.1
HCM LOS	D	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	764	-	-	215	135	1060	-	-
HCM Lane V/C Ratio	0.047	-	-	0.336	0.491	0.011	-	-
HCM Control Delay (s)	9.9	-	-	30	55	8.4	-	-
HCM Lane LOS	A	-	-	D	F	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1.4	2.3	0	-	-

HCM 6th Signalized Intersection Summary
6: OR 551 & Ehlen Road

Opening Year (2025) PM



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	70	320	25	85	390	25	40	335	25	100	590	50
Future Volume (veh/h)	70	320	25	85	390	25	40	335	25	100	590	50
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668
Adj Flow Rate, veh/h	78	356	28	94	433	28	44	372	28	111	656	56
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	6	6	6	6	6	6	6	6	6	6	6
Cap, veh/h	98	439	35	117	464	30	55	705	597	134	787	667
Arrive On Green	0.06	0.29	0.28	0.07	0.30	0.29	0.03	0.42	0.42	0.08	0.47	0.47
Sat Flow, veh/h	1589	1524	120	1589	1547	100	1589	1668	1414	1589	1668	1414
Grp Volume(v), veh/h	78	0	384	94	0	461	44	372	28	111	656	56
Grp Sat Flow(s),veh/h/ln	1589	0	1643	1589	0	1648	1589	1668	1414	1589	1668	1414
Q Serve(g_s), s	5.9	0.0	26.4	7.1	0.0	33.0	3.3	20.1	1.4	8.4	41.5	2.6
Cycle Q Clear(g_c), s	5.9	0.0	26.4	7.1	0.0	33.0	3.3	20.1	1.4	8.4	41.5	2.6
Prop In Lane	1.00		0.07	1.00		0.06	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	98	0	473	117	0	494	55	705	597	134	787	667
V/C Ratio(X)	0.79	0.00	0.81	0.80	0.00	0.93	0.80	0.53	0.05	0.83	0.83	0.08
Avail Cap(c_a), veh/h	458	0	493	458	0	494	262	852	722	262	852	722
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	56.2	0.0	40.2	55.3	0.0	41.3	58.2	26.1	20.7	54.7	27.9	17.6
Incr Delay (d2), s/veh	10.2	0.0	9.3	9.1	0.0	24.7	18.1	0.9	0.0	9.4	7.1	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	0.0	11.3	3.1	0.0	16.2	1.6	7.6	0.4	3.6	16.5	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	66.4	0.0	49.5	64.4	0.0	66.1	76.3	26.9	20.7	64.2	35.0	17.7
LnGrp LOS	E	A	D	E	A	E	E	C	C	E	C	B
Approach Vol, veh/h		462			555			444			823	
Approach Delay, s/veh		52.3			65.8			31.4			37.7	
Approach LOS		D			E			C			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.2	61.3	11.5	40.4	14.2	55.3	13.0	38.9
Change Period (Y+Rc), s	4.0	6.0	4.0	* 5.4	4.0	6.0	4.0	* 5.4
Max Green Setting (Gmax), s	20.0	60.0	35.0	* 35	20.0	60.0	35.0	* 35
Max Q Clear Time (g_c+I1), s	5.3	43.5	7.9	35.0	10.4	22.1	9.1	28.4
Green Ext Time (p_c), s	0.1	11.8	0.2	0.0	0.1	11.3	0.3	0.8

Intersection Summary	
HCM 6th Ctrl Delay	46.3
HCM 6th LOS	D

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	0.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	5	10	85	170	5
Future Vol, veh/h	5	5	10	85	170	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	70	70	70	70	70	70
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	7	7	14	121	243	7

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	396	247	250	0	-	0
Stage 1	247	-	-	-	-	-
Stage 2	149	-	-	-	-	-
Critical Hdwy	6.43	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.527	3.327	2.227	-	-	-
Pot Cap-1 Maneuver	607	789	1310	-	-	-
Stage 1	792	-	-	-	-	-
Stage 2	876	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	600	789	1310	-	-	-
Mov Cap-2 Maneuver	600	-	-	-	-	-
Stage 1	783	-	-	-	-	-
Stage 2	876	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.4	0.8	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1310	-	682	-	-
HCM Lane V/C Ratio	0.011	-	0.021	-	-
HCM Control Delay (s)	7.8	0	10.4	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

SECTION 7: HCM REPORTS - OPENING YEAR 2025 BUILD AM AND PM

HCM 6th Signalized Intersection Summary
1: Airport Road & Arndt Road

Opening Year (2025) + Project AM



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	25	425	66	22	630	315	68	110	11	70	32	10
Future Volume (veh/h)	25	425	66	22	630	315	68	110	11	70	32	10
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		0.98	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1586	1586	1586	1641	1641	1641	1723	1723	1723	1709	1709	1709
Adj Flow Rate, veh/h	28	478	74	25	708	354	76	124	12	79	36	11
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Percent Heavy Veh, %	12	12	12	8	8	8	2	2	2	3	3	3
Cap, veh/h	122	1687	260	582	658	329	292	174	17	218	143	44
Arrive On Green	0.04	0.64	0.63	0.04	0.64	0.63	0.07	0.11	0.10	0.07	0.11	0.10
Sat Flow, veh/h	1511	2617	403	1563	1024	512	1641	1546	150	1628	1248	381
Grp Volume(v), veh/h	28	274	278	25	0	1062	76	0	136	79	0	47
Grp Sat Flow(s),veh/h/ln	1511	1507	1514	1563	0	1536	1641	0	1696	1628	0	1629
Q Serve(g_s), s	0.7	9.6	9.8	0.6	0.0	78.0	4.8	0.0	9.4	5.1	0.0	3.2
Cycle Q Clear(g_c), s	0.7	9.6	9.8	0.6	0.0	78.0	4.8	0.0	9.4	5.1	0.0	3.2
Prop In Lane	1.00		0.27	1.00		0.33	1.00		0.09	1.00		0.23
Lane Grp Cap(c), veh/h	122	971	976	582	0	987	292	0	191	218	0	187
V/C Ratio(X)	0.23	0.28	0.28	0.04	0.00	1.08	0.26	0.00	0.71	0.36	0.00	0.25
Avail Cap(c_a), veh/h	159	971	976	622	0	987	328	0	363	251	0	349
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	31.2	9.4	9.5	6.6	0.0	22.0	42.7	0.0	52.0	42.9	0.0	49.2
Incr Delay (d2), s/veh	0.7	0.5	0.5	0.0	0.0	51.3	0.3	0.0	3.6	0.7	0.0	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	3.0	3.0	0.2	0.0	37.8	1.9	0.0	4.1	2.0	0.0	1.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	31.9	9.9	10.0	6.6	0.0	73.3	43.0	0.0	55.6	43.6	0.0	49.7
LnGrp LOS	C	A	B	A	A	F	D	A	E	D	A	D
Approach Vol, veh/h		580			1087			212			126	
Approach Delay, s/veh		11.0			71.7			51.1			45.9	
Approach LOS		B			E			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	12.3	17.9	9.1	82.0	12.6	17.7	8.8	82.2
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Green Setting (Gmax), s	9.0	24.0	6.0	76.0	9.0	24.0	6.0	76.0
Max Q Clear Time (g_c+I1), s	6.8	5.2	2.7	80.0	7.1	11.4	2.6	11.8
Green Ext Time (p_c), s	0.0	0.1	0.0	0.0	0.0	0.3	0.0	21.4

Intersection Summary	
HCM 6th Ctrl Delay	50.4
HCM 6th LOS	D

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	10	25	207	47	20
Future Vol, veh/h	17	10	25	207	47	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	12	12	2	2	9	9
Mvmt Flow	20	11	29	238	54	23

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	362	66	77	0	-	0
Stage 1	66	-	-	-	-	-
Stage 2	296	-	-	-	-	-
Critical Hdwy	6.52	6.32	4.12	-	-	-
Critical Hdwy Stg 1	5.52	-	-	-	-	-
Critical Hdwy Stg 2	5.52	-	-	-	-	-
Follow-up Hdwy	3.608	3.408	2.218	-	-	-
Pot Cap-1 Maneuver	618	970	1522	-	-	-
Stage 1	932	-	-	-	-	-
Stage 2	732	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	604	970	1522	-	-	-
Mov Cap-2 Maneuver	604	-	-	-	-	-
Stage 1	911	-	-	-	-	-
Stage 2	732	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.4	0.8	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1522	-	702	-	-
HCM Lane V/C Ratio	0.019	-	0.044	-	-
HCM Control Delay (s)	7.4	0	10.4	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection	
Int Delay, s/veh	1.7

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		⋎	
Traffic Vol, veh/h	27	395	365	195	51	16
Future Vol, veh/h	27	395	365	195	51	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	9	9	9	9	9	9
Mvmt Flow	31	449	415	222	58	18

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	637	0	-	0	1037	526
Stage 1	-	-	-	-	526	-
Stage 2	-	-	-	-	511	-
Critical Hdwy	4.19	-	-	-	6.49	6.29
Critical Hdwy Stg 1	-	-	-	-	5.49	-
Critical Hdwy Stg 2	-	-	-	-	5.49	-
Follow-up Hdwy	2.281	-	-	-	3.581	3.381
Pot Cap-1 Maneuver	914	-	-	-	248	538
Stage 1	-	-	-	-	579	-
Stage 2	-	-	-	-	588	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	914	-	-	-	237	538
Mov Cap-2 Maneuver	-	-	-	-	237	-
Stage 1	-	-	-	-	553	-
Stage 2	-	-	-	-	588	-

Approach	EB	WB	SB
HCM Control Delay, s	0.6	0	23.1
HCM LOS			C

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	914	-	-	-	274
HCM Lane V/C Ratio	0.034	-	-	-	0.278
HCM Control Delay (s)	9.1	0	-	-	23.1
HCM Lane LOS	A	A	-	-	C
HCM 95th %tile Q(veh)	0.1	-	-	-	1.1

HCM 6th Signalized Intersection Summary
4: OR 551 & Arndt Road

Opening Year (2025) + Project AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	45	82	10	50	65	608	20	610	60	374	385	20
Future Volume (veh/h)	45	82	10	50	65	608	20	610	60	374	385	20
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adj Flow Rate, veh/h	48	88	11	54	70	0	22	656	65	402	414	22
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	11	11	11	11	11	11	11	11	11	11	11	11
Cap, veh/h	102	139	16	120	121		43	896	759	508	1126	934
Arrive On Green	0.12	0.15	0.12	0.12	0.15	0.00	0.03	0.56	0.56	0.17	0.70	0.70
Sat Flow, veh/h	364	958	107	459	835	1356	1524	1600	1356	2956	1600	1328
Grp Volume(v), veh/h	147	0	0	124	0	0	22	656	65	402	414	22
Grp Sat Flow(s),veh/h/ln	1429	0	0	1294	0	1356	1524	1600	1356	1478	1600	1328
Q Serve(g_s), s	0.6	0.0	0.0	0.0	0.0	0.0	1.4	29.9	2.2	12.7	10.1	0.5
Cycle Q Clear(g_c), s	9.8	0.0	0.0	9.2	0.0	0.0	1.4	29.9	2.2	12.7	10.1	0.5
Prop In Lane	0.33		0.07	0.44		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	228	0	0	215	0		43	896	759	508	1126	934
V/C Ratio(X)	0.65	0.00	0.00	0.58	0.00		0.51	0.73	0.09	0.79	0.37	0.02
Avail Cap(c_a), veh/h	505	0	0	484	0		242	1016	861	1075	1126	934
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	40.1	0.0	0.0	39.8	0.0	0.0	46.8	16.0	9.9	38.7	5.8	4.4
Incr Delay (d2), s/veh	2.3	0.0	0.0	2.4	0.0	0.0	6.9	2.7	0.1	2.1	0.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.4	0.0	0.0	2.9	0.0	0.0	0.6	9.5	0.6	4.4	2.3	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	42.4	0.0	0.0	42.2	0.0	0.0	53.7	18.8	10.0	40.9	6.1	4.4
LnGrp LOS	D	A	A	D	A		D	B	B	D	A	A
Approach Vol, veh/h		147			124			743			838	
Approach Delay, s/veh		42.4			42.2			19.0			22.7	
Approach LOS		D			D			B			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.7	72.7		18.2	20.8	58.7		18.2				
Change Period (Y+Rc), s	4.5	6.0		6.0	4.5	6.0		6.0				
Max Green Setting (Gmax), s	15.0	60.0		31.0	35.0	60.0		31.0				
Max Q Clear Time (g_c+I1), s	3.4	12.1		11.2	14.7	31.9		11.8				
Green Ext Time (p_c), s	0.0	17.4		0.5	1.6	20.8		0.4				

Intersection Summary	
HCM 6th Ctrl Delay	24.1
HCM 6th LOS	C

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	2.4

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↰	↱		↰	↑	↱
Traffic Vol, veh/h	20	5	35	5	5	10	40	665	32	20	410	10
Future Vol, veh/h	20	5	35	5	5	10	40	665	32	20	410	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	500	-	160
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	9	9	9	9	9	9	9	9	9	9	9	9
Mvmt Flow	23	6	40	6	6	11	45	756	36	23	466	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1385	1394	466	1405	1387	774	477	0	0	792	0	0
Stage 1	512	512	-	864	864	-	-	-	-	-	-	-
Stage 2	873	882	-	541	523	-	-	-	-	-	-	-
Critical Hdwy	7.19	6.59	6.29	7.19	6.59	6.29	4.19	-	-	4.19	-	-
Critical Hdwy Stg 1	6.19	5.59	-	6.19	5.59	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.19	5.59	-	6.19	5.59	-	-	-	-	-	-	-
Follow-up Hdwy	3.581	4.081	3.381	3.581	4.081	3.381	2.281	-	-	2.281	-	-
Pot Cap-1 Maneuver	116	137	582	113	138	387	1050	-	-	798	-	-
Stage 1	532	525	-	339	362	-	-	-	-	-	-	-
Stage 2	335	355	-	513	519	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	103	127	582	96	128	387	1050	-	-	798	-	-
Mov Cap-2 Maneuver	103	127	-	96	128	-	-	-	-	-	-	-
Stage 1	509	510	-	324	346	-	-	-	-	-	-	-
Stage 2	306	340	-	459	504	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	31.3	29.3	0.5	0.4
HCM LOS	D	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1050	-	-	204	171	798	-	-
HCM Lane V/C Ratio	0.043	-	-	0.334	0.133	0.028	-	-
HCM Control Delay (s)	8.6	-	-	31.3	29.3	9.6	-	-
HCM Lane LOS	A	-	-	D	D	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1.4	0.4	0.1	-	-

HCM 6th Signalized Intersection Summary
6: OR 551 & Ehlen Road

Opening Year (2025) + Project AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	130	360	25	45	271	35	50	572	32	40	380	30
Future Volume (veh/h)	130	360	25	45	271	35	50	572	32	40	380	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614
Adj Flow Rate, veh/h	141	391	27	49	295	38	54	622	35	43	413	33
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	10	10	10	10	10	10	10	10	10	10	10	10
Cap, veh/h	168	462	32	61	336	43	67	770	653	52	755	640
Arrive On Green	0.11	0.31	0.30	0.04	0.24	0.23	0.04	0.48	0.48	0.03	0.47	0.47
Sat Flow, veh/h	1537	1492	103	1537	1401	180	1537	1614	1367	1537	1614	1367
Grp Volume(v), veh/h	141	0	418	49	0	333	54	622	35	43	413	33
Grp Sat Flow(s),veh/h/ln	1537	0	1595	1537	0	1581	1537	1614	1367	1537	1614	1367
Q Serve(g_s), s	10.4	0.0	28.2	3.6	0.0	23.3	4.0	37.7	1.6	3.2	21.1	1.5
Cycle Q Clear(g_c), s	10.4	0.0	28.2	3.6	0.0	23.3	4.0	37.7	1.6	3.2	21.1	1.5
Prop In Lane	1.00		0.06	1.00		0.11	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	168	0	494	61	0	379	67	770	653	52	755	640
V/C Ratio(X)	0.84	0.00	0.85	0.80	0.00	0.88	0.81	0.81	0.05	0.82	0.55	0.05
Avail Cap(c_a), veh/h	467	0	505	467	0	500	267	869	737	267	869	737
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	50.2	0.0	37.2	54.8	0.0	42.2	54.5	25.6	16.1	55.2	21.9	16.7
Incr Delay (d2), s/veh	7.9	0.0	12.1	16.4	0.0	12.3	15.4	5.6	0.0	20.5	0.9	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.2	0.0	11.9	1.7	0.0	10.0	1.8	14.0	0.5	1.5	7.4	0.4
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	58.2	0.0	49.3	71.2	0.0	54.5	69.9	31.1	16.2	75.7	22.8	16.7
LnGrp LOS	E	A	D	E	A	D	E	C	B	E	C	B
Approach Vol, veh/h		559			382			711			489	
Approach Delay, s/veh		51.5			56.6			33.3			27.0	
Approach LOS		D			E			C			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	9.0	57.8	16.6	31.6	7.9	58.9	8.6	39.6
Change Period (Y+Rc), s	4.0	6.0	4.0	* 5.4	4.0	6.0	4.0	* 5.4
Max Green Setting (Gmax), s	20.0	60.0	35.0	* 35	20.0	60.0	35.0	* 35
Max Q Clear Time (g_c+I1), s	6.0	23.1	12.4	25.3	5.2	39.7	5.6	30.2
Green Ext Time (p_c), s	0.1	12.6	0.4	0.9	0.0	13.2	0.1	0.7

Intersection Summary	
HCM 6th Ctrl Delay	40.8
HCM 6th LOS	D

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	7	1	12	207	70	15
Future Vol, veh/h	7	1	12	207	70	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	0	0	2	2	7	7
Mvmt Flow	8	1	14	238	80	17

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	355	89	97	0	-	0
Stage 1	89	-	-	-	-	-
Stage 2	266	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.12	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.218	-	-	-
Pot Cap-1 Maneuver	647	975	1496	-	-	-
Stage 1	940	-	-	-	-	-
Stage 2	783	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	640	975	1496	-	-	-
Mov Cap-2 Maneuver	640	-	-	-	-	-
Stage 1	930	-	-	-	-	-
Stage 2	783	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.5	0.4	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1496	-	669	-	-
HCM Lane V/C Ratio	0.009	-	0.014	-	-
HCM Control Delay (s)	7.4	0	10.5	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Intersection	
Int Delay, s/veh	0.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	1	0	4	220	62	5
Future Vol, veh/h	1	0	4	220	62	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	2	2	2	2	7	7
Mvmt Flow	1	0	5	253	71	6

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	337	74	77	0	-	0
Stage 1	74	-	-	-	-	-
Stage 2	263	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	658	988	1522	-	-	-
Stage 1	949	-	-	-	-	-
Stage 2	781	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	655	988	1522	-	-	-
Mov Cap-2 Maneuver	655	-	-	-	-	-
Stage 1	945	-	-	-	-	-
Stage 2	781	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.5	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1522	-	655	-	-
HCM Lane V/C Ratio	0.003	-	0.002	-	-
HCM Control Delay (s)	7.4	0	10.5	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Intersection	
Int Delay, s/veh	0.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	1	1	3	218	66	5
Future Vol, veh/h	1	1	3	218	66	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	2	2	2	2	7	7
Mvmt Flow	1	1	3	251	76	6

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	336	79	82	0	-	0
Stage 1	79	-	-	-	-	-
Stage 2	257	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	659	981	1515	-	-	-
Stage 1	944	-	-	-	-	-
Stage 2	786	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	658	981	1515	-	-	-
Mov Cap-2 Maneuver	658	-	-	-	-	-
Stage 1	942	-	-	-	-	-
Stage 2	786	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.6	0.1	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1515	-	788	-	-
HCM Lane V/C Ratio	0.002	-	0.003	-	-
HCM Control Delay (s)	7.4	0	9.6	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Intersection	
Int Delay, s/veh	4.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	5	0	17	10	0	3
Future Vol, veh/h	5	0	17	10	0	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	6	0	20	11	0	3

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	6	0	57	6
Stage 1	-	-	-	-	6	-
Stage 2	-	-	-	-	51	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1615	-	950	1077
Stage 1	-	-	-	-	1017	-
Stage 2	-	-	-	-	971	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1615	-	939	1077
Mov Cap-2 Maneuver	-	-	-	-	939	-
Stage 1	-	-	-	-	1017	-
Stage 2	-	-	-	-	959	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4.6	8.4
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	1077	-	-	1615	-
HCM Lane V/C Ratio	0.003	-	-	0.012	-
HCM Control Delay (s)	8.4	-	-	7.3	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0	-

HCM 6th Signalized Intersection Summary
1: Airport Road & Arndt Road

Opening Year (2025) + Project PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	695	68	11	525	115	70	47	41	185	60	30
Future Volume (veh/h)	10	695	68	11	525	115	70	47	41	185	60	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709
Adj Flow Rate, veh/h	11	764	75	12	577	126	77	52	45	203	66	33
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	355	1811	178	429	825	180	286	84	73	294	143	71
Arrive On Green	0.03	0.61	0.59	0.03	0.61	0.59	0.07	0.10	0.08	0.11	0.13	0.11
Sat Flow, veh/h	1628	2987	293	1628	1359	297	1628	839	726	1628	1075	537
Grp Volume(v), veh/h	11	415	424	12	0	703	77	0	97	203	0	99
Grp Sat Flow(s),veh/h/ln	1628	1624	1656	1628	0	1655	1628	0	1566	1628	0	1612
Q Serve(g_s), s	0.3	14.0	14.1	0.3	0.0	30.2	4.3	0.0	6.2	11.0	0.0	5.9
Cycle Q Clear(g_c), s	0.3	14.0	14.1	0.3	0.0	30.2	4.3	0.0	6.2	11.0	0.0	5.9
Prop In Lane	1.00		0.18	1.00		0.18	1.00		0.46	1.00		0.33
Lane Grp Cap(c), veh/h	355	984	1004	429	0	1005	286	0	157	294	0	214
V/C Ratio(X)	0.03	0.42	0.42	0.03	0.00	0.70	0.27	0.00	0.62	0.69	0.00	0.46
Avail Cap(c_a), veh/h	428	1220	1245	500	0	1244	340	0	392	294	0	404
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	11.3	10.8	10.9	7.8	0.0	14.1	37.2	0.0	45.2	36.8	0.0	41.9
Incr Delay (d2), s/veh	0.0	0.9	0.9	0.0	0.0	4.0	0.4	0.0	2.9	6.2	0.0	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	4.6	4.7	0.1	0.0	10.7	1.6	0.0	2.4	4.8	0.0	2.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	11.3	11.7	11.8	7.8	0.0	18.1	37.6	0.0	48.2	43.0	0.0	43.0
LnGrp LOS	B	B	B	A	A	B	D	A	D	D	A	D
Approach Vol, veh/h		850			715			174			302	
Approach Delay, s/veh		11.8			17.9			43.5			43.0	
Approach LOS		B			B			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	11.6	17.8	7.4	67.0	15.0	14.4	7.5	66.9
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Green Setting (Gmax), s	9.0	24.0	6.0	76.0	9.0	24.0	6.0	76.0
Max Q Clear Time (g_c+I1), s	6.3	7.9	2.3	32.2	13.0	8.2	2.3	16.1
Green Ext Time (p_c), s	0.0	0.2	0.0	28.8	0.0	0.2	0.0	34.8

Intersection Summary	
HCM 6th Ctrl Delay	21.3
HCM 6th LOS	C

Intersection	
Int Delay, s/veh	2.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	30	30	10	68	171	17
Future Vol, veh/h	30	30	10	68	171	17
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	75	75	75	75	75	75
Heavy Vehicles, %	4	4	6	6	2	2
Mvmt Flow	40	40	13	91	228	23

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	357	240	251	0	-	0
Stage 1	240	-	-	-	-	-
Stage 2	117	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.16	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.254	-	-	-
Pot Cap-1 Maneuver	637	794	1291	-	-	-
Stage 1	795	-	-	-	-	-
Stage 2	903	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	630	794	1291	-	-	-
Mov Cap-2 Maneuver	630	-	-	-	-	-
Stage 1	786	-	-	-	-	-
Stage 2	903	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.8	1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1291	-	703	-	-
HCM Lane V/C Ratio	0.01	-	0.114	-	-
HCM Control Delay (s)	7.8	0	10.8	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.4	-	-

Intersection	
Int Delay, s/veh	11

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		⋔	
Traffic Vol, veh/h	17	415	465	66	155	36
Future Vol, veh/h	17	415	465	66	155	36
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	7	7	5	5	2	2
Mvmt Flow	20	477	534	76	178	41

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	610	0	-	0	1089	572
Stage 1	-	-	-	-	572	-
Stage 2	-	-	-	-	517	-
Critical Hdwy	4.17	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.263	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	945	-	-	-	238	520
Stage 1	-	-	-	-	565	-
Stage 2	-	-	-	-	598	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	945	-	-	-	231	520
Mov Cap-2 Maneuver	-	-	-	-	231	-
Stage 1	-	-	-	-	549	-
Stage 2	-	-	-	-	598	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	65.8
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	945	-	-	-	258
HCM Lane V/C Ratio	0.021	-	-	-	0.851
HCM Control Delay (s)	8.9	0	-	-	65.8
HCM Lane LOS	A	A	-	-	F
HCM 95th %tile Q(veh)	0.1	-	-	-	7

HCM 6th Signalized Intersection Summary
4: OR 551 & Arndt Road

Opening Year (2025) + Project PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	35	100	20	80	92	453	5	360	45	638	610	50
Future Volume (veh/h)	35	100	20	80	92	453	5	360	45	638	610	50
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668
Adj Flow Rate, veh/h	37	105	21	84	97	0	5	379	47	672	642	53
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	6	6	6	6	6	6	6	6	6	6	6	6
Cap, veh/h	96	206	37	166	149		20	680	576	817	1101	933
Arrive On Green	0.16	0.19	0.16	0.16	0.19	0.00	0.01	0.41	0.41	0.27	0.66	0.66
Sat Flow, veh/h	236	1110	199	561	801	1414	1589	1668	1414	3082	1668	1414
Grp Volume(v), veh/h	163	0	0	181	0	0	5	379	47	672	642	53
Grp Sat Flow(s),veh/h/ln	1545	0	0	1362	0	1414	1589	1668	1414	1541	1668	1414
Q Serve(g_s), s	0.0	0.0	0.0	2.8	0.0	0.0	0.3	14.8	1.7	17.3	18.0	1.1
Cycle Q Clear(g_c), s	8.2	0.0	0.0	11.0	0.0	0.0	0.3	14.8	1.7	17.3	18.0	1.1
Prop In Lane	0.23		0.13	0.46		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	303	0	0	283	0		20	680	576	817	1101	933
V/C Ratio(X)	0.54	0.00	0.00	0.64	0.00		0.25	0.56	0.08	0.82	0.58	0.06
Avail Cap(c_a), veh/h	613	0	0	574	0		291	1221	1035	1292	1221	1035
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	31.6	0.0	0.0	32.9	0.0	0.0	41.4	19.2	15.4	29.2	8.0	5.1
Incr Delay (d2), s/veh	1.1	0.0	0.0	2.4	0.0	0.0	4.9	1.0	0.1	1.9	0.8	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	3.0	0.0	0.0	3.6	0.0	0.0	0.1	5.1	0.5	5.9	4.4	0.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	32.7	0.0	0.0	35.4	0.0	0.0	46.3	20.3	15.5	31.2	8.7	5.1
LnGrp LOS	C	A	A	D	A		D	C	B	C	A	A
Approach Vol, veh/h		163			181			431			1367	
Approach Delay, s/veh		32.7			35.4			20.0			19.6	
Approach LOS		C			D			C			B	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	5.1	59.9		19.7	26.4	38.5		19.7				
Change Period (Y+Rc), s	4.5	6.0		6.0	4.5	6.0		6.0				
Max Green Setting (Gmax), s	15.0	60.0		31.0	35.0	60.0		31.0				
Max Q Clear Time (g_c+I1), s	2.3	20.0		13.0	19.3	16.8		10.2				
Green Ext Time (p_c), s	0.0	25.8		0.7	2.6	15.7		0.5				

Intersection Summary	
HCM 6th Ctrl Delay	22.0
HCM 6th LOS	C

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	4.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↰	↱		↰	↑	↱
Traffic Vol, veh/h	10	5	45	17	25	15	30	395	5	10	680	35
Future Vol, veh/h	10	5	45	17	25	15	30	395	5	10	680	35
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	500	-	160
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	6	6	6	6	6	6	6	6	6	6	6	6
Mvmt Flow	12	6	54	20	30	18	36	476	6	12	819	42

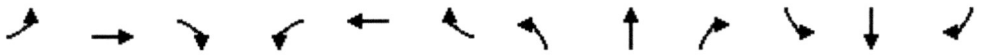
Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1418	1397	819	1445	1436	479	861	0	0	482	0	0
Stage 1	843	843	-	551	551	-	-	-	-	-	-	-
Stage 2	575	554	-	894	885	-	-	-	-	-	-	-
Critical Hdwy	7.16	6.56	6.26	7.16	6.56	6.26	4.16	-	-	4.16	-	-
Critical Hdwy Stg 1	6.16	5.56	-	6.16	5.56	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.16	5.56	-	6.16	5.56	-	-	-	-	-	-	-
Follow-up Hdwy	3.554	4.054	3.354	3.554	4.054	3.354	2.254	-	-	2.254	-	-
Pot Cap-1 Maneuver	112	138	369	107	131	579	764	-	-	1060	-	-
Stage 1	353	374	-	512	509	-	-	-	-	-	-	-
Stage 2	496	507	-	330	358	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	84	130	369	84	124	579	764	-	-	1060	-	-
Mov Cap-2 Maneuver	84	130	-	84	124	-	-	-	-	-	-	-
Stage 1	336	370	-	488	485	-	-	-	-	-	-	-
Stage 2	429	483	-	274	354	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	30	57.9	0.7	0.1
HCM LOS	D	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	764	-	-	215	133	1060	-	-
HCM Lane V/C Ratio	0.047	-	-	0.336	0.516	0.011	-	-
HCM Control Delay (s)	9.9	-	-	30	57.9	8.4	-	-
HCM Lane LOS	A	-	-	D	F	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1.4	2.5	0	-	-

HCM 6th Signalized Intersection Summary
6: OR 551 & Ehlen Road

Opening Year (2025) + Project PM



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	70	321	25	87	395	25	40	335	25	100	592	50
Future Volume (veh/h)	70	321	25	87	395	25	40	335	25	100	592	50
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668
Adj Flow Rate, veh/h	78	357	28	97	439	28	44	372	28	111	658	56
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	6	6	6	6	6	6	6	6	6	6	6
Cap, veh/h	98	435	34	121	464	30	55	705	598	134	788	668
Arrive On Green	0.06	0.29	0.27	0.08	0.30	0.29	0.03	0.42	0.42	0.08	0.47	0.47
Sat Flow, veh/h	1589	1524	120	1589	1549	99	1589	1668	1414	1589	1668	1414
Grp Volume(v), veh/h	78	0	385	97	0	467	44	372	28	111	658	56
Grp Sat Flow(s),veh/h/ln	1589	0	1644	1589	0	1648	1589	1668	1414	1589	1668	1414
Q Serve(g_s), s	5.9	0.0	26.6	7.3	0.0	33.7	3.3	20.1	1.4	8.4	41.7	2.6
Cycle Q Clear(g_c), s	5.9	0.0	26.6	7.3	0.0	33.7	3.3	20.1	1.4	8.4	41.7	2.6
Prop In Lane	1.00		0.07	1.00		0.06	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	98	0	469	121	0	494	55	705	598	134	788	668
V/C Ratio(X)	0.79	0.00	0.82	0.80	0.00	0.95	0.80	0.53	0.05	0.83	0.83	0.08
Avail Cap(c_a), veh/h	458	0	492	458	0	494	262	851	721	262	851	721
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	56.2	0.0	40.5	55.2	0.0	41.6	58.3	26.0	20.6	54.8	27.9	17.6
Incr Delay (d2), s/veh	10.2	0.0	9.9	8.9	0.0	27.3	18.1	0.9	0.0	9.4	7.2	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.5	0.0	11.4	3.2	0.0	16.8	1.6	7.6	0.4	3.6	16.6	0.8
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	66.5	0.0	50.4	64.2	0.0	69.0	76.3	26.9	20.7	64.2	35.1	17.7
LnGrp LOS	E	A	D	E	A	E	E	C	C	E	D	B
Approach Vol, veh/h		463			564			444			825	
Approach Delay, s/veh		53.1			68.1			31.4			37.9	
Approach LOS		D			E			C			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.2	61.4	11.5	40.4	14.2	55.4	13.2	38.7
Change Period (Y+Rc), s	4.0	6.0	4.0	* 5.4	4.0	6.0	4.0	* 5.4
Max Green Setting (Gmax), s	20.0	60.0	35.0	* 35	20.0	60.0	35.0	* 35
Max Q Clear Time (g_c+I1), s	5.3	43.7	7.9	35.7	10.4	22.1	9.3	28.6
Green Ext Time (p_c), s	0.1	11.7	0.2	0.0	0.1	11.2	0.3	0.7

Intersection Summary	
HCM 6th Ctrl Delay	47.1
HCM 6th LOS	D

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	14	11	12	94	172	7
Future Vol, veh/h	14	11	12	94	172	7
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	70	70	70	70	70	70
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	20	16	17	134	246	10

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	419	251	256	0	-	0
Stage 1	251	-	-	-	-	-
Stage 2	168	-	-	-	-	-
Critical Hdwy	6.43	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.527	3.327	2.227	-	-	-
Pot Cap-1 Maneuver	589	785	1303	-	-	-
Stage 1	788	-	-	-	-	-
Stage 2	859	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	581	785	1303	-	-	-
Mov Cap-2 Maneuver	581	-	-	-	-	-
Stage 1	777	-	-	-	-	-
Stage 2	859	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.8	0.9	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1303	-	656	-	-
HCM Lane V/C Ratio	0.013	-	0.054	-	-
HCM Control Delay (s)	7.8	0	10.8	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.2	-	-

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	4	3	1	98	184	1
Future Vol, veh/h	4	3	1	98	184	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	70	70	70	70	70	70
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	6	4	1	140	263	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	406	264	264	0	-	0
Stage 1	264	-	-	-	-	-
Stage 2	142	-	-	-	-	-
Critical Hdwy	6.43	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.527	3.327	2.227	-	-	-
Pot Cap-1 Maneuver	599	772	1294	-	-	-
Stage 1	778	-	-	-	-	-
Stage 2	883	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	598	772	1294	-	-	-
Mov Cap-2 Maneuver	598	-	-	-	-	-
Stage 1	777	-	-	-	-	-
Stage 2	883	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.5	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1294	-	662	-	-
HCM Lane V/C Ratio	0.001	-	0.015	-	-
HCM Control Delay (s)	7.8	0	10.5	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	3	1	101	182	1
Future Vol, veh/h	5	3	1	101	182	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	70	70	70	70	70	70
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	7	4	1	144	260	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	407	261	261	0	-	0
Stage 1	261	-	-	-	-	-
Stage 2	146	-	-	-	-	-
Critical Hdwy	6.43	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.527	3.327	2.227	-	-	-
Pot Cap-1 Maneuver	598	775	1298	-	-	-
Stage 1	780	-	-	-	-	-
Stage 2	879	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	597	775	1298	-	-	-
Mov Cap-2 Maneuver	597	-	-	-	-	-
Stage 1	779	-	-	-	-	-
Stage 2	879	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.6	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1298	-	653	-	-
HCM Lane V/C Ratio	0.001	-	0.018	-	-
HCM Control Delay (s)	7.8	0	10.6	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

Intersection	
Int Delay, s/veh	3.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	10	0	4	15	0	15
Future Vol, veh/h	10	0	4	15	0	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	70	70	70	70	70	70
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	14	0	6	21	0	21

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	14	0	47	14
Stage 1	-	-	-	-	14	-
Stage 2	-	-	-	-	33	-
Critical Hdwy	-	-	4.13	-	6.43	6.23
Critical Hdwy Stg 1	-	-	-	-	5.43	-
Critical Hdwy Stg 2	-	-	-	-	5.43	-
Follow-up Hdwy	-	-	2.227	-	3.527	3.327
Pot Cap-1 Maneuver	-	-	1598	-	960	1063
Stage 1	-	-	-	-	1006	-
Stage 2	-	-	-	-	987	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1598	-	956	1063
Mov Cap-2 Maneuver	-	-	-	-	956	-
Stage 1	-	-	-	-	1006	-
Stage 2	-	-	-	-	983	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	8.5
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	1063	-	-	1598	-
HCM Lane V/C Ratio	0.02	-	-	0.004	-
HCM Control Delay (s)	8.5	-	-	7.3	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0	-

SECTION 8: HCM REPORTS - SHORT-TERM 2030 NO BUILD AM AND PM

HCM 6th Signalized Intersection Summary
1: Airport Road & Arndt Road

Short-Term (2030) AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	25	470	55	15	700	315	65	110	10	70	30	10
Future Volume (veh/h)	25	470	55	15	700	315	65	110	10	70	30	10
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		0.98	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1586	1586	1586	1641	1641	1641	1723	1723	1723	1709	1709	1709
Adj Flow Rate, veh/h	28	528	62	17	787	354	73	124	11	79	34	11
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Percent Heavy Veh, %	12	12	12	8	8	8	2	2	2	3	3	3
Cap, veh/h	122	1768	207	558	685	308	293	175	16	219	143	46
Arrive On Green	0.04	0.65	0.63	0.03	0.64	0.63	0.07	0.11	0.10	0.07	0.12	0.10
Sat Flow, veh/h	1511	2718	318	1563	1064	479	1641	1559	138	1628	1229	397
Grp Volume(v), veh/h	28	292	298	17	0	1141	73	0	135	79	0	45
Grp Sat Flow(s),veh/h/ln	1511	1507	1529	1563	0	1542	1641	0	1698	1628	0	1626
Q Serve(g_s), s	0.7	10.2	10.3	0.4	0.0	78.0	4.6	0.0	9.3	5.1	0.0	3.1
Cycle Q Clear(g_c), s	0.7	10.2	10.3	0.4	0.0	78.0	4.6	0.0	9.3	5.1	0.0	3.1
Prop In Lane	1.00		0.21	1.00		0.31	1.00		0.08	1.00		0.24
Lane Grp Cap(c), veh/h	122	980	995	558	0	992	293	0	190	219	0	189
V/C Ratio(X)	0.23	0.30	0.30	0.03	0.00	1.15	0.25	0.00	0.71	0.36	0.00	0.24
Avail Cap(c_a), veh/h	159	980	995	608	0	992	332	0	364	251	0	349
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	31.2	9.2	9.3	6.7	0.0	21.9	42.8	0.0	52.0	42.9	0.0	48.9
Incr Delay (d2), s/veh	0.7	0.5	0.5	0.0	0.0	79.2	0.3	0.0	3.6	0.7	0.0	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	3.1	3.2	0.1	0.0	45.6	1.8	0.0	4.0	2.0	0.0	1.2
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	31.9	9.7	9.8	6.8	0.0	101.1	43.1	0.0	55.6	43.7	0.0	49.4
LnGrp LOS	C	A	A	A	A	F	D	A	E	D	A	D
Approach Vol, veh/h		618			1158			208			124	
Approach Delay, s/veh		10.8			99.7			51.2			45.7	
Approach LOS		B			F			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	12.1	18.1	9.1	82.0	12.6	17.6	8.2	82.9
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Green Setting (Gmax), s	9.0	24.0	6.0	76.0	9.0	24.0	6.0	76.0
Max Q Clear Time (g_c+I1), s	6.6	5.1	2.7	80.0	7.1	11.3	2.4	12.3
Green Ext Time (p_c), s	0.0	0.1	0.0	0.0	0.0	0.3	0.0	23.2

Intersection Summary	
HCM 6th Ctrl Delay	65.7
HCM 6th LOS	E

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	15	10	25	195	45	20
Future Vol, veh/h	15	10	25	195	45	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	12	12	2	2	9	9
Mvmt Flow	17	11	29	224	52	23

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	346	64	75	0	-	0
Stage 1	64	-	-	-	-	-
Stage 2	282	-	-	-	-	-
Critical Hdwy	6.52	6.32	4.12	-	-	-
Critical Hdwy Stg 1	5.52	-	-	-	-	-
Critical Hdwy Stg 2	5.52	-	-	-	-	-
Follow-up Hdwy	3.608	3.408	2.218	-	-	-
Pot Cap-1 Maneuver	631	973	1524	-	-	-
Stage 1	934	-	-	-	-	-
Stage 2	743	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	617	973	1524	-	-	-
Mov Cap-2 Maneuver	617	-	-	-	-	-
Stage 1	913	-	-	-	-	-
Stage 2	743	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.2	0.8	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1524	-	723	-	-
HCM Lane V/C Ratio	0.019	-	0.04	-	-
HCM Control Delay (s)	7.4	0	10.2	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection	
Int Delay, s/veh	1.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↰	↱		⋔	
Traffic Vol, veh/h	20	435	400	190	50	15
Future Vol, veh/h	20	435	400	190	50	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	9	9	9	9	9	9
Mvmt Flow	23	494	455	216	57	17

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	671	0	-	0	1103	563
Stage 1	-	-	-	-	563	-
Stage 2	-	-	-	-	540	-
Critical Hdwy	4.19	-	-	-	6.49	6.29
Critical Hdwy Stg 1	-	-	-	-	5.49	-
Critical Hdwy Stg 2	-	-	-	-	5.49	-
Follow-up Hdwy	2.281	-	-	-	3.581	3.381
Pot Cap-1 Maneuver	887	-	-	-	227	513
Stage 1	-	-	-	-	556	-
Stage 2	-	-	-	-	570	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	887	-	-	-	219	513
Mov Cap-2 Maneuver	-	-	-	-	219	-
Stage 1	-	-	-	-	536	-
Stage 2	-	-	-	-	570	-

Approach	EB	WB	SB
HCM Control Delay, s	0.4	0	25.1
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	887	-	-	-	252
HCM Lane V/C Ratio	0.026	-	-	-	0.293
HCM Control Delay (s)	9.2	0	-	-	25.1
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	1.2

HCM 6th Signalized Intersection Summary
4: OR 551 & Arndt Road

Short-Term (2030) AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	50	85	10	55	70	665	20	670	65	400	420	25
Future Volume (veh/h)	50	85	10	55	70	665	20	670	65	400	420	25
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adj Flow Rate, veh/h	54	91	11	59	75	0	22	720	70	430	452	27
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	11	11	11	11	11	11	11	11	11	11	11	11
Cap, veh/h	103	138	15	118	120		41	885	750	528	1128	936
Arrive On Green	0.14	0.16	0.14	0.14	0.16	0.00	0.03	0.55	0.55	0.18	0.70	0.70
Sat Flow, veh/h	373	889	96	444	774	1356	1524	1600	1356	2956	1600	1328
Grp Volume(v), veh/h	156	0	0	134	0	0	22	720	70	430	452	27
Grp Sat Flow(s),veh/h/ln	1357	0	0	1219	0	1356	1524	1600	1356	1478	1600	1328
Q Serve(g_s), s	0.4	0.0	0.0	0.0	0.0	0.0	1.5	38.8	2.6	14.9	12.3	0.7
Cycle Q Clear(g_c), s	12.0	0.0	0.0	11.7	0.0	0.0	1.5	38.8	2.6	14.9	12.3	0.7
Prop In Lane	0.35		0.07	0.44		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	230	0	0	215	0		41	885	750	528	1128	936
V/C Ratio(X)	0.68	0.00	0.00	0.62	0.00		0.53	0.81	0.09	0.81	0.40	0.03
Avail Cap(c_a), veh/h	453	0	0	432	0		222	934	791	988	1128	936
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	43.2	0.0	0.0	42.9	0.0	0.0	51.0	19.3	11.2	41.9	6.5	4.7
Incr Delay (d2), s/veh	2.6	0.0	0.0	3.0	0.0	0.0	7.6	5.7	0.1	2.3	0.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.0	0.0	0.0	3.5	0.0	0.0	0.6	13.4	0.7	5.3	3.1	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	45.8	0.0	0.0	45.9	0.0	0.0	58.6	24.9	11.3	44.3	6.8	4.7
LnGrp LOS	D	A	A	D	A		E	C	B	D	A	A
Approach Vol, veh/h		156			134			812			909	
Approach Delay, s/veh		45.8			45.9			24.7			24.4	
Approach LOS		D			D			C			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.9	78.9		20.5	23.0	62.8		20.5				
Change Period (Y+Rc), s	4.5	6.0		6.0	4.5	6.0		6.0				
Max Green Setting (Gmax), s	15.0	60.0		31.0	35.0	60.0		31.0				
Max Q Clear Time (g_c+I1), s	3.5	14.3		13.7	16.9	40.8		14.0				
Green Ext Time (p_c), s	0.0	18.9		0.5	1.6	15.9		0.4				

Intersection Summary	
HCM 6th Ctrl Delay	27.6
HCM 6th LOS	C

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	2.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↰	↱		↰	↑	↱
Traffic Vol, veh/h	20	5	35	5	5	10	40	735	30	20	450	10
Future Vol, veh/h	20	5	35	5	5	10	40	735	30	20	450	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	500	-	160
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	9	9	9	9	9	9	9	9	9	9	9	9
Mvmt Flow	23	6	40	6	6	11	45	835	34	23	511	11

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1508	1516	511	1528	1510	852	522	0	0	869	0	0
Stage 1	557	557	-	942	942	-	-	-	-	-	-	-
Stage 2	951	959	-	586	568	-	-	-	-	-	-	-
Critical Hdwy	7.19	6.59	6.29	7.19	6.59	6.29	4.19	-	-	4.19	-	-
Critical Hdwy Stg 1	6.19	5.59	-	6.19	5.59	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.19	5.59	-	6.19	5.59	-	-	-	-	-	-	-
Follow-up Hdwy	3.581	4.081	3.381	3.581	4.081	3.381	2.281	-	-	2.281	-	-
Pot Cap-1 Maneuver	96	115	549	92	116	349	1010	-	-	746	-	-
Stage 1	502	501	-	307	332	-	-	-	-	-	-	-
Stage 2	303	326	-	484	495	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	84	106	549	77	107	349	1010	-	-	746	-	-
Mov Cap-2 Maneuver	84	106	-	77	107	-	-	-	-	-	-	-
Stage 1	479	485	-	293	317	-	-	-	-	-	-	-
Stage 2	275	311	-	430	480	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	39	34.9	0.4	0.4
HCM LOS	E	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1010	-	-	172	143	746	-	-
HCM Lane V/C Ratio	0.045	-	-	0.396	0.159	0.03	-	-
HCM Control Delay (s)	8.7	-	-	39	34.9	10	-	-
HCM Lane LOS	A	-	-	E	D	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1.7	0.5	0.1	-	-

HCM 6th Signalized Intersection Summary
6: OR 551 & Ehlen Road

Short-Term (2030) AM



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	140	385	25	50	295	40	55	625	30	40	420	30
Future Volume (veh/h)	140	385	25	50	295	40	55	625	30	40	420	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614
Adj Flow Rate, veh/h	152	418	27	54	321	43	60	679	33	43	457	33
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	10	10	10	10	10	10	10	10	10	10	10	10
Cap, veh/h	178	489	32	68	354	47	75	759	643	53	736	624
Arrive On Green	0.12	0.33	0.32	0.04	0.25	0.24	0.05	0.47	0.47	0.03	0.46	0.46
Sat Flow, veh/h	1537	1499	97	1537	1393	187	1537	1614	1367	1537	1614	1367
Grp Volume(v), veh/h	152	0	445	54	0	364	60	679	33	43	457	33
Grp Sat Flow(s),veh/h/ln	1537	0	1596	1537	0	1580	1537	1614	1367	1537	1614	1367
Q Serve(g_s), s	12.4	0.0	33.3	4.4	0.0	28.5	4.9	49.1	1.7	3.6	27.4	1.7
Cycle Q Clear(g_c), s	12.4	0.0	33.3	4.4	0.0	28.5	4.9	49.1	1.7	3.6	27.4	1.7
Prop In Lane	1.00		0.06	1.00		0.12	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	178	0	520	68	0	402	75	759	643	53	736	624
V/C Ratio(X)	0.86	0.00	0.86	0.80	0.00	0.91	0.81	0.89	0.05	0.82	0.62	0.05
Avail Cap(c_a), veh/h	421	0	520	421	0	450	241	783	664	241	783	664
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	55.4	0.0	40.3	60.5	0.0	46.2	60.2	30.9	18.3	61.3	26.3	19.3
Incr Delay (d2), s/veh	8.5	0.0	12.9	14.6	0.0	19.8	13.8	12.9	0.0	19.8	1.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.0	0.0	14.2	2.0	0.0	13.1	2.1	20.1	0.5	1.6	10.1	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	64.0	0.0	53.2	75.1	0.0	66.0	74.0	43.8	18.4	81.1	28.0	19.4
LnGrp LOS	E	A	D	E	A	E	E	D	B	F	C	B
Approach Vol, veh/h		597			418			772			533	
Approach Delay, s/veh		55.9			67.2			45.1			31.8	
Approach LOS		E			E			D			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	10.2	62.3	18.8	36.5	8.4	64.1	9.6	45.6
Change Period (Y+Rc), s	4.0	6.0	4.0	* 5.4	4.0	6.0	4.0	* 5.4
Max Green Setting (Gmax), s	20.0	60.0	35.0	* 35	20.0	60.0	35.0	* 35
Max Q Clear Time (g_c+I1), s	6.9	29.4	14.4	30.5	5.6	51.1	6.4	35.3
Green Ext Time (p_c), s	0.1	12.8	0.4	0.6	0.0	7.0	0.1	0.0

Intersection Summary	
HCM 6th Ctrl Delay	48.8
HCM 6th LOS	D

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	0	5	205	60	5
Future Vol, veh/h	5	0	5	205	60	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	0	0	2	2	7	7
Mvmt Flow	6	0	6	236	69	6

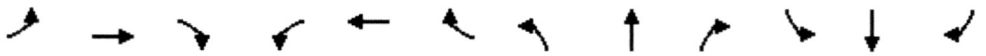
Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	320	72	75	0	-	0
Stage 1	72	-	-	-	-	-
Stage 2	248	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.12	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.218	-	-	-
Pot Cap-1 Maneuver	678	996	1524	-	-	-
Stage 1	956	-	-	-	-	-
Stage 2	798	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	675	996	1524	-	-	-
Mov Cap-2 Maneuver	675	-	-	-	-	-
Stage 1	951	-	-	-	-	-
Stage 2	798	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.4	0.2	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1524	-	675	-	-
HCM Lane V/C Ratio	0.004	-	0.009	-	-
HCM Control Delay (s)	7.4	0	10.4	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

HCM 6th Signalized Intersection Summary
1: Airport Road & Arndt Road

Short-Term (2030) PM



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	770	65	10	585	115	60	45	35	185	60	30
Future Volume (veh/h)	10	770	65	10	585	115	60	45	35	185	60	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.98	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709
Adj Flow Rate, veh/h	11	846	71	11	643	126	66	49	38	203	66	33
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	328	1901	160	409	870	170	264	82	63	282	138	69
Arrive On Green	0.03	0.63	0.61	0.03	0.63	0.61	0.07	0.09	0.07	0.10	0.13	0.11
Sat Flow, veh/h	1628	3032	254	1628	1388	272	1628	886	687	1628	1075	537
Grp Volume(v), veh/h	11	453	464	11	0	769	66	0	87	203	0	99
Grp Sat Flow(s),veh/h/ln	1628	1624	1663	1628	0	1660	1628	0	1573	1628	0	1612
Q Serve(g_s), s	0.3	15.6	15.7	0.3	0.0	35.0	3.9	0.0	5.8	11.0	0.0	6.2
Cycle Q Clear(g_c), s	0.3	15.6	15.7	0.3	0.0	35.0	3.9	0.0	5.8	11.0	0.0	6.2
Prop In Lane	1.00		0.15	1.00		0.16	1.00		0.44	1.00		0.33
Lane Grp Cap(c), veh/h	328	1018	1043	409	0	1040	264	0	145	282	0	207
V/C Ratio(X)	0.03	0.45	0.45	0.03	0.00	0.74	0.25	0.00	0.60	0.72	0.00	0.48
Avail Cap(c_a), veh/h	398	1171	1199	478	0	1197	324	0	378	282	0	388
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	12.1	10.4	10.5	7.5	0.0	14.2	40.0	0.0	47.6	39.4	0.0	44.1
Incr Delay (d2), s/veh	0.0	1.0	1.0	0.0	0.0	4.7	0.4	0.0	2.9	8.1	0.0	1.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	5.1	5.3	0.1	0.0	12.4	1.5	0.0	2.3	5.2	0.0	2.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	12.1	11.4	11.5	7.5	0.0	18.9	40.4	0.0	50.6	47.5	0.0	45.4
LnGrp LOS	B	B	B	A	A	B	D	A	D	D	A	D
Approach Vol, veh/h		928			780			153			302	
Approach Delay, s/veh		11.5			18.7			46.2			46.8	
Approach LOS		B			B			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	11.1	17.9	7.4	71.8	15.0	14.0	7.4	71.8
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Green Setting (Gmax), s	9.0	24.0	6.0	76.0	9.0	24.0	6.0	76.0
Max Q Clear Time (g_c+I1), s	5.9	8.2	2.3	37.0	13.0	7.8	2.3	17.7
Green Ext Time (p_c), s	0.0	0.2	0.0	28.8	0.0	0.2	0.0	37.8

Intersection Summary	
HCM 6th Ctrl Delay	21.5
HCM 6th LOS	C

Intersection	
Int Delay, s/veh	2.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	30	30	10	65	160	15
Future Vol, veh/h	30	30	10	65	160	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	75	75	75	75	75	75
Heavy Vehicles, %	4	4	6	6	2	2
Mvmt Flow	40	40	13	87	213	20

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	336	223	233	0	-	0
Stage 1	223	-	-	-	-	-
Stage 2	113	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.16	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.254	-	-	-
Pot Cap-1 Maneuver	655	812	1311	-	-	-
Stage 1	809	-	-	-	-	-
Stage 2	907	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	648	812	1311	-	-	-
Mov Cap-2 Maneuver	648	-	-	-	-	-
Stage 1	801	-	-	-	-	-
Stage 2	907	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.6	1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1311	-	721	-	-
HCM Lane V/C Ratio	0.01	-	0.111	-	-
HCM Control Delay (s)	7.8	0	10.6	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.4	-	-

Intersection	
Int Delay, s/veh	12.6

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	15	455	510	65	150	30
Future Vol, veh/h	15	455	510	65	150	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	7	7	5	5	2	2
Mvmt Flow	17	523	586	75	172	34

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	661	0	-	0	1181	624
Stage 1	-	-	-	-	624	-
Stage 2	-	-	-	-	557	-
Critical Hdwy	4.17	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.263	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	904	-	-	-	210	485
Stage 1	-	-	-	-	534	-
Stage 2	-	-	-	-	574	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	904	-	-	-	204	485
Mov Cap-2 Maneuver	-	-	-	-	204	-
Stage 1	-	-	-	-	520	-
Stage 2	-	-	-	-	574	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	85.1
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	904	-	-	-	226
HCM Lane V/C Ratio	0.019	-	-	-	0.915
HCM Control Delay (s)	9.1	0	-	-	85.1
HCM Lane LOS	A	A	-	-	F
HCM 95th %tile Q(veh)	0.1	-	-	-	7.7

HCM 6th Signalized Intersection Summary
4: OR 551 & Arndt Road

Short-Term (2030) PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	40	110	20	90	95	490	5	395	50	700	665	55
Future Volume (veh/h)	40	110	20	90	95	490	5	395	50	700	665	55
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668
Adj Flow Rate, veh/h	42	116	21	95	100	0	5	416	53	737	700	58
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	6	6	6	6	6	6	6	6	6	6	6	6
Cap, veh/h	94	218	36	166	139		18	669	567	851	1111	941
Arrive On Green	0.18	0.20	0.18	0.18	0.20	0.00	0.01	0.40	0.40	0.28	0.67	0.67
Sat Flow, veh/h	243	1072	175	553	683	1414	1589	1668	1414	3082	1668	1414
Grp Volume(v), veh/h	179	0	0	195	0	0	5	416	53	737	700	58
Grp Sat Flow(s),veh/h/ln	1490	0	0	1236	0	1414	1589	1668	1414	1541	1668	1414
Q Serve(g_s), s	0.0	0.0	0.0	4.9	0.0	0.0	0.3	20.1	2.4	22.9	24.4	1.4
Cycle Q Clear(g_c), s	10.9	0.0	0.0	15.8	0.0	0.0	0.3	20.1	2.4	22.9	24.4	1.4
Prop In Lane	0.23		0.12	0.49		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	318	0	0	280	0		18	669	567	851	1111	941
V/C Ratio(X)	0.56	0.00	0.00	0.70	0.00		0.28	0.62	0.09	0.87	0.63	0.06
Avail Cap(c_a), veh/h	506	0	0	455	0		244	1026	870	1085	1111	941
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.4	0.0	0.0	39.0	0.0	0.0	49.4	24.1	18.8	34.7	9.7	5.9
Incr Delay (d2), s/veh	1.2	0.0	0.0	3.1	0.0	0.0	5.9	1.4	0.1	5.8	1.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.0	0.0	0.0	4.8	0.0	0.0	0.1	7.3	0.7	8.6	6.9	0.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	37.6	0.0	0.0	42.1	0.0	0.0	55.3	25.4	18.9	40.5	11.0	5.9
LnGrp LOS	D	A	A	D	A		E	C	B	D	B	A
Approach Vol, veh/h		179			195			474			1495	
Approach Delay, s/veh		37.6			42.1			25.0			25.3	
Approach LOS		D			D			C			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	5.2	71.1		24.5	31.8	44.4		24.5				
Change Period (Y+Rc), s	4.5	6.0		6.0	4.5	6.0		6.0				
Max Green Setting (Gmax), s	15.0	60.0		31.0	35.0	60.0		31.0				
Max Q Clear Time (g_c+I1), s	2.3	26.4		17.8	24.9	22.1		12.9				
Green Ext Time (p_c), s	0.0	24.6		0.7	2.4	16.4		0.5				

Intersection Summary												
HCM 6th Ctrl Delay			27.6									
HCM 6th LOS			C									

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	5.3

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↰	↱		↰	↑	↱
Traffic Vol, veh/h	10	5	50	15	25	15	30	430	5	10	750	35
Future Vol, veh/h	10	5	50	15	25	15	30	430	5	10	750	35
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	500	-	160
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	6	6	6	6	6	6	6	6	6	6	6	6
Mvmt Flow	12	6	60	18	30	18	36	518	6	12	904	42

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1545	1524	904	1575	1563	521	946	0	0	524	0	0
Stage 1	928	928	-	593	593	-	-	-	-	-	-	-
Stage 2	617	596	-	982	970	-	-	-	-	-	-	-
Critical Hdwy	7.16	6.56	6.26	7.16	6.56	6.26	4.16	-	-	4.16	-	-
Critical Hdwy Stg 1	6.16	5.56	-	6.16	5.56	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.16	5.56	-	6.16	5.56	-	-	-	-	-	-	-
Follow-up Hdwy	3.554	4.054	3.354	3.554	4.054	3.354	2.254	-	-	2.254	-	-
Pot Cap-1 Maneuver	91	116	330	87	109	548	709	-	-	1023	-	-
Stage 1	316	341	-	485	487	-	-	-	-	-	-	-
Stage 2	471	486	-	295	326	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	65	109	330	65	102	548	709	-	-	1023	-	-
Mov Cap-2 Maneuver	65	109	-	65	102	-	-	-	-	-	-	-
Stage 1	300	337	-	460	462	-	-	-	-	-	-	-
Stage 2	404	461	-	234	322	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	38	79.5	0.7	0.1
HCM LOS	E	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	709	-	-	185	109	1023	-	-
HCM Lane V/C Ratio	0.051	-	-	0.423	0.608	0.012	-	-
HCM Control Delay (s)	10.3	-	-	38	79.5	8.6	-	-
HCM Lane LOS	B	-	-	E	F	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	1.9	3	0	-	-

HCM 6th Signalized Intersection Summary
6: OR 551 & Ehlen Road

Short-Term (2030) PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	350	25	90	430	30	40	360	25	110	650	55
Future Volume (veh/h)	75	350	25	90	430	30	40	360	25	110	650	55
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668
Adj Flow Rate, veh/h	83	389	28	100	478	33	44	400	28	122	722	61
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	6	6	6	6	6	6	6	6	6	6	6
Cap, veh/h	104	426	31	124	447	31	55	710	602	145	805	682
Arrive On Green	0.07	0.28	0.27	0.08	0.29	0.28	0.03	0.43	0.43	0.09	0.48	0.48
Sat Flow, veh/h	1589	1535	110	1589	1540	106	1589	1668	1414	1589	1668	1414
Grp Volume(v), veh/h	83	0	417	100	0	511	44	400	28	122	722	61
Grp Sat Flow(s),veh/h/ln	1589	0	1645	1589	0	1646	1589	1668	1414	1589	1668	1414
Q Serve(g_s), s	6.5	0.0	30.7	7.8	0.0	36.4	3.4	22.7	1.5	9.5	49.5	2.9
Cycle Q Clear(g_c), s	6.5	0.0	30.7	7.8	0.0	36.4	3.4	22.7	1.5	9.5	49.5	2.9
Prop In Lane	1.00		0.07	1.00		0.06	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	104	0	457	124	0	478	55	710	602	145	805	682
V/C Ratio(X)	0.80	0.00	0.91	0.81	0.00	1.07	0.80	0.56	0.05	0.84	0.90	0.09
Avail Cap(c_a), veh/h	443	0	478	443	0	478	253	825	699	253	825	699
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	57.8	0.0	43.8	56.9	0.0	44.5	60.1	27.2	21.1	56.1	29.6	17.6
Incr Delay (d2), s/veh	10.0	0.0	21.0	9.0	0.0	61.0	17.9	1.0	0.0	9.4	12.7	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.8	0.0	14.5	3.4	0.0	22.4	1.6	8.6	0.5	4.0	20.7	0.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	67.8	0.0	64.9	65.9	0.0	105.5	78.1	28.2	21.1	65.5	42.3	17.6
LnGrp LOS	E	A	E	E	A	F	E	C	C	E	D	B
Approach Vol, veh/h		500			611			472			905	
Approach Delay, s/veh		65.3			99.0			32.4			43.8	
Approach LOS		E			F			C			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.3	64.5	12.2	40.4	15.4	57.4	13.8	38.8
Change Period (Y+Rc), s	4.0	6.0	4.0	* 5.4	4.0	6.0	4.0	* 5.4
Max Green Setting (Gmax), s	20.0	60.0	35.0	* 35	20.0	60.0	35.0	* 35
Max Q Clear Time (g_c+I1), s	5.4	51.5	8.5	38.4	11.5	24.7	9.8	32.7
Green Ext Time (p_c), s	0.1	6.9	0.2	0.0	0.1	11.8	0.3	0.4

Intersection Summary	
HCM 6th Ctrl Delay	59.5
HCM 6th LOS	E

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	0.6

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	5	10	85	170	5
Future Vol, veh/h	5	5	10	85	170	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	70	70	70	70	70	70
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	7	7	14	121	243	7

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	396	247	250	0	-	0
Stage 1	247	-	-	-	-	-
Stage 2	149	-	-	-	-	-
Critical Hdwy	6.43	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.527	3.327	2.227	-	-	-
Pot Cap-1 Maneuver	607	789	1310	-	-	-
Stage 1	792	-	-	-	-	-
Stage 2	876	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	600	789	1310	-	-	-
Mov Cap-2 Maneuver	600	-	-	-	-	-
Stage 1	783	-	-	-	-	-
Stage 2	876	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.4	0.8	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1310	-	682	-	-
HCM Lane V/C Ratio	0.011	-	0.021	-	-
HCM Control Delay (s)	7.8	0	10.4	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

SECTION 9: HCM REPORTS - SHORT-TERM 2030 BUILD AM AND PM

HCM 6th Signalized Intersection Summary
1: Airport Road & Arndt Road

Short-Term (2030) + Project AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	25	470	66	22	700	315	68	110	11	70	32	10
Future Volume (veh/h)	25	470	66	22	700	315	68	110	11	70	32	10
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		0.98	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1586	1586	1586	1641	1641	1641	1723	1723	1723	1709	1709	1709
Adj Flow Rate, veh/h	28	528	74	25	787	354	76	124	12	79	36	11
Peak Hour Factor	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Percent Heavy Veh, %	12	12	12	8	8	8	2	2	2	3	3	3
Cap, veh/h	122	1712	239	554	684	308	292	174	17	218	143	44
Arrive On Green	0.04	0.64	0.63	0.04	0.64	0.63	0.07	0.11	0.10	0.07	0.11	0.10
Sat Flow, veh/h	1511	2655	371	1563	1064	479	1641	1546	150	1628	1248	381
Grp Volume(v), veh/h	28	299	303	25	0	1141	76	0	136	79	0	47
Grp Sat Flow(s),veh/h/ln	1511	1507	1519	1563	0	1542	1641	0	1696	1628	0	1629
Q Serve(g_s), s	0.7	10.7	10.9	0.6	0.0	78.0	4.8	0.0	9.4	5.1	0.0	3.2
Cycle Q Clear(g_c), s	0.7	10.7	10.9	0.6	0.0	78.0	4.8	0.0	9.4	5.1	0.0	3.2
Prop In Lane	1.00		0.24	1.00		0.31	1.00		0.09	1.00		0.23
Lane Grp Cap(c), veh/h	122	971	980	554	0	992	292	0	191	218	0	187
V/C Ratio(X)	0.23	0.31	0.31	0.05	0.00	1.15	0.26	0.00	0.71	0.36	0.00	0.25
Avail Cap(c_a), veh/h	159	971	980	595	0	992	328	0	363	251	0	349
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	31.2	9.6	9.7	6.7	0.0	22.0	42.7	0.0	52.0	42.9	0.0	49.2
Incr Delay (d2), s/veh	0.7	0.6	0.6	0.0	0.0	79.6	0.3	0.0	3.6	0.7	0.0	0.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	3.3	3.4	0.2	0.0	45.7	1.9	0.0	4.1	2.0	0.0	1.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	31.9	10.1	10.3	6.7	0.0	101.5	43.0	0.0	55.6	43.6	0.0	49.7
LnGrp LOS	C	B	B	A	A	F	D	A	E	D	A	D
Approach Vol, veh/h		630			1166			212			126	
Approach Delay, s/veh		11.2			99.5			51.1			45.9	
Approach LOS		B			F			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	12.3	17.9	9.1	82.0	12.6	17.7	8.8	82.2
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Green Setting (Gmax), s	9.0	24.0	6.0	76.0	9.0	24.0	6.0	76.0
Max Q Clear Time (g_c+I1), s	6.8	5.2	2.7	80.0	7.1	11.4	2.6	12.9
Green Ext Time (p_c), s	0.0	0.1	0.0	0.0	0.0	0.3	0.0	23.8

Intersection Summary	
HCM 6th Ctrl Delay	65.4
HCM 6th LOS	E

Intersection	
Int Delay, s/veh	1.4

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	17	10	25	207	47	20
Future Vol, veh/h	17	10	25	207	47	20
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	12	12	2	2	9	9
Mvmt Flow	20	11	29	238	54	23

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	362	66	77	0	-	0
Stage 1	66	-	-	-	-	-
Stage 2	296	-	-	-	-	-
Critical Hdwy	6.52	6.32	4.12	-	-	-
Critical Hdwy Stg 1	5.52	-	-	-	-	-
Critical Hdwy Stg 2	5.52	-	-	-	-	-
Follow-up Hdwy	3.608	3.408	2.218	-	-	-
Pot Cap-1 Maneuver	618	970	1522	-	-	-
Stage 1	932	-	-	-	-	-
Stage 2	732	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	604	970	1522	-	-	-
Mov Cap-2 Maneuver	604	-	-	-	-	-
Stage 1	911	-	-	-	-	-
Stage 2	732	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.4	0.8	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1522	-	702	-	-
HCM Lane V/C Ratio	0.019	-	0.044	-	-
HCM Control Delay (s)	7.4	0	10.4	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0.1	-	0.1	-	-

Intersection	
Int Delay, s/veh	1.8

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	27	435	400	195	51	16
Future Vol, veh/h	27	435	400	195	51	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	88	88	88	88	88	88
Heavy Vehicles, %	9	9	9	9	9	9
Mvmt Flow	31	494	455	222	58	18

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	677	0	-	0	1122	566
Stage 1	-	-	-	-	566	-
Stage 2	-	-	-	-	556	-
Critical Hdwy	4.19	-	-	-	6.49	6.29
Critical Hdwy Stg 1	-	-	-	-	5.49	-
Critical Hdwy Stg 2	-	-	-	-	5.49	-
Follow-up Hdwy	2.281	-	-	-	3.581	3.381
Pot Cap-1 Maneuver	883	-	-	-	221	511
Stage 1	-	-	-	-	555	-
Stage 2	-	-	-	-	561	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	883	-	-	-	210	511
Mov Cap-2 Maneuver	-	-	-	-	210	-
Stage 1	-	-	-	-	528	-
Stage 2	-	-	-	-	561	-

Approach	EB	WB	SB
HCM Control Delay, s	0.5	0	26.3
HCM LOS			D

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	883	-	-	-	244
HCM Lane V/C Ratio	0.035	-	-	-	0.312
HCM Control Delay (s)	9.2	0	-	-	26.3
HCM Lane LOS	A	A	-	-	D
HCM 95th %tile Q(veh)	0.1	-	-	-	1.3

HCM 6th Signalized Intersection Summary
4: OR 551 & Arndt Road

Short-Term (2030) + Project AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	50	87	10	55	70	668	20	670	65	409	420	25
Future Volume (veh/h)	50	87	10	55	70	668	20	670	65	409	420	25
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		0.98
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adj Flow Rate, veh/h	54	94	11	59	75	0	22	720	70	440	452	27
Peak Hour Factor	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Percent Heavy Veh, %	11	11	11	11	11	11	11	11	11	11	11	11
Cap, veh/h	102	141	15	117	120		41	879	745	538	1127	935
Arrive On Green	0.14	0.16	0.14	0.14	0.16	0.00	0.03	0.55	0.55	0.18	0.70	0.70
Sat Flow, veh/h	366	899	94	439	769	1356	1524	1600	1356	2956	1600	1328
Grp Volume(v), veh/h	159	0	0	134	0	0	22	720	70	440	452	27
Grp Sat Flow(s),veh/h/ln	1359	0	0	1208	0	1356	1524	1600	1356	1478	1600	1328
Q Serve(g_s), s	0.5	0.0	0.0	0.0	0.0	0.0	1.5	39.5	2.6	15.3	12.5	0.7
Cycle Q Clear(g_c), s	12.4	0.0	0.0	11.9	0.0	0.0	1.5	39.5	2.6	15.3	12.5	0.7
Prop In Lane	0.34		0.07	0.44		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	233	0	0	215	0		41	879	745	538	1127	935
V/C Ratio(X)	0.68	0.00	0.00	0.62	0.00		0.53	0.82	0.09	0.82	0.40	0.03
Avail Cap(c_a), veh/h	449	0	0	425	0		220	925	784	978	1127	935
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	43.5	0.0	0.0	43.2	0.0	0.0	51.5	19.8	11.5	42.2	6.5	4.8
Incr Delay (d2), s/veh	2.6	0.0	0.0	2.9	0.0	0.0	7.7	6.0	0.1	2.4	0.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.1	0.0	0.0	3.6	0.0	0.0	0.6	13.8	0.7	5.4	3.1	0.1
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	46.2	0.0	0.0	46.2	0.0	0.0	59.2	25.8	11.6	44.5	6.9	4.8
LnGrp LOS	D	A	A	D	A		E	C	B	D	A	A
Approach Vol, veh/h		159			134			812			919	
Approach Delay, s/veh		46.2			46.2			25.5			24.8	
Approach LOS		D			D			C			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	6.9	79.6		20.8	23.5	63.0		20.8				
Change Period (Y+Rc), s	4.5	6.0		6.0	4.5	6.0		6.0				
Max Green Setting (Gmax), s	15.0	60.0		31.0	35.0	60.0		31.0				
Max Q Clear Time (g_c+I1), s	3.5	14.5		13.9	17.3	41.5		14.4				
Green Ext Time (p_c), s	0.0	18.8		0.5	1.7	15.4		0.4				

Intersection Summary	
HCM 6th Ctrl Delay	28.2
HCM 6th LOS	C

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	2.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔		↰	↱		↰	↑	↱
Traffic Vol, veh/h	20	5	35	5	5	10	40	735	32	20	450	10
Future Vol, veh/h	20	5	35	5	5	10	40	735	32	20	450	10
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	500	-	160
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	9	9	9	9	9	9	9	9	9	9	9	9
Mvmt Flow	23	6	40	6	6	11	45	835	36	23	511	11

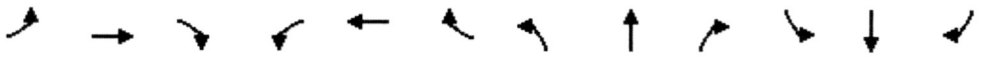
Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1509	1518	511	1529	1511	853	522	0	0	871	0	0
Stage 1	557	557	-	943	943	-	-	-	-	-	-	-
Stage 2	952	961	-	586	568	-	-	-	-	-	-	-
Critical Hdwy	7.19	6.59	6.29	7.19	6.59	6.29	4.19	-	-	4.19	-	-
Critical Hdwy Stg 1	6.19	5.59	-	6.19	5.59	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.19	5.59	-	6.19	5.59	-	-	-	-	-	-	-
Follow-up Hdwy	3.581	4.081	3.381	3.581	4.081	3.381	2.281	-	-	2.281	-	-
Pot Cap-1 Maneuver	95	115	549	92	116	349	1010	-	-	745	-	-
Stage 1	502	501	-	306	332	-	-	-	-	-	-	-
Stage 2	303	326	-	484	495	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	83	106	549	77	107	349	1010	-	-	745	-	-
Mov Cap-2 Maneuver	83	106	-	77	107	-	-	-	-	-	-	-
Stage 1	479	485	-	292	317	-	-	-	-	-	-	-
Stage 2	275	311	-	430	480	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	39.4	34.9	0.4	0.4
HCM LOS	E	D		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1010	-	-	171	143	745	-	-
HCM Lane V/C Ratio	0.045	-	-	0.399	0.159	0.031	-	-
HCM Control Delay (s)	8.7	-	-	39.4	34.9	10	-	-
HCM Lane LOS	A	-	-	E	D	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	1.8	0.5	0.1	-	-

HCM 6th Signalized Intersection Summary
6: OR 551 & Ehlen Road

Short-Term (2030) + Project AM



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	140	390	25	50	296	40	55	627	32	40	420	30
Future Volume (veh/h)	140	390	25	50	296	40	55	627	32	40	420	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614	1614
Adj Flow Rate, veh/h	152	424	27	54	322	43	60	682	35	43	457	33
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	10	10	10	10	10	10	10	10	10	10	10	10
Cap, veh/h	178	490	31	68	355	47	75	759	643	53	736	624
Arrive On Green	0.12	0.33	0.32	0.04	0.25	0.24	0.05	0.47	0.47	0.03	0.46	0.46
Sat Flow, veh/h	1537	1501	96	1537	1394	186	1537	1614	1367	1537	1614	1367
Grp Volume(v), veh/h	152	0	451	54	0	365	60	682	35	43	457	33
Grp Sat Flow(s),veh/h/ln	1537	0	1596	1537	0	1580	1537	1614	1367	1537	1614	1367
Q Serve(g_s), s	12.4	0.0	34.0	4.5	0.0	28.7	5.0	49.7	1.8	3.6	27.5	1.7
Cycle Q Clear(g_c), s	12.4	0.0	34.0	4.5	0.0	28.7	5.0	49.7	1.8	3.6	27.5	1.7
Prop In Lane	1.00		0.06	1.00		0.12	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	178	0	521	68	0	403	75	759	643	53	736	624
V/C Ratio(X)	0.86	0.00	0.87	0.80	0.00	0.91	0.81	0.90	0.05	0.82	0.62	0.05
Avail Cap(c_a), veh/h	420	0	521	420	0	449	240	781	662	240	781	662
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	55.6	0.0	40.5	60.7	0.0	46.3	60.3	31.1	18.4	61.4	26.4	19.4
Incr Delay (d2), s/veh	8.6	0.0	14.0	14.6	0.0	20.1	13.8	13.4	0.0	19.8	1.7	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.0	0.0	14.6	2.0	0.0	13.1	2.1	20.3	0.5	1.6	10.1	0.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	64.1	0.0	54.5	75.3	0.0	66.4	74.1	44.5	18.5	81.2	28.1	19.5
LnGrp LOS	E	A	D	E	A	E	E	D	B	F	C	B
Approach Vol, veh/h		603			419			777			533	
Approach Delay, s/veh		57.0			67.6			45.6			31.9	
Approach LOS		E			E			D			C	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	10.2	62.4	18.8	36.6	8.4	64.2	9.6	45.8
Change Period (Y+Rc), s	4.0	6.0	4.0	* 5.4	4.0	6.0	4.0	* 5.4
Max Green Setting (Gmax), s	20.0	60.0	35.0	* 35	20.0	60.0	35.0	* 35
Max Q Clear Time (g_c+I1), s	7.0	29.5	14.4	30.7	5.6	51.7	6.5	36.0
Green Ext Time (p_c), s	0.1	12.8	0.4	0.6	0.0	6.6	0.1	0.0

Intersection Summary	
HCM 6th Ctrl Delay	49.3
HCM 6th LOS	D

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	0.5

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	7	1	12	207	70	15
Future Vol, veh/h	7	1	12	207	70	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	0	0	2	2	7	7
Mvmt Flow	8	1	14	238	80	17

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	355	89	97	0	-	0
Stage 1	89	-	-	-	-	-
Stage 2	266	-	-	-	-	-
Critical Hdwy	6.4	6.2	4.12	-	-	-
Critical Hdwy Stg 1	5.4	-	-	-	-	-
Critical Hdwy Stg 2	5.4	-	-	-	-	-
Follow-up Hdwy	3.5	3.3	2.218	-	-	-
Pot Cap-1 Maneuver	647	975	1496	-	-	-
Stage 1	940	-	-	-	-	-
Stage 2	783	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	640	975	1496	-	-	-
Mov Cap-2 Maneuver	640	-	-	-	-	-
Stage 1	930	-	-	-	-	-
Stage 2	783	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.5	0.4	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1496	-	669	-	-
HCM Lane V/C Ratio	0.009	-	0.014	-	-
HCM Control Delay (s)	7.4	0	10.5	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Intersection	
Int Delay, s/veh	0.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	1	0	4	220	62	5
Future Vol, veh/h	1	0	4	220	62	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	2	2	2	2	7	7
Mvmt Flow	1	0	5	253	71	6

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	337	74	77	0	-	0
Stage 1	74	-	-	-	-	-
Stage 2	263	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	658	988	1522	-	-	-
Stage 1	949	-	-	-	-	-
Stage 2	781	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	655	988	1522	-	-	-
Mov Cap-2 Maneuver	655	-	-	-	-	-
Stage 1	945	-	-	-	-	-
Stage 2	781	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.5	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1522	-	655	-	-
HCM Lane V/C Ratio	0.003	-	0.002	-	-
HCM Control Delay (s)	7.4	0	10.5	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Intersection	
Int Delay, s/veh	0.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	1	1	3	218	66	5
Future Vol, veh/h	1	1	3	218	66	5
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	2	2	2	2	7	7
Mvmt Flow	1	1	3	251	76	6

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	336	79	82	0	-	0
Stage 1	79	-	-	-	-	-
Stage 2	257	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	659	981	1515	-	-	-
Stage 1	944	-	-	-	-	-
Stage 2	786	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	658	981	1515	-	-	-
Mov Cap-2 Maneuver	658	-	-	-	-	-
Stage 1	942	-	-	-	-	-
Stage 2	786	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	9.6	0.1	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1515	-	788	-	-
HCM Lane V/C Ratio	0.002	-	0.003	-	-
HCM Control Delay (s)	7.4	0	9.6	-	-
HCM Lane LOS	A	A	A	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Intersection						
Int Delay, s/veh	4.3					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	5	0	17	10	0	3
Future Vol, veh/h	5	0	17	10	0	3
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	6	0	20	11	0	3

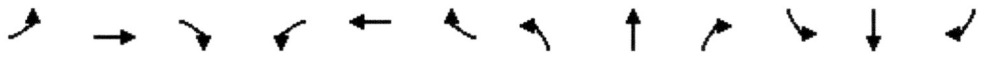
Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	6	0	57	6
Stage 1	-	-	-	-	6	-
Stage 2	-	-	-	-	51	-
Critical Hdwy	-	-	4.12	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	-	-	2.218	-	3.518	3.318
Pot Cap-1 Maneuver	-	-	1615	-	950	1077
Stage 1	-	-	-	-	1017	-
Stage 2	-	-	-	-	971	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1615	-	939	1077
Mov Cap-2 Maneuver	-	-	-	-	939	-
Stage 1	-	-	-	-	1017	-
Stage 2	-	-	-	-	959	-

Approach	EB	WB	NB
HCM Control Delay, s	0	4.6	8.4
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	1077	-	-	1615	-
HCM Lane V/C Ratio	0.003	-	-	0.012	-
HCM Control Delay (s)	8.4	-	-	7.3	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0	-	-	0	-

HCM 6th Signalized Intersection Summary
1: Airport Road & Arndt Road

Short-Term (2030) + Project PM



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	770	68	11	585	115	70	47	41	185	60	30
Future Volume (veh/h)	10	770	68	11	585	115	70	47	41	185	60	30
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		0.99	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709	1709
Adj Flow Rate, veh/h	11	846	75	12	643	126	77	52	45	203	66	33
Peak Hour Factor	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Percent Heavy Veh, %	3	3	3	3	3	3	3	3	3	3	3	3
Cap, veh/h	323	1877	166	404	865	169	273	83	71	280	136	68
Arrive On Green	0.03	0.62	0.60	0.03	0.62	0.60	0.07	0.10	0.08	0.10	0.13	0.11
Sat Flow, veh/h	1628	3017	267	1628	1388	272	1628	839	726	1628	1075	537
Grp Volume(v), veh/h	11	455	466	12	0	769	77	0	97	203	0	99
Grp Sat Flow(s),veh/h/ln	1628	1624	1661	1628	0	1660	1628	0	1565	1628	0	1612
Q Serve(g_s), s	0.3	16.1	16.2	0.3	0.0	35.7	4.5	0.0	6.5	11.0	0.0	6.3
Cycle Q Clear(g_c), s	0.3	16.1	16.2	0.3	0.0	35.7	4.5	0.0	6.5	11.0	0.0	6.3
Prop In Lane	1.00		0.16	1.00		0.16	1.00		0.46	1.00		0.33
Lane Grp Cap(c), veh/h	323	1010	1033	404	0	1034	273	0	154	280	0	204
V/C Ratio(X)	0.03	0.45	0.45	0.03	0.00	0.74	0.28	0.00	0.63	0.73	0.00	0.48
Avail Cap(c_a), veh/h	391	1159	1186	471	0	1185	319	0	373	280	0	384
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	1.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	12.5	10.8	10.9	7.8	0.0	14.6	39.5	0.0	47.8	40.1	0.0	44.7
Incr Delay (d2), s/veh	0.0	1.0	1.0	0.0	0.0	4.8	0.4	0.0	3.1	8.6	0.0	1.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.1	5.3	5.5	0.1	0.0	12.8	1.8	0.0	2.6	5.4	0.0	2.5
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	12.5	11.9	11.9	7.8	0.0	19.4	39.9	0.0	50.9	48.8	0.0	46.0
LnGrp LOS	B	B	B	A	A	B	D	A	D	D	A	D
Approach Vol, veh/h		932			781			174			302	
Approach Delay, s/veh		11.9			19.3			46.0			47.9	
Approach LOS		B			B			D			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	11.9	17.8	7.4	72.1	15.0	14.7	7.5	72.0
Change Period (Y+Rc), s	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Max Green Setting (Gmax), s	9.0	24.0	6.0	76.0	9.0	24.0	6.0	76.0
Max Q Clear Time (g_c+I1), s	6.5	8.3	2.3	37.7	13.0	8.5	2.3	18.2
Green Ext Time (p_c), s	0.0	0.2	0.0	28.4	0.0	0.2	0.0	37.7

Intersection Summary	
HCM 6th Ctrl Delay	22.2
HCM 6th LOS	C

Intersection	
Int Delay, s/veh	2.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	30	30	10	68	171	17
Future Vol, veh/h	30	30	10	68	171	17
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	75	75	75	75	75	75
Heavy Vehicles, %	4	4	6	6	2	2
Mvmt Flow	40	40	13	91	228	23

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	357	240	251	0	-	0
Stage 1	240	-	-	-	-	-
Stage 2	117	-	-	-	-	-
Critical Hdwy	6.44	6.24	4.16	-	-	-
Critical Hdwy Stg 1	5.44	-	-	-	-	-
Critical Hdwy Stg 2	5.44	-	-	-	-	-
Follow-up Hdwy	3.536	3.336	2.254	-	-	-
Pot Cap-1 Maneuver	637	794	1291	-	-	-
Stage 1	795	-	-	-	-	-
Stage 2	903	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	630	794	1291	-	-	-
Mov Cap-2 Maneuver	630	-	-	-	-	-
Stage 1	786	-	-	-	-	-
Stage 2	903	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.8	1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1291	-	703	-	-
HCM Lane V/C Ratio	0.01	-	0.114	-	-
HCM Control Delay (s)	7.8	0	10.8	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.4	-	-

Intersection	
Int Delay, s/veh	15.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	17	455	510	66	155	36
Future Vol, veh/h	17	455	510	66	155	36
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	87	87	87	87	87	87
Heavy Vehicles, %	7	7	5	5	2	2
Mvmt Flow	20	523	586	76	178	41

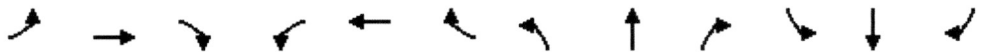
Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	662	0	-	0	1187	624
Stage 1	-	-	-	-	624	-
Stage 2	-	-	-	-	563	-
Critical Hdwy	4.17	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.263	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	903	-	-	-	208	485
Stage 1	-	-	-	-	534	-
Stage 2	-	-	-	-	570	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	903	-	-	-	202	485
Mov Cap-2 Maneuver	-	-	-	-	202	-
Stage 1	-	-	-	-	517	-
Stage 2	-	-	-	-	570	-

Approach	EB	WB	SB
HCM Control Delay, s	0.3	0	96.9
HCM LOS			F

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	903	-	-	-	227
HCM Lane V/C Ratio	0.022	-	-	-	0.967
HCM Control Delay (s)	9.1	0	-	-	96.9
HCM Lane LOS	A	A	-	-	F
HCM 95th %tile Q(veh)	0.1	-	-	-	8.6

HCM 6th Signalized Intersection Summary
4: OR 551 & Arndt Road

Short-Term (2030) + Project PM



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	40	110	20	90	97	498	5	395	50	703	665	55
Future Volume (veh/h)	40	110	20	90	97	498	5	395	50	703	665	55
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668
Adj Flow Rate, veh/h	42	116	21	95	102	0	5	416	53	740	700	58
Peak Hour Factor	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Percent Heavy Veh, %	6	6	6	6	6	6	6	6	6	6	6	6
Cap, veh/h	93	219	36	165	141		18	668	566	853	1110	941
Arrive On Green	0.18	0.20	0.18	0.18	0.20	0.00	0.01	0.40	0.40	0.28	0.67	0.67
Sat Flow, veh/h	242	1070	174	548	691	1414	1589	1668	1414	3082	1668	1414
Grp Volume(v), veh/h	179	0	0	197	0	0	5	416	53	740	700	58
Grp Sat Flow(s),veh/h/ln	1487	0	0	1239	0	1414	1589	1668	1414	1541	1668	1414
Q Serve(g_s), s	0.0	0.0	0.0	5.0	0.0	0.0	0.3	20.2	2.4	23.2	24.5	1.4
Cycle Q Clear(g_c), s	11.0	0.0	0.0	16.0	0.0	0.0	0.3	20.2	2.4	23.2	24.5	1.4
Prop In Lane	0.23		0.12	0.48		1.00	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	319	0	0	282	0		18	668	566	853	1110	941
V/C Ratio(X)	0.56	0.00	0.00	0.70	0.00		0.28	0.62	0.09	0.87	0.63	0.06
Avail Cap(c_a), veh/h	503	0	0	453	0		243	1021	865	1080	1110	941
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	36.5	0.0	0.0	39.1	0.0	0.0	49.7	24.3	18.9	34.9	9.8	5.9
Incr Delay (d2), s/veh	1.2	0.0	0.0	3.1	0.0	0.0	6.0	1.4	0.1	5.9	1.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	4.0	0.0	0.0	4.9	0.0	0.0	0.1	7.4	0.7	8.7	6.9	0.3
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	37.7	0.0	0.0	42.2	0.0	0.0	55.6	25.6	19.0	40.8	11.1	5.9
LnGrp LOS	D	A	A	D	A		E	C	B	D	B	A
Approach Vol, veh/h		179			197			474			1498	
Approach Delay, s/veh		37.7			42.2			25.2			25.6	
Approach LOS		D			D			C			C	

Timer - Assigned Phs	1	2		4	5	6		8				
Phs Duration (G+Y+Rc), s	5.2	71.4		24.7	32.0	44.5		24.7				
Change Period (Y+Rc), s	4.5	6.0		6.0	4.5	6.0		6.0				
Max Green Setting (Gmax), s	15.0	60.0		31.0	35.0	60.0		31.0				
Max Q Clear Time (g_c+I1), s	2.3	26.5		18.0	25.2	22.2		13.0				
Green Ext Time (p_c), s	0.0	24.5		0.7	2.4	16.4		0.5				

Intersection Summary	
HCM 6th Ctrl Delay	27.8
HCM 6th LOS	C

Notes

Unsignalized Delay for [WBR] is excluded from calculations of the approach delay and intersection delay.

Intersection	
Int Delay, s/veh	5.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕		↰	↱		↰	↑	↱
Traffic Vol, veh/h	10	5	50	17	25	15	30	430	5	10	750	35
Future Vol, veh/h	10	5	50	17	25	15	30	430	5	10	750	35
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	500	-	-	500	-	160
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	83	83	83	83	83	83	83	83	83	83	83	83
Heavy Vehicles, %	6	6	6	6	6	6	6	6	6	6	6	6
Mvmt Flow	12	6	60	20	30	18	36	518	6	12	904	42

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1545	1524	904	1575	1563	521	946	0	0	524	0	0
Stage 1	928	928	-	593	593	-	-	-	-	-	-	-
Stage 2	617	596	-	982	970	-	-	-	-	-	-	-
Critical Hdwy	7.16	6.56	6.26	7.16	6.56	6.26	4.16	-	-	4.16	-	-
Critical Hdwy Stg 1	6.16	5.56	-	6.16	5.56	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.16	5.56	-	6.16	5.56	-	-	-	-	-	-	-
Follow-up Hdwy	3.554	4.054	3.354	3.554	4.054	3.354	2.254	-	-	2.254	-	-
Pot Cap-1 Maneuver	91	116	330	87	109	548	709	-	-	1023	-	-
Stage 1	316	341	-	485	487	-	-	-	-	-	-	-
Stage 2	471	486	-	295	326	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	65	109	330	65	102	548	709	-	-	1023	-	-
Mov Cap-2 Maneuver	65	109	-	65	102	-	-	-	-	-	-	-
Stage 1	300	337	-	460	462	-	-	-	-	-	-	-
Stage 2	404	461	-	234	322	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	38	85.4	0.7	0.1
HCM LOS	E	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	709	-	-	185	107	1023	-	-
HCM Lane V/C Ratio	0.051	-	-	0.423	0.642	0.012	-	-
HCM Control Delay (s)	10.3	-	-	38	85.4	8.6	-	-
HCM Lane LOS	B	-	-	E	F	A	-	-
HCM 95th %tile Q(veh)	0.2	-	-	1.9	3.2	0	-	-

HCM 6th Signalized Intersection Summary
6: OR 551 & Ehlen Road

Short-Term (2030) + Project PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	75	351	25	92	435	30	40	360	25	110	652	55
Future Volume (veh/h)	75	351	25	92	435	30	40	360	25	110	652	55
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		0.98	1.00		0.98	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Work Zone On Approach		No			No			No			No	
Adj Sat Flow, veh/h/ln	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668	1668
Adj Flow Rate, veh/h	83	390	28	102	483	33	44	400	28	122	724	61
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	6	6	6	6	6	6	6	6	6	6	6	6
Cap, veh/h	104	424	30	126	447	31	55	710	602	145	805	682
Arrive On Green	0.07	0.28	0.27	0.08	0.29	0.28	0.03	0.43	0.43	0.09	0.48	0.48
Sat Flow, veh/h	1589	1535	110	1589	1541	105	1589	1668	1414	1589	1668	1414
Grp Volume(v), veh/h	83	0	418	102	0	516	44	400	28	122	724	61
Grp Sat Flow(s),veh/h/ln	1589	0	1645	1589	0	1646	1589	1668	1414	1589	1668	1414
Q Serve(g_s), s	6.5	0.0	30.9	7.9	0.0	36.4	3.5	22.7	1.5	9.5	49.8	2.9
Cycle Q Clear(g_c), s	6.5	0.0	30.9	7.9	0.0	36.4	3.5	22.7	1.5	9.5	49.8	2.9
Prop In Lane	1.00		0.07	1.00		0.06	1.00		1.00	1.00		1.00
Lane Grp Cap(c), veh/h	104	0	455	126	0	478	55	710	602	145	805	682
V/C Ratio(X)	0.80	0.00	0.92	0.81	0.00	1.08	0.80	0.56	0.05	0.84	0.90	0.09
Avail Cap(c_a), veh/h	443	0	477	443	0	478	253	824	698	253	824	698
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	57.8	0.0	44.1	56.9	0.0	44.6	60.2	27.2	21.1	56.1	29.7	17.6
Incr Delay (d2), s/veh	10.0	0.0	22.2	8.9	0.0	64.5	17.9	1.0	0.0	9.4	12.9	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.8	0.0	14.7	3.4	0.0	22.8	1.6	8.6	0.5	4.0	20.9	0.9
Unsig. Movement Delay, s/veh												
LnGrp Delay(d),s/veh	67.8	0.0	66.3	65.8	0.0	109.1	78.1	28.2	21.1	65.6	42.6	17.6
LnGrp LOS	E	A	E	E	A	F	E	C	C	E	D	B
Approach Vol, veh/h		501			618			472			907	
Approach Delay, s/veh		66.5			102.0			32.4			44.0	
Approach LOS		E			F			C			D	

Timer - Assigned Phs	1	2	3	4	5	6	7	8
Phs Duration (G+Y+Rc), s	8.3	64.6	12.2	40.4	15.4	57.4	13.9	38.7
Change Period (Y+Rc), s	4.0	6.0	4.0	* 5.4	4.0	6.0	4.0	* 5.4
Max Green Setting (Gmax), s	20.0	60.0	35.0	* 35	20.0	60.0	35.0	* 35
Max Q Clear Time (g_c+I1), s	5.5	51.8	8.5	38.4	11.5	24.7	9.9	32.9
Green Ext Time (p_c), s	0.1	6.8	0.2	0.0	0.1	11.8	0.3	0.3

Intersection Summary	
HCM 6th Ctrl Delay	60.7
HCM 6th LOS	E

Notes

* HCM 6th computational engine requires equal clearance times for the phases crossing the barrier.

Intersection	
Int Delay, s/veh	1.2

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	14	11	12	94	172	7
Future Vol, veh/h	14	11	12	94	172	7
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	70	70	70	70	70	70
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	20	16	17	134	246	10

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	419	251	256	0	-	0
Stage 1	251	-	-	-	-	-
Stage 2	168	-	-	-	-	-
Critical Hdwy	6.43	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.527	3.327	2.227	-	-	-
Pot Cap-1 Maneuver	589	785	1303	-	-	-
Stage 1	788	-	-	-	-	-
Stage 2	859	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	581	785	1303	-	-	-
Mov Cap-2 Maneuver	581	-	-	-	-	-
Stage 1	777	-	-	-	-	-
Stage 2	859	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.8	0.9	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1303	-	656	-	-
HCM Lane V/C Ratio	0.013	-	0.054	-	-
HCM Control Delay (s)	7.8	0	10.8	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.2	-	-

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	4	3	1	98	184	1
Future Vol, veh/h	4	3	1	98	184	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	70	70	70	70	70	70
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	6	4	1	140	263	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	406	264	264	0	-	0
Stage 1	264	-	-	-	-	-
Stage 2	142	-	-	-	-	-
Critical Hdwy	6.43	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.527	3.327	2.227	-	-	-
Pot Cap-1 Maneuver	599	772	1294	-	-	-
Stage 1	778	-	-	-	-	-
Stage 2	883	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	598	772	1294	-	-	-
Mov Cap-2 Maneuver	598	-	-	-	-	-
Stage 1	777	-	-	-	-	-
Stage 2	883	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.5	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1294	-	662	-	-
HCM Lane V/C Ratio	0.001	-	0.015	-	-
HCM Control Delay (s)	7.8	0	10.5	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0	-	-

Intersection	
Int Delay, s/veh	0.3

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	5	3	1	101	182	1
Future Vol, veh/h	5	3	1	101	182	1
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	70	70	70	70	70	70
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	7	4	1	144	260	1

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	407	261	261	0	-	0
Stage 1	261	-	-	-	-	-
Stage 2	146	-	-	-	-	-
Critical Hdwy	6.43	6.23	4.13	-	-	-
Critical Hdwy Stg 1	5.43	-	-	-	-	-
Critical Hdwy Stg 2	5.43	-	-	-	-	-
Follow-up Hdwy	3.527	3.327	2.227	-	-	-
Pot Cap-1 Maneuver	598	775	1298	-	-	-
Stage 1	780	-	-	-	-	-
Stage 2	879	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	597	775	1298	-	-	-
Mov Cap-2 Maneuver	597	-	-	-	-	-
Stage 1	779	-	-	-	-	-
Stage 2	879	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	10.6	0.1	0
HCM LOS	B		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1298	-	653	-	-
HCM Lane V/C Ratio	0.001	-	0.018	-	-
HCM Control Delay (s)	7.8	0	10.6	-	-
HCM Lane LOS	A	A	B	-	-
HCM 95th %tile Q(veh)	0	-	0.1	-	-

Intersection	
Int Delay, s/veh	3.5

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Vol, veh/h	10	0	4	15	0	15
Future Vol, veh/h	10	0	4	15	0	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	70	70	70	70	70	70
Heavy Vehicles, %	3	3	3	3	3	3
Mvmt Flow	14	0	6	21	0	21

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	14	0	47	14
Stage 1	-	-	-	-	14	-
Stage 2	-	-	-	-	33	-
Critical Hdwy	-	-	4.13	-	6.43	6.23
Critical Hdwy Stg 1	-	-	-	-	5.43	-
Critical Hdwy Stg 2	-	-	-	-	5.43	-
Follow-up Hdwy	-	-	2.227	-	3.527	3.327
Pot Cap-1 Maneuver	-	-	1598	-	960	1063
Stage 1	-	-	-	-	1006	-
Stage 2	-	-	-	-	987	-
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	1598	-	956	1063
Mov Cap-2 Maneuver	-	-	-	-	956	-
Stage 1	-	-	-	-	1006	-
Stage 2	-	-	-	-	983	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.5	8.5
HCM LOS			A

Minor Lane/Major Mvmt	NBLn1	EBT	EBR	WBL	WBT
Capacity (veh/h)	1063	-	-	1598	-
HCM Lane V/C Ratio	0.02	-	-	0.004	-
HCM Control Delay (s)	8.5	-	-	7.3	0
HCM Lane LOS	A	-	-	A	A
HCM 95th %tile Q(veh)	0.1	-	-	0	-

SECTION 10: TURN LANE WARRANTS

Right-Turn Lane Warrant Analysis

Project: North Marion County Vertiport Development
Scenario(s): Short-Term 2030 Build

Intersection	Approach (NB,SB, EB,WB)	2-lane or Multi-lane Highway	Volume Advancing (Va)	RT Vol	ODOT RT Lane Warrant	ODOT RT Lane?	NCHRP RT Volume	Taper Warrant	RT Lane Warrant	NCHRP Taper?	NCHRP RT Lane?
AM Project Driveway - South	SB	2-lane	67	5	104	No	5	64	112	No	No
AM Project Driveway - North	SB	2-lane	71	5	103	No	5	63	111	No	No
PM Project Driveway - North	SB	2-lane	185	1	88	No	1	52	96	No	No
PM Project Driveway - South	SB	2-lane	183	1	88	No	1	52	96	No	No

Left Turn Lane Warrant Analysis

Project: North Marion County Vertiport Development
Scenario(s): Short-Term 2030 Build

AM Project Driveways on Airport Road

Intersection	Approach (NB,SB, EB,WB)	Number of Advancing Lanes	Number of Opposing Lanes	Volume Advancing (Va)	LT Vol	LT %	Volume Opposing (Vo)	Warrant Factor	5% Warrant Va	Va Warrant Threshold	HRB Warrant Met?	ODOT Volume	ODOT LT Threshold	ODOT Criteria Met?	Max. Est. Queue	Storage Length (ft)
AM Project Driveway - South	NB	1	1	224	4	2%	67	1.65	524	862	No	291	25	No	0	
AM Project Driveway - North	NB	1	1	221	3	1%	71	1.88	521	982	No	292	25	No	0	

PM Project Driveways on Airport Road

Intersection	Approach (NB,SB, EB,WB)	Number of Advancing Lanes	Number of Opposing Lanes	Volume Advancing (Va)	LT Vol	LT %	Volume Opposing (Vo)	Warrant Factor	5% Warrant Va	Va Warrant Threshold	HRB Warrant Met?	ODOT Volume	ODOT LT Threshold	ODOT Criteria Met?	Max. Est. Queue	Storage Length (ft)
PM Project Driveway - North	NB	1	1	99	1	1%	185	2.18	462	1006	No	284	25	No	0	
PM Project Driveway - South	NB	1	1	102	1	1%	183	2.21	464	1027	No	285	25	No	0	

*The "Consider" note applies when there are high through volumes but less than 10 left turning vehicles.

ODOT LEFT TURN CRITERIA IS BASED ON THE **8-13-03** LEFT TURN CRITERIA
MAX QUEUE AND STORAGE ESTIMATES BASED ON GARD METHOD

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Portland, Oregon ▪ Vancouver, Washington ▪ Seattle, Washington

MEMORANDUM

DATE:	December 13, 2023
TO:	**Aron Faegre**
FROM:	Chad Lawrence
PROJECT NAME:	North Marion County Vertiport/Heliport
PROJECT #:	2180516.01

SUBJECT: **Stormwater Compliance**

The purpose of this memo is to demonstrate that the current site plan (Attachment A – Proposed Site Plan) for the proposed vertiport/heliport is comparable to the 2019 site plan (Attachment B – 2019 Site Plan) for the Aurora Airport Business Center proposal in both impervious area and functionality. Given those similarities, Mackenzie Engineers concludes that the same stormwater infrastructure approach that was used for the previous site plan could be used to satisfy the Marion County Public Works-Land Development Engineering and Oregon DEQ requirements. In particular, the requirements that the post-developed 10-year runoff rate will be discharged at the existing 5-year runoff rate will be satisfied by the proposed design because there is slightly less impervious surface proposed for the vertiport/heliport.

Site Conditions:

The North Marion County Vertiport/Heliport project will require grading and drainage improvements to prepare the site for the proposed development. Similar to the previous site design, the proposed project will consist of office buildings, hangars, parking, and infrastructure improvements for the development. The only significant difference is in the use of this development. This project is for a vertiport/heliport, not airplane use. The property is located on the eastern side of the Aurora State Airport in Aurora, Oregon. The development runoff will discharge into an existing storm ditch along Airport Road NE under the jurisdiction of Marion County.

The proposed site plan will have less than 89% of the site be impervious. This is similar to, but slightly less than, the previous site plan which had 89.7% of site impervious area. Maintaining a similar impervious area will ensure that the same stormwater approach can be used for the proposed site plan. See Attachment A – Proposed Site Plan for additional information.

The drainage system for detention will need to follow the pre-established design criteria developed specifically to accomplish the detention requirements governed by Marion County and provide geometric characteristics for taxiways that accommodate special grading requirements for aircraft and rotorcraft. Specifically, cross slopes and longitudinal slopes of taxiways shall be limited to around 1.0% maximum to ensure adequate aircraft and rotorcraft maneuverability.

The site conditions detailed above are aligned with the previous site conditions that had been approved by Marion County Public Works-Land Development Engineering and Oregon DEQ.

Storm Water Approach:

The proposed site can detain the required amount of volume by using a similar approach to the one outlined in Attachment C – December 2018 Stormwater Report. The proposed stormwater site plan will utilize a combination of 18" strip drains, detention pipes, and detention ponds. These elements detain the water ahead of release off-site and allow some surface ponding to occur. When the detention volume is met there is an overflow control structure that collects the water and conveys it to the existing ditch along Airport Way. The flow leaving the site will be limited by an orifice and will comply with the Marion County Public Works Standards.

Conveyance calculations for the Airport Road NE ditch, which is the natural drainage path for this proposed development, are satisfied by the calculations shown in the December 2018 storm report in regard to the proposed changes to the previous site design. This is due to multiple factors including the impervious area remaining at 89.7% or less (less than 89% in this instance), the similar approach in storm infrastructure (strip drains, detention pipes, detention pond, and layout), and a similar methodology. The calculation methodology conservatively did not consider the time of concentration for the northernmost water to travel 6,426 feet along the Airport Way ditch. Therefore, it is unlikely that the flow will be as high as shown in the calculations. Regardless, the calculations showed that the existing ditch has capacity to convey the 5-year design discharge rate for the 53-acre Basin of the ditch. Since the ditch was shown to have the capacity for the previous site design, this indicates it will have the capacity for the proposed site design.

Downstream Analysis:

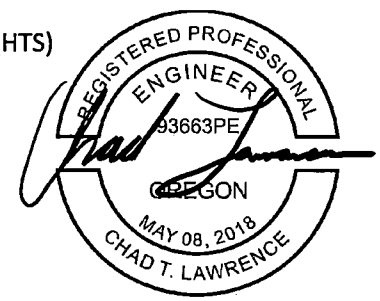
A downstream analysis was provided for the downstream storm system along Airport Road as part of the existing storm report. The ditch along Airport Road south of the intersection of Keil Road has already been analyzed (see Attachment D - 2010 Downstream Analysis and Detention Design – Helicopter Transport Services) and it was determined that it had adequate capacity for the 110-acre basin containing this site within the Aurora State Airport. Since the proposed flow leaving the site will be similar, if not less than the previous site design, downstream analysis impacts would be the same.

Cumulative Impacts:

In our professional opinion, there should be no adverse cumulative effects of the proposed development and future development in the area. The analysis of the Airport Road stormwater ditch and the downstream analysis demonstrates that the system has the capacity to handle the proposed development and reasonably anticipated development that manages stormwater as prescribed by the county and state. We are not aware of any existing development in the area of the airport being in violation of state or federal environmental standards concerning stormwater. Our understanding is that Marion County and Oregon DEQ standards are in compliance with applicable state and federal standards and our project stormwater management will be in compliance with those local standards.

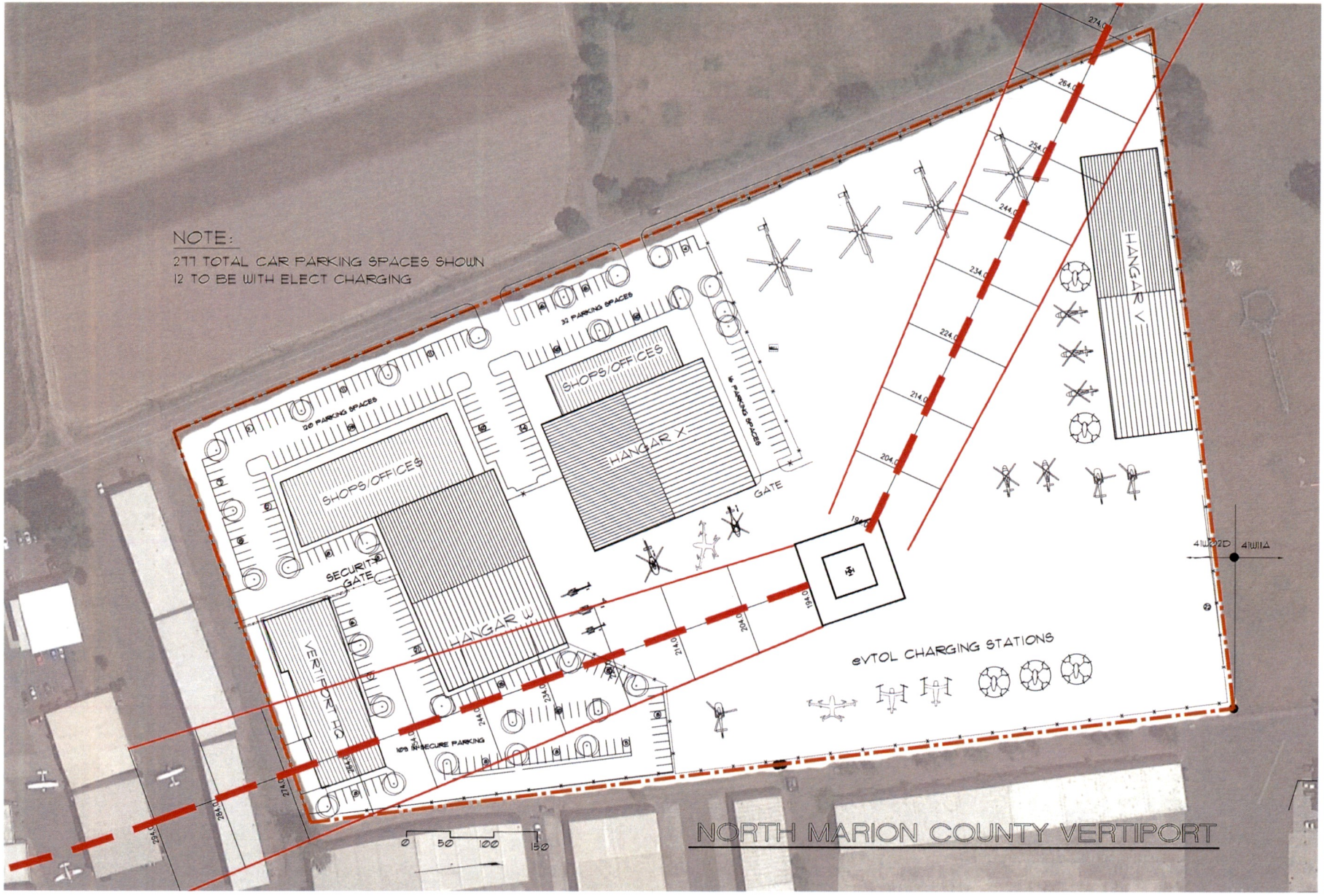
Enclosure(s): Attachment A – Proposed Site Plan
Attachment B – 2019 Site Plan
Attachment C – December 2018 Stormwater Report
Attachment D – 2010 Downstream Analysis and Detention Design (HTS)

c: Aron Faegre – Aron Faegre Architect



EXPIRES: 12/31/2024

Attachment A – Proposed Site Plan



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REGISTERED ARCHITECT
ARON FAEGRE
LAKE OSWEGO OREGON
STATE OF OREGON

NORTH MARION COUNTY VERTIPORT

SITE PLAN

AIRPORT ROAD - AURORA, OREGON

SITE PLAN

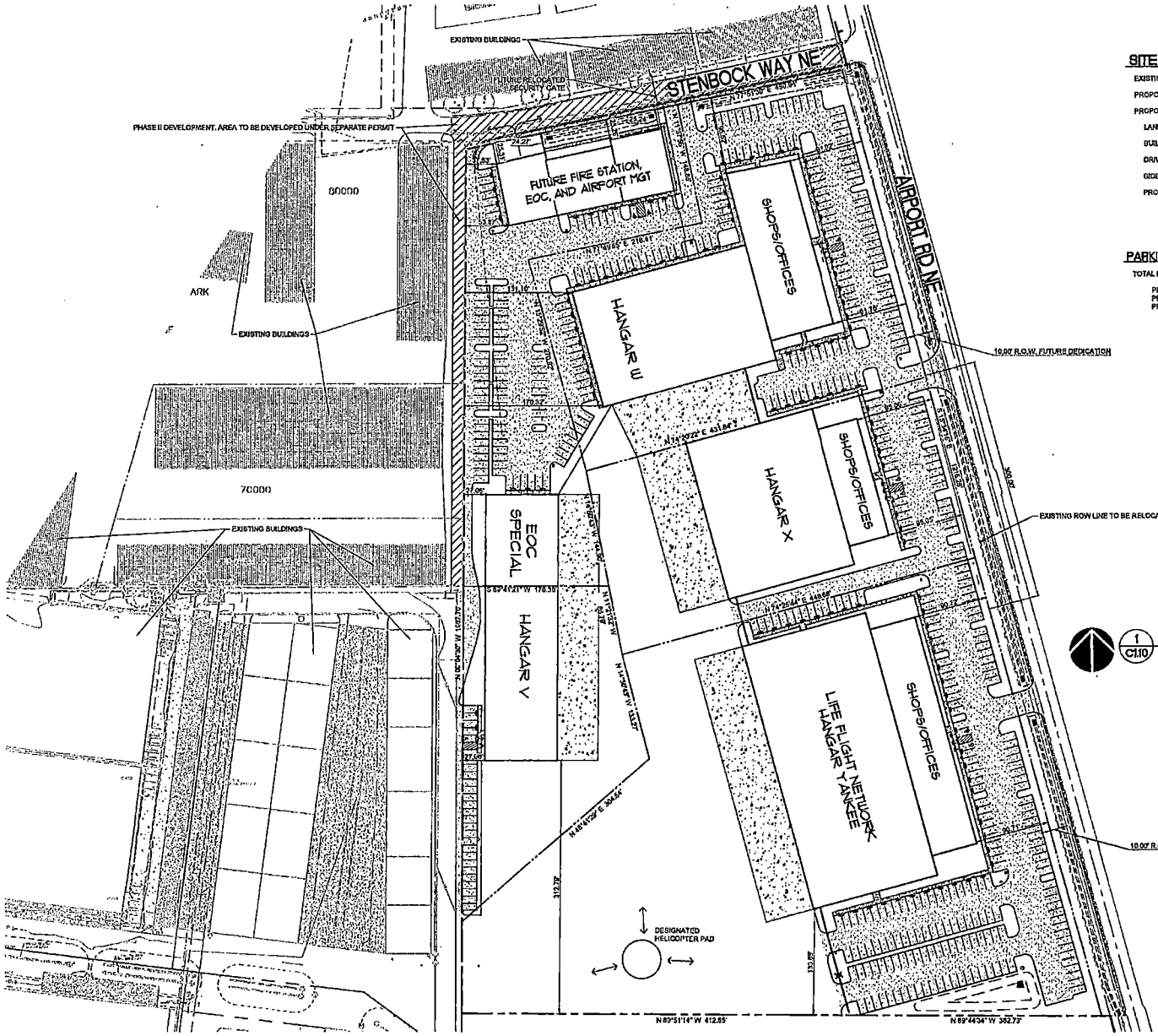
DATE: 12-15-2023

CHECKED BY: AF

REVISIONS

PAGE: L1.0

Attachment B – 2019 Site Plan



SITE DATA

EXISTING SITE AREA	716,604 SF	16.45 AC	
PROPOSED RIGHT-OF-WAY DEDICATION	12,152 SF	0.28 AC	
PROPOSED SITE AREA	704,351 SF	16.17 AC	
LANDSCAPE AREA	72,564 SF	1.67 AC	10.3%
BUILDING FOOTPRINT AREA	202,555 SF+-	4.65 AC	
DRIVE AISLE/PARKING AREA	415,749 SF	9.54 AC	
SIDEWALK/HARDSCAPE AREA	13,453 SF	0.31 AC	
PROPOSED SITE IMPERVIOUS AREA	631,757 SF	14.50 AC	89.7%

PARKING DATA

TOTAL PROPOSED PARKING SPACES PROVIDED	501
PROPOSED UNIVERSAL PARKING SPACES (9'x18'), (9'x10')	490
PROPOSED ADA PARKING SPACES	9
PROPOSED VAN ONLY SPACES	2

1 C1.10 OVERALL SITE PLAN

0 0 30 60 120 240
(IN FEET)
1 inch = 60 ft

PERMIT SET: 1-4-2021

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Planning • Engineering

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Client
ARON FAEGRE
ARCHITECT

Project
AURORA AIRPARK
BUSINESS CENTER

REGISTERED PROFESSIONAL ENGINEER
STATE OF OREGON
BRIAN C. HOLLENBECK
EXPIRES: 06/30/21

MACKENZIE, 2020
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REVISIONS:

REVISION DELTA	REVISION DELTA CLOSING DATE

SHEET TITLE:
OVERALL SITE PLAN

DRAWN BY: CTL
CHECKED BY: MWB
SHEET:
C1.10
JOB NO. 2180518.00

Attachment C – December 2018 Stormwater Report

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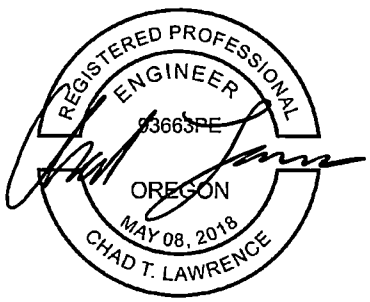

EXPIRES: 12-31-2020

STORMWATER REPORT

AURORA AIRPORT BUSINESS CENTER Downstream Analysis and Site Detention Design

To
Marion County
Department of Public Works

Prepared
October 23rd, 2020

Project Number
2180516.00

MACKENZIE.
RiverEast Center, 1515 SE Water Ave #100, Portland, OR 97214
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H:\Projects\217018500\Design\516-Storm\STORMREPORT.docx

1. INTRODUCTION

This project consists of grading and drainage improvements to prepare the site for Aurora Airport Business Center. The business center will consist of office buildings, hangars, parking, and infrastructure improvements for the development. The property is located on the eastern side of the Aurora State Airport in Aurora, OR. The development runoff will discharge into an existing storm ditch along Airport Road NE. See attached map showing the property.

The proposed drainage system for detention follows the pre-established design criteria developed specifically to accomplish the detention requirements governed by Marion County and provide geometric characteristics for taxiways that accommodate special grading requirements for aircraft. Specifically, cross slopes and longitudinal slopes of taxiways shall be limited to around 1.0% maximum to ensure adequate aircraft maneuverability.

2. PURPOSE

The purpose of this report is to demonstrate the feasibility of the future drainage improvements with Marion County Public Works-Land Development Engineering Requirements. The post-developed 10-yr runoff rate will be discharged at the existing 5-yr runoff rate.

The site is able to detain the required amount of volume by using a series of 18" strip drains. The strip drains hold the water and allow some surface ponding to occur. When the detention volume is met there are overflow catch basins that collect the water and convey it to the ditech along Airport Way. The flow leaving the strip drains will have an orifice and comply with the Marion County Standards.

Conveyance calculations are provided for the Airport Road NE ditch, which is the natural drainage path for this proposed development. The calculation methodology does not consider the time of concentration for the northern most water to travel 6,426 FT along the Airport Way ditch. Therefore, it is unlikely that the flow will be as high as shown in our calculations. Our calculations show that the existing ditch has capacity to convey the 5-year design discharge rate for the 53 AC Basin.

A downstream analysis is provided for the downstream storm system along Airport Road. The ditch along Airport Road south of the intersection of Keil road has already been analyzed (2010 Downstream Analysis and Detention Design – Helicopter Transport Services) and it was determined that it had adequate capacity for the 110 AC Basin in the Aurora State Airport.

1. INTRODUCTION

This project consists of grading and drainage improvements to prepare the site for Aurora Airport Business Center. The business center will consist of office buildings, hangars, parking, and infrastructure improvements for the development. The property is located on the eastern side of the Aurora State Airport in Aurora, OR. The development runoff will discharge into an existing storm ditch along Airport Road NE. See attached map showing the property.

The proposed drainage system for detention follows the pre-established design criteria developed specifically to accomplish the detention requirements governed by Marion County and provide geometric characteristics for taxiways that accommodate special grading requirements for aircraft. Specifically, cross slopes and longitudinal slopes of taxiways shall be limited to around 1.0% maximum to ensure adequate aircraft maneuverability.

2. PURPOSE

The purpose of this report is to demonstrate the compliance of the improvements with Marion County Public Works-Land Development Engineering Requirements. The post-developed 10-yr runoff rate will be discharged at the existing 5-yr runoff rate.

The site is able to detain the required amount of volume by using a series of 18" strip drains, detention pipes, and one detention pond. The detention elements hold the water and allow some surface ponding to occur. When the detention volume is met there is an overflow control structure that collect the water and convey it to the ditch along Airport Way. The flow leaving the site will be limited by an orifice and comply with the Marion County Standards.

Conveyance calculations are provided for the Airport Road NE ditch, which is the natural drainage path for this proposed development. The calculation methodology does not consider the time of concentration for the northern most water to travel 6,426 FT along the Airport Way ditch. Therefore, it is unlikely that the flow will be as high as shown in our calculations. Our calculations show that the existing ditch has capacity to convey the 5-year design discharge rate for the 53 AC Basin.

A downstream analysis is provided for the downstream storm system along Airport Road. The ditch along Airport Road south of the intersection of Keil road has already been analyzed (2010 Downstream Analysis and Detention Design – Helicopter Transport Services) and it was determined that it had adequate capacity for the 110 AC Basin in the Aurora State Airport.

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3. DESIGN ASSUMPTIONS AND METHODOLOGY

Standards	Marion County Engineering Standards (MC)	
Method:	Rational Method, using ODOT Hydraulics Manual (ODOT) and Marion County IDF Curve	
Design Storm:	Pre-Developed:	MC 5-year
	Developed:	MC 10-year
	Intensity:	MC Table I-D Curves
Time of Concentration:	Kinematic Wave Equation, 10 min. minimum, MC	
Runoff Coefficients:	MC Table 10	

Please see the appendix for all design calculations.

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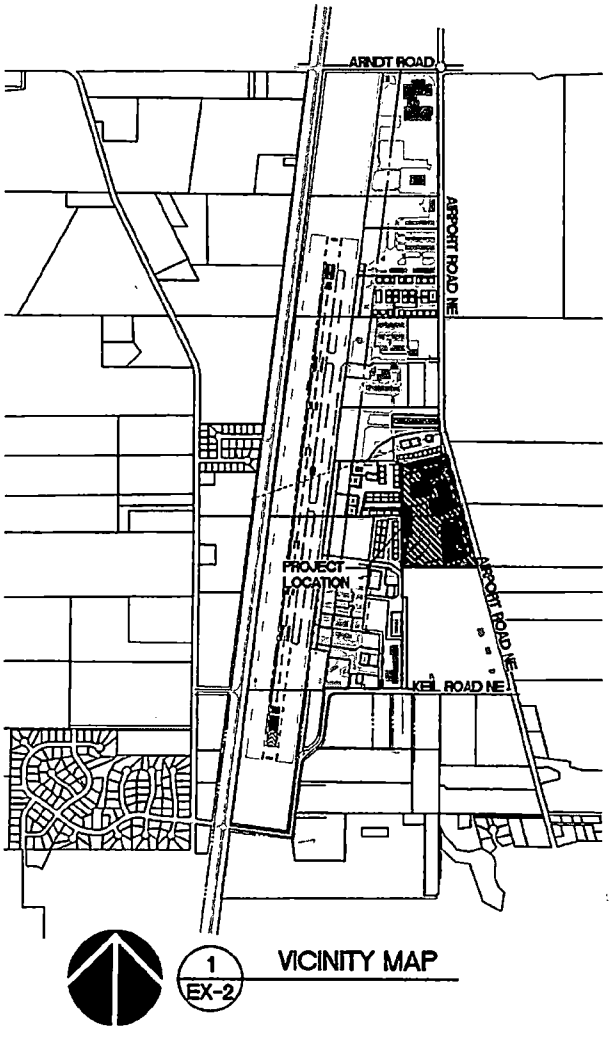
3. VICINITY MAP



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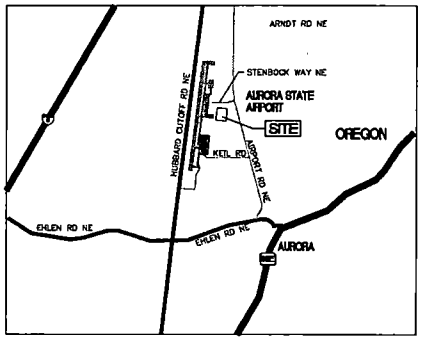
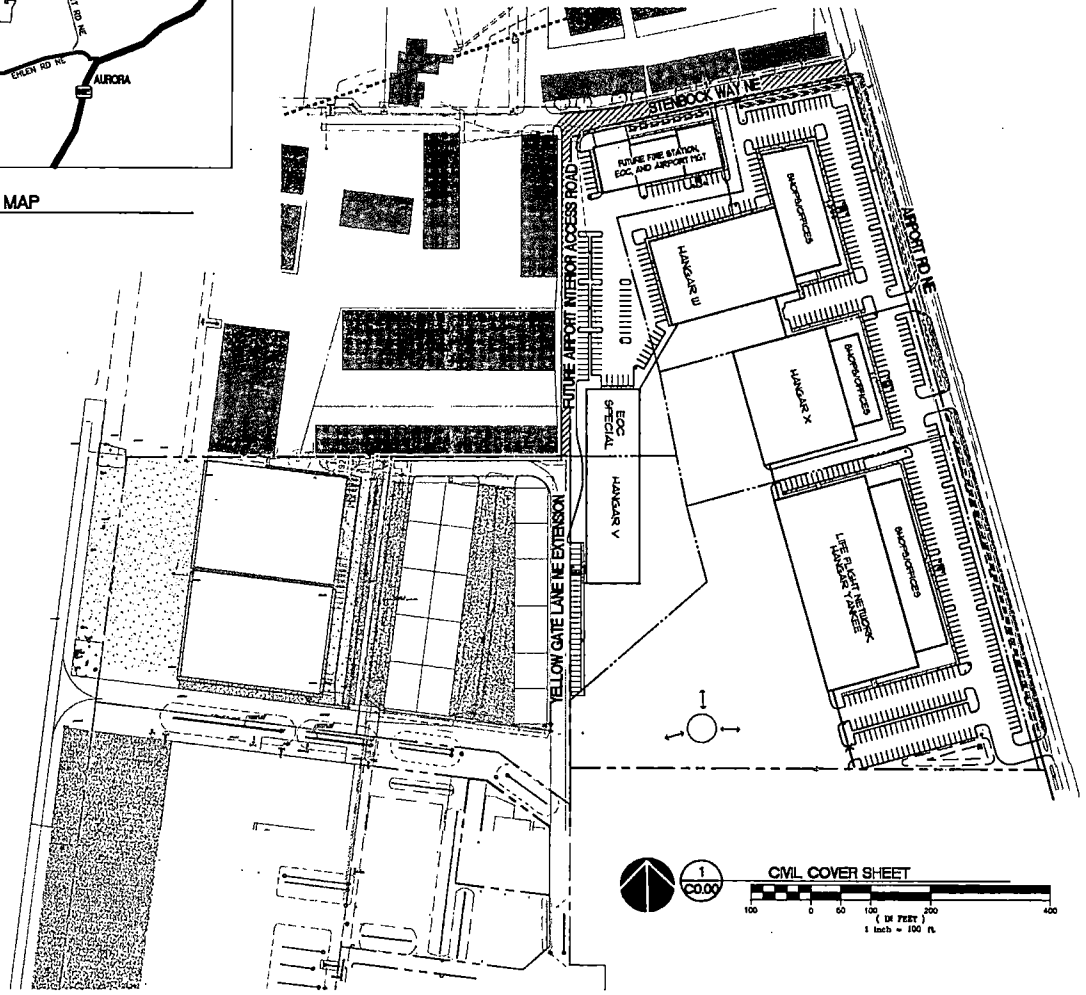
4. DRAINAGE IMPROVEMENTS
(project plans attached)

AURORA AIRPARK
BUSINESS CENTER
AURORA, OR



VICINITY MAP
N.T.S



1 C0.00 CIVIL COVER SHEET
100 0 50 100 200 400
(IN FEET)
1 inch = 100 ft

SHEET INDEX

C0.00 CIVIL COVER SHEET
C0.01 CIVIL NOTES AND LEGEND
C0.02 CIVIL NOTES AND SPECIFICATIONS
C1.01 EXISTING CONDITION & DEMOLITION PLAN
C1.10 OVERALL SITE PLAN
C1.11 SITE PLAN NORTH
C1.12 SITE PLAN SOUTH
C1.20 GRADING PLAN NORTH
C1.21 GRADING PLAN SOUTH
C1.30 STORMWATER PLAN (NORTH)
C1.31 STORMWATER PLAN (SOUTH)
C1.32 WATERLINE PLAN (NORTH)
C1.33 WATERLINE PLAN (SOUTH)
C5.10 CIVIL DETAILS
C5.11 CIVIL DETAILS
C5.12 CIVIL DETAILS
R1.10 AIRPORT RD NE IMPROVEMENTS
R1.11 AIRPORT RD NE IMPROVEMENTS
R5.10 AIRPORT RD NE CROSS SECTION
EC1.0 EROSION AND SEDIMENT CONTROL COVER SHEET
EC2.0 CLEARING AND DEMOLITION EROSION AND SEDIMENT CONTROL PLAN
EC3.0 GRADING, SIDEWALK, BUILDING AND UTILITY CONSTRUCTION EROSION AND SEDIMENT CONTROL PLAN
EC4.0 EROSION AND SEDIMENT CONTROL DETAILS

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Project
AURORA AIRPARK BUSINESS CENTER

REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 09, 2013
CHAD T. LAWRENCE
EXPIRES: 12-31-2020

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CIVIL COVER SHEET

DRAWN BY: CTL
CHECKED BY: MWB
SHEET: C0.00
JOB NO. 2180516.00

DEMOLITION AND CONSTRUCTION NOTES

1. DEMOLITION GENERALLY INCLUDES PROPER REMOVAL OF ALL EXISTING IMPROVEMENTS FROM THE SITE, INCLUDING ABOVE AND BELOW GROUND VEGETATION, UTILITIES AND STRUCTURES. KEYNOTES ARE PROVIDED WHERE SPECIFIC REQUIREMENTS MAY BE WARRANTED.
2. CONTRACTOR SHALL BE RESPONSIBLE TO VERIFY ALL UTILITIES ARE PROPERLY TURNED OFF PRIOR TO ANY SITE OR BUILDING DEMOLITION.
3. ALL HAZARDOUS MATERIALS (IF ANY ARE FOUND TO EXIST) SHALL BE DISPOSED IN ACCORDANCE WITH DEQ REQUIREMENTS.
4. COORDINATE DEMOLITION WORK WITH THE PROPOSED SITE DEVELOPMENT PLANS.
5. ALL EXCAVATIONS SHALL BE BACKFILLED AS SPECIFIED IN THE GEOTECHNICAL REPORT (GRI REPORT DATED MAY 13TH, 2019)
6. DO NOT STOCKPILE DEMOLISHED MATERIALS, OR SOILS, ON-SITE FOR EXTENDED PERIODS OF TIME.
7. OREGON LAW REQUIRES YOU TO FOLLOW RULES ADOPTED BY THE OREGON UTILITY NOTIFICATION CENTER. THOSE RULES ARE SET FORTH IN OAR 952-001-0010 THROUGH OAR 952-001-0090. YOU MAY OBTAIN COPIES OF THESE RULES FROM THE CENTER BY CALLING 503-232-1987. IF YOU HAVE ANY QUESTIONS ABOUT THE RULES, YOU MAY CONTACT THE CENTER. YOU MUST NOTIFY THE CENTER AT LEAST TWO BUSINESS DAYS, BEFORE COMMENCING AN EXCAVATION. CALL 8-1-1.
8. INSTALL EROSION CONTROL MEASURES AND TEMPORARY FENCING PRIOR TO WORK. CONTRACTOR TO HOLD PRECONSTRUCTION MEETING PRIOR TO FENCE ERECTION OR ANY CONSTRUCTION ACTIVITIES.
9. DEMOLISH EXISTING PAVED AND GRAVEL AREAS ON SITE WITHIN THE LIMITS OF CONSTRUCTION AND AS SHOWN. MATERIALS SHALL BE REMOVED FROM SITE. PAVED AREAS SHOULD BE EXCAVATED TO A MIN. OF 4" TO REMOVE SUBBASE. IF REMOVED GRAVEL OR ASPHALT MATERIALS ARE TO BE RECYCLED OR RE-USED ON SITE, PREVENT CONTAMINATION OF THESE MATERIALS FROM TOPSOIL OR OTHER DELETERIOUS MATERIAL. REFER TO GEOTECHNICAL REPORT FOR APPLICABILITY OF USING RECYCLED MATERIALS ON SITE.
10. DEMOLISH AND REMOVE ALL STRUCTURES, SLABS AND FEATURES AS SHOWN.
11. DEMOLISH AND REMOVE RETAINING WALLS, FENCING, INTERIOR SIDEWALKS, DRIVEWAYS, PLANTERS, AND TREES AS SHOWN. PROTECT FEATURES TO REMAIN.
12. REMOVE ALL UNDERGROUND UTILITY SERVICES AND CONDUIT WITHIN THE CONSTRUCTION LIMITS AND AS SHOWN, UNLESS NOTED OTHERWISE. COORDINATE WITH UTILITY AND ELECTRICAL PLANS.
13. MAINTAIN SERVICES DURING CONSTRUCTION TO EXISTING BUILDINGS SERVED BY UTILITY LINES AFFECTED BY CONSTRUCTION.
14. PROTECT ALL STRUCTURES, FENCING AND VEGETATION OUTSIDE CONSTRUCTION LIMITS, EXCEPT AS SHOWN.
15. UNDOCUMENTED AND UNCOMPACTED FILL MATERIALS ARE EXPECTED TO BE PRESENT IN SEVERAL AREAS ACROSS THE SITE, PARTICULARLY WITHIN FORMER BUILDING FOOTPRINTS. DELETERIOUS FILL MATERIAL MUST BE COMPLETELY REMOVED TO NATIVE SOILS AND BACKFILLED WITH STRUCTURAL FILL.

GENERAL NOTES

1. ALL WORK SHALL CONFORM TO THE STANDARD SPECIFICATIONS AND THE REQUIREMENTS OF MARION COUNTY AND THE CURRENT AMERICAN PUBLIC WORKS ASSOCIATION STANDARDS FOR PUBLIC WORKS CONSTRUCTION.
2. THE WORKING DRAWINGS ARE GENERALLY DIAGRAMMATIC. THEY DO NOT SHOW EVERY OFFSET, BEND OR ELBOW REQUIRED FOR INSTALLATION IN THE SPACE PROVIDED. THEY DO NOT SHOW EVERY DIMENSION, COMPONENT PIECE, SECTION, JOINT OR FITTING REQUIRED TO COMPLETE THE PROJECT. ALL LOCATIONS FOR WORK SHALL BE CHECKED AND COORDINATED WITH EXISTING CONDITIONS IN THE FIELD BEFORE BEGINNING CONSTRUCTION. EXISTING UNDERGROUND UTILITIES LAYING WITHIN THE LIMITS OF EXCAVATION SHALL BE VERIFIED AS TO CONDITION, SIZE AND LOCATION BY UNCOVERING, PROVIDING SUCH IS PERMITTED BY LOCAL PUBLIC AUTHORITIES WITH JURISDICTION, BEFORE BEGINNING CONSTRUCTION. CONTRACTOR TO NOTIFY ENGINEER IF THERE ARE ANY DISCREPANCIES.
3. EFFECTIVE EROSION CONTROL IS REQUIRED. EROSION CONTROL DEVICES MUST BE INSTALLED AND MAINTAINED TO MEET MARION COUNTY AND OREGON DEQ REQUIREMENTS. THE GOVERNING JURISDICTION MAY, AT ANY TIME, ORDER CORRECTIVE ACTION AND STOPPAGE OF WORK TO ACCOMPLISH EFFECTIVE EROSION CONTROL.
4. EFFECTIVE DRAINAGE CONTROL IS REQUIRED. DRAINAGE SHALL BE CONTROLLED WITHIN THE WORK SITE AND SHALL BE ROUTED SO THAT ADJACENT PRIVATE PROPERTY, PUBLIC PROPERTY, AND THE RECEIVING SYSTEM ARE NOT ADVERSELY IMPACTED. THE GOVERNING JURISDICTION MAY, AT ANY TIME, ORDER CORRECTIVE ACTION AND STOPPAGE OF WORK TO ACCOMPLISH EFFECTIVE DRAINAGE CONTROL.
5. CONTRACTOR SHALL ADJUST ALL STRUCTURES IMPACTED BY CONSTRUCTION IMPROVEMENTS TO NEW FINISH GRADES.
6. EXCAVATION: EXCAVATE FOR SLABS, PAVING, AND OTHER IMPROVEMENTS TO SIZES AND LEVELS SHOWN OR REQUIRED. ALLOW FOR FORM CLEARANCE AND FOR PROPER COMPACTION OF REQUIRED BACKFILLING MATERIAL. EXCAVATOR(S) MUST COMPLY WITH O.R.S. 757.541 THROUGH 757.571; EXCAVATOR(S) SHALL NOTIFY ALL UTILITY COMPANIES FOR LINE LOCATIONS SEVENTY-TWO (72) HOURS (MINIMUM) PRIOR TO START OF WORK. DAMAGE TO UTILITIES SHALL BE CORRECTED AT THE CONTRACTOR'S EXPENSE. (ONE CALL LOCATE UTILITY NOTIFICATION CENTER – SALEM METRO AREA 246-6699, OREGON 696-4848, ALL OTHER AREAS 1-800-332-2344).
7. WHERE CONNECTING TO AN EXISTING PIPE, AND PRIOR TO ORDERING MATERIALS, THE CONTRACTOR SHALL EXPOSE THE END OF THE EXISTING PIPE VERIFY THE LOCATION, SIZE, AND ELEVATION. NOTIFY ENGINEER OF ANY DISCREPANCIES PRIOR TO START OF CONSTRUCTION.
8. REQUEST BY THE CONTRACTOR FOR CHANGES TO THE PLANS MUST BE APPROVED BY THE ENGINEER.

UTILITY NOTES

1. ALL WORK SHALL CONFORM TO THE REQUIREMENTS OF MARION COUNTY AND THE CURRENT EDITION OF THE OREGON PLUMBING SPECIALTY CODE AND THE OREGON STRUCTURAL SPECIALITY CODE. ALL WORK WITHIN THE PUBLIC ROW REQUIRES A PUBLIC WORKS PERMIT.
2. THE WORKING DRAWINGS ARE GENERALLY DIAGRAMMATIC. THEY DO NOT SHOW EVERY OFFSET, BEND OR ELBOW REQUIRED FOR INSTALLATION IN THE SPACE PROVIDED. THEY DO NOT SHOW EVERY DIMENSION, COMPONENT PIECE, SECTION, JOINT OR FITTING REQUIRED TO COMPLETE THE PROJECT. ALL LOCATIONS FOR WORK SHALL BE CHECKED AND COORDINATED WITH EXISTING CONDITIONS IN THE FIELD BEFORE BEGINNING CONSTRUCTION. EXISTING UNDERGROUND UTILITIES LAYING WITHIN THE LIMITS OF EXCAVATION SHALL BE VERIFIED AS TO CONDITION, SIZE AND LOCATION BY UNCOVERING, PROVIDING SUCH IS PERMITTED BY LOCAL PUBLIC AUTHORITIES WITH JURISDICTION, BEFORE BEGINNING CONSTRUCTION. CONTRACTOR TO NOTIFY ENGINEER IF THERE ARE ANY DISCREPANCIES.
3. PROVIDE CLEANOUTS AS REQUIRED IN THE CURRENT OREGON PLUMBING SPECIALITY CODE CHAPTER 7, SECTIONS 707 AND 719, AND CHAPTER 11, SECTION 1101.13. NOTE: NOT ALL REQUIRED STORM CLEANOUTS ARE SHOWN ON THE PLANS.
4. ALL STORM PIPING IS SIZED FOR A MANNING'S "N" VALUE = 0.013. ALL STORM PIPING IS DESIGNED USING CONCENTRIC PIPE TO PIPE AND WYE FITTINGS, UNLESS OTHERWISE NOTED.
5. CONTRACTOR TO COORDINATE MECHANICAL CONNECTIONS WITH LICENSED PLUMBER FOR UTILITIES LOCATED WITHIN THE BUILDING AND TO 5' OUTSIDE THE BUILDING.
6. VERIFY LOCATION, SIZE, SLOPE AND DEPTH OF EXISTING UTILITIES BY POTHOLING AND OR VIDEO SCOPE PRIOR TO CONSTRUCTION. NOTIFY ENGINEER OF DISCREPANCIES.
7. SEE PLUMBING DRAWINGS FOR PIPING WITHIN THE BUILDING AND UP TO 5' OUTSIDE THE BUILDING, INCLUDING ANY FOUNDATION DRAINAGE PIPING.
8. CONTRACTOR TO MAINTAIN MINIMUM 3 FT OF COVER OVER ALL WATER LINES.
9. CONTRACTOR TO OBTAIN ALL TRADE PERMITS AND COORDINATE WITH UTILITY PROVIDERS FOR SERVICE.
10. IRRIGATION SHOULD BE DESIGNED AND BUILT BY CONTRACTOR.

GRADING NOTES

1. ROUGH GRADING: BRING ALL FINISH GRADES TO APPROXIMATE LEVELS INDICATED. WHERE GRADES ARE NOT OTHERWISE INDICATED, FINISH GRADES ARE TO BE THE SAME AS ADJACENT SIDEWALKS, CURBS, OR THE OBVIOUS GRADE OF ADJACENT STRUCTURE. GRADE TO UNIFORM LEVELS OR SLOPES BETWEEN POINTS WHERE GRADES ARE GIVEN. ROUND OFF SURFACES. AVOID ABRUPT CHANGES IN LEVELS. ROUGH GRADE TO ALLOW FOR DEPTH OF CONCRETE SLABS, WALKS, AND THEIR BASE COURSES. GRADE FOR PAVED DRIVES AND PAVED PARKING AREAS AS INDICATED AND SPECIFIED HEREIN, AND PROVIDE FOR SURFACE DRAINAGE AS SHOWN, ALLOWING FOR THICKNESS OF SURFACING MATERIAL.
   FINISH GRADING: AT COMPLETION OF JOB AND AFTER BACKFILLING HAS BEEN COMPLETED, REFILL AND COMPACT AREAS WHICH HAVE SETTLED OR ERODED TO BRING TO FINAL GRADES. GRADING TOLERANCES:
   ROUGH GRADE AT PAVED OR LANDSCAPED AREAS: ±0.1 FT.
   FINISH GRADE PRIOR TO PLACING FINAL SURFACING: ±0.03 FT.
2. EXCAVATION: EXCAVATE FOR SLABS, PAVING, AND OTHER IMPROVEMENTS TO SIZES AND LEVELS SHOWN OR REQUIRED. ALLOW FOR FORM CLEARANCE AND FOR PROPER COMPACTION OF REQUIRED BACKFILLING MATERIAL. EXCAVATOR(S) MUST COMPLY WITH O.R.S. 757.541 THROUGH 757.571; EXCAVATOR(S) SHALL NOTIFY ALL UTILITY COMPANIES FOR LINE LOCATIONS SEVENTY-TWO (72) HOURS (MINIMUM) PRIOR TO START OF WORK. DAMAGE TO UTILITIES SHALL BE CORRECTED AT THE CONTRACTOR'S EXPENSE.
3. EFFECTIVE EROSION PREVENTION IS REQUIRED. EROSION CONTROL DEVICES MUST BE INSTALLED AND MAINTAINED MEETING THE CITY OF SCAPPOOSE REQUIREMENTS. THE GOVERNING JURISDICTION MAY, AT ANY TIME, ORDER CORRECTIVE ACTION AND STOPPAGE OF WORK TO ACCOMPLISH EFFECTIVE EROSION CONTROL.
4. EFFECTIVE DRAINAGE CONTROL IS REQUIRED. DRAINAGE SHALL BE CONTROLLED WITHIN THE WORK SITE AND SHALL BE SO ROUTED THAT ADJACENT PRIVATE PROPERTY, PUBLIC PROPERTY, AND THE RECEIVING SYSTEM ARE NOT ADVERSELY IMPACTED. THE GOVERNING JURISDICTION MAY, AT ANY TIME, ORDER CORRECTIVE ACTION AND STOPPAGE OF WORK TO ACCOMPLISH EFFECTIVE DRAINAGE CONTROL.
5. THE SURVEY INFORMATION SHOWN AS A BACKGROUND SCREEN ON THIS SHEET IS BASED ON A SURVEY BY CHASE, JONES AND ASSOCIATES ON APRIL 17, 2019, AND IS SHOWN FOR REFERENCE ONLY. CONTRACTOR TO VERIFY ALL EXISTING CONDITIONS WITH HIS OWN RESOURCES PRIOR TO START OF ANY CONSTRUCTION.
6. 2% MAXIMUM SLOPE AT ALL ADA-COMPLIANT PARKING SPACES AND LOADING ZONES.
7. 5% MAX SLOPE (EXCLUDING RAMPS) AT PEDESTRIAN SIDEWALK CONNECTIONS BETWEEN PUBLIC ROW AND BUILDING ENTRANCES.
8. WHERE SLOPES ARE STEEPER THAN 3:1, CONTRACTOR SHALL INSTALL JUTE MATTING. SLOPE SHALL BE PREPARED TO ENSURE COMPLETE AND DIRECT CONTACT OF MATTING WITH SOIL. FOLLOW MANUFACTURER'S RECOMMENDATIONS.
9. ALL ELEVATIONS ARE FINISHED SURFACE UNLESS OTHERWISE NOTED.

ABBREVIATIONS

℄	CENTER LINE
℞	PROPERTY LINE
AC	ASPHALT CONCRETE
BC	BOTTOM OF CURB ELEVATION
BCR	BEGIN CURB RETURN
BMP	BEST MANAGEMENT PRACTICE
BS	BOTTOM OF STEP ELEVATION
BW	BACK OF WALK ELEVATION
CB	CATCH BASIN
CI	CAST IRON
CO	CLEANOUT
CLR	CLEAR
CVR	COVER
DI	DUCTILE IRON
DW	DOMESTIC WATER
ECR	END CURB RETURN
ELEV	ELEVATION
EP	EDGE OF PAVEMENT
ESC	EROSION/SEDIMENT CONTROL
EW	EACH WAY
EX	EXISTING
FDC	FIRE DEPARTMENT CONNECTION
FF	FINISH FLOOR
FG	FINISHED GRADE ELEVATION
FH	FIRE HYDRANT
FI	FIELD INLET
FL	FLOWLINE ELEVATION
FS	FINISHED SURFACE ELEVATION
FW	FIRE WATER/FACE OF WALL
G	GUTTER LINE
GB	GRADE BREAK
IE	INVERT ELEVATION
LT	LEFT
ME	MATCH EXISTING ELEVATION
MH	MANHOLE
MJ	MECHANICAL JOINT
OC	ON CENTER
ODOT	OREGON DEPARTMENT OF TRANSPORTATION
OSHA	OREGON STATE HEALTH AUTHORITY
PC	POINT OF CURVATURE
PCC	POINT OF COMPOUND CURVATURE
PR	PROPOSED
PRC	POINT OF REVERSE CURVATURE
PT	POINT OF TANGENCY
RD	ROOF DRAIN
RIM	RIM ELEVATION
ROW	RIGHT OF WAY
RSGV	RESILIENT SEAT GATE VALVE
RT	RIGHT
SS	SANITARY SEWER
STA	STATION
SW	SIDEWALK
TC	TOP OF CURB ELEVATION
TH	THRESHOLD ELEVATION
TS	TOP OF STEP ELEVATION
TW	TOP OF WALL ELEVATION
TYP	TYPICAL

LEGEND

	EXISTING	PROPOSED
RIGHT-OF-WAY LINE		
BOUNDARY LINE		
CENTERLINE		
PROPERTY LINE		
CURB		
WETLAND BOUNDARY		
EDGE OF PAVEMENT		
EASEMENT		
FENCE LINE		
GRAVEL EDGE		
POWER LINE		
OVERHEAD WIRE		
TRAFFIC SIGNAL WIRE		
TELEPHONE LINE		
TELEVISION LINE		
GAS LINE		
STORM SEWER LINE		
SANITARY SEWER LINE		
WATER LINE		
TREE		
CONTOURS		200
CONTROL MANHOLE		
DRYWELL		
FIRE DEPARTMENT CONNECTION		
FIRE HYDRANT		
WATER BLOWOFF/AIR RELEASE		
WATER METER		
WATER VALVE		
BACKFLOW PREVENTOR		
WATER VAULT		
MONITORING WELL		
STORM/SANITARY MANHOLE		
STORM SEWER CATCH BASIN		
SANITARY CLEAN OUT		
GAS VALVE		
GAS METER		
SIGN		
MAIL BOX		
FOUND SURVEY MONUMENT		
GUY WIRE ANCHOR		
UTILITY POLE		
HVAC UNIT		
POWER VAULT		
ELECTRICAL METER		
POWER JUNCTION BOX		
POWER TRANSFORMER		
LIGHT POLE		
TELEPHONE/TELEVISION VAULT		
TELEPHONE/TELEVISION JUNCTION BOX		
TELEPHONE/TELEVISION RISER		
SIGNAL JUNCTION BOX		
BOLLARD		
ADA COMPLIANT CURB RAMP SLOPE ARROW		
SLOPE ARROW		
LIGHT ASPHALT PAVEMENT		
HEAVY ASPHALT PAVEMENT		

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REVISIONS:

REVISION DELTA	REVISION DELTA CLOSING DATE

SHEET TITLE:
CIVIL NOTES
AND LEGEND

DRAWN BY: JAZ
CHECKED BY: DGL
SHEET:
C0.01

JOB NO. 2180516.00

GRADING SPECIFICATION NOTES

1. MATERIALS:
   - A. IMPORTED STRUCTURAL FILL: WELL-GRADED PIT- OR QUARRY-RUN ROCK, CRUSHED ROCK, CRUSHED GRAVEL, OR SAND FREE OF CLAY BALLS, ROOTS, ORGANIC MATTER, AND OTHER DELETERIOUS MATERIALS. FILL SHALL HAVE A MAXIMUM PARTICLE SIZE OF 3 INCHES AND IN WET WEATHER HAVE LESS THAN 12 PERCENT BY DRY WEIGHT PASSING THE U.S. STANDARD NO. 200 SIEVE (ASTM C 117) OR 5 PERCENT IN DRY WEATHER
   - B. SELECT STRUCTURAL FILL: ON-SITE OR IMPORTED SILTY MATERIALS THAT ARE FREE OF DELETERIOUS MATERIALS AND PARTICLES GREATER THAN 4 INCHES IN DIAMETER. ALL SELECT STRUCTURAL FILLS SHALL BE APPROVED BY THE GEOTECHNICAL ENGINEER PRIOR TO USE AS STRUCTURAL FILL MATERIAL
   - C. IMPORTED GRANULAR MATERIAL: 3/4 INCH MINUS TO 1-1/2 INCH CRUSHED ROCK OR CRUSHED GRAVEL AND SAND WITH LESS THAN 5 PERCENT BY DRY WEIGHT PASSING THE U.S. STANDARD NO. 200 SIEVE (ASTM C 117)
   - D. STABILIZATION MATERIAL: IMPORTED GRANULAR MATERIAL, 6 INCH MINUS, PIT- OR QUARRY-RUN ROCK, CRUSHED ROCK FREE OF CLAY BALLS, ROOTS, ORGANIC MATTER, AND OTHER DELETERIOUS MATERIALS WITH LESS THAN 5 PERCENT BY DRY WEIGHT PASSING THE U.S. STANDARD NO. 200 SIEVE (ASTM C 117)
   - E. DRAIN ROCK: CRUSHED ROCK OR GRAVEL CONFORMING TO THE FOLLOWING GRADATION (U.S STANDARD SIEVE SIZE, PERCENT PASSING (BY DRY WEIGHT):

     E.1. 1-1/2 INCH (100);1 INCH (95-100);1/2 INCH (25-60);NO.4 (0-10);NO.8 (0-5)
   - F. ON-SITE TOPSOIL: IF NOT DEFINED BY THE LANDSCAPE ARCHITECT, ON-SITE TOPSOIL SHALL BE FREE OF PARTICLES GREATER THAN 1 INCH DIAMETER, ADMIXTURES OF SUBSOIL, CLAY, NOXIOUS WEEDS AND GRASSES (I.E. HORSETAIL, QUACKGRASS, JOHNSON GRASS) AND OTHER MATERIAL DELETERIOUS TO PLANT GROWTH OR THAT HINDER GRADING, PLANTING, OR MAINTENANCE OPERATIONS
   - G. IMPORTED TOPSOIL: IF NOT DEFINED BY THE LANDSCAPE ARCHITECT, IMPORTED TOPSOIL SHALL CONSIST OF SANDY-LOAM FROM APPROVED SOURCES AND SHALL BE FREE OF PARTICLES GREATER THAN 1-INCH DIAMETER AND ADMIXTURES OF SUBSOIL, CLAY, NOXIOUS WEEDS AND GRASSES (I.E. HORSETAIL, QUACKGRASS, JOHNSON GRASS) AND OTHER MATERIAL DELETERIOUS TO PLANT GROWTH OR THAT HINDER GRADING, PLANTING, OR MAINTENANCE OPERATIONS
2. MINIMUM COMPACTION DENSITY UNLESS OTHERWISE NOTED (MAXIMUM DRY DENSITY DETERMINED BY ASTM D1557).
   - A. UNDER PAVING, SLAB ON GRADE, OR OTHER STRUCTURES OR PAVEMENTS: MINIMUM OF 95% OF MAXIMUM DRY DENSITY
   - B. UNDER LANDSCAPING: MINIMUM OF 90% OF MAXIMUM DRY DENSITY
3. ALL FILL AND BACKFILL SHALL BE BE PROPERLY MOISTURE CONDITIONED TO MEET THE COMPACTION REQUIREMENTS. IMPORTED GRANULAR MATERIALS SHALL BE COMPACTED IN UNIFORM LAYERS NOT EXCEEDING 12 INCHES, 8 INCHES FOR SELECT STRUCTURAL FILL

GRADING TOLERANCES:

A. ROUGH GRADE AT PAVED OR LANDSCAPED AREAS:	±0.1 FEET
B. FINISH GRADE PRIOR TO PLACING FINAL SURFACING:	±0.04 FEET
C. FINISH GRADE OF FINAL SURFACING:	±0.02 FEET

SITE WORK SPECIFICATION NOTES

1. BASE ROCK FOR CONCRETE SLABS, PAVEMENT, AND SIDEWALKS: 3/4 INCH CRUSHED AGGREGATE BASE IN ACCORDANCE WITH STATE DEPARTMENT OF TRANSPORTATION (DOT) SPECIFICATIONS, LATEST EDITION
2. PLACE AGGREGATE IN MAXIMUM 4 INCH LAYERS, ROLLER COMPACT TO SPECIFIED DENSITY, USE MECHANICAL TAMPING EQUIPMENT IN AREAS INACCESSIBLE TO ROLLER EQUIPMENT. COMPACT AGGREGATE BASE TO MINIMUM 95% OF MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D1557,
3. WHERE NOT NOTED ON PLANS, ENSURE 0.5% MINIMUM SLOPE ON CONCRETE SURFACES, 1.0% ON ASPHALT SURFACES, AND 2.0% IN LANDSCAPED AREAS
4. HOT MIX ASPHALT CONCRETE (HMAC): LEVEL 2, 1/2 INCH DENSE-GRADED HMAC PER STATE DOT SPECIFICATIONS, PG 64-22 OR BETTER
   - A. PLACE HMAC OVER PREPARED AND COMPACTED AGGREGATE BASE PER PLAN. MINIMUM COMPACTED LIFT THICKNESS: 2.0 INCHES, MAXIMUM COMPACTED LIFT THICKNESS: 3.0 INCHES
   - B. COMPACT HMAC TO MINIMUM DENSITY 91% OF ASTM D2041 LABORATORY DENSITY.
   - C. SEAL COAT (FOG COAT): EMULSIFIED ASPHALT FOG COAT, CSS-1, CSS-1H, OR HFRS-P1 TYPE PER STATE DOT SPECIFICATIONS
     - C.1. PREPARE EMULSIFIED ASPHALT PER MANUFACTURER'S REQUIREMENTS, APPLY UNIFORMLY WITH AN ASPHALT DISTRIBUTOR AT A RATE OF 0.10 TO 0.15 GALLONS PER SQUARE YARD, OR AS RECOMMENDED BY THE MANUFACTURER. PROTECT SEALED ASPHALT PAVEMENT SURFACE FROM VEHICLE AND FOOT TRAFFIC UNTIL CURED
5. SITE CONCRETE: ALL MATERIALS AND WORK SHALL CONFORM WITH ACI 318, LATEST EDITION
   - A. COMPRESSIVE STRENGTH (PSI) AT 28 DAYS:
     - A.1. VEHICULAR PAVEMENTS: 4,000 (MINIMUM)
     - A.2. PEDESTRIAN PAVEMENTS: 3,000 (MINIMUM)
     - A.3. CURBS AND GUTTERS: 3,000 (MINIMUM)
   - B. JOINTS: ALIGN CURB, GUTTER, AND SIDEWALK JOINTS
     - B.1. PROVIDE SCORED JOINTS AT 5 FOOT MAXIMUM INTERVALS, EVENLY SPACED, BETWEEN SIDEWALKS AND CURBS, BETWEEN CURBS AND PAVEMENT, OR AS INDICATED ON PLAN.
     - B.2. PROVIDE EXPANSION JOINTS EVERY FOURTH JOINT TO SEPARATE PAVING FROM VERTICAL SURFACES AND UTILITY PENETRATIONS, OR AS INDICATED ON PLAN
   - C. FINISHING:
     - C.1. PAVEMENTS: BROOM FINISH, PERPENDICULAR TO DIRECTION OF TRAVEL
     - C.2. SIDEWALKS: LIGHT BROOM, PERPENDICULAR TO DIRECTION OF TRAVEL, TROWELED AND RADIUSED EDGE, 1/8 TO 1/4 INCH RADIUS, NO SHINERS UNLESS SPECIFICALLY CALLED FOR ON PLAN
     - C.3. CURBS AND GUTTERS: LIGHT BROOM, PARALLEL TO PAVEMENT DIRECTION
6. PAINTED PAVEMENT MARKINGS:
   - A. PAINT: MPI NO. 97 (OR EQUAL) LATEX TRAFFIC MARKING PAINT, WHITE (FOR STANDARD PARKING STRIPING) OR AS INDICATED ON PLAN
     - A.1. PREPARATION: CLEAN PAVEMENT SURFACES THOROUGHLY PRIOR TO INSTALLATION. PREPARE SURFACES IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS
     - A.2. INSTALLATION: APPLY PAINT WHEN PAVEMENT SURFACE OR THE ATMOSPHERE TEMPERATURE IS BETWEEN 50 DEGREES AND 95 DEGREES F. APPLY IN ACCORDANCE WITH MANUFACTURER'S INSTRUCTIONS. APPLY PAINT IN ONE COAT ONLY, FOR SYMBOLS, UTILIZE A TEMPLATE THAT WILL PROVIDE TRUE, SHARP EDGES AND ENDS FOR THE PAVEMENT MARKING. PROTECT NEWLY PAINTED MARKINGS FROM DISTURBANCE AND TRACKING
     - A.3. PAVEMENT MARKING REMOVAL: SANDBLAST OR OTHER METHOD OF COMPLETE REMOVAL OF SPECIFIED MARKING. BLACKOUT METHODS MUST BE APPROVED BY THE OWNER
7. CHAIN LINK FENCE AND GATE MATERIALS AND INSTALLATION SHALL BE CONFORMANT WITH THE CHAIN LINK FENCE MANUFACTURER'S INSTITUTE PRODUCT MANUAL AND ASSOCIATED SPECIFICATIONS

PRIVATE UTILITY SPECIFICATION NOTES

1. PRODUCTS:
   - B. DOMESTIC WATER:
     - B.1. PLASTIC PIPE CONFORMING TO THE STATE PLUMBING CODE, LATEST EDITION, WITH PRESSURE RATED FITTINGS PER MANUFACTURER RECOMMENDATIONS
     - B.2. BACKFLOW PREVENTER: CONTRACTOR TO CONFIRM WITH AGENCY HAVING JURISDICTION (AHJ). IF AHJ DOES NOT SPECIFY, USE DOUBLE CHECK VALVE BACKFLOW PREVENTION ASSEMBLY COMPLIANT WITH THE STATE PLUMBING CODE, LATEST EDITION. IF REQUIRED, REDUCED PRESSURE DEVICES SHALL BE INSTALLED ABOVE GRADE IN A HEATED ENCLOSURE
   - C. FIRE WATER:
     - C.1. PLASTIC PIPE CONFORMING TO AWWA C900, RATED FOR 200 PSI MINIMUM, WITH MECHANICAL JOINT FITTINGS/RESTRAINTS PER MANUFACTURER RECOMMENDATIONS
     - C.2. BACKFLOW PREVENTER: CONTRACTOR TO CONFIRM WITH AGENCY HAVING JURISDICTION (AHJ). IF AHJ DOES NOT SPECIFY, USE DOUBLE CHECK DETECTOR FIRE PROTECTION BACKFLOW PREVENTION ASSEMBLY COMPLIANT WITH THE STATE PLUMBING CODE
   - D. SANITARY SEWER:
     - D.1. PLASTIC PIPE CONFORMING TO ASTM D3034, LATEST EDITION, WITH ELASTOMERIC GASKETED CONNECTIONS AND WYE FITTINGS PER MANUFACTURER RECOMMENDATIONS
   - E. STORM DRAINAGE:
     - E.1. PLASTIC PIPE CONFORMING TO ASTM D3034, LATEST EDITION, WITH ELASTOMERIC GASKETED CONNECTIONS AND WYE FITTINGS PER MANUFACTURER RECOMMENDATIONS
   - F. MANHOLES:
     - F.1. REINFORCED PRECAST CONCRETE IN ACCORDANCE WITH ASTM C478 (ASTM C478M) WITH RESILIENT CONNECTORS COMPLYING WITH ASTM C923 (ASTM C923M)
     - F.2. LID AND FRAME: ASTM A48/A48M, CLASS 30B CAST IRON CONSTRUCTION, MACHINED FLAT BEARING SURFACE, REMOVABLE LID, H-20 LOAD RATED, WITH LID MOLDED WITH IDENTIFYING NAME
     - F.3. MANHOLE STEPS: FORMED GALVANIZED STEEL RUNGS, 3/4 INCH DIAMETER
   - G. TRACER WIRE:
     - G.1. MAGNETIC DETECTABLE CONDUCTOR, CLEAR PLASTIC COVERING, IMPRINTED WITH THE NAME OF THE TYPE OF UTILITY SERVICE (I.E. "STORM SEWER SERVICE") IN LARGE LETTERS
2. TRENCHING, BEDDING, AND BACKFILL:
   - A. IF MINIMUM COMPACTION DENSITIES CANNOT BE ACHIEVED, EXCAVATE UNSUITABLE TRENCH BOTTOM MATERIALS AND REPLACE WITH TRENCH STABILIZATION MATERIAL PLACED AND COMPACTED TO MINIMUM COMPACTION DENSITIES NOTED UNDER GRADING SPECIFICATIONS. TRENCH STABILIZATION MATERIAL SHALL BE 6-INCH-MINUS CRUSHED ROCK FREE OF DELETERIOUS MATERIALS WITH LESS THAN 5 PERCENT PASSING THE U.S. STANDARD NO. 200 SIEVE WHEN TESTED IN ACCORDANCE WITH ASTM C 117
   - B. PIPE BEDDING AND PIPE ZONE MATERIAL SHALL BE IMPORTED GRANULAR MATERIAL, 3/4 INCH-MINUS SIZE, WITH THE EXCEPTION THAT THE PERCENT PASSING THE U.S. STANDARD NO. 200 SIEVE SHALL BE LESS THAN 8 PERCENT BY DRY WEIGHT WHEN TESTED IN ACCORDANCE WITH ASTM C 117
   - C. SPREAD BEDDING AND GRADE SO PIPE IS UNIFORMLY SUPPORTED ALONG THE BARREL. EXCAVATE BELL HOLES AT EACH JOINT TO PERMIT ASSEMBLY AND EVALUATION OF THE ENTIRE JOINT. BACKFILL THE TRENCH TO 12 INCHES ABOVE THE TOP OF THE PIPE WITH PIPE ZONE MATERIAL
   - D. PLACE PIPE ZONE MATERIAL IN LOOSE LIFTS NOT EXCEEDING 6 INCHES IN UNCOMPACTED THICKNESS SIMULTANEOUSLY ON BOTH SIDES OF THE PIPE
   - E. CAREFULLY WORK PIPE ZONE MATERIAL UNDER THE SIDES OF THE PIPE TO PROVIDE A FIRM BACKING AND PREVENT LATERAL MOVEMENT OF THE PIPE
   - F. COMPACT PIPE ZONE MATERIAL TO 90 PERCENT OF THE MAXIMUM DRY DENSITY OR AS RECOMMENDED BY THE PIPE MANUFACTURER. BACKFILL THE REMAINDER OF THE TRENCH WITH IMPORTED GRANULAR MATERIAL
   - G. COMPACT BACKFILL ABOVE PIPE ZONE TO MINIMUM COMPACTION DENSITIES NOTED UNDER GRADING SPECIFICATIONS
3. INSTALLATION:
   - A. PIPE COVER:
     - A.1. WATER: 36 INCH MINIMUM
     - A.2. STORM AND SANITARY: 12 INCH MINIMUM. PLASTIC PIPING SHALL BE SUBSTITUTED WITH DUCTILE IRON PIPING (CONFORMANT WITH ASTM A746) WHERE MINIMUM COVER CANNOT BE ACHIEVED. THE CONTRACTOR SHALL CONSULT WITH ENGINEER OF RECORD PRIOR TO MAKING THE MATERIAL SUBSTITUTION AND SHALL TAKE NECESSARY PRECAUTIONS TO PROTECT SHALLOW PIPING DURING CONSTRUCTION
   - B. SANITARY SEWER AND WATER PIPES: WHERE SANITARY SEWER PIPING WILL BE INSTALLED WITHIN 10 FEET OF A DOMESTIC WATER PIPE, AND AS APPROVED BY THE LOCAL BUILDING OFFICIAL, THE SANITARY PIPE SHALL BE MADE OF A MATERIAL APPROVED FOR USE WITHIN A BUILDING (I.E. PVC SCHEDULE 40). HOWEVER, IN NO CASE SHALL THE SANITARY LINE BE LOCATED WITHIN 12 INCHES OF A DOMESTIC WATER LINE (BOTH HORIZONTALLY AND VERTICALLY)
   - C. PIPE CROSSINGS/SEPARATION: MAINTAIN MINIMUM SEPARATION OF WATER MAIN FROM SEWER PIPING IN ACCORDANCE WITH LOCAL AGENCY AND STATE PLUMBING CODES, LATEST EDITIONS. WHERE NOT REGULATED BY CODE, MAINTAIN A MINIMUM OF 12 INCH VERTICAL SEPARATION AT PIPE CROSSINGS
   - D. GRAVITY SYSTEMS: MAINTAIN MINIMUM SLOPES AS DEFINED BY LOCAL AGENCY AND STATE PLUMBING CODES. WHERE NOT REGULATED BY CODE OR INDICATED ON PLANS, MAINTAIN A MINIMUM OF 1.0% SLOPE ON ALL SANITARY SEWER PIPING AND 0.5% ON ALL STORM DRAIN PIPING UNLESS NOTED OTHERWISE ON PROJECT PLANS
   - E. PIPE OUTLETS: ALL EXPOSED PIPE INLETS AND OUTLETS SHALL BE PROPERLY STABILIZED WITH RIP RAP.
   - F. CATCH BASINS: ALL CATCH BASINS TO HAVE A 24 INCH MINIMUM SUMP AND HOODED OUTLET UNLESS NOTED OTHERWISE ON PROJECT PLANS
   - G. MANHOLES: ALL SANITARY MANHOLES SHALL BE CHANNELIZED, STORM MANHOLES SHALL PROVIDE A 24 INCH SUMP UNLESS UNLESS OTHERWISE SPECIFIED ON PROJECT PLANS. ENSURE WATERTIGHT SEAL AT ALL PIPE PENETRATIONS TO MANHOLES. LIDS SHALL BE MARKED TO IDENTIFY TYPE OF UTILITY
   - H. CLEANOUTS: CLEANOUTS SHALL BE PROVIDED IN ACCORDANCE WITH THE UNIFORM PLUMBING CODE, LATEST EDITION (AT A MINIMUM, EVERY 100 LINEAL FEET OF PIPE RUN OR EVERY 135 DEGREE OF CUMULATIVE ANGLE). CLEANOUTS SHALL BE OF THE SAME SIZE OF THE PIPE THEY ARE SERVING, LIDS SHALL BE MARKED TO IDENTIFY TYPE OF UTILITY
   - I. BACKFLOW PREVENTERS: BACKFLOW PREVENTERS SHALL BE INSTALLED IN A COMPLIANT UNDERGROUND VAULT (EXCEPT REDUCED PRESSURE DEVICES) WITH SUMP PUMP DISCHARGING TO AN APPROVED DISCHARGE POINT. VAULT SHALL BE SIZED TO ACCOMMODATE THE INSTALLATION OF AN FDC ON THE DOWNSTREAM END WITHIN THE VAULT, EVEN IF THE FDC IS NOT INSTALLED AT TIME OF VAULT INSTALLATION. REDUCED PRESSURE DEVICES SHALL BE INSTALLED IN AN ABOVE GROUND HEATED ENCLOSURE, UNLESS THE AUTHORITY HAVING JURISDICTION ALLOWS FOR INSTALLATION IN A VAULT
   - J. MECHANICAL JOINT RESTRAINTS: UNLESS NOTED OTHERWISE, ALL FIRE WATER SUPPLY SYSTEMS SHALL BE PROVIDED WITH MECHANICAL JOINT RESTRAINTS AT FITTINGS, CALCULATED AND SIZED BASED ON PROJECT CONDITIONS. CONTRACTOR SHALL PROVIDE RESTRAINT LENGTH SIZING CALCULATIONS WITH WATER SYSTEM PRODUCT SUBMITTAL

DEMOLITION NOTES

1. INSTALL EROSION CONTROL MEASURES AND TEMPORARY FENCING PRIOR TO ANY DEMOLITION ACTIVITIES.
2. DEMOLISH AND REMOVE ALL STRUCTURES AND ASSOCIATED FEATURES (APPURTENANCES), AS SHOWN.
3. DEMOLISH ALL PAVED AREAS ON SITE AS SHOWN, DOWN TO NATIVE SUBGRADE.
4. PROTECT ALL EXISTING LANDSCAPING TO THE MAXIMUM EXTENT PRACTICABLE.
5. PROTECT ALL UNDERGROUND UTILITY SERVICES AND CONDUIT UNLESS NOTED OTHERWISE
6. WHERE APPLICABLE, VERIFY DISCONNECT OF GAS AND ELECTRIC WITH UTILITY. CUT/CAP UTILITY SERVICES (STORM/WATER AND SANITARY WITHIN 5' OF EDGE OF R.O.W.) CAP WATERLINE ON OWNER'S SIDE OF METER AND PERFORM OTHER DEMOLITION TASKS AS REQUIRED.

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OREGON
MAY 04, 2018
CHAD T. LAWRENCE
EXPIRES: 12-31-2020

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SHEET TITLE:
CIVIL NOTES

DRAWN BY: CME
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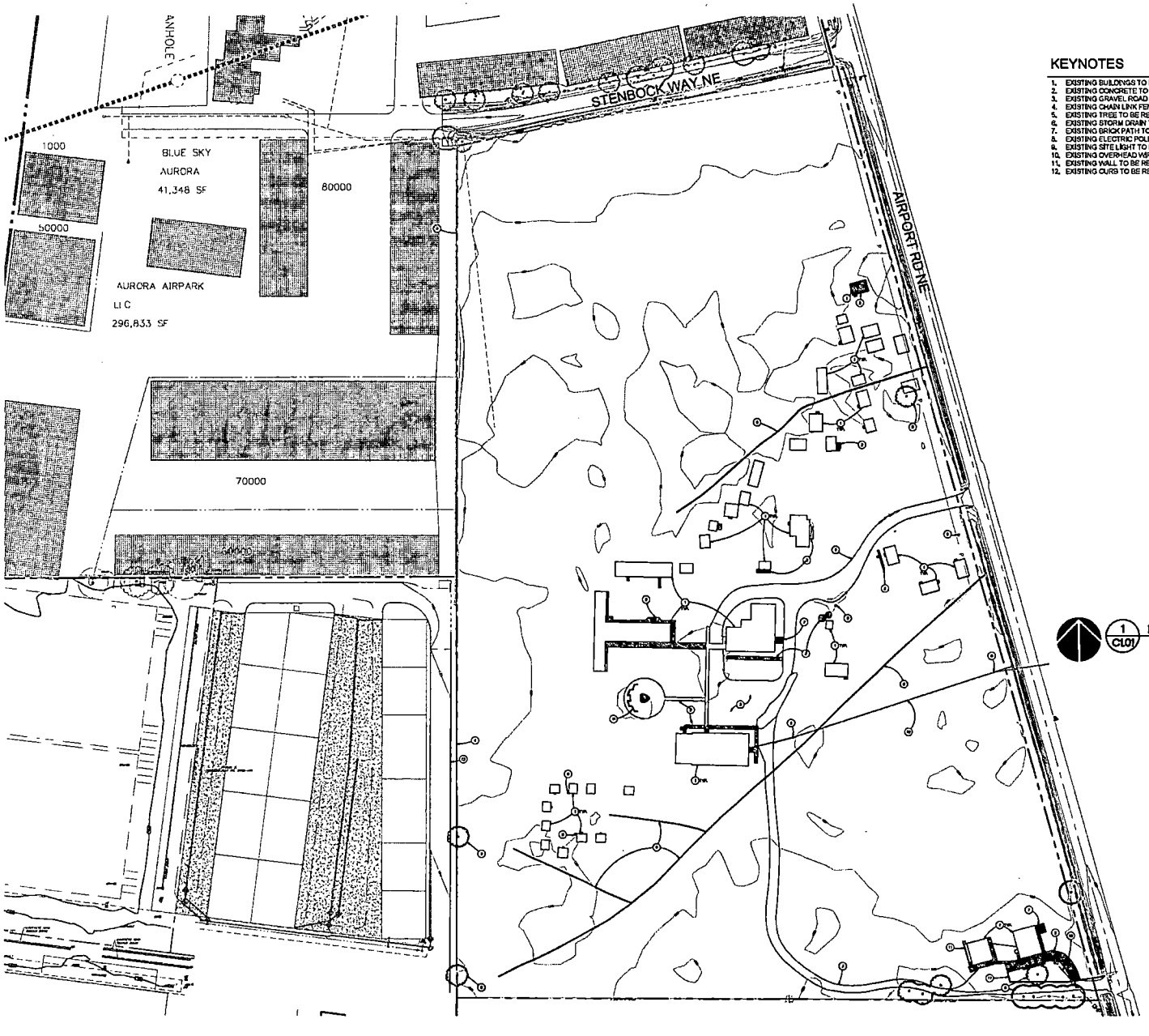
SHEET:
C0.02

JOB NO. 2180516.00



KEYNOTES

1. EXISTING BUILDINGS TO BE REMOVED
2. EXISTING CONCRETE TO BE REMOVED
3. EXISTING GRAVEL ROAD TO BE REMOVED
4. EXISTING CHAIN LINK FENCE TO BE REMOVED
5. EXISTING TREE TO BE REMOVED
6. EXISTING STORM DRAIN TO BE REMOVED
7. EXISTING BRICK PATH TO BE REMOVED
8. EXISTING ELECTRIC POLE TO BE REMOVED
9. EXISTING SITE LIGHT TO BE REMOVED
10. EXISTING OVERHEAD WIRE TO BE REMOVED
11. EXISTING WALL TO BE REMOVED
12. EXISTING CURB TO BE REMOVED

1 / C1.01 EXISTING CONDITION + DEMOLITION PLAN

100 0 50 100 200 400
(IN FEET)
1 inch = 100 ft.

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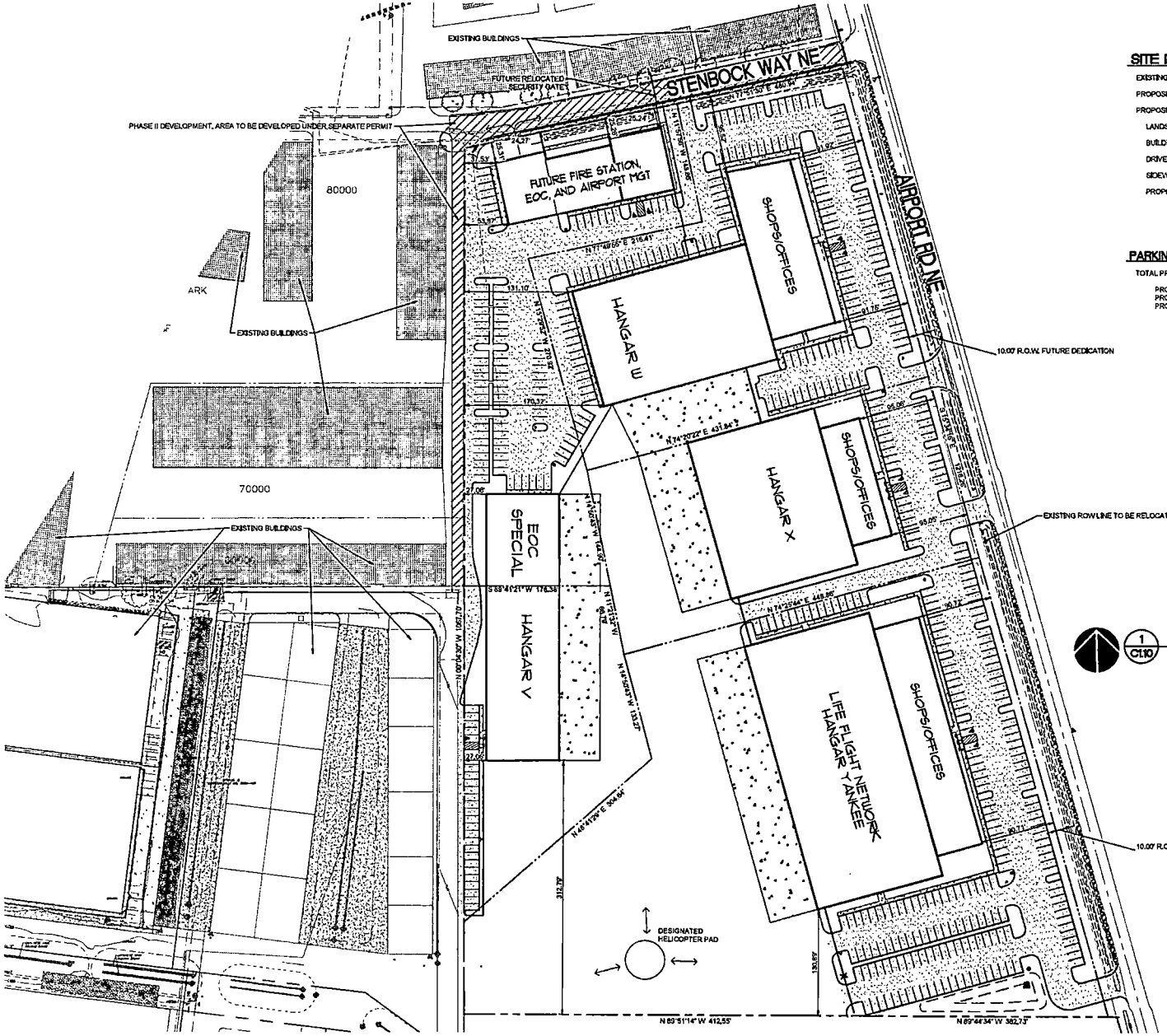
SHEET TITLE:
EXISTING CONDITION + DEMOLITION PLAN

DRAWN BY: CTL
CHECKED BY: MWB
SHEET:
C1.01

JOB NO. 2180516.00



SITE DATA

EXISTING SITE AREA	716,504 SF	16.45 AC	
PROPOSED RIGHT-OF-WAY DEDICATION	12,152 SF	0.28 AC	
PROPOSED SITE AREA	704,351 SF	16.17 AC	
LANDSCAPE AREA	72,594 SF	1.67 AC	10.3%
BUILDING FOOTPRINT AREA	202,555 SF	4.65 AC	
DRIVE AISLE/PARKING AREA	415,749 SF	9.54 AC	
SIDEWALK/HARDSCAPE AREA	13,453 SF	0.31 AC	
PROPOSED SITE IMPERVIOUS AREA	631,757 SF	14.50 AC	89.7%

PARKING DATA

TOTAL PROPOSED PARKING SPACES PROVIDED	501
PROPOSED UNIVERSAL PARKING SPACES (9'x18'), (9'x19')	490
PROPOSED ADA PARKING SPACES	9
PROPOSED VAN ONLY SPACES	2

1 C1.10 OVERALL SITE PLAN

60 0 30 60 120 240
(IN FEET)
1 inch = 60 ft.

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OVERALL SITE PLAN

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CHECKED BY: MWB
SHEET:
C1.10

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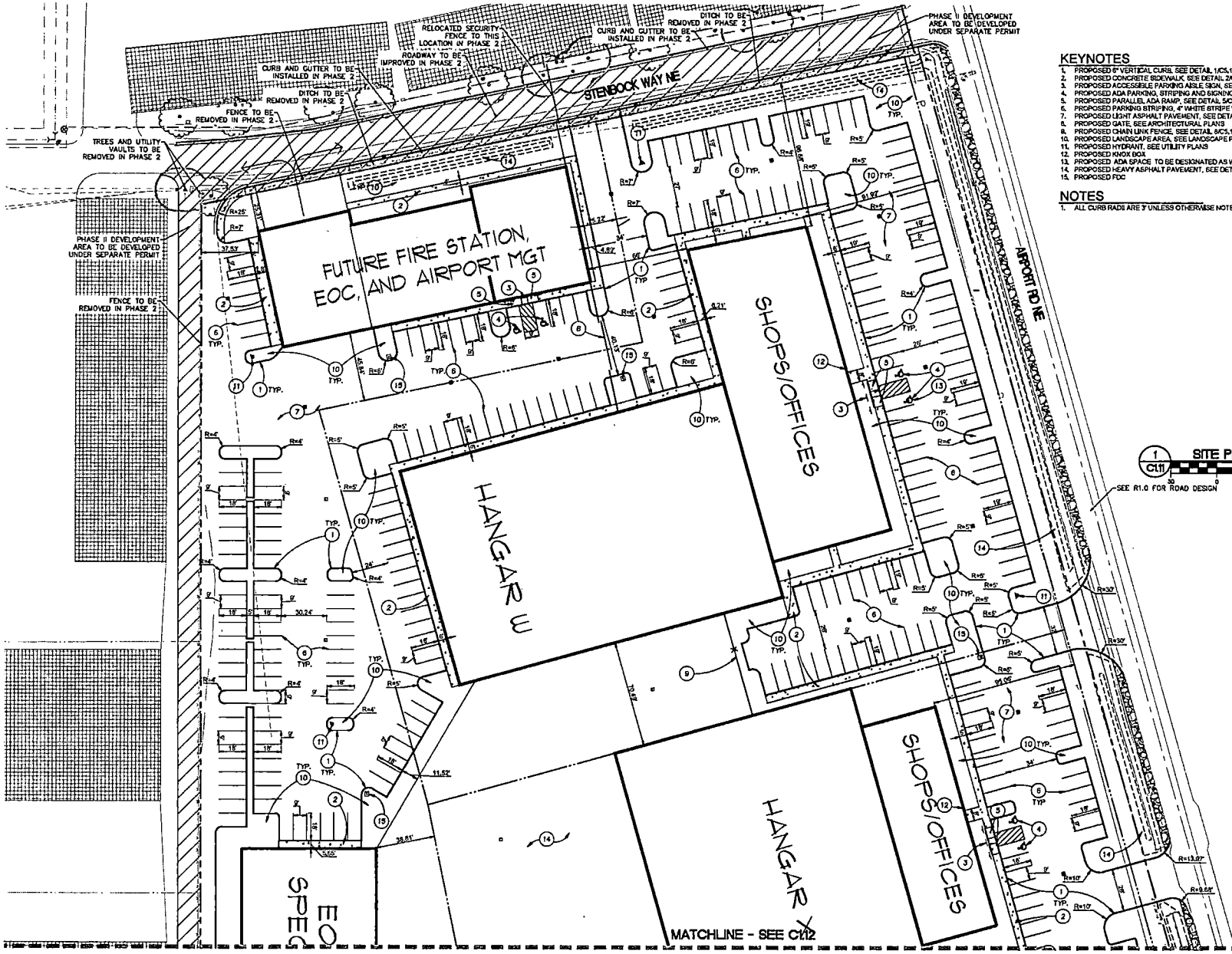

KEYNOTES

1. PROPOSED 6" VERTICAL CURB, SEE DETAIL 1/C5.10
2. PROPOSED CONCRETE SIDEWALK, SEE DETAIL 2/C5.10
3. PROPOSED ACCESSIBLE PARKING AISLE SIGN, SEE DETAIL 3/C5.10
4. PROPOSED ADA PARKING, STRIPING AND SIGNING, SEE DETAIL 4/C5.10
5. PROPOSED PARALLEL ADA RAMP, SEE DETAIL 5/C5.10
6. PROPOSED PARKING STRIPING, 4" WHITE STRIPE WITH 2 COATS
7. PROPOSED LIGHT ASPHALT PAVEMENT, SEE DETAIL 7/C5.10
8. PROPOSED GATE, SEE ARCHITECTURAL PLANS
9. PROPOSED CHAIN LINK FENCE, SEE DETAIL 9/C5.10
10. PROPOSED LANDSCAPE AREA, SEE LANDSCAPE PLANS
11. PROPOSED HYDRANT, SEE UTILITY PLANS
12. PROPOSED KNOX BOX
13. PROPOSED ADA SPACE TO BE DESIGNATED AS WHEEL CHAIR USER ONLY SPACE
14. PROPOSED HEAVY ASPHALT PAVEMENT, SEE DETAIL 7/C5.10
15. PROPOSED FDC

NOTES

1. ALL CURB RADII ARE 3' UNLESS OTHERWISE NOTED

1 C1.11 SITE PLAN - NORTH

30 0 15 30 60 120
(IN FEET)
1 inch = 30 ft.

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SHEET TITLE:
SITE PLAN NORTH

DRAWN BY: JAZ
CHECKED BY: DGL
SHEET:
C1.11

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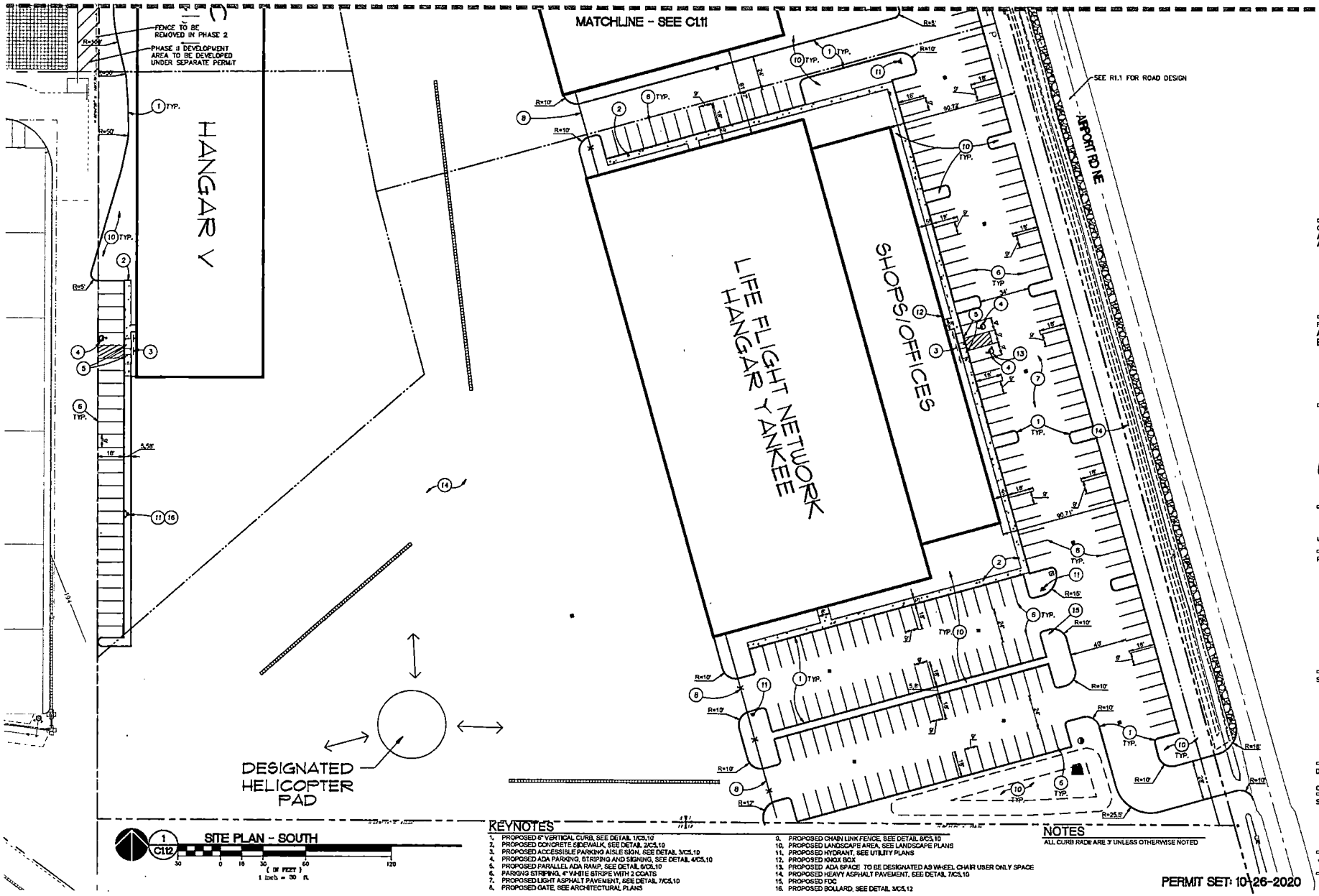

1 C1.12 SITE PLAN - SOUTH
30 0 15 30 60 120
(IN FEET)
1 inch = 30 ft.

KEYNOTES

1. PROPOSED 6" VERTICAL CURB, SEE DETAIL 1/C5.10
2. PROPOSED CONCRETE SIDEWALK, SEE DETAIL 2/C5.10
3. PROPOSED ACCESSIBLE PARKING AISLE SIGN, SEE DETAIL 3/C5.10
4. PROPOSED ADA PARKING, STRIPING AND SIGNING, SEE DETAIL 4/C5.10
5. PROPOSED PARALLEL ADA RAMP, SEE DETAIL 6/C5.10
6. PARKING STRIPING, 4" WHITE STRIPE WITH 2 COATS
7. PROPOSED LIGHT ASPHALT PAVEMENT, SEE DETAIL 7/C5.10
8. PROPOSED GATE, SEE ARCHITECTURAL PLANS
9. PROPOSED CHAIN LINK FENCE, SEE DETAIL 8/C5.10
10. PROPOSED LANDSCAPE AREA, SEE LANDSCAPE PLANS
11. PROPOSED HYDRANT, SEE UTILITY PLANS
12. PROPOSED KNOX BOX
13. PROPOSED ADA SPACE TO BE DESIGNATED AS WHEEL CHAIR USER ONLY SPACE
14. PROPOSED HEAVY ASPHALT PAVEMENT, SEE DETAIL 7/C5.10
15. PROPOSED FDC
16. PROPOSED BOLLARD, SEE DETAIL 3/C5.12

NOTES

ALL CURB RADII ARE 3' UNLESS OTHERWISE NOTED

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SITE PLAN - SOUTH

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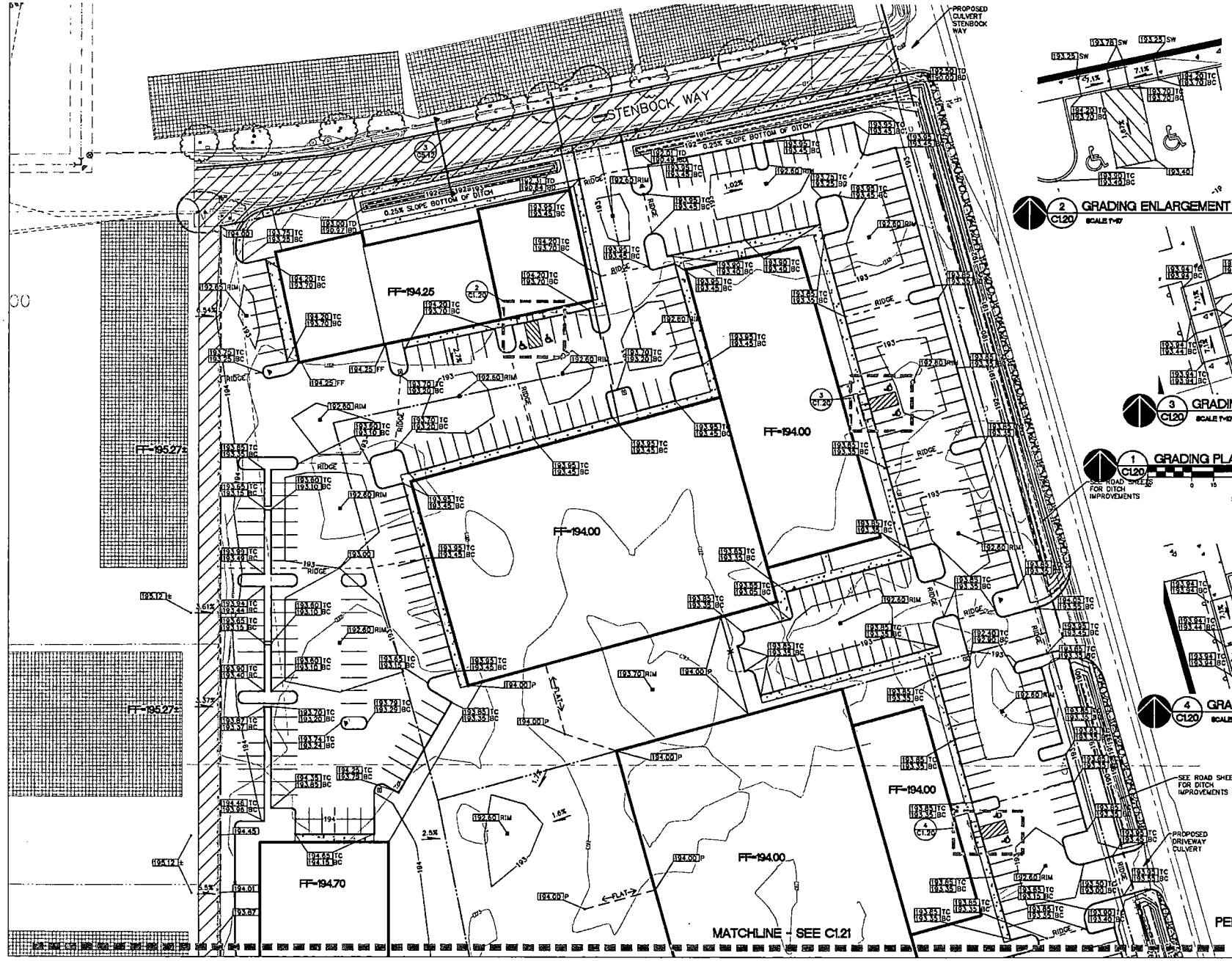
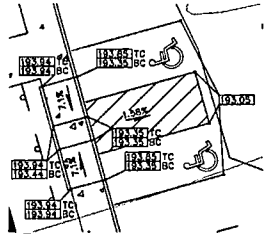
CHECKED BY: DGL
SHEET:
C1.12

JOB NO. 2180516.00

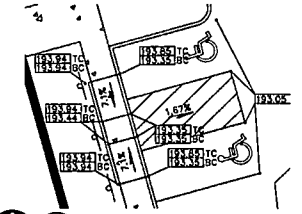


2 C1.20 GRADING ENLARGEMENT
SCALE 1"=10'



3 C1.20 GRADING ENLARGEMENT
SCALE 1"=10'

1 C1.20 GRADING PLAN - NORTH
SCALE 1"=30'



4 C1.20 GRADING ENLARGEMENT
SCALE 1"=10'

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GRADING PLAN NORTH

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SHEET:
C1.20

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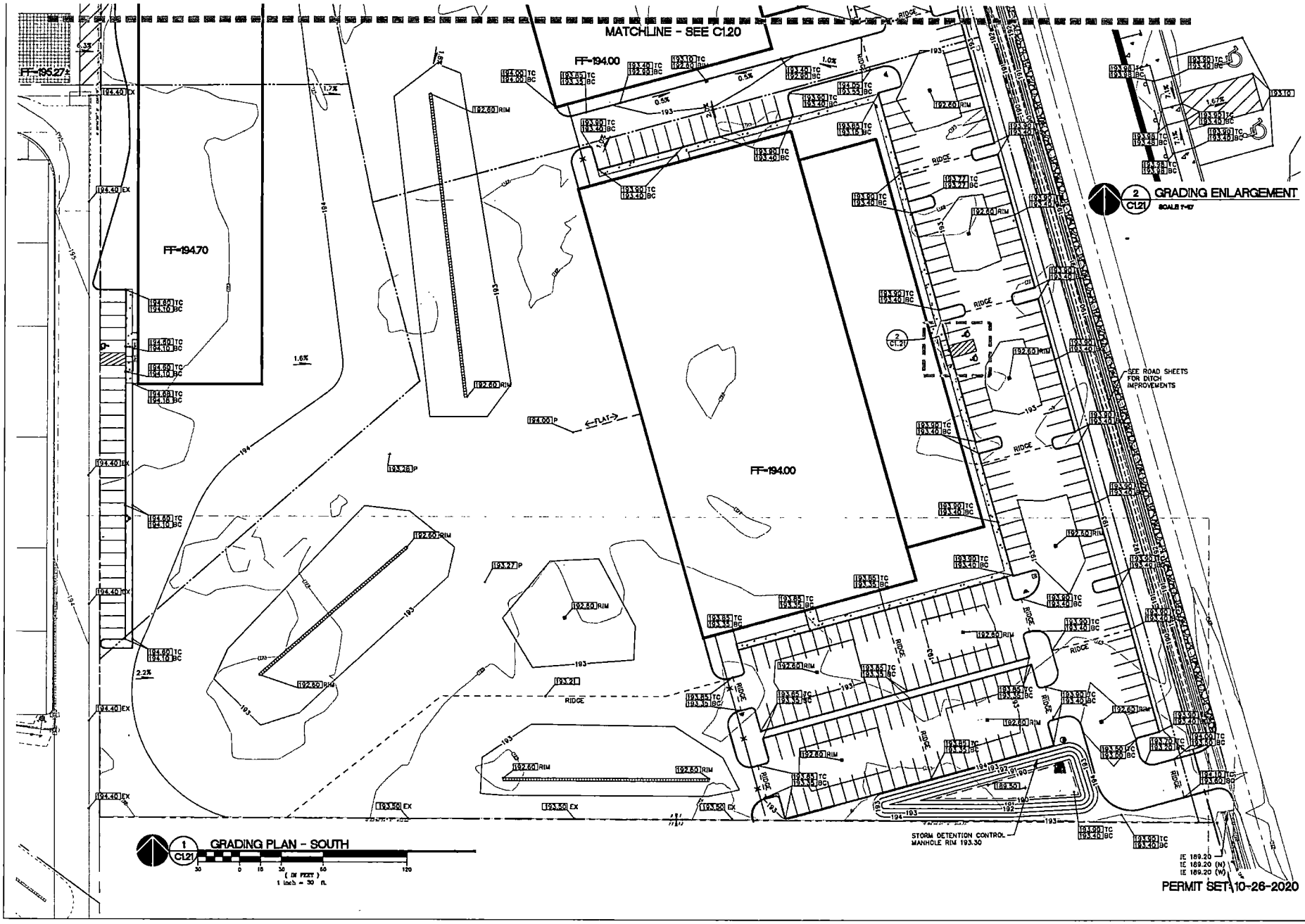

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GRADING PLAN
SOUTH

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SHEET:
C1.21

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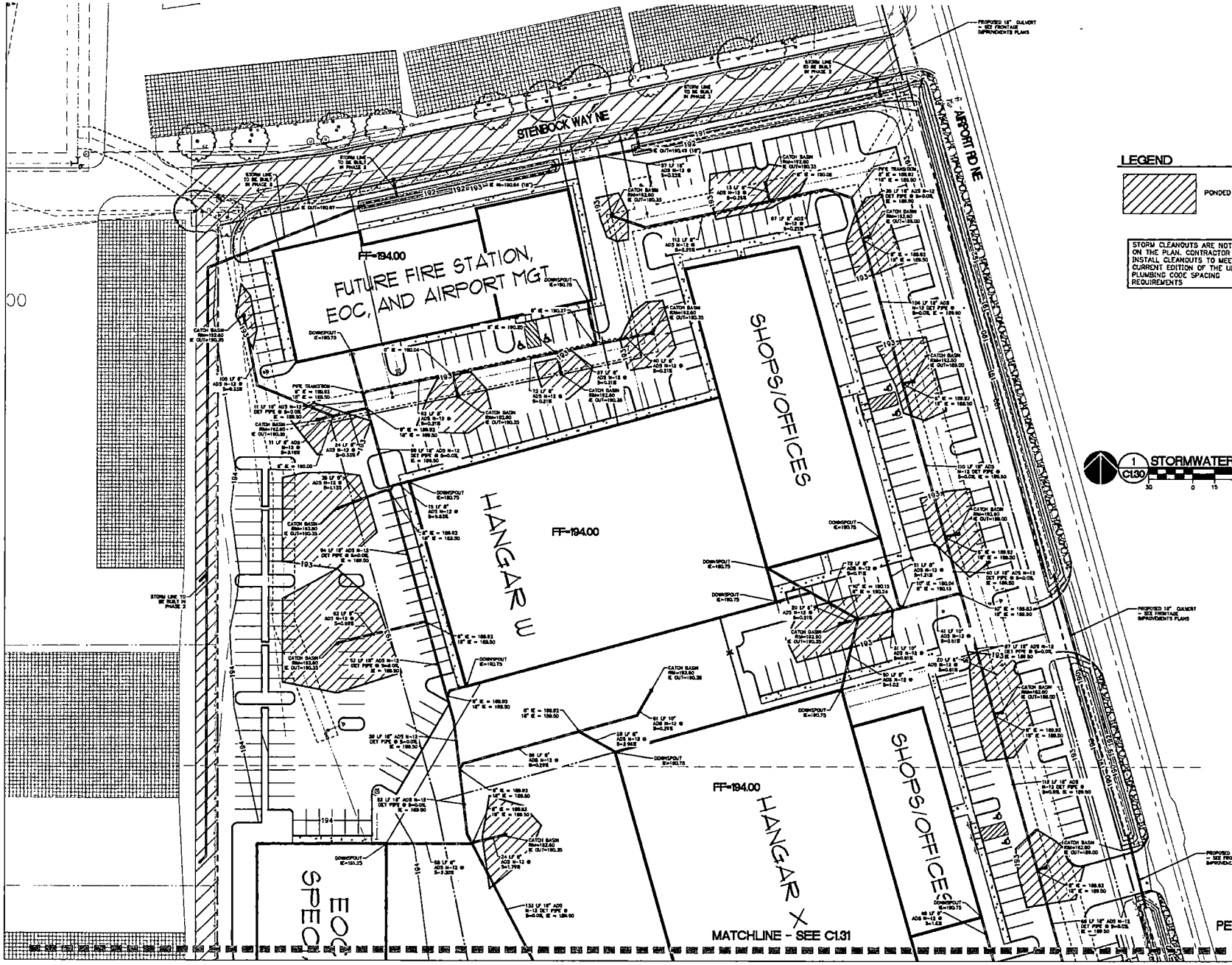

LEGEND

PONDED SURFACE

STORM CLEANOUTS ARE NOT SHOWN ON THE PLAN. CONTRACTOR SHALL INSTALL CLEANOUTS TO MEET CURRENT EDITION OF THE UNIFORM PLUMBING CODE SPACING REQUIREMENTS

1 C1.30 STORMWATER PLAN - NORTH

30 0 15 30 60 120
(IN FEET)
1 inch = 30 ft.

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ARON FAEGRE ARCHITECT

Project
AURORA AIRPARK BUSINESS CENTER

REGISTERED PROFESSIONAL ENGINEER
OREGON
MAY 04, 2018
CHAD T. LAWRENCE
EXPIRES: 12-31-2020

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REVISIONS:

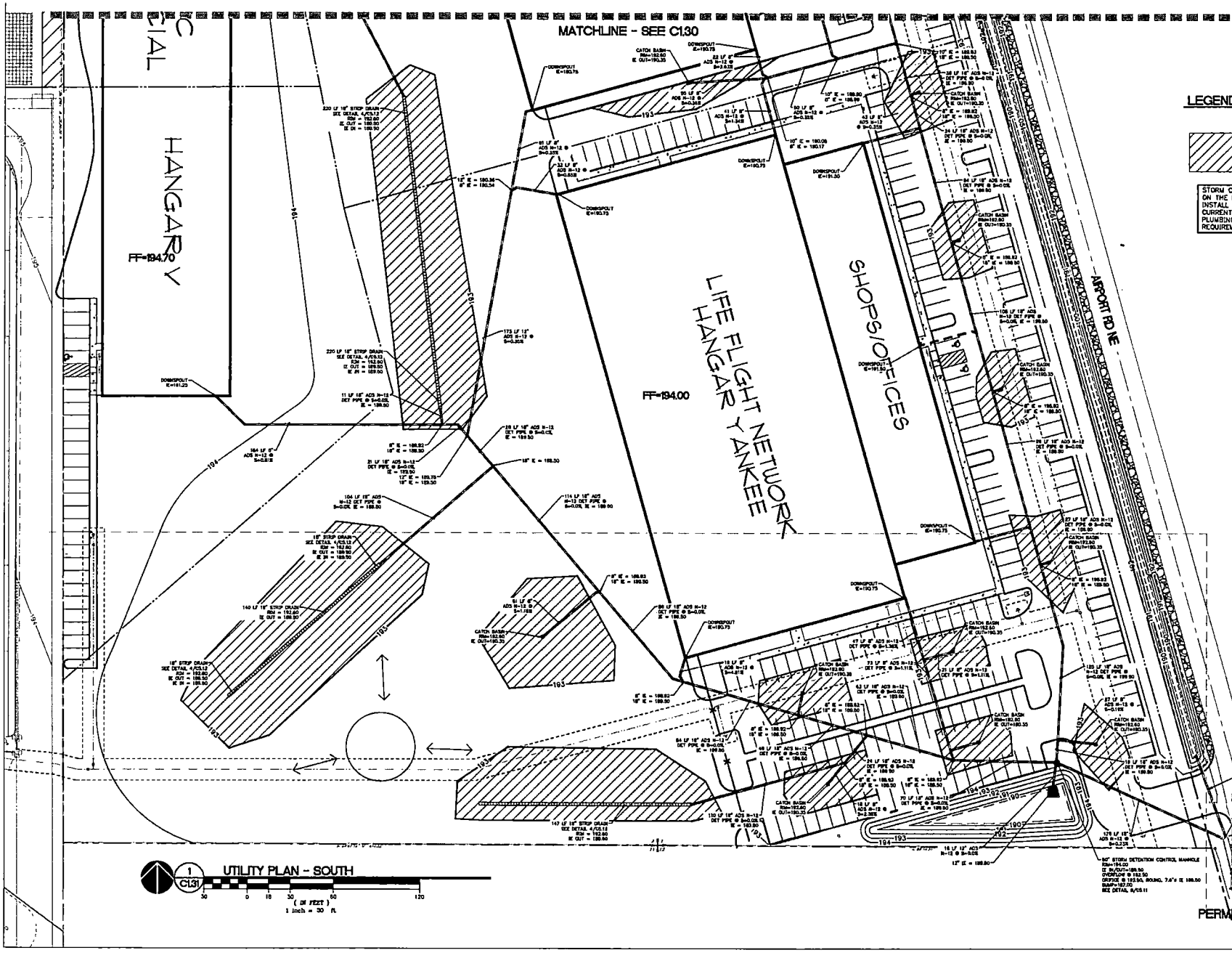
REVISION DELTA	REVISION DELTA CLOSING DATE

SHEET TITLE:
STORMWATER PLAN (NORTH)

DRAWN BY: JAZ
CHECKED BY: DGL
SHEET:
C1.30

JOB NO. 2180516.00

PERMIT SET: 10-26-2020



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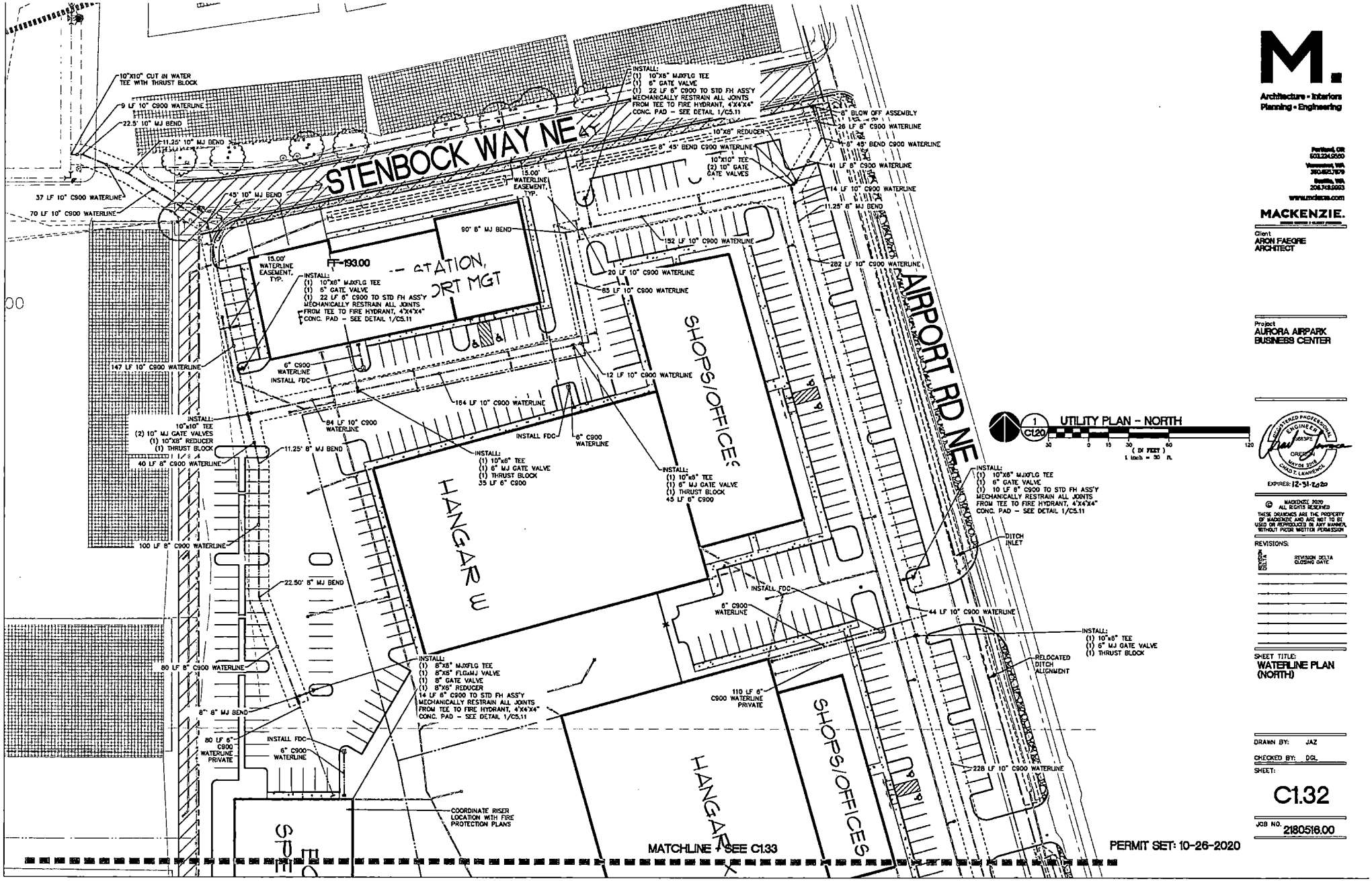
1	REVISION DELTA CLOSING GATE	

SHEET TITLE:
STORMWATER PLAN (SOUTH)

DRAWN BY: JAZ
CHECKED BY: DGL
SHEET:
C1.31
JOB NO. 2180516.00



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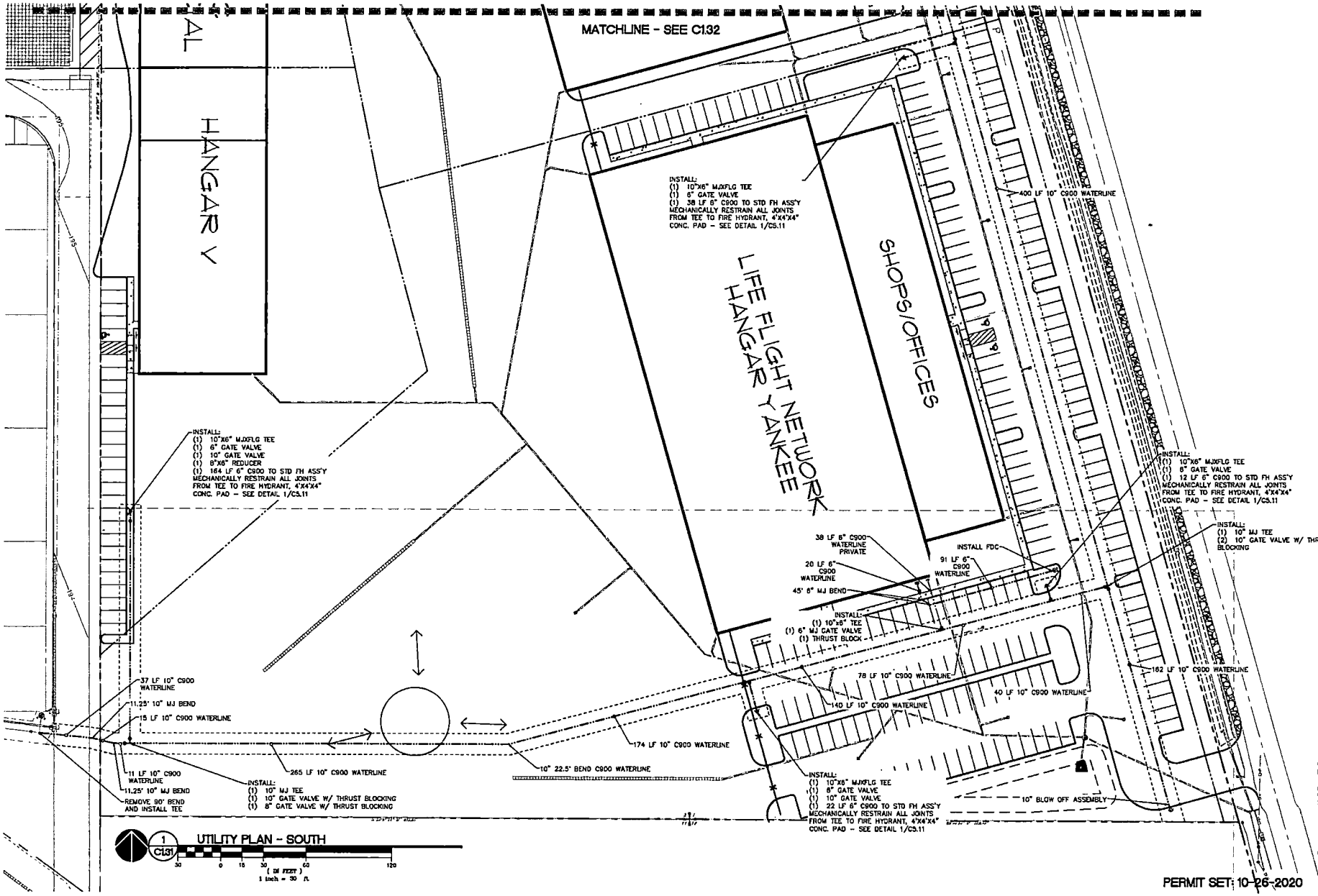
SHEET TITLE:
WATERLINE PLAN (NORTH)

DRAWN BY: JAZ
CHECKED BY: DGL
SHEET:
C1.32
JOB NO. 2180516.00

PERMIT SET: 10-26-2020



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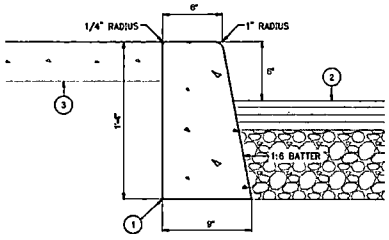
WATERLINE PLAN (SOUTH)

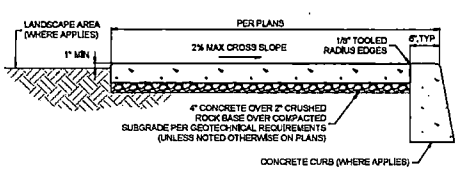
DRAWN BY: JAZ
CHECKED BY: DGL
SHEET:
C1.33
JOB NO. 2180516.00



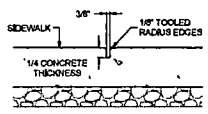
KEYNOTES:
1. CONCRETE FOR CURBING PER PROJECT SPECIFICATIONS ON C0.02
2. PAVEMENT SECTION PER CIVIL PLANS
3. SEE PLANS FOR IMPROVEMENTS AT BACK OF CURB. WHERE SIDEWALK OCCURS, THE SIDEWALK AND TOP OF CURB SHALL BE FLUSH. WHERE ABUTTING A PLANTER AREA, THE FINAL GRADE SHALL BE 1" MINIMUM BELOW TOP OF CURB, OR AS DIRECTED BY THE LANDSCAPE ARCHITECT

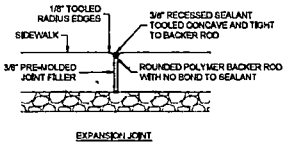
1 C5.10 VERTICAL CURB

NTS



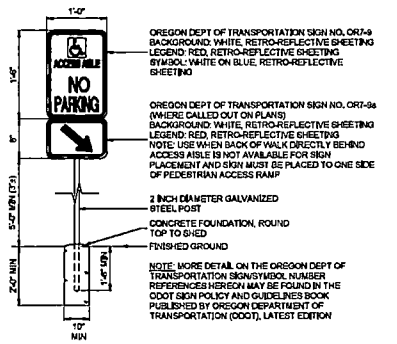
NOTES:
A. CONCRETE SIDEWALK SHALL BE BROOM FINISHED UNLESS OTHERWISE NOTED ON PLANS
B. SEE PROJECT SPECIFICATIONS ON SHEET C0.02 FOR CONCRETE, AGGREGATE BASE, AND JOINT MATERIALS
C. WHERE SIDEWALK ABUTS CURBING, SURFACE SHALL BE FLUSH WITH TOP OF CURB UNLESS NOTED OTHERWISE ON PLANS. WHERE SIDEWALK ABUTS LANDSCAPE OR OTHER PERVIOUS AREA, GRADE SHALL BE RECESSED 1" MINIMUM OR AS OTHERWISE DICTATED BY THE LANDSCAPE ARCHITECT OR NOTED ON PROJECT PLANS
D. DO NOT USE EDGERS ON TOOLED EDGES UNLESS NOTED OTHERWISE
E. CONTROL JOINTS SHALL BE EVENLY SPACED AND LOCATED EVERY 5' MAXIMUM, WITH EXPANSION JOINTS EVERY FOURTH JOINT, OR PER PLAN. SIDEWALK JOINTS SHALL BE ALIGNED WITH CURB JOINTS OR WHERE PERPENDICULAR CURBING INTERSECTS.





2 C5.10 CONCRETE SIDEWALK AND JOINTS

NTS



OREGON DEPT OF TRANSPORTATION SIGN NO. R7-9
BACKGROUND: WHITE, RETRO-REFLECTIVE SHEETING
LEGEND: RED, RETRO-REFLECTIVE SHEETING
SYMBOL: WHITE ON BLUE, RETRO-REFLECTIVE SHEETING

OREGON DEPT OF TRANSPORTATION SIGN NO. R7-9a
(WHERE CALLED OUT ON PLANS)
BACKGROUND: WHITE, RETRO-REFLECTIVE SHEETING
LEGEND: RED, RETRO-REFLECTIVE SHEETING
NOTE: USE WHEN BACK OF WALK DIRECTLY BEHIND ACCESS AISLE IS NOT AVAILABLE FOR SIGN PLACEMENT AND SIGN MUST BE PLACED TO ONE SIDE OF PEDESTRIAN ACCESS RAMP

2 INCH DIAMETER GALVANIZED STEEL POST

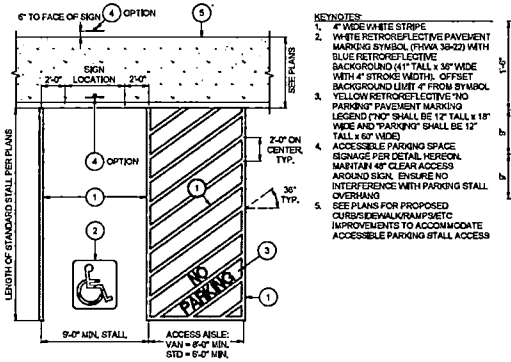
CONCRETE FOUNDATION, ROUND TOP TO SHED

FINISHED GROUND

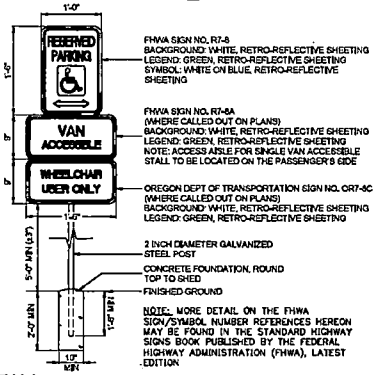
NOTE: MORE DETAIL ON THE OREGON DEPT OF TRANSPORTATION SIGN/SYMBOL NUMBER REFERENCES HEREON MAY BE FOUND IN THE ODOT SIGN POLICY AND GUIDELINES BOOK PUBLISHED BY OREGON DEPARTMENT OF TRANSPORTATION (ODOT), LATEST EDITION

3 C5.10 ACCESSIBLE PARKING AISLE SIGN

NTS



KEYNOTES:
1. 4" WIDE WHITE STRIPE
2. WHITE RETROREFLECTIVE PAVEMENT MARKING SYMBOL (FHWA 1M-22) WITH BLUE RETROREFLECTIVE BACKGROUND (41" TALL x 36" WIDE WITH 4" STROKE WIDTH). OFFSET BACKGROUND LIMIT 4" FROM SYMBOL
3. YELLOW RETROREFLECTIVE "NO PARKING" PAVEMENT MARKING LEGEND ("NO" SHALL BE 12" TALL x 18" WIDE AND "PARKING" SHALL BE 12" TALL x 60" WIDE)
4. ACCESSIBLE PARKING SPACE SIGNAGE PER DETAIL HEREON. MAINTAIN 48" CLEAR ACCESS AROUND SIGN. ENSURE NO INTERFERENCE WITH PARKING STALL OVERHANG
5. SEE PLANS FOR PROPOSED CURB/SIDEWALK/RAMP/SETC IMPROVEMENTS TO ACCOMMODATE ACCESSIBLE PARKING STALL ACCESS



FHWA SIGN NO. R7-8
BACKGROUND: WHITE, RETRO-REFLECTIVE SHEETING
LEGEND: GREEN, RETRO-REFLECTIVE SHEETING
SYMBOL: WHITE ON BLUE, RETRO-REFLECTIVE SHEETING

FHWA SIGN NO. R7-8A
(WHERE CALLED OUT ON PLANS)
BACKGROUND: WHITE, RETRO-REFLECTIVE SHEETING
LEGEND: GREEN, RETRO-REFLECTIVE SHEETING
NOTE: ACCESS AISLE FOR SINGLE VAN ACCESSIBLE STALL TO BE LOCATED ON THE PASSENGER'S SIDE

OREGON DEPT OF TRANSPORTATION SIGN NO. OR7-8C
(WHERE CALLED OUT ON PLANS)
BACKGROUND: WHITE, RETRO-REFLECTIVE SHEETING
LEGEND: GREEN, RETRO-REFLECTIVE SHEETING

2 INCH DIAMETER GALVANIZED STEEL POST

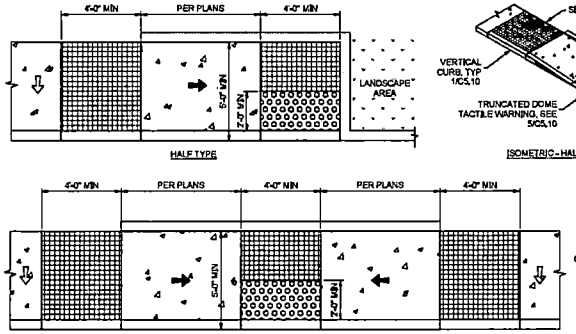
CONCRETE FOUNDATION, ROUND TOP TO SHED

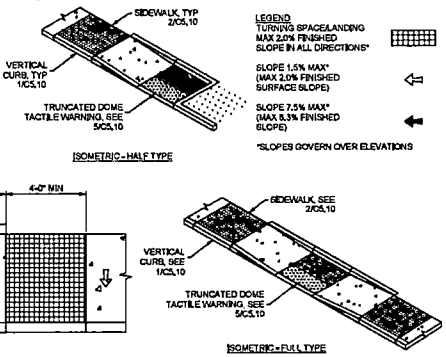
FINISHED GROUND

NOTE: MORE DETAIL ON THE FHWA SIGN/SYMBOL NUMBER REFERENCES HEREON MAY BE FOUND IN THE STANDARD HIGHWAY SIGNS BOOK PUBLISHED BY THE FEDERAL HIGHWAY ADMINISTRATION (FHWA), LATEST EDITION

4 C5.10 ACCESSIBLE PARKING STALL

NTS





LEGEND
TURNING SPACE/LANDING MAX 2.0% FINISHED SLOPE IN ALL DIRECTIONS*

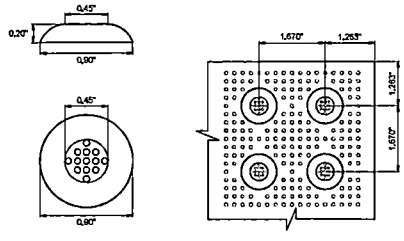
SLOPE 1.5% MAX* (MAX 2.0% FINISHED SURFACE SLOPE)

SLOPE 7.5% MAX* (MAX 8.3% FINISHED SLOPE)

*SLOPES GOVERN OVER ELEVATIONS

5 C5.10 PARALLEL CURB RAMPS

NTS



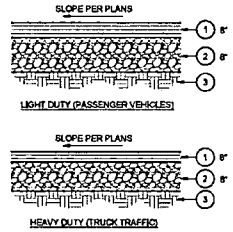
TRUNCATED DOME DETAIL

TRUNCATED DOME PANEL

NOTES:
A. PLACE TRUNCATED DOME DETECTABLE WARNING TEXTURE (OR CAST-IN-PLACE PANELS) IN THE LOWER 24" FOR THE FULL WIDTH OF THE RAMP
B. ARRANGE DOMES USING AN INLINE PATTERN AS SHOWN IN THE DETAIL ABOVE
C. COLOR OF DOME TEXTURE (OR PANELS) TO BE SAFETY YELLOW, UNLESS NOTED OTHERWISE ON PLANS
D. SURFACE APPLIED PANELS SHALL ONLY BE ALLOWED IN RETROFIT CONDITIONS AND WITH THE PRIOR APPROVAL OF THE ENGINEER

6 C5.10 TRUNCATED DOMES

NTS

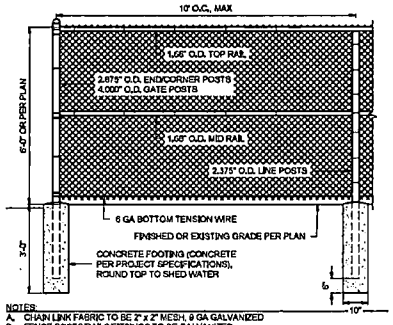


KEYNOTES:
1. ASPHALT PAVEMENT SECTION PER PROJECT SPECIFICATIONS
2. CRUSHED ROCK BASE SECTION PER PROJECT SPECIFICATIONS
3. COMPACTED SUBGRADE PER GEOTECHNICAL RECOMMENDATIONS

NOTES:
A. SEE PLANS FOR LOCATIONS OF LIGHT AND HEAVY DUTY PAVEMENTS. IF NONE SPECIFIED, USE LIGHT DUTY IN PASSENGER VEHICLE PARKING STALLS ONLY AND HEAVY DUTY IN ALL OTHER LOCATIONS
B. SEE PROJECT GEOTECHNICAL REPORT FOR PAVEMENT AND SUBGRADE PREPARATION RECOMMENDATIONS

7 C5.10 ASPHALT PAVEMENT SECTION

NTS



NOTES:
A. CHAIN LINK FABRIC TO BE 2" x 2" MESH, 9 GA GALVANIZED
B. FENCE POST/RAIL/FITTINGS TO BE GALVANIZED
C. FITTINGS TO BE HEAVY PRESSED GALVANIZED PER ASTM F626
D. FENCE MATERIALS AND CONSTRUCTION SHALL CONFORM WITH THE CHAIN LINK FENCE MANUFACTURERS INSTITUTE (CLFMI) GUIDELINES FOR HEAVY INDUSTRIAL FENCE

8 C5.10 CHAIN LINK FENCE

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JULY 06, 2004
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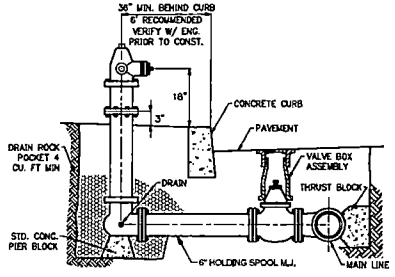
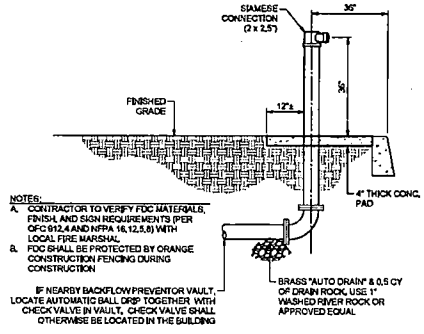
REVISIONS THIS SHEET

SHEET TITLE:
CIVIL DETAILS

DRAWN BY: CME
CHECKED BY: CTL
SHEET:
C5.10
JOB NO. 2180516.00



1 C5.11 FIRE HYDRANT NTS

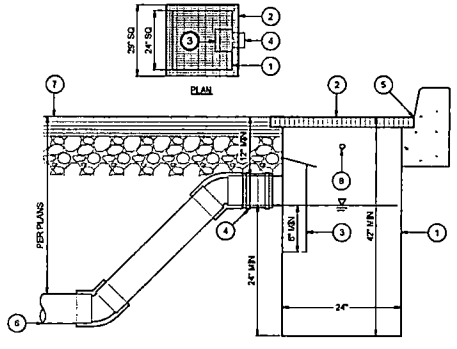


NOTES:
A. CONTRACTOR TO VERIFY FDC MATERIALS, FINISH, AND SIGN REQUIREMENTS (PER OFC 912.4 AND NFPA 16, 12.5.5) WITH LOCAL FIRE MARSHAL
B. FDC SHALL BE PROTECTED BY ORANGE CONSTRUCTION FENCING DURING CONSTRUCTION

IF NEARBY BACKFLOW PREVENTOR VAULT, LOCATE AUTOMATIC BALL DRIP TOGETHER WITH CHECK VALVE IN VAULT, CHECK VALVE SHALL OTHERWISE BE LOCATED IN THE BUILDING

2 C5.11 FIRE DEPARTMENT CONNECTION NTS

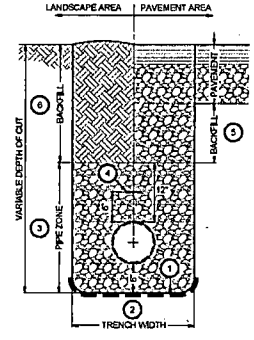
3 C5.11 NOT USED NTS



KEYNOTES:
1. PREFABRICATED, ASPHALT DIPPED, 10 GAUGE STEEL SUMPED CATCH BASIN WITH INTEGRAL GRATE FRAME
2. BIKE PROOF, HEAVY DUTY REMOVABLE TRAFFIC GRATE CAPABLE OF SUPPORTING H20 LOADING
3. SEDIMENT TRAP WITH HINGED LID
4. INSTALL FLEXIBLE CLAMPED COUPLING ON INTEGRAL CATCH BASIN OUTLET. IMMEDIATELY TURN DOWN PIPING AT 45 DEGREES TO INTERSECT WITH THE SITE PIPING
5. LOCATE CATCH BASIN SUCH THAT THE EDGE OF GRATE FRAME IS INLINE WITH THE ABUTTING CURBLINE (WHERE APPLIES).
6. PIPE SIZE, INVERT, AND SLOPE PER PLANS
7. PAVING SECTION PER PLANS
8. 1/2 INCH TO 1 INCH DIAMETER WEEPHOLES, MINIMUM 1 PER SIDE. CONTRACTOR SHALL VERIFY COMPLIANCE WITH LOCAL JURISDICTION PRIOR TO PROCURING MATERIALS

NOTES:
A. ALL PRODUCTS USED SHALL BE COMPLIANT WITH BOTH THE UNIFORM AND LOCAL JURISDICTION PLUMBING CODES
B. WHERE ABUTTING CURBING, GRATE SHALL BE ORIENTED SO THAT THE ELONGATED PATTERN IS PERPENDICULAR TO THE CURB FACE

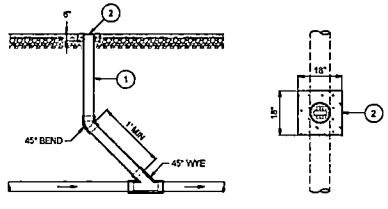
4 C5.11 STEEL CATCH BASIN NTS



KEYNOTES:
1. INSTALL TRENCH STABILIZATION AS NECESSARY TO OBTAIN COMPACTION
2. TRENCH WIDTH SHALL ACCOMMODATE THE PIPE DIAMETER PLUS ONE ADDITIONAL PIPE DIAMETER ON EITHER SIDE OF THE PIPE, BUT IN NO CASE LESS THAN 6 INCHES OR MORE THAN 18 INCHES
3. PIPE ZONE TO CONSIST OF IMPORTED GRANULAR MATERIAL
4. TRACER WIRE PER PROJECT SPECIFICATIONS
5. BACKFILL IN PAVEMENT AREAS WITH IMPORTED GRANULAR MATERIAL TO PAVEMENT SUBGRADE ELEVATION
6. BACKFILL IN LANDSCAPE AREAS WITH NATIVE MATERIAL TO PLANTER SUBGRADE ELEVATION, MOUND TOP TO SHED AT 2% EACH DIRECTION

NOTES:
A. THIS DETAIL IS FOR USE ON PRIVATE PROPERTY ONLY. TRENCHING AND BACKFILL REQUIREMENTS FOR WORK IN THE PUBLIC RIGHT-OF-WAY SHALL BE COMPLIANT WITH THE STANDARDS OF THE AUTHORITY HAVING JURISDICTION
B. SEE GEOTECHNICAL REPORT AND PROJECT SPECIFICATIONS FOR RECOMMENDED MATERIALS AND FURTHER REQUIREMENTS (I.e. SIZE AND GRADATION OF GRANULAR MATERIALS, MINIMUM COMPACTION, MAXIMUM LIFT PLACEMENT, TRACER WIRE, ETC.)
C. IF GROUNDWATER IS ENCOUNTERED, CONSULT THE GEOTECHNICAL ENGINEER OF RECORD FOR ADDITIONAL RECOMMENDATIONS WITH REGARD TO TRENCHING, PIPE PLACEMENT, AND BACKFILL
D. REFER TO PROJECT SPECIFICATIONS FOR MINIMUM PIPE COVER AND ALTERNATE MATERIAL REQUIREMENTS. CONTRACTOR SHALL PREVENT CONSTRUCTION VEHICLES FROM DRIVING OVER PIPING WITH LESS THAN 12" COVER AT ANY POINT IN TIME DURING CONSTRUCTION

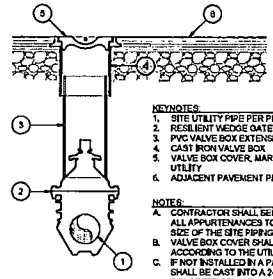
5 C5.11 UTILITY TRENCH BEDDING + BACKFILL NTS



KEYNOTES:
1. CLEANOUT PIPING AND FITTINGS TO BE OF THE SAME SIZE (6" MAX) AND MATERIAL AS THE PIPING IT IS SERVING
2. CLEANOUT LID, FRAME, AND CONCRETE COLLAR PER PROJECT SPECIFICATIONS. UTILIZE H-20 RATED TRAFFIC RATED FRAME AND LID IN PAVED AREAS

NOTES:
A. CONCRETE COLLAR MAY BE OMITTED IN LANDSCAPE AREAS. USE PLASTIC PIPE CAP AND SET 3 INCHES ABOVE GRADE

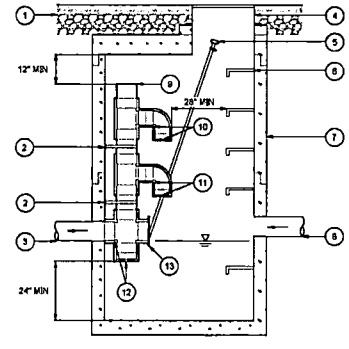
6 C5.11 CLEANOUT NTS



KEYNOTES:
1. SITE UTILITY PIPE PER PLANS
2. RESILIENT WEDGE GATE VALVE
3. PVC VALVE BOX EXTENSION, 6" MIN.
4. CAST IRON VALVE BOX
5. VALVE BOX COVER, MARKED ACCORDING TO UTILITY
6. ADJACENT PAVEMENT PER PLANS

NOTES:
A. CONTRACTOR SHALL SELECT GATE VALVE AND ALL APPURTENANCES TO ACCOMMODATE THE SIZE OF THE SITE PIPING
B. VALVE BOX COVER SHALL BE MARKED ACCORDING TO THE UTILITY IT SERVES
C. IF NOT INSTALLED IN A PAVED AREA, VALVE LID SHALL BE CAST INTO A 24" SQUARE OR ROUND CONCRETE COLLAR
D. INSTALL VALVE OPERATOR EXTENSION IF TOP VALVE OPERATOR NUT IS 48" OR MORE BELOW FINISHED GRADE
E. ALL MATERIALS AND INSTALLATION METHODS SHALL MEET THE PROJECT SPECIFICATIONS AND GOVERNING CODE REQUIREMENTS

7 C5.11 GATE VALVE NTS



KEYNOTES:
1. PAVING SECTION PER PLANS
2. SECURE PIPE STACK TO MANHOLE WITH RUST PROOF TIE STRAPS AND BOLTS
3. OUTLET PIPE SIZE, INVERT, AND SLOPE PER PLANS
4. STANDARD MANHOLE FRAME AND COVER. RIM ELEVATION PER PLANS
5. LIFT HANDLE FOR SHEAR GATE, SEE DETAIL 1/C5.12
6. MANHOLE STEP PER 3/C5.11
7. MANHOLE PER 3/C5.11
8. INLET PIPE SIZE, INVERT, AND SLOPE PER PLANS
9. OVERFLOW SIZE AND ELEVATION = 16", 192.50
10. ORIFICE 3 SIZE AND ELEVATION = N/A
11. ORIFICE 2 SIZE AND ELEVATION = 18", 192.5
12. ORIFICE 1 SIZE AND ELEVATION = 7.6", 189.5
13. SHEAR GATE PER DETAIL 1/C5.12

NOTES:
A. CONTRACTOR IS RESPONSIBLE FOR SELECTING THE MANHOLE SIZE, TYPE, AND MATERIAL BASED UPON PROJECT SITE CONDITIONS, PROJECT PLANS & SPECIFICATIONS, AND THE DIMENSIONAL CRITERIA HEREON
B. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS OF ALL FLOW CONTROL MANHOLES FOR REVIEW AND APPROVAL BY THE ENGINEER PRIOR TO PROCURING MATERIALS
C. SELECTED MANHOLE SHALL MEET THE CRITERIA OF THE PROJECT SPECIFICATIONS AND BE INSTALLED ACCORDINGLY
D. INLET AND OUTLET PIPES CONNECTIONS SHALL BE COMPLIANT WITH PROJECT SPECIFICATIONS OR THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION, WHICHEVER IS MOST STRINGENT
E. UNLESS NOTED OTHERWISE, PIPE STACK, CROSS FITTING FOR ORIFICE 1 & SHEAR GATE, AND OVERFLOW SHALL BE THE SIZE OF THE OUTLET PIPE. USE REDUCING TEES AS APPROPRIATE FOR THE ADDITIONAL ORIFICES TO OPTIMIZE SPACE CONSTRAINTS

8 C5.11 FLOW CONTROL MANHOLE NTS

PERMIT SET: 10-26-2020

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BUSINESS CENTER

REGISTERED PROFESSIONAL ENGINEER
OREGON
MAY 05, 2006
CHAD T. LAWRENCE
EXPIRES: 12-31-2020

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SHEET:
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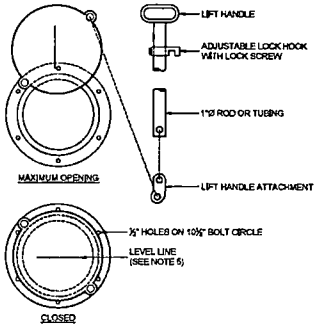
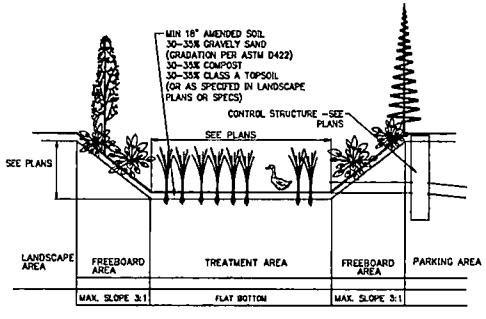
JOB NO. 2180516.00



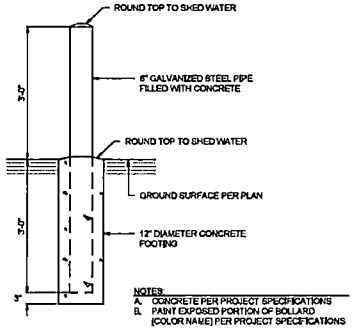
NOTES
A. THE FRAME AND LADDER OR STEPS ARE TO BE OFFSET SO THAT: THE SHEAR GATE IS VISIBLE FROM THE TOP; THE CLIMB-DOWN SPACE IS CLEAR OF RISER AND GATE, THE FRAME IS CLEAR OF THE CURB (IF APPLICABLE)
B. THE SHEAR GATE SHALL BE MADE OF ALUMINUM ALLOY IN ACCORDANCE WITH ASTM B 26M AND ASTM B 275, DESIGNATION 2G32A; OR CAST IRON IN ACCORDANCE WITH ASTM A 48, CLASS 30B
C. THE LIFT HANDLE SHALL BE MADE OF SIMILAR METAL TO THE GATE (TO PREVENT GALVANIC CORROSION)
D. A NEOPRENE RUBBER GASKET IS REQUIRED BETWEEN THE PIPE MOUNTING FLANGE AND THE GATE FLANGE
E. INSTALL THE GATE SO THAT THE LEVEL-LINE IS LEVEL WHEN THE GATE IS CLOSED
F. THE MATING SURFACES OF THE LID AND THE BODY SHALL BE MACHINED TO PROPER FIT
G. ALL SHEAR GATE BOLTS SHALL BE STAINLESS STEEL
H. THE SHEAR GATE MAXIMUM OPENING SHALL BE CONTROLLED BY LIMITED HINGE MOVEMENT, A STOP TAB, OR SOME OTHER DEVICE
I. ALTERNATIVE SHEAR GATE DESIGNS ARE ACCEPTABLE IF MATERIAL SPECIFICATIONS ARE MET AND FLANGE BOLT PATTERN MATCHES. CONTRACTOR TO SUBMIT SHOP DRAWINGS TO ENGINEER PRIOR TO PROCURING PRODUCT OR CONSTRUCTION

1 C5.12 SHEAR GATE
NTS



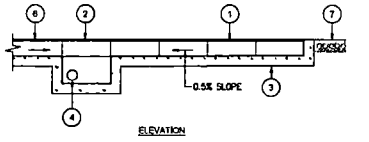
NOTES
1. SEE LANDSCAPE PLANS AND SPECIFICATIONS FOR REQUIREMENTS INCLUDING TREE PLACEMENT, AMENDED SOIL AND ALL PLANTING SPECIFICATIONS.
2. PROVIDE IRRIGATION AS PER THE LANDSCAPE PLAN.
3. 18-INCHES OF AMENDED SOIL SHALL BE PLACED THROUGHOUT THE WATER QUALITY TRACT.
4. SEE CIVIL PLANS FOR LOCATION, DIMENSION AND GRADING OF SWALE/WQ BASIN. SEE STORM REPORT FOR SIZING AND TREATMENT CALCULATIONS.

2 C5.12 TYPICAL SWALE/WQ BASIN SECTION
N.T.S.

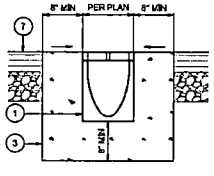


NOTES:
A. CONCRETE PER PROJECT SPECIFICATIONS
B. PAINT EXPOSED PORTION OF BOLLARD [COLOR NAME] PER PROJECT SPECIFICATIONS

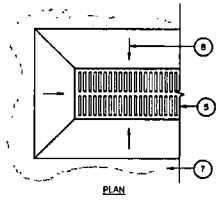
3 C5.12 6" PIPE BOLLARD
NTS



ELEVATION



SECTION



PLAN

KEYNOTES:
1. PREFABRICATED POLYMER CONCRETE INTERLOCKING MODULAR TRENCH DRAIN CHANNEL SECTION WITH STAINLESS STEEL EDGE RAILS, SLOPED 0.5%. MINIMUM DEPTH OF CHANNEL INVERT TO BE 8 INCHES UNLESS NOTED OTHERWISE
2. IN-LINE CATCH BASIN SECTION, CONTRACTOR TO SELECT TO MATCH SIZE AND INVERT OF OUTLET PIPE PER PLAN
3. CONCRETE SURROUND (4,000 PSI). SET 1/8" HIGHER THAN TOP OF CHANNEL EDGE AND FLUSH WITH ADJACENT PAVEMENT
4. OUTLET PIPE, SIZE AND SLOPE PER PLAN
5. GRATE PER PLAN OR PROJECT SPECIFICATIONS
6. ADDITIONAL CHANNEL SECTIONS, SLOPED TO CATCH BASIN, IF APPLICABLE
7. PAVING SECTION PER PLANS
8. SLOPE OF CONCRETE SURROUND TO BE 1.5% MAX IF IN PEDESTRIAN PATH OF TRAVEL, 5% OTHERWISE

NOTES:
A. SYSTEM SHALL BE PROVIDED BY SINGLE MANUFACTURER
B. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS OF EACH SITE SPECIFIC SYSTEM TO ENGINEER FOR REVIEW AND APPROVAL PRIOR TO PROCURING MATERIALS
C. IF NONE SPECIFIED, CONTRACTOR SHALL BE RESPONSIBLE FOR SELECTING LOAD CLASS APPROPRIATE FOR EXPECTED TRAFFIC CONDITIONS
D. CATCH BASIN OUTLET STRUCTURE SHALL BE OF THE "INLINE" TYPE UNLESS PROJECT CONDITIONS REQUIRE OTHERWISE

4 C5.12 TRENCH DRAIN
NTS

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SHEET:
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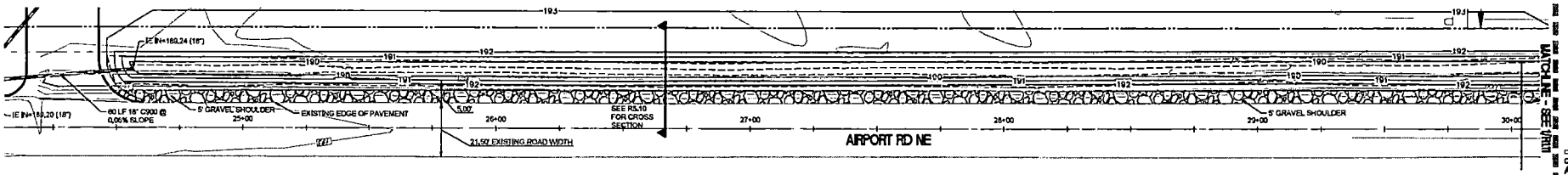
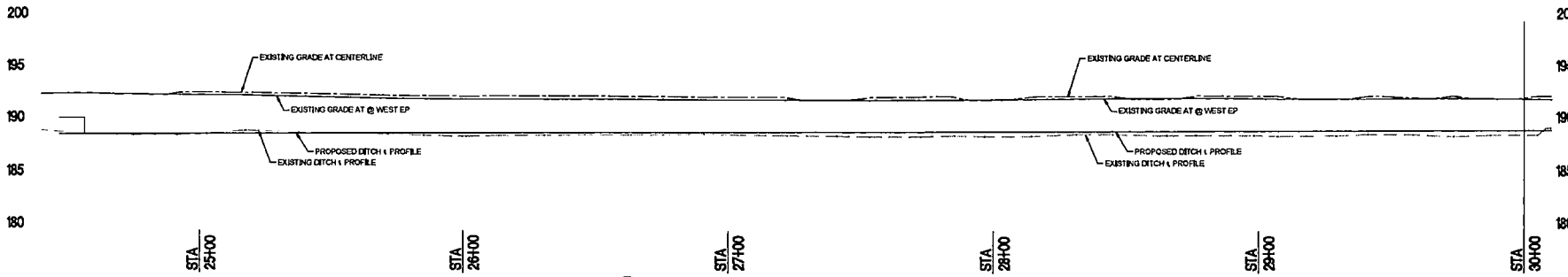


1 / R1.10 AIRPORT RD NE ROAD PLAN

10 0 5 10 20 40
(IN FEET)
1 inch = 10 ft.



2 / R1.10 AIRPORT RD NE PROFILE

HORIZONTAL SCALE 1"=10
VERTICAL SCALE 1"=5

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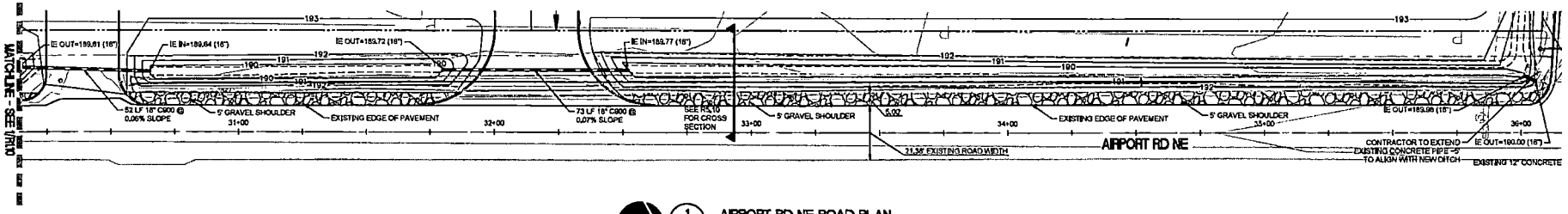
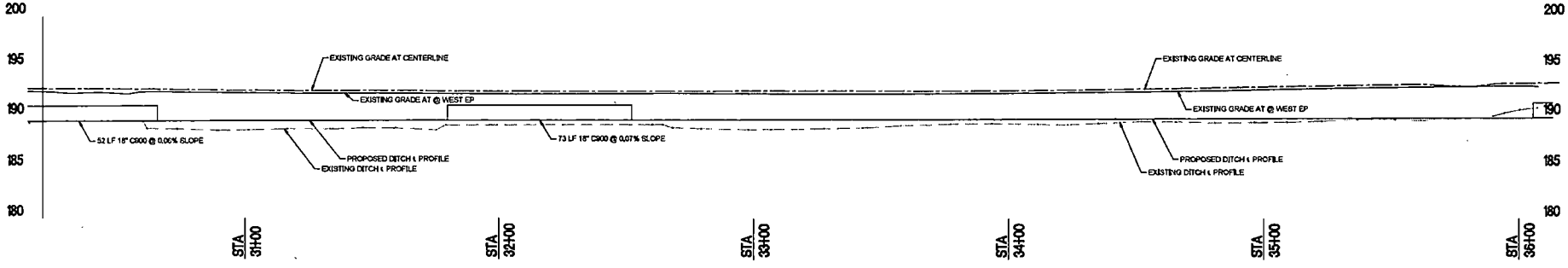


1 R1.11 AIRPORT RD NE ROAD PLAN

10 0 5 10 20 40
(IN FEET)
1 inch = 10 ft.



2 R1.11 AIRPORT RD NE PROFILE
HORIZONTAL SCALE 1"=10
VERTICAL SCALE 1"=5

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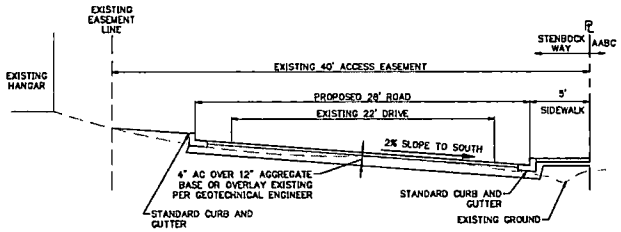
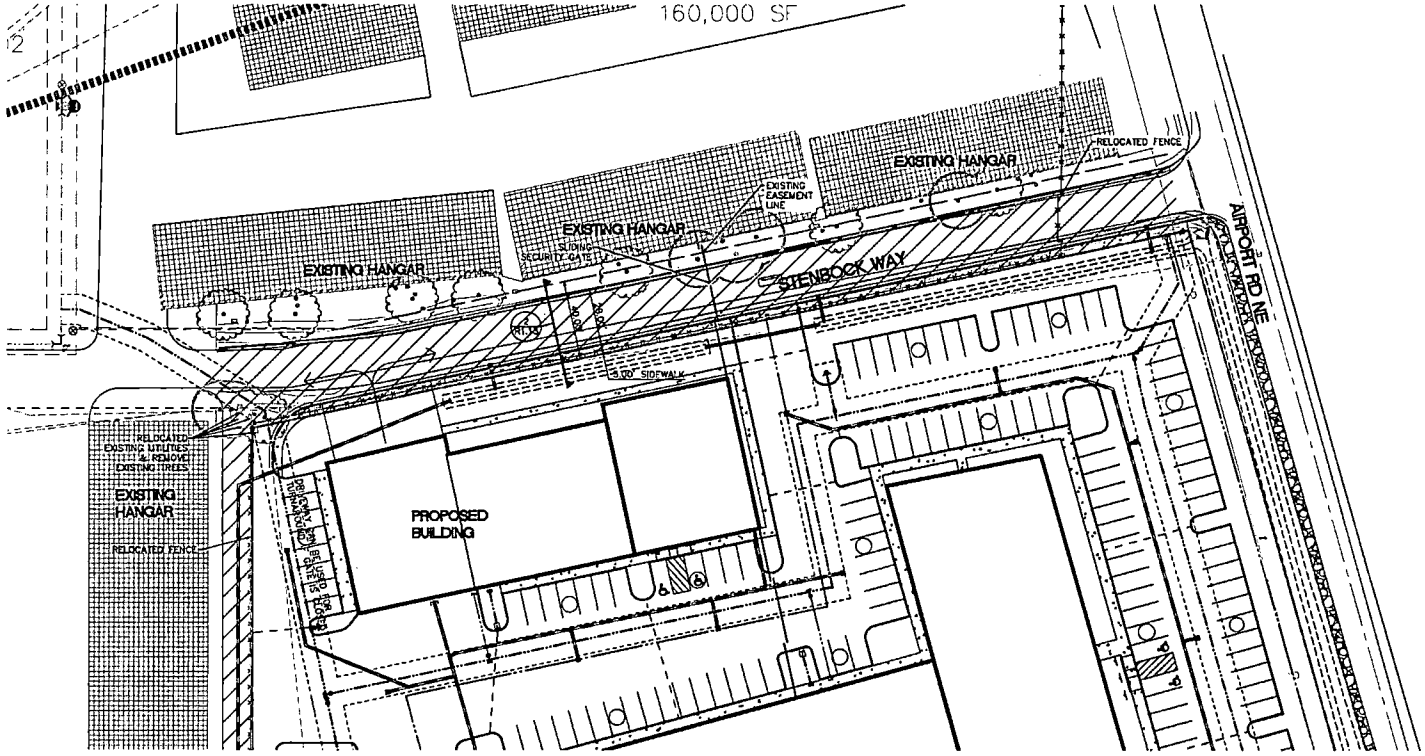


2 R1.12 STENBOCK TYPICAL SECTION
PRIVATE ROAD
1"=5' HORIZONTAL
(LOOKING EAST)



1 R1.12 STENBOCK ROAD IMPROVEMENTS (FUTURE)
30 0 15 30 60 120
(IN FEET)
1 inch = 30 ft.

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SHEET:
R1.12

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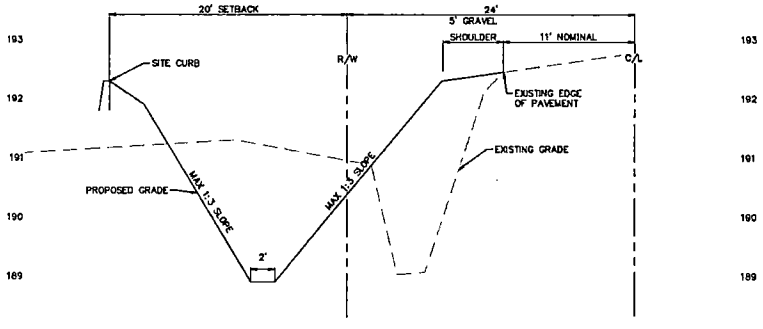

AIRPORT ROAD • AABC
OPTION 1 - RELOCATE DITCH
(LOOKING NORTH, NORTH OF EXISTING SOUTHERN DRIVEWAY)
HORIZONTAL: 1"=5'
VERTICAL 1"=1'

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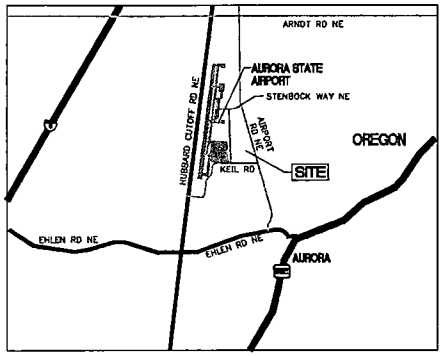
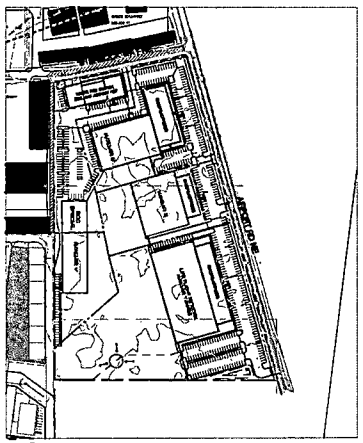
EROSION AND SEDIMENT CONTROL PLANS



VICINITY MAP
N.T.S



SITE MAP
SCALE: 1" = 200'

PROJECT LOCATION:
MARION COUNTY TAX ID #041811A 00100, 041W20 00600, 041W20D 00900
SE CORNER OF AURORA STATE AIRPORT
NE OF KEIL RD NE AND AIRPORT RD NE INTERSECTION,
AURORA, OR, 97002
LATITUDE = 45°14'41.2574, LONGITUDE = 122°45'50.7978"

ATTENTION EXCAVATORS:
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AURORA, OR 97002
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SURVEYOR
CHASE, JONES & ASSOCIATES INC
CONTACT: ERIC JONES
718 S. E. 11TH AVE.
PORTLAND, OR 97214
PHONE: 503-228-5941

STANDARD EROSION AND SEDIMENT CONTROL PLAN DRAWING NOTES:

1. HOLD A PRE-CONSTRUCTION MEETING OF PROJECT CONSTRUCTION PERSONNEL THAT INCLUDES THE INSPECTOR TO DISCUSS EROSION AND SEDIMENT CONTROL MEASURES AND CONSTRUCTION LIMITS. (SCHEDULE A.8.C.(1.(1))
2. ALL INSPECTIONS MUST BE MADE IN ACCORDANCE WITH DEQ 1200-C PERMIT REQUIREMENTS. (SCHEDULE A.12.B AND SCHEDULE B.1)
3. INSPECTION LOGS MUST BE KEPT IN ACCORDANCE WITH DEQ'S 1200-C PERMIT REQUIREMENTS. (SCHEDULE B.1.C AND D.2)
4. RETAIN A COPY OF THE ESCP AND ALL REVISIONS ON SITE AND MAKE IT AVAILABLE ON REQUEST TO DEQ, AGENT, OR THE LOCAL MUNICIPALITY. DURING INACTIVE PERIODS OF GREATER THAN SEVEN (7) CONSECUTIVE CALENDAR DAYS, THE ESCP RECORDS MUST BE RETAINED BY THE PERMIT REGISTRANT BUT DO NOR NEED TO BE AT THE CONSTRUCTION SITE. (SCHEDULE B.2.C)
5. ALL PERMIT REGISTRANTS MUST IMPLEMENT THE ESCP. FAILURE TO IMPLEMENT ANY OF THE CONTROL MEASURES OR PRACTICES DESCRIBED IN THE ESCP IS A VIOLATION OF THE PERMIT. (SCHEDULE A 6.A)
6. THE ESCP MUST BE ACCURATE AND REFLECT SITE CONDITIONS. (SCHEDULE A.9.B.C)
7. SUBMISSION OF ALL ESCP REVISIONS IS NOT REQUIRED. SUBMITTAL OF THE ESCP REVISIONS IS ONLY UNDER SPECIFIC CONDITIONS. SUBMIT ALL NECESSARY REVISION TO DEQ OR AGENT WITHIN 10 DAYS. (SCHEDULE A.17.C.(4. AND 9)
8. PHASE CLEARING AND GRADING TO THE MAXIMUM EXTENT PRACTICAL TO PREVENT EXPOSED INACTIVE AREAS FROM BECOMING A SOURCE OF EROSION. (SCHEDULE A.7.A.(8)
9. IDENTIFY, MARK, AND PROTECT DRY CONSTRUCTION FENCING OR OTHER MEANS) CRITICAL RIPARIAN AREAS AND VEGETATION INCLUDING IMPORTANT TREES AND ASSOCIATED ROOTING ZONES, AND VEGETATION AREAS TO BE PRESERVED. SENSITIVE VEGETATIVE BUFFER ZONES BETWEEN THE SITE AND RIPARIAN AREAS (E.G., WETLANDS), AND OTHER AREAS TO BE PRESERVED, ESPECIALLY IN PERIMETER AREAS. (SCHEDULE A.8.C.(.(1) AND (3))
10. PRESERVE EXISTING VEGETATION WHEN PRACTICAL AND RE-VEGETATE OPEN AREAS. RE-VEGETATE OPEN AREAS WHEN PRACTICABLE BEFORE AND AFTER GRADING OR CONSTRUCTION. IDENTIFY THE TYPE OF VEGETATIVE SEED MIX USED. (SCHEDULE A.7.A.(4)
11. MARK/FLAG AND DELINEATE ANY EXISTING NATURAL BUFFER WITHIN THE 50-FEET OF WATERS OF THE STATE. (SCHEDULE A.7.B.(AND D)(A)(B))
12. INSTALL PERIMETER SEDIMENT CONTROL, INCLUDING STORM DRAIN INLET PROTECTION AS WELL AS ALL SEDIMENT BASINS, TRAPS, AND BARRIERS PRIOR TO LAND DISTURBANCE. (SCHEDULE A.8.C.(.(1))
13. CONTROL BOTH PEAK FLOW RATES AND TOTAL STORMWATER VOLUME, TO MINIMIZE EROSION AT OUTLETS AND DOWNSTREAM CHANNELS AND STREAMBANKS. (SCHEDULE A.1.C.)
14. CONTROL SEDIMENTS AS NEEDED ALONG THE SITE PERIMETER AND AT ALL OPERATIONAL INTERNAL STORM DRAIN INLETS AT ALL TIMES DURING CONSTRUCTION, BOTH INTERNALLY AND AT THE SITE BOUNDARY. (SCHEDULE A.7.A.(3)
15. ESTABLISH CONCRETE TRUCK AND OTHER CONCRETE EQUIPMENT WASHOUT AREAS BEFORE BEGINNING CONCRETE WORK. (SCHEDULE A.8.C.(.(6))
16. APPLY TEMPORARY AND/OR PERMANENT SOIL STABILIZATION MEASURES IMMEDIATELY ON ALL DISTURBED AREAS AS GRADING PROGRESSES. TEMPORARY OR PERMANENT STABILIZATION MEASURES ARE NOT REQUIRED FOR AREAS THAT ARE INTENDED TO BE LEFT UNVEGETATED, SUCH AS GRIT ACCESS ROADS OR UTILITY POLE PADS.(SCHEDULE A.8.C.(.(5))
17. ESTABLISH MATERIAL AND WASTE STORAGE AREAS, AND OTHER NON-STORMWATER CONTROLS. (SCHEDULE A.8.C.(7))
18. PREVENT TRACKING OF SEDIMENT ONTO PUBLIC OR PRIVATE ROADS USING BMPS SUCH AS: CONSTRUCTION ENTRANCE, GRAVELED (OR PAVED) EXITS AND PARKING AREAS, GRAVEL ALL UNPAVED ROADS LOCATED ONSITE, OR USE AN EXIT TIRE WASH. THESE BMPS MUST BE IN PLACE PRIOR TO LAND-DISTURBING ACTIVITIES. (SCHEDULE A 7.D.8 AND A.8.C.(.(4))
19. WHEN TRUCKING SATURATED SOILS FROM THE SITE, EITHER USE WATER-TIGHT TRUCKS OR DRAIN LOADS ON SITE. (SCHEDULE A.7.B.(.(2))
20. CONTROL PREMINETED DISCHARGES FROM LEAVING THE CONSTRUCTION SITE, I.E., CONCRETE WASH-OUT, WASTEWATER FROM CLEANOUT OF STUCCO, PAINT AND CURING COMPOUNDS. (SCHEDULE A.8)
21. USE BMPS TO PREVENT OR MINIMIZE STORMWATER EXPOSURE TO POLLUTANTS FROM SPILLS; VEHICLE AND EQUIPMENT FUELING, MAINTENANCE, AND STORAGE; CONCRETE CLEANING AND MAINTENANCE ACTIVITIES; AND WASTE HANDLING ACTIVITIES. THESE POLLUTANTS INCLUDE FUEL, HYDRAULIC FLUID, AND OTHER OILS FROM VEHICLES AND MACHINERY, AS WELL AS DEBRIS, FERTILIZER, PESTICIDES AND HERBICIDES, PAINTS, SOLVENTS, CURING COMPOUNDS AND ADHESIVES FROM CONSTRUCTION OPERATIONS. (SCHEDULE A.7.C.(.(5))
22. IMPLEMENT THE FOLLOWING BMPS WHEN APPLICABLE: WRITTEN SPILL PREVENTION AND RESPONSE PROCEDURES, EMPLOYEE TRAINING ON SPILL PREVENTION AND PROPER DISPOSAL PROCEDURES, SPILL KITS IN ALL VEHICLES, REGULAR MAINTENANCE SCHEDULE FOR VEHICLES AND MACHINERY, MATERIAL DELIVERY AND STORAGE CONTROLS, TRAINING AND SIGNAGE, AND COVERED STORAGE AREAS FOR WASTE AND SUPPLIES. (SCHEDULE A. 7.E.8.)
23. USE WATER, SOIL-BINDING AGENT OR OTHER DUST CONTROL TECHNIQUE AS NEEDED TO AVOID WIND-BLOWN SOIL. (SCHEDULE A 7.A.M)
24. THE APPLICATION RATE OF FERTILIZERS USED TO REESTABLISH VEGETATION MUST FOLLOW MANUFACTURER'S RECOMMENDATIONS TO MINIMIZE NUTRIENT RELEASES TO SURFACE WATERS. EXERCISE CAUTION WHEN USING TIME-RELEASE FERTILIZERS WITHIN ANY WATERWAY RIPARIAN ZONE. (SCHEDULE A.8.B.(8)
25. IF AN ACTIVE TREATMENT SYSTEM (FOR EXAMPLE, ELECTRO-COAGULATION, FLOCCULATION, FILTRATION, ETC.) FOR SEDIMENT OR OTHER POLLUTANT REMOVAL IS EMPLOYED, SUBMIT AN OPERATION AND MAINTENANCE PLAN (INCLUDING SYSTEM SCHEMATIC, LOCATION OF SYSTEM, LOCATION OF INLET, LOCATION OF DISCHARGE, DISCHARGE DISPERSION DEVICE DESIGN, AND A SAMPLING PLAN AND FREQUENCY) BEFORE OPERATING THE TREATMENT SYSTEM. OBTAIN PLAN APPROVAL BEFORE OPERATING THE TREATMENT SYSTEM. OPERATE AND MAINTAIN THE TREATMENT SYSTEM ACCORDING TO MANUFACTURER'S SPECIFICATIONS. (SCHEDULE A.8.B.(1)
26. TEMPORARILY STABILIZE SOILS AT THE END OF THE SHIFT BEFORE HOLIDAYS AND WEEKENDS, IF NEEDED. THE REGISTRANT IS RESPONSIBLE FOR ENSURING THAT SOILS ARE STABLE DURING RAIN EVENTS AT ALL TIMES OF THE YEAR. (SCHEDULE A 7.B)
27. AS NEEDED BASED ON WEATHER CONDITIONS, AT THE END OF EACH WORKDAY SOIL STOCKPILES MUST BE STABILIZED OR COVERED, OR OTHER BMPS MUST BE IMPLEMENTED TO PREVENT DISCHARGES TO SURFACE WATERS OR CONVEYANCE SYSTEMS LEADING TO SURFACE WATERS. (SCHEDULE A 7.E.8.(3))
28. CONSTRUCTION ACTIVITIES MUST AVOID OR MINIMIZE EXCAVATION AND BARE GROUND ACTIVITIES DURING WET WEATHER. (SCHEDULE A.7.A.)
29. SEDIMENT FENCES: REMOVE TRAPPED SEDIMENT BEFORE IT REACHES ONE THIRD OF THE ABOVE GROUND FENCE HEIGHT AND BEFORE FENCE REMOVAL. (SCHEDULE A.8.C.)
30. OTHER SEDIMENT BARRIERS (SUCH AS BIOBAGS): REMOVE SEDIMENT BEFORE IT REACHES TWO INCHES DEPTH ABOVE GROUND HEIGHT AND BEFORE BMP REMOVAL. (SCHEDULE A.8.C.)
31. CATCH BASINS: CLEAN BEFORE RETENTION CAPACITY HAS BEEN REDUCED BY FIFTY PERCENT. SEDIMENT BASINS AND SEDIMENT TRAPS: REMOVE TRAPPED SEDIMENTS BEFORE DESIGN CAPACITY HAS BEEN REDUCED BY FIFTY PERCENT AND AT COMPLETION OF PROJECT. (SCHEDULE A.8.C.(8) (9))
32. WITHIN 24 HOURS, SCRAPE/SWEEP SEDIMENT THAT HAS LEFT THE CONSTRUCTION SITE. MUST BE REMEDIATED, MINIMIZE THE CAUSE OF THE SEDIMENT RELEASE AND IMPLEMENT STEPS TO PREVENT A RECURRENCE OF THE DISCHARGE WITHIN THE SAME 24 HOURS. ANY IN-STREAM CLEAN-UP OF SEDIMENT SHALL BE PERFORMED ACCORDING TO THE OREGON DIVISION OF STATE LANDS REQUIRED TIMEFRAME. (SCHEDULE A.8.B.(1)
33. THE INTENTIONAL WASHING OF SEDIMENT INTO STORM SEWERS OR DRAINAGE WAYS MUST NOT OCCUR. VACUUMING OR DRY SWEEPING AND MATERIAL PICKUP MUST BE USED TO CLEANUP RELEASED SEDIMENTS. (SCHEDULE A.8.B.(4)
34. THE ENTIRE SITE MUST BE TEMPORARILY STABILIZED USING VEGETATION OR A HEAVY MULCH LAYER, TEMPORARY SEEDING, OR OTHER METHOD SHOULD ALL CONSTRUCTION ACTIVITIES CEASE FOR 30 DAYS OR MORE. (SCHEDULE A.7.F.)
35. PROVIDE TEMPORARY STABILIZATION FOR ANY PORTION OF THE SITE WHERE CONSTRUCTION ACTIVITIES CEASE FOR 14 DAYS OR MORE WITH A COVERING OF BLOWN STRAW AND A TACKIFIER, LOOSE STRAW, OR AN ACCEPTABLE COVERING OF COMPOST MULCH UNTIL WORK RESUMES ON THAT PORTION OF THE SITE. (SCHEDULE A.7.F.II)
36. DO NOT REMOVE TEMPORARY SEDIMENT CONTROL PRACTICES UNTIL PERMANENT VEGETATION OR OTHER COVER OF EXPOSED AREAS IS ESTABLISHED. ONCE CONSTRUCTION IS COMPLETE AND THE SITE IS STABILIZED, ALL TEMPORARY EROSION CONTROLS AND RETAINED SOILS MUST BE REMOVED AND DISPOSED OF PROPERLY, UNLESS DOING SO CONFLICTS WITH LOCAL REQUIREMENTS. (SCHEDULE A.8.C.(8) AND D.3.C.(3 AND 8))

- HOLD A PRE-CONSTRUCTION MEETING OF PROJECT CONSTRUCTION PERSONNEL THAT INCLUDES THE INSPECTOR TO DISCUSS EROSION AND SEDIMENT CONTROL MEASURES AND CONSTRUCTION LIMITS.
- ALL INSPECTIONS MUST BE MADE IN ACCORDANCE WITH DEQ'S 1200-C PERMIT REQUIREMENTS
- INSPECTION LOGS MUST BE KEPT IN ACCORDANCE WITH DEQ'S 1200-C PERMIT REQUIREMENTS.
- RETAIN A COPY OF THE ESCP AND ALL REVISIONS ON SITE AND MAKE IT AVAILABLE ON REQUEST TO DEQ AGENT, OR THE LOCAL MUNICIPALITY. DURING INACTIVE PERIODS OF GREATER THAN SEVEN (7) CONSECUTIVE CALENDAR DAYS, RETAIN THE ESCP AT THE CONSTRUCTION SITE OR AT ANOTHER LOCATION.

NARRATIVE DESCRIPTION

EXISTING SITE CONDITIONS

* GRAVEL IMPERVIOUS AREA WITH OVE TO 3% SLOPE.

DEVELOPED CONDITIONS

* FOUR NEW HANGER FACILITIES WITH SIDEWALKS, PARKING, AND CURB & GUTTER.

NATURE OF CONSTRUCTION ACTIVITY AND ESTIMATED TIME TABLE

* CLEARING AND DEMOLITION (JAN 2021)
* GRADING (JAN 2021 – FEB 2021)
* UTILITY INSTALLATION (FEB 2021 – JUNE 2021)
* STREET AND SITE CONSTRUCTION (FEB 2021 – OCT 2021)
* FINAL STABILIZATION (NOV 2021)

TOTAL SITE AREA = 716,500 SF =16.45 ACRES

TOTAL DISTURBED AREA = 716,500 SF = 16.45 ACRES

SITE SOIL CLASSIFICATION:

100 % AMITY SILT LOAM, 0%-3% SLOPE.

ON-SITE SOILS HAVE LITTLE TO NO EROSION POTENTIAL. ALL FILL MATERIAL SHALL BE GENERATED ON-SITE FROM GRADING EXCAVATION AND UTILITY TRENCH SPOILS.

RECEIVING WATER BODIES:

ALL STORM RUNOFF TO BE DISCHARGES EAST TOWARDS AIRPORT RD NE AND INTO PUDDING CREEK.

PERMITTEE'S SITE INSPECTOR: TOM SEVERSON
COMPANY/AGENCY: OR DEPT CONSTRUCTION
PHONE: (503) 584 – 3460
FAX: (503) 870 – 6692
E-MAIL: TOMSEVERSON@CONSTRUCTION.NET
DESCRIPTION OF EXPERIENCE: OVER 200 HOURS OF EROSION CONTROL MAINTENANCE FOR VARIOUS SUITE CONSTRUCTION PROJECTS INCLUDING SITE GRADING, UTILITY, AND BUILDING CONSTRUCTION.

INSPECTION FREQUENCY:

SITE CONDITION	MINIMUM FREQUENCY
1. ACTIVE PERIOD	DAILY WHEN STORMWATER RUNOFF, INCLUDING RUNOFF FROM SNOWMELT, IS OCCURRING. AT LEAST ONCE EVERY TWO WEEKS, REGARDLESS OF WHETHER OR NOT RUNOFF IS OCCURRING.
2. PRIOR TO SITE BECOMING INACTIVE OR IN ANTICIPATION OF SITE INACCESSIBILITY	ONCE TO ENSURE THAT EROSION AND SEDIMENT CONTROL MEASURES ARE IN WORKING ORDER. ANY NECESSARY MAINTENANCE AND REPAIR MUST BE MADE PRIOR TO LEAVING THE SITE
3. INACTIVE PERIODS GREATER THAN (7) CONSECUTIVE CALENDAR DAYS	ONCE EVERY (2) TWO WEEKS
4. PERIODS AT WHICH THE SITE IS INACCESSIBLE DUE TO INCLEMENT WEATHER	IF PRACTICAL, INSPECTIONS MUST OCCUR DAILY AT A RELEVANT AND ACCESSIBLE DISCHARGE POINT OR DOWNSTREAM LOCATION.

THE PERMITTEE IS REQUIRED TO MEET ALL THE CONDITIONS OF THE 1200C PERMIT. THIS ESCP AND SEASONAL CONDITIONS HAVE BEEN DEVELOPED TO FACILITATE COMPLIANCE WITH THE 1200C PERMIT REQUIREMENTS. IN CASES OF DISCREPANCIES OR OMISSIONS, THE 1200C PERMIT REQUIREMENTS SUPERCEDE REQUIREMENTS OF THIS PLAN.

BMP MATRIX FOR CONSTRUCTION PHASES

REFER TO DEQ GUIDANCE MANUAL FOR A COMPREHENSIVE LIST OF AVAILABLE BMP'S.

	CLEARING	MASS GRADING	UTILITY INSTALLATION	STREET CONSTRUCTION	FINAL STABILIZATION	WET WEATHER (OCT. 1 – MAY 31ST)
EROSION PREVENTION						
PRESERVE NATURAL VEGETATION						
GROUND COVER					X	X
HYDRAULIC APPLICATIONS						
PLASTIC SHEETING		X	X	X	X	X
MATTING						
DUST CONTROL			X		X	X
TEMPORARY/PERMANENT SEEDING			X	X	X	X
BUFFER ZONE						
OTHER:						
SEDIMENT CONTROL						
SEDIMENT FENCE (PERIMETER)	X	X	X	X	X	X
SEDIMENT FENCE (INTERIOR)	X	X	X	X	X	X
STRAW WATTLES						
FILTER BERM						
INLET PROTECTION	X	X	X	X	X	X
DEWATERING						
SEDIMENT TRAP						
NATURAL BUFFER ENCROACHMENT						
OTHER:						
RUNOFF CONTROL						
CONSTRUCTION ENTRANCE	X	X	X	X	X	X
PIPE SLOPE DRAIN						
OUTLET PROTECTION			X		X	
SURFACE ROUGHENING						
CHECK DAMS						
OTHER:						
POLLUTION PREVENTION						
PROPER SIGNAGE			X		X	X
HAZ WASTE MGMT			X		X	X
SPILL KIT ON-SITE			X		X	X
CONCRETE WASHOUT AREA	X	X	X	X	X	X
OTHER:						

*SIGNIFIES ADDITIONAL BMP'S REQUIRED FOR WORK WITHIN 50' OF WATER OF THE STATE.

RATIONALE STATEMENT

A COMPREHENSIVE LIST OF AVAILABLE BEST MANAGEMENT PRACTICES (BMP) OPTIONS BASED ON DEQ's GUIDANCE MANUAL HAS BEEN REVIEWED TO COMPLETE THIS EROSION AND SEDIMENT CONTROL PLAN. SOME OF THE ABOVE LISTED BMP's WERE NOT CHOSEN BECAUSE THEY WERE DETERMINED TO NOT EFFECTIVELY MANAGE EROSION PREVENTION AND SEDIMENT CONTROL FOR THIS PROJECTED BASED ON SPECIFIC SITE CONDITIONS, INCLUDING SOIL CONDITIONS, TOPOGRAPHIC CONSTRAINTS, ACCESSIBILITY TO THE SITE, AND OTHER RELATED CONDITIONS. AS THE PROJECT PROGRESSES AND THERE IS A NEED TO REVISE THE ESC PLAN, AN ACTION PLAN WILL BE SUBMITTED. NTBAL

SHEET INDEX

EROSION AND SEDIMENT CONTROL PLANS

EC1.0 EROSION AND SEDIMENT CONTROL COVER SHEET
EC2.0 CLEARING AND DEMOLITION EROSION AND SEDIMENT CONTROL PLAN
EC3.0 GRADING, SOD/BALK, BUILDING AND UTILITY CONSTRUCTION EROSION AND SEDIMENT CONTROL PLAN
EC4.0 EROSION AND SEDIMENT CONTROL DETAILS

PERMIT SET 10-26-2020

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Client
ARON FAEGRE + ASSOCIATES

Project
AURORA AIRPARK BUSINESS CENTER

REGISTERED PROFESSIONAL ENGINEER — OREGON — JULY 12, 2005 — CHRISTOPHER T. LAWRENCE
EXPIRES: 12-31-20

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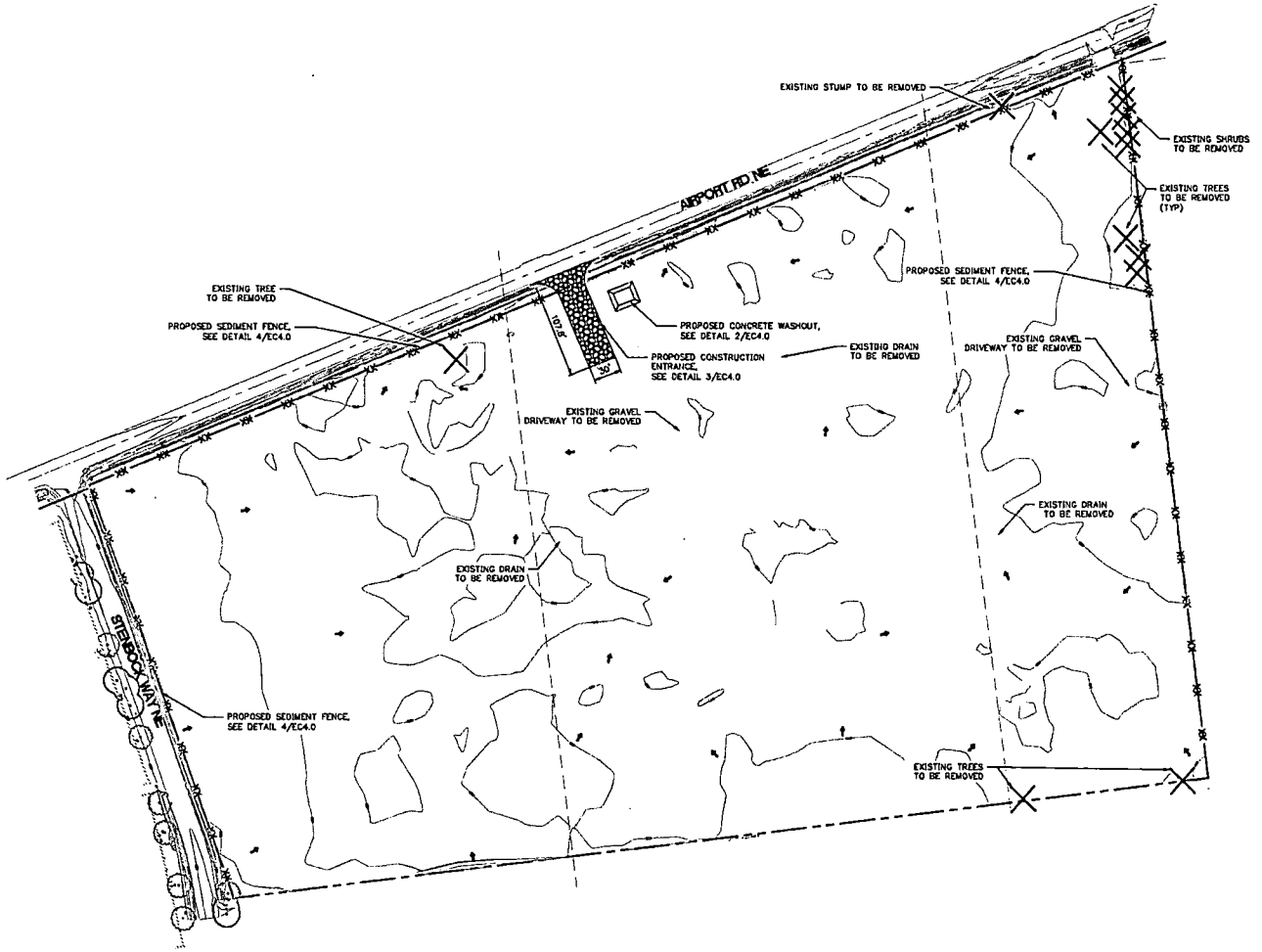
REVISIONS:

REVISION NO.	REVISION DELTA	REVISION DATE	CLOSING DATE

SHEET TITLE:
EROSION AND SEDIMENT CONTROL COVER SHEET

DRAWN BY: CTL
CHECKED BY: RLF
SHEET:
EC1.0

JOB NO. 2180516.00



LEGEND

- PROPERTY LINE
- EXISTING CONTOUR
- CONCRETE WASH AREA
- INLET PROTECTION
- SEDIMENT BARRIER (INTERIOR)
- CONSTRUCTION ENTRANCE
- DRAINAGE FLOW DIRECTION
- EXISTING TREE TO BE REMOVED

PRE-CONSTRUCTION, CLEARING, AND DEMOLITION NOTES

1. ALL BASE ESC MEASURES (INLET PROTECTION, PERIMETER SEDIMENT CONTROL, GRAVEL CONSTRUCTION ENTRANCES, ETC.) MUST BE IN PLACE, FUNCTIONAL, AND APPROVED IN AN INITIAL INSPECTION, PRIOR TO COMMENCEMENT OF CONSTRUCTION ACTIVITIES.

2. SEDIMENT BARRIERS APPROVED FOR USE INCLUDE SEDIMENT FENCE, BERMS CONSTRUCTED OUT OF MULCH OR OTHER SUITABLE MATERIAL, STRAW WATTLES, OR OTHER APPROVED MATERIALS.

3. SENSITIVE RESOURCES INCLUDING, BUT NOT LIMITED TO, TREES, WETLANDS, AND RIPARIAN PROTECTION AREAS SHALL BE CLEARLY DELINEATED WITH ORANGE CONSTRUCTION FENCING OR CHAIN LINK FENCING IN A MANNER THAT IS CLEARLY VISIBLE TO ANYONE IN THE AREA. NO ACTIVITIES ARE PERMITTED TO OCCUR BEYOND THE CONSTRUCTION BARRIER.

4. CONSTRUCTION ENTRANCES SHALL BE INSTALLED AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES INCLUDING, BUT NOT LIMITED TO, STREET SWEEPING, AND VACUUMING, MAY BE REQUIRED TO INSURE THAT ALL PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.

5. RUN-ON AND RUN-OFF CONTROLS SHALL BE IN PLACE AND FUNCTIONING PRIOR TO BEGINNING SUBSTANTIAL CONSTRUCTION ACTIVITIES. RUN-ON AND RUN-OFF CONTROL MEASURES INCLUDE: SLOPE DRAINS (WITH OUTLET PROTECTION), CHECK DAMS, SURFACE ROUGHENING, AND BANK STABILIZATION.

PRE-DEVELOPED STORM WATER RUN-OFF OF THE EXISTING AREA SHEET FLOWS TOWARDS DRAIN LOCATED ON SITE. THE DRAINS LEAD TO AIRPORT RD NE AND INTO PUDDING RIVER

NOTES TO CONTRACTOR:
1. PROVIDE INLET PROTECTION AND BIO BAGS AT ALL DISCOVERED CATCH BASINS AND STORM DRAIN INLETS (TYP). PER DETAIL 1 AND 6 ON SHEET EC4.0

1 EC2.0 CLEARING AND DEMOLITION EROSION AND SEDIMENT CONTROL PLAN

60 0 30 60 120 240
(IN FEET)
1 inch = 60 ft.

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Project
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REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 19, 2005
CHAD T. LAWRENCE
EXPIRES: 12-31-2020

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REVISIONS:

NO.	DATE	BY	REVISION DELTA CLOUDING DATE
1	10/26/20	CTL	PERMIT SET

SHEET TITLE:
CLEARING AND DEMOLITION EROSION AND SEDIMENT CONTROL PLAN

DRAWN BY: CTL
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SHEET:
EC2.0

JOB NO. 2180516.00

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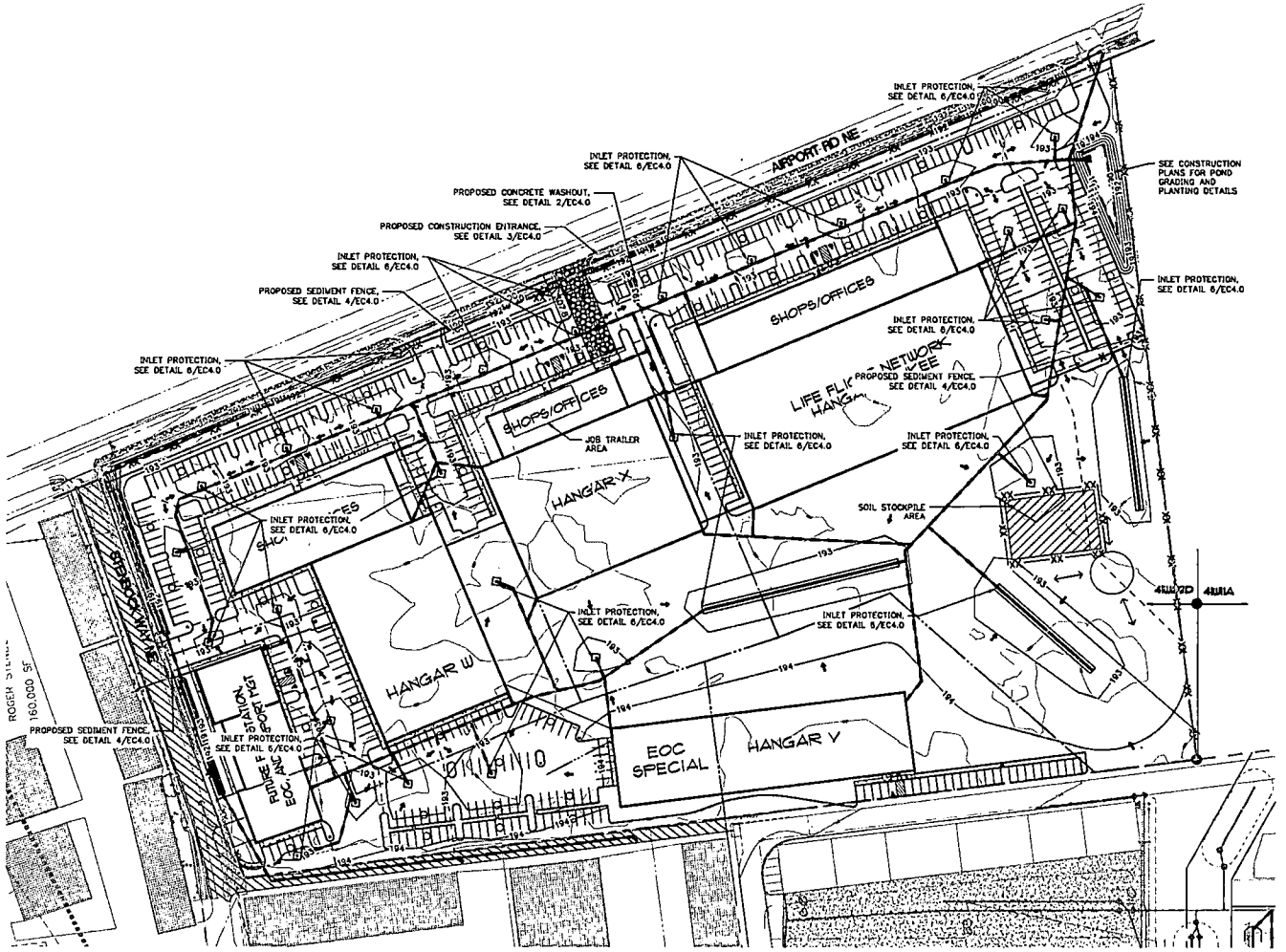

GRADING, SIDEWALK, BUILDING AND UTILITY CONSTRUCTION EROSION AND SEDIMENT CONTROL PLAN

1 / EC3.0

60 0 30 60 120 240

(IN FEET)
1 inch = 60 ft.

LEGEND

- PROPERTY LINE
- 192 EXISTING CONTOUR
- 192 PROPOSED CONTOUR
- PROPOSED STORM SEWER LINE
- CONCRETE WASH AREA
- INLET PROTECTION
- XX SEDIMENT BARRIER (INTERIOR)
- CONSTRUCTION ENTRANCE
- SOIL STOCKPILE AREA
- DRAINAGE FLOW DIRECTION

GRADING, STREET, AND UTILITY EROSION AND SEDIMENT CONSTRUCTION NOTES

1. SEED USED FOR TEMPORARY OR PERMANENT SEEDING SHALL BE COMPOSED OF ONE OF THE FOLLOWING MIXTURES, UNLESS OTHERWISE AUTHORIZED:
   - A. VEGITATED CORRIDOR AREAS REQUIRE NATIVE SEED MIXES. SEE RESTORATION PLAN FOR APPROPRIATE SEED MIX.
   - B. DWARF GRASS MIX (MIN. 100LB./AC.)
     1. DWARF PERENNIAL RYEGRASS (80% BY WEIGHT)
     2. CREEPING RED FESCUE (20% BY WEIGHT)
   - A. STANDARD HEIGHT GRASS MIX (MIN. 100LB./AC.)
     1. ANNUAL RYEGRASS (40% BY WEIGHT)
     2. TURF-TYPE FESCUE (80% BY WEIGHT)
2. SLOPE TO RECIEVE TEMPORARY OR PERMANENT SEEDING SHALL HAVE THE SURFACE ROUGHENED BY MEANS OF TRACK-WALKING OR THE USE OF OTHER APPROVED IMPLEMENTS. SURFACE ROUGHENING IMPROVES SEED BEDDING AND REDUCES RUN-OFF VELOCITY
3. LONG TERM SLOPE STABILIZATION MEASURES SHALL INCLUDE THE ESTABLISHMENT OF PERMANENT VEGETATIVE COVER VIA SEEDING WITH APPROVED MIX AND APPLICATION RATE.
4. TEMPORARY SLOPE STABILIZATION MEASURES SHALL INCLUDE: COVERING EXPOSED SOIL WITH PLASTIC SHEETING, STRAW MULCHING, WOOD CHIPS, OR OTHER APPROVED MEASURES.
5. STOCKPILED SOIL OR STRIPPINGS SHALL BE PLACED IN A STABLE LOCATION AND CONFIGURATION. STOCKPILES SHALL BE COVERED WITH PLASTIC SHEETING OR STRAW MULCH. SEDIMENT FENCE IS REQUIRED AROUND THE PERIMETER OF THE STOCKPILE.
6. EXPOSED CUT OR FILL AREAS SHALL BE STABILIZED THROUGH THE USE OF TEMPORARY SEEDING AND MULCHING, EROSION CONTROL BLANKETS OR MATS, MID-SLOPE SEDIMENT FENCES OR WATTLES, OR OTHER APPROPRIATE MEASURES. SLOPES EXCEEDING 25% MAY REQUIRE ADDITIONAL EROSION CONTROL MEASURES.
7. AREAS SUBJECT TO WIND EROSION SHALL USE APPROPRIATE DUST CONTROL MEASURES INCLUDING THE APPLICATION OF A FINE SPRAY OF WATER, PLASTIC SHEETING, STRAW MULCHING, OR OTHER APPROVED MEASURES.
8. CONSTRUCTION ENTRANCES SHALL BE INSTALLED AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES INCLUDING, BUT NOT LIMITED TO, TIRE WASHES, STREET SWEEPING, AND VACUUMING MAY BE BE REQUIRED TO INSURE THAT ALL PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.
9. ACTIVE INLETS TO STORM WATER SYSTEMS SHALL BE PROTECTED THROUGH THE USE OF APPROVED INLET PROTECTION MEASURES. ALL INLET PROTECTION MEASURES ARE TO BE REGULARLY INSPECTED AND MAINTAINED AS NEEDED.
10. SATURATED MATERIALS THAT ARE HAULED OFF-SITE MUST BE TRANSPORTED IN WATER-TIGHT TRUCKS TO ELIMINATE SPILLAGE OF SEDIMENT AND SEDIMENT-LADEN WATER.
11. AN AREA SHALL BE PROVIDED FOR THE WASHING OUT OF CONCRETE TRUCKS IN A LOCATION THAT DOES NOT PROVIDE RUN-OFF THAT CAN ENTER THE STORM WATER SYSTEM. IF THE CONCRETE WASH-OUT AREA CAN NOT BE CONSTRUCTED GREATER THAN 50' FROM ANY DISCHARGE POINT, SECONDARY MEASURES SUCH AS BERMS OR TEMPORARY SETTLING PITS MAY BE REQUIRED. THE WASH-OUT SHALL BE LOCATED WITHIN SIX FEET OF TRUCK ACCESS AND BE CLEANED WHEN IT REACHES 50% OF THE CAPACITY.
12. SWEEPINGS FROM EXPOSED AGGREGATE CONCRETE SHALL NOT BE TRANSFERRED TO THE STORM WATER SYSTEM. SWEEPINGS SHALL BE PICKED UP AND DISPOSED IN THE TRASH.
13. AVOID PAVING IN WET WEATHER WHEN PAVING CHEMICALS CAN RUN-OFF INTO THE STORM WATER SYSTEM.
14. USE BMPs SUCH AS CHECK-DAMS, BERMS, AND INLET PROTECTION TO PREVENT RUN-OFF FROM REACHING DISCHARGE POINTS.
15. COVER CATCH BASINS, MANHOLES, AND OTHER DISCHARGE POINTS WHEN APPLYING SEAL COAT, TACK COAT, ETC. TO PREVENT INTRODUCING THESE MATERIALS TO THE STORM WATER SYSTEM.

EROSION AND SEDIMENT CONTROL BMP IMPLEMENTATION

1. ALL BASE ESC MEASURES (INLET PROTECTION, PERIMETER SEDIMENT CONTROL, GRAVEL CONSTRUCTION ENTRANCES, ETC.) MUST BE IN PLACE, FUNCTIONAL, AND APPROVED IN AN INITIAL INSPECTION, PRIOR TO COMMENCEMENT OF CONSTRUCTION ACTIVITIES.
2. ALL "SEDIMENT BARRIERS (TO BE INSTALLED AFTER GRADING)" SHALL BE INSTALLED IMMEDIATELY FOLLOWING ESTABLISHMENT OF FINISHED GRADE AS SHOWN ON THESE PLANS.
3. LONG TERM SLOPE STABILIZATION MEASURES "INCLUDING MATTING" SHALL BE IN PLACE OVER ALL EXPOSED SOILS AND IMMEDIATELY AFTER GRADING IS COMPLETE
4. THE STORM WATER FACILITY SHALL BE CONSTRUCTED AND LANDSCAPED PRIOR TO THE STORM WATER SYSTEM FUNCTIONING AND SITE PAVING.
5. INLET PROTECTION SHALL BE IN-PLACE IMMEDIATELY FOLLOWING PAVING ACTIVITIES.

POST DEVELOPED STORM WATER RUNOFF OF THE PROPOSED DEVELOPMENT AREA IS COLLECTED VIA CATCH BASINS, TRENCH DRAINS AND ROOF DOWNSPOUTS. IT IS DIRECTED TO A FLOW CONTROL MANHOLE. RUNOFF FROM THE FLOW CONTROL MANHOLE WILL BE DIRECTED TO AN EXISTING DITCH THAT RUNS ALONG THE EAST SIDE OF THE PROPERTY.

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Project
AURORA AIRPARK BUSINESS CENTER

REGISTERED PROFESSIONAL ENGINEER — OREGON — JULIE M. RUF — 79307 — RENEWAL DATE: 12/31/2020

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REVISIONS:

REVISION DELTA NO.	REVISIONS AND/OR ISSUE	REVISION DELTA CLOUDING DATE

SHEET TITLE:
GRADING, SIDEWALK, BUILDING, AND UTILITY CONSTRUCTION EROSION AND SEDIMENT CONTROL PLAN

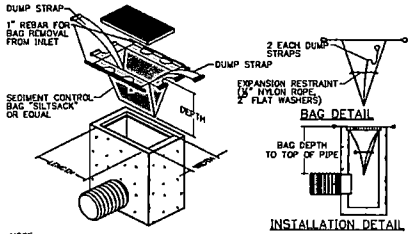
DRAWN BY: CTL

CHECKED BY: RUF

SHEET:
EC3.0

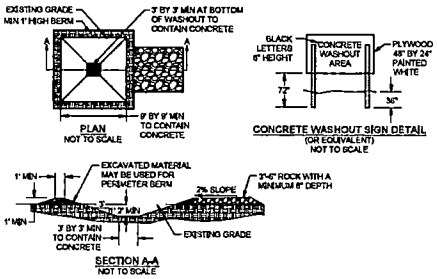
JOB NO. 2180516.00

PERMIT SET 10-26-2020



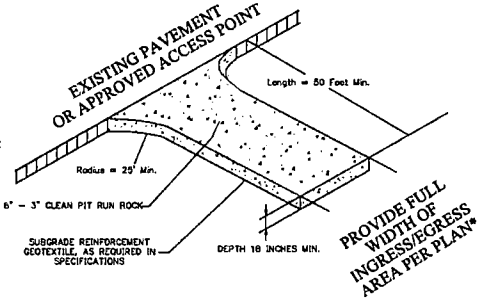
NOTE:
1. THE DIMENSION CHART ABOVE IS FOR STANDARD CATCH BASINS AND INLETS ONLY. THE CONTRACTOR IS RESPONSIBLE FOR PROVIDING THE CORRECT SIZE DEVICE FOR EACH INLET.
2. THE CONTRACTOR SHALL MEASURE DIMENSIONS IN THE FIELD AND ORDER THE APPROPRIATE SIZE(S).
3. THE INLET SEDIMENT CONTROL DEVICE SHALL BE OF NORMAL FLOW DESIGN, 40 GAL/MIN/SF WITH NO OVERFLOWS.
4. THE SEDIMENT CONTROL DEVICE SHALL BE INSPECTED DAILY BY THE CONTRACTOR AND MAINTAINED A MINIMUM ONCE PER MONTH OR WITHIN THE 24 HOURS FOLLOWING A STORM EVENT.
5. SUBSTITUTION OF A SHEET OF FILTER FABRIC PLACED OVER THE OPENING OF THE INLET IS NOT APPROVED.

1 CATCH BASIN SEDIMENT FILTER BAG
EC4.0 N.T.S.



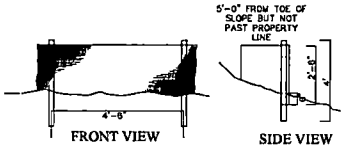
NOTES:
1. WASHOUT FACILITIES SHALL BE MAINTAINED TO PROVIDE ADEQUATE HOLDING CAPACITY WITH A MINIMUM FREEBOARD OF 12 INCHES.
2. WASHOUT FACILITIES MUST BE CLEANED, OR NEW FACILITIES MUST BE CONSTRUCTED AND READY FOR USE ONCE THE WASHOUT IS 75% FULL.
3. IF THE WASHOUT IS NEARING CAPACITY, VACUUM AND DISPOSE OF THE WASTE MATERIAL IN AN APPROVED MANNER.
4. TEMPORARY CONCRETE WASHOUT FACILITIES SHALL BE LOCATED A MINIMUM OF 50 FT FROM SENSITIVE AREAS INCLUDING OPEN DRAINAGE FACILITIES AND WATER SOURCES.
5. CONCRETE WASHOUT FACILITIES SHALL BE CONSTRUCTED AND MAINTAINED IN SUFFICIENT QUANTITY AND SIZE TO CONTAIN ALL LIQUID AND CONCRETE WASTE GENERATED BY WASHOUT OPERATIONS
6. INSTALL CONCRETE WASHOUT SIGN WITHIN 30 FEET OF TEMPORARY CONCRETE WASHOUT FACILITY.
7. TEMPORARY CONCRETE WASHOUTS MAY BE A PREFABRICATED CONTAINER THAT IS PORTABLE AND REUSABLE.

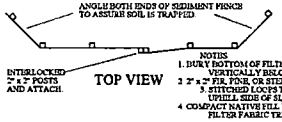
2 CONCRETE WASH-OUT
EC4.0 N.T.S.



* 20' MIN. FOR SINGLE FAMILY AND DUPLEX RESIDENTIAL

3 CONSTRUCTION ENTRANCE
EC4.0 N.T.S.





NOTES:
1. BURY BOTTOM OF FILTER FABRIC 6" MIN VERTICALLY BELOW GRADE.
2. 2" x 2" FIR, PINE, OR STEEL FENCE POSTS.
3. STITCHED LOOPS TO BE INSTALLED UPHILL SIDE OF SLOPE.
4. COMPACT NATIVE FILL IN ALL AREAS OF FILTER FABRIC TRENCH.

4 SEDIMENT FENCE
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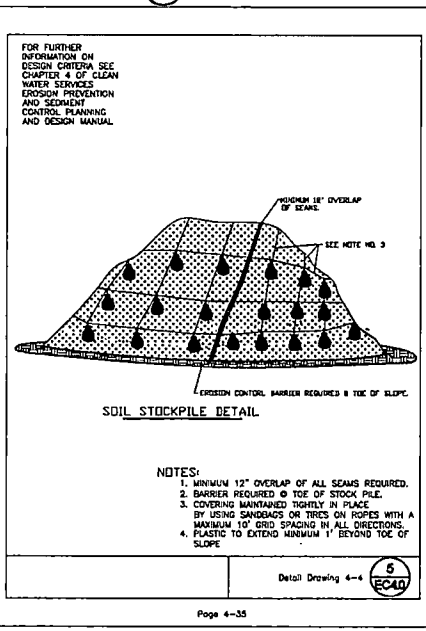
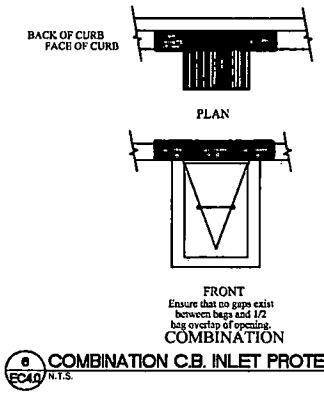
NTS





6 COMBINATION C.B. INLET PROTECTION
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Client
ARON FAEGRE + ASSOCIATES

Project
AURORA AIRPARK BUSINESS CENTER

REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 31, 2007
ROBERT LAMPSHIRE
EXPIRES: 12-31-20

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JOB NO. 2180516.00

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5. DRAINAGE BASIN MAP/ CULVERT CALCULATIONS

Aurora Business Center
Stormwater Calculations

Detention Calculations

Project Number 2180516.00

Use Rational Method and ODOT Detention Routing to size detention facilties

Total Area Requiring Detention (Project Site) 16.45 AC

One Detention System is used to provide necessary storage for the total area.

Detention Basin #1

Pre-Developed			
Area		16.45 AC	
Runoff Coefficient		0.20	Pasture
Rainfall Intensity		1.0	
Pre-Developed Flow		3.29	Allowed Flow
Developed Conditions			
Impervious Area		16.00	
Pervious Area		0.45	
Runoff Coefficient		0.90	Impervious
(CA)		14.49	See attached Detention Routing C
Orifice Sizing			
	Q	3.29	
	C	0.62	
	A	Solve for Orifice Area	
	g	32.2	
	h	1.65	
	Area	0.319 sf	Orifice area
	diameter	7.65 in	Calculated Orifice diameter
Detention Volume:			
Required Volume		25162.00 cf	
Pipe Length			
	Pipe #1	222 ft	18" diameter strip drain
	Pipe #2	140 ft	18" diameter strip drain
	Pipe #3	147 ft	18" diameter strip drain
	18" Detention Pipe	2190 ft	
Cross Sectional Ponding Area			
	Pipe #1	11.2 ft^2	
	Pipe #2	15.2 ft^2	
	Pipe #3	8 ft^2	
	18" Detention Pipe	0 ft^2	
Pipe Volume		4770 cf	
Pond Volue		9723 cf	
Surface Volume		10746 cf	
Provided Volume		25239 cf	

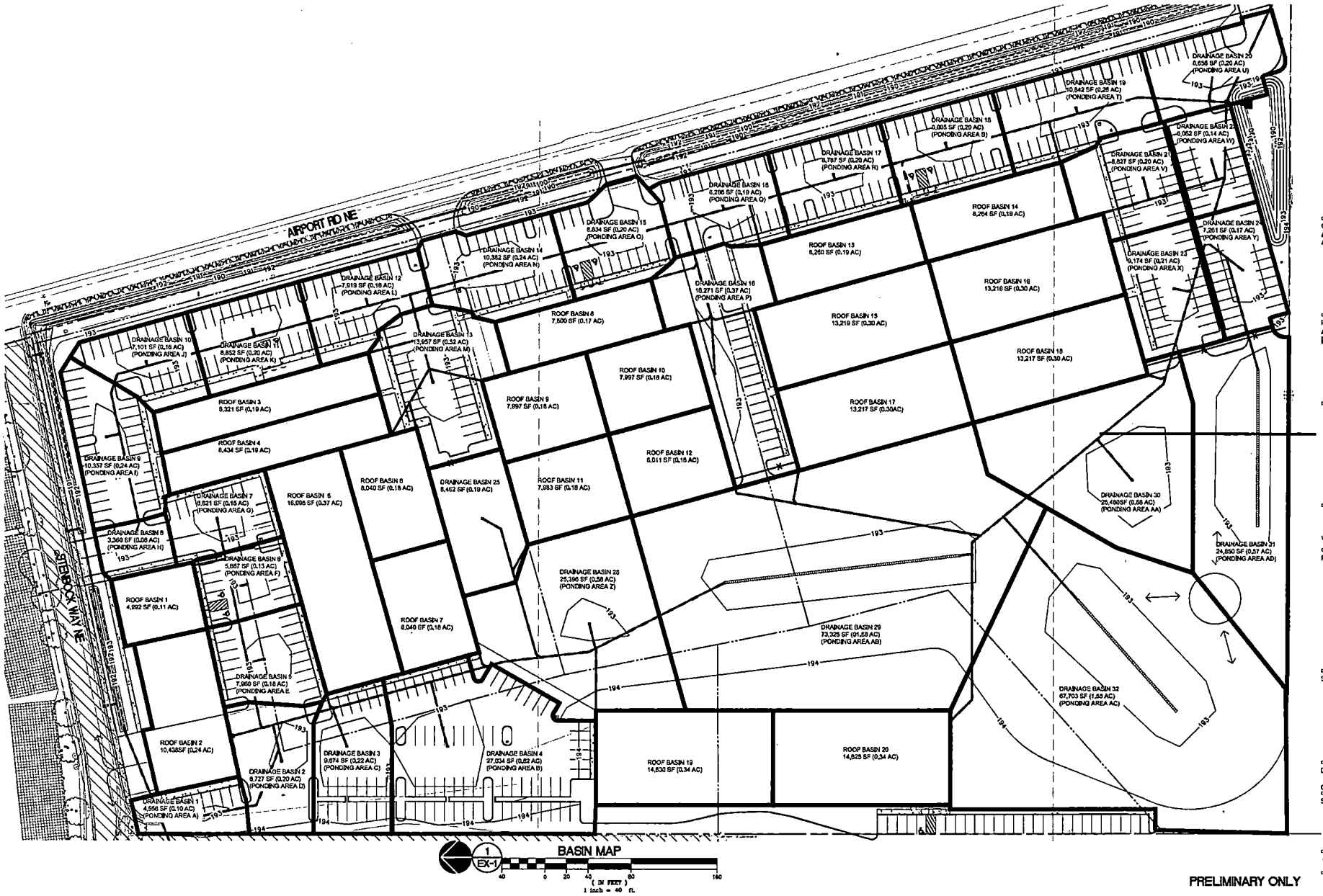
ODOT Methodology
Aurora Business Center
Project #2180516.00
Proposed Condition: 10-year Storm restricted to 5-year release rate

Date: 14-Nov-18
Detention Basin #1

Time (min.)	CA (Ac)	Intensity (in/hr)	Inflow (cfs)	Inflow Vol. (cf)	Outflow (cfs)	Outflow Vol. (cf)	Req'd Storage (cf)	
10	14.49	1.25	18.11	10867.50	3.29	1974.00	8893.50	
11	14.49	1.22	17.68	11667.35	3.29	2171.40	9495.95	
12	14.49	1.16	16.81	12102.05	3.29	2368.80	9733.25	
13	14.49	1.10	15.94	12432.42	3.29	2566.20	9866.22	
14	14.49	1.07	15.50	13023.61	3.29	2763.60	10260.01	
15	14.49	1.04	15.07	13562.64	3.29	2961.00	10601.64	
16	14.49	1.01	14.63	14049.50	3.29	3158.40	10891.10	
17	14.49	0.98	14.20	14484.20	3.29	3355.80	11128.40	
18	14.49	0.96	13.91	15023.23	3.29	3553.20	11470.03	
19	14.49	0.94	13.62	15527.48	3.29	3750.60	11776.88	
20	14.49	0.92	13.33	15996.96	3.29	3948.00	12048.96	
21	14.49	0.90	13.04	16431.66	3.29	4145.40	12286.26	
22	14.49	0.88	12.75	16831.58	3.29	4342.80	12488.78	
23	14.49	0.86	12.46	17196.73	3.29	4540.20	12656.53	
24	14.49	0.85	12.32	17735.76	3.29	4737.60	12998.16	
25	14.49	0.84	12.17	18257.40	3.29	4935.00	13322.40	
26	14.49	0.82	11.88	18535.61	3.29	5132.40	13403.21	
27	14.49	0.81	11.74	19013.78	3.29	5329.80	13683.98	
28	14.49	0.80	11.59	19474.56	3.29	5527.20	13947.36	
29	14.49	0.78	11.30	19665.83	3.29	5724.60	13941.23	
30	14.49	0.76	11.01	19822.32	3.29	5922.00	13900.32	
35	14.49	0.73	10.58	22213.17	3.29	6909.00	15304.17	
40	14.49	0.70	10.14	24343.20	3.29	7896.00	16447.20	
45	14.49	0.67	9.71	26212.41	3.29	8883.00	17329.41	
50	14.49	0.63	9.13	27386.10	3.29	9870.00	17516.10	
60	14.49	0.58	8.40	30255.12	3.29	11844.00	18411.12	
70	14.49	0.56	8.11	34080.48	3.29	13818.00	20262.48	
80	14.49	0.52	7.53	36167.04	3.29	15792.00	20375.04	
90	14.49	0.50	7.25	39123.00	3.29	17766.00	21357.00	
100	14.49	0.48	6.96	41731.20	3.29	19740.00	21991.20	
150	14.49	0.42	6.09	54772.20	3.29	29610.00	25162.20	<<<<<
200	14.49	0.37	5.36	64335.60	3.29	39480.00	24855.60	
250	14.49	0.34	4.93	73899.00	3.29	49350.00	24549.00	
300	14.49	0.31	4.49	80854.20	3.29	59220.00	21634.20	
350	14.49	0.28	4.06	85201.20	3.29	69090.00	16111.20	
400	14.49	0.27	3.91	93895.20	3.29	78960.00	14935.20	
450	14.49	0.25	3.62	97807.50	3.29	88830.00	8977.50	
500	14.49	0.23	3.33	99981.00	3.29	98700.00	1281.00	

CATCH BASIN	RADIUS	CONICAL VOLUME	
A		13.74	69.16
B		35.47	526.73
C		24.93	260.20
D		20.59	177.49
E		17.77	132.20
F		14.68	90.22
G		15.76	103.99
H		11.79	58.20
I		22.92	219.94
J		18.2	138.68
K		17.34	125.88
L		18.25	139.44
M		20.22	171.17
N		24.91	259.79
O		19.16	153.69
P		20.64	178.36
Q		19.29	155.79
R		17.37	126.32
S		17.37	126.32
T		19.74	163.14
U		20.34	173.21
V		15.72	103.46
W		15.71	103.33
X		17.84	133.25
Y		17.81	132.80
Z		22.45	211.01
AA		41.54	722.44
			4956.21

Pond Volume	AREA	VOLUME
	189.5	1290	0
	190	1650	735
	191	2485	2802.5
	192	3446	5768
	193	4465	9723.5
TOTAL VOLUME PROVIDED		9723.50	



BASIN MAP

1 EX-1

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

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Client
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Project
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BUSINESS CENTER

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BASIN MAP

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Aurora Business Center - 53 AC Basin
Stormwater Calculations

Detention Calculations

Project Number 2180516.00

Use Rational Method and ODOT Detention Routing to size detention facilties

Total Airport Road Basin Area (Including Site) 53 AC

Allowed Flow:		
Area	53.00	
Runoff Coefficient	0.20	Pasture
Rainfall Intensity	1.0	
Pre-Developed Flow	10.60	Allowed Flow

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc.

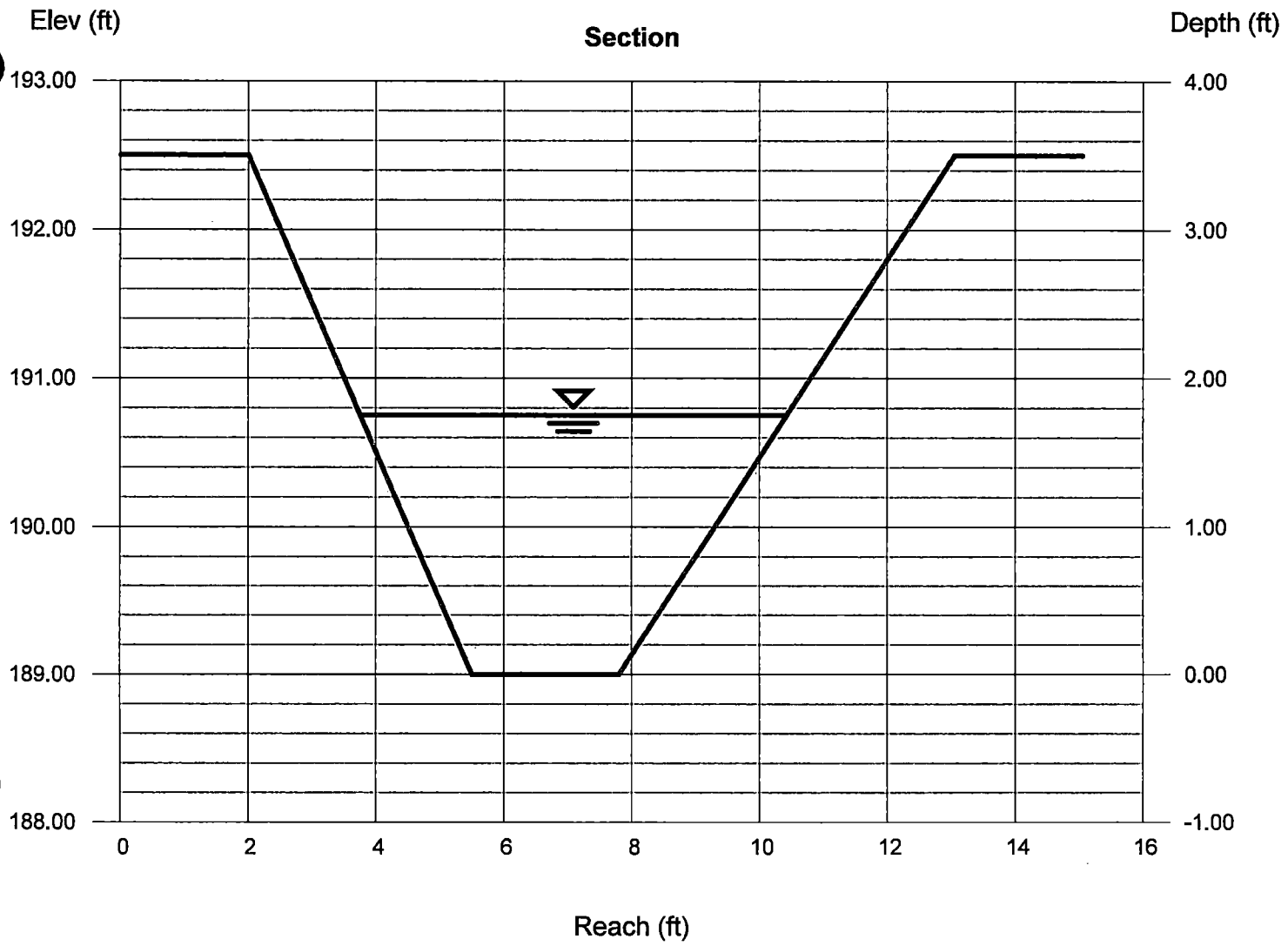
<Name>

Trapezoidal	
Bottom Width (ft)	= 2.30
Side Slopes (z:1)	= 1.00, 1.50
Total Depth (ft)	= 3.50
Invert Elev (ft)	= 189.00
Slope (%)	= 0.10
N-Value	= 0.026

Highlighted	
Depth (ft)	= 1.75
Q (cfs)	= 14.10
Area (sqft)	= 7.85
Velocity (ft/s)	= 1.80
Wetted Perim (ft)	= 7.93
Crit Depth, Yc (ft)	= 0.89
Top Width (ft)	= 6.68
EGL (ft)	= 1.80

Calculations

Compute by:	Q vs Depth
No. Increments	= 10



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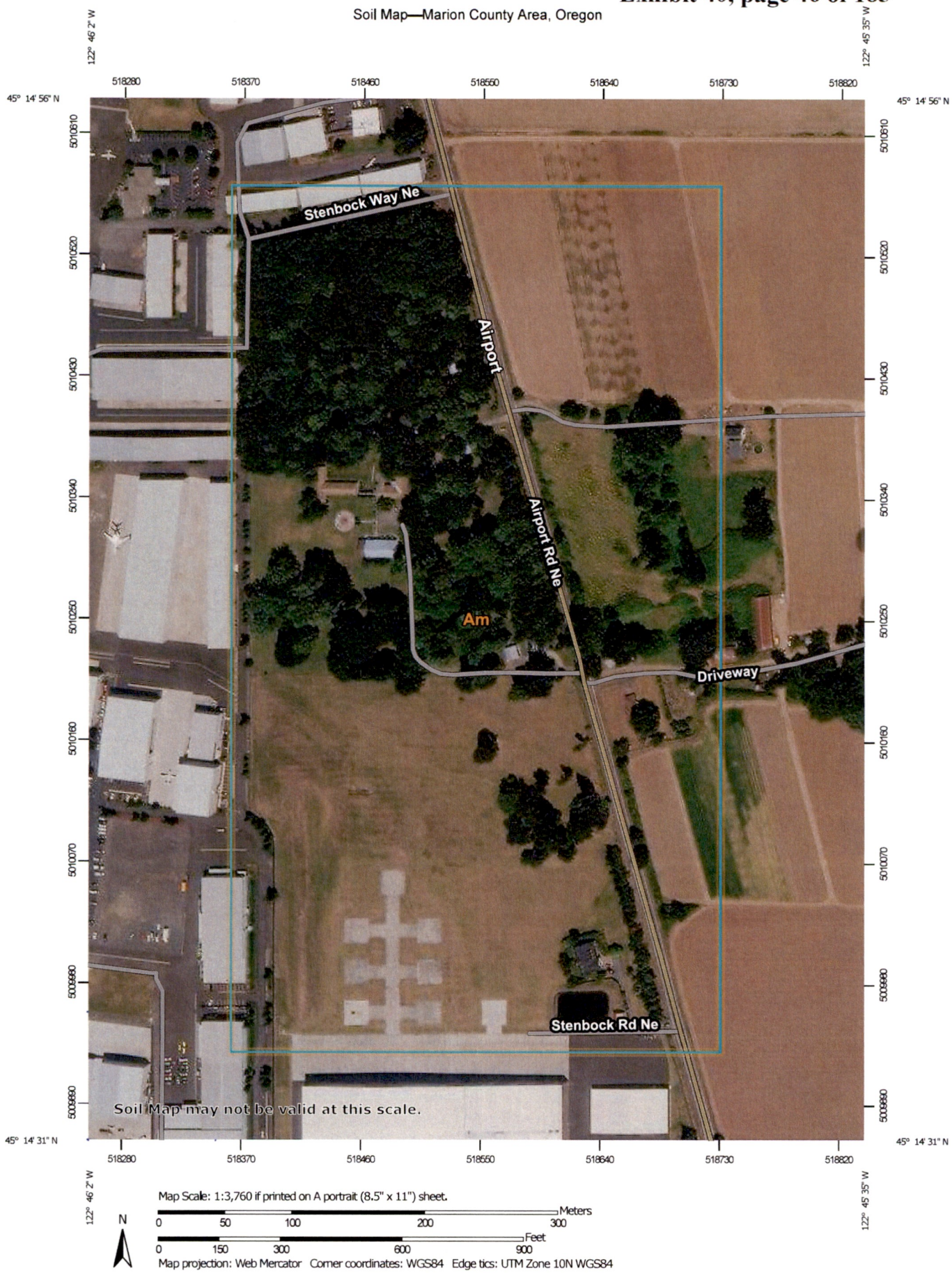
6. APPENDIX

Soil Map—Marion County Area, Oregon



Map Scale: 1:3,760 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 17, Jun 11, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

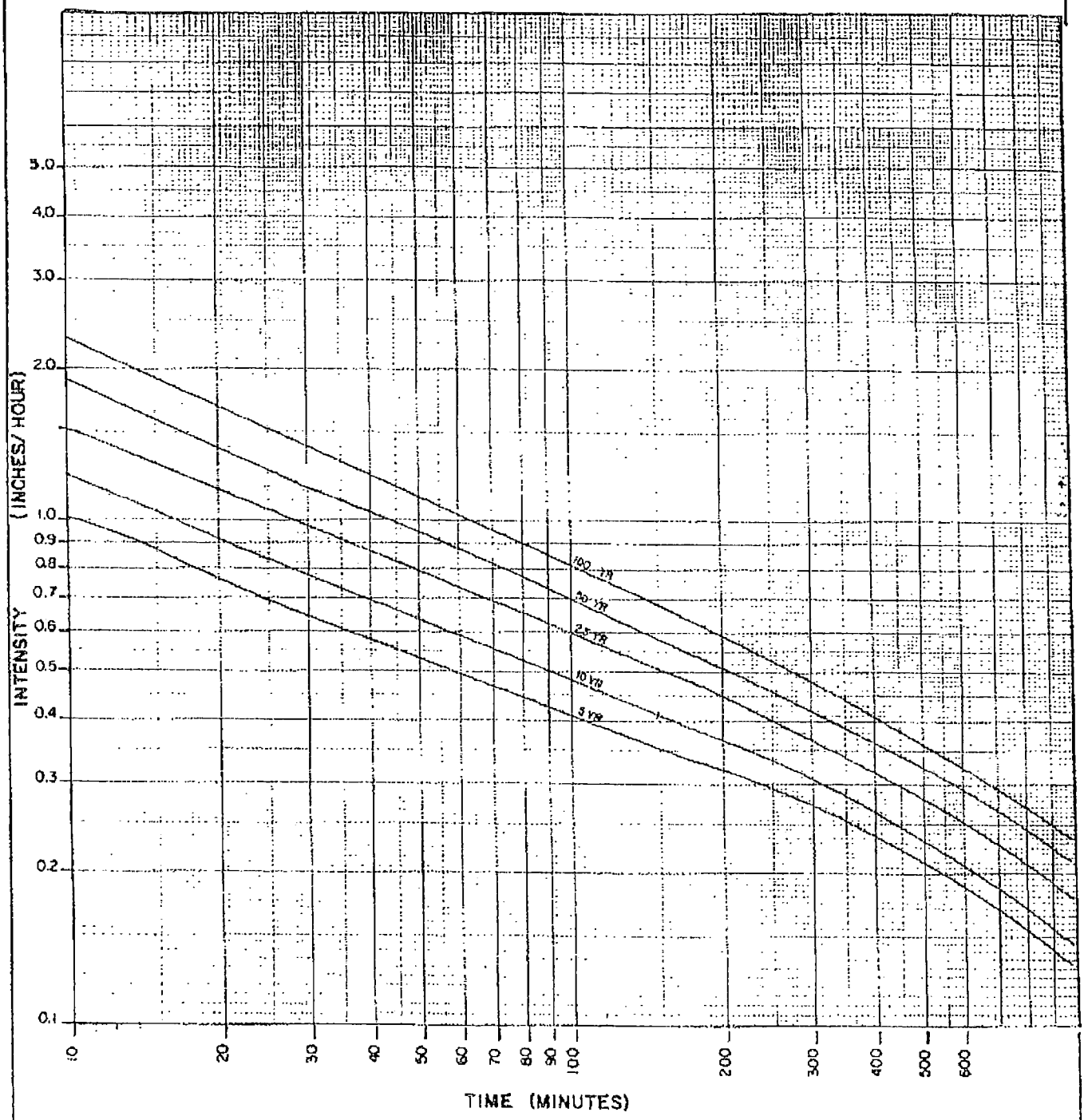
Date(s) aerial images were photographed: Aug 19, 2015—Sep 13, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Am	Amity silt loam	58.8	100.0%
Totals for Area of Interest		**58.8**	**100.0%**

RAINFALL INTENSITY-DURATION CURVES FOR MARION COUNTY



Source: U.S. Geological Survey
Water Resources Investigation
for Salem, Oregon

MARION COUNTY, OREGON DEPARTMENT OF PUBLIC WORKS	
RAINFALL INTENSITY-DURATION CURVES	
DATE: 1/18/83	STD. DWG. NO. 27

4

TABLE 10

RUNOFF COEFFICIENTS

Soil Cover	Flat Terrain s<2%	Rolling Terrain 2%<s<10%	Steep Terrain s>10%
Relatively high permeability (lawns, pasture, woods)	0.20	0.25	0.30
Moderate impermeability			
1) Single-family residential in urban areas, except corner lots with duplex potential	0.40	0.45	0.50
2) Gravel parking lots	0.50	0.55	0.60
3) Mobile home parks	0.60	0.65	0.70
4) Multi-family residential, zero-lot-line single-family residential and potential duplex lots in Single-family residential	0.70	0.75	0.80
High impermeability (roofs and paved areas)	0.90	0.90	0.90

TABLE 10

RUNOFF COEFFICIENTS

Soil Cover	Flat Terrain s<2%	Rolling Terrain 2%<s<10%	Steep Terrain s>10%
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High impermeability (roofs and paved areas)	0.90	0.90	0.90

GEODESIGN INC

REPORT OF GEOTECHNICAL ENGINEERING SERVICES

Aurora Airport Business Center
22515 Airport Road NE
Aurora, Oregon

For
Aron Faegre & Associates
May 13, 2019

GeoDesign Project: AronFA-1-01

GEODESIGN INC

May 13, 2019

Aron Faegre & Associates
520 SW Yamhill Street, Roofgarden 1
Portland, OR 97204

Attention: Aron Faegre

Report of Geotechnical Engineering Services
Aurora Airport Business Center
22515 Airport Road NE
Aurora, Oregon
GeoDesign Project: AronFA-1-01

GeoDesign, Inc. is pleased to submit this report of geotechnical engineering services for the proposed future Aurora Airport Business Center located east of the Aurora Airport in Aurora, Oregon. Our services for this project were conducted in accordance with our proposal dated March 1, 2019.

We appreciate the opportunity to be of service to you. Please call if you have questions regarding this report.

Sincerely,

GeoDesign, Inc.

George Saunders, P.E., G.E.
Principal Engineer

JTW:GPS:kt
Attachments
One copy submitted (via email only)
Document ID: AronFA-1-01-051319-geor.docx
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EXECUTIVE SUMMARY

Based on the results of our explorations, laboratory testing, and analysis, it is our opinion that the proposed future Aurora Airport Business Center (AABC) can be constructed at the site. The main report should be referenced for a detailed description of the subsurface conditions and a full understanding of our geotechnical recommendations while a summary of the primary geotechnical considerations for the project are summarized as follows:

- Our analysis indicates that total post-liquefaction settlement at the existing ground surface will be negligible during a design-level earthquake.
- Based on the results of our evaluation, it is our opinion that the site soil is capable of supporting the proposed buildings on conventional spread footings underlain by firm, undisturbed native soil or structural fill that extends to the underlying native material. Undocumented fill, if encountered, beneath footings should be removed and replaced with structural fill.
- The on-site soil is suitable for use as structural fill only if it can be properly moisture conditioned. The moisture content of the soil encountered is above that required for compaction. It will be difficult, if not impossible, to achieve adequate compaction of on-site soil during periods of wet weather.
- The on-site soil will provide inadequate support for construction equipment during periods of wet weather or when above optimum moisture. Granular haul roads and working pads or cement amendment should be employed if earthwork will occur during the wet winter months.
- Groundwater was measured at a depth of approximately 5 feet BGS at the time of our explorations. Perched groundwater is anticipated near the ground surface during the wet winter months. The contractor should be prepared to dewater, if necessary.
- As requested, our explorations were limited to one deep boring and one CPT near the proposed area of the AABC. We note that future explorations will likely be needed for other areas of the proposed AABC. Future explorations will likely include test pits or shallow borings to better identify near-surface soil, including variability across the site with regard to site stripping and grubbing and pavement support.

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ACRONYMS AND ABBREVIATIONS

AABC	Aurora Airport Business Center
AASHTO	American Association of State Highway and Transportation Officials
AC	asphalt concrete
ACP	asphalt concrete pavement
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
BGS	below ground surface
CPT	cone penetration test
CRBG	Columbia River Basalt Group
CSZ	Cascadia subduction zone
ESA	effective stress analysis
fps	feet per second
g	gravitational acceleration (32.2 feet/second^2)
H:V	horizontal to vertical
IBC	International Building Code
km	kilometers
MCE	maximum considered earthquake
MCE_R	risk-targeted maximum considered earthquake
MSL	mean sea level
OSHA	Occupational Safety and Health Administration
OSSC	Oregon Standard Specifications for Construction (2018)
OWRD	Oregon Water Resources Department
PCC	portland cement concrete
pcf	pounds per cubic foot
PG	performance grade
PGA	peak ground acceleration
psf	pounds per square foot
PSHA	probabilistic seismic hazard analysis
psi	pounds per square inch
SAR	spectral amplitude ratio
SOSSC	State of Oregon Structural Specialty Code
SPT	standard penetration test
TSA	total stress analysis
USGS	U.S. Geological Survey

1.0 INTRODUCTION

GeoDesign, Inc. is pleased to submit this report of geotechnical engineering services for the proposed future AABC located at the Aurora Airport in Aurora, Oregon. Figure 1 shows the site relative to existing topographic and physical features. Existing conditions, the proposed site boundary, and approximate exploration locations are shown on Figure 2.

The boring logs and laboratory testing results, the CPT data, and nearby well logs obtained from OWRD are presented in Appendices A, B, and C, respectively. Our site-specific seismic hazard evaluation of the site is presented in Appendix D. Acronyms and abbreviations used herein are defined above, immediately following the Table of Contents.

2.0 PROJECT UNDERSTANDING

Based on correspondence with Aron Faegre of Aron Faegre & Associates, we understand the first step for the proposed development is a land zone change to switch the approximately 16 acres of agricultural land to airport use. We understand geologic hazard maps indicate that the area is susceptible to liquefaction and soil amplification during an earthquake. Specifically, the Relative Earthquake Hazard Maps (Madin and Wang, 1999) assigns a Zone B (intermediate to high hazard) earthquake risk to the southern portion of the airport. We prepared a March 25, 2019 memorandum that summarized seismic considerations for the site (GeoDesign, 2019).

We understand the proposed development will likely consist of new hangars, shops, offices, and associated pavement and utilities. In addition, aircraft staging areas and taxi lanes will be constructed. The future development may also include an essential facility; therefore, a site-specific seismic hazard evaluation has been requested in accordance with the SOSSC.

Foundation loads for the proposed structures were unknown at the time of this report; however, we have assumed that the buildings will be constructed at grade and will be two stories or less. We estimate maximum column and wall loads will be less than 200 kips and 6 kips per foot, respectively, based on our experience with similar structures. We anticipate floor slab loads will be less than 250 psf. Once building loads are known, we should be contacted to re-evaluate our foundation recommendations.

Based on existing topography, we anticipate that site cuts and fills will be less than a few feet each. We should be contacted to review grading plans when available. As requested, our explorations were limited to one deep boring and one CPT near the proposed essential facility. We note that future explorations will likely be needed for other areas of the AABC. Future explorations will likely include test pits or shallow borings to better identify near-surface soil, including variability across the site with regard to site stripping and grubbing and pavement support.

2.1 BACKGROUND

GeoDesign has conducted numerous projects in the area, including explorations and a geotechnical report for the proposed Lima North Hangar site. In addition, we completed a geotechnical report for a proposed fuel farm on the south portion of the airport. As shown on

Figure 1, the Lima North Hangar site is located approximately 800 feet west of the AABC site and the fuel farm is located approximately 2,000 feet southwest of the AABC site. These additional explorations are presented in Appendix E for reference.

3.0 SCOPE OF SERVICES

3.1 GEOTECHNICAL EXPLORATION

The purpose of our geotechnical engineering services was to characterize site subsurface conditions and provide geotechnical engineering recommendations for use in design and construction of the proposed development. Our scope of services included the following:

- Reviewed information from previous geological and geotechnical studies conducted at and in the vicinity of the site available in our in-house files.
- Coordinated and managed the field explorations, including utility locates, site access authorization, access preparation, and scheduling subcontractors and GeoDesign staff.
- Completed the following explorations:
  - One boring to a depth of 101.5 feet BGS using mud rotary drilling methods
  - One CPT probe to a depth of 114.5 feet BGS
- Collected representative soil samples from the boring, classified the materials encountered in the boring, and maintained a detailed log of the boring.
- Performed a laboratory testing program that included the following:
  - Seventeen moisture content determinations in general accordance with ASTM D2216
  - Five particle-size analyses in general accordance with ASTM D1140
  - Three Atterberg limits tests in general accordance with ASTM D4318
- Provided recommendations for site preparation and grading, including temporary and permanent slopes, fill placement criteria, suitability of on-site soil for fill, and subgrade preparation.
- Provided recommendations for wet weather construction.
- Provided foundation support recommendations for the proposed buildings, including preferred foundation type, allowable bearing pressure, and lateral resistance parameters.
- Provided recommendations for floor slab support.
- Provided pavement design recommendations for AC and PCC paving, if necessary.
- Evaluated groundwater conditions at the site and provided general recommendations for dewatering during construction and subsurface drainage (if required).
- Provided seismic design recommendations in accordance with the procedures outlined in the IBC and SOSSC (presented in Appendix D).
- Prepared this geotechnical engineering report that presents our findings, conclusions, and recommendations.

3.2 SITE-SPECIFIC SEISMIC EVALUATION

The SOSSC requires a seismic hazard investigation for "special occupancy structures." Special occupancy structures include "essential facilities" which include hospitals, fire and police stations, emergency vehicle shelters, and structures and equipment in emergency-preparedness centers. As requested, our services included a site-specific seismic hazard evaluation. The specific scope of our services is summarized as follows:

- Reviewed available seismic hazard maps, published dynamic soil properties in the vicinity, and geologic maps and geotechnical reports discussing subsurface conditions.
- Evaluated design-level base rock motions at the site using both probabilistic and deterministic methods.
- Selected and modified existing analogous earthquake records to model expected base rock motions.
- Modeled the soil response at the site using the computer program EZ-FRISK and conducted sensitivity analyses of model parameters, including soil properties, soil thicknesses, and base rock motions.
- Provided response spectra at the ground surface and primary foundation elevations, as well as PGAs.
- Evaluated liquefaction potential and other pertinent and code-identified hazards and their potential effect on the proposed development.
- The results of our site-specific seismic hazard evaluation are presented in Appendix D.

4.0 SITE CONDITIONS

4.1 GEOLOGIC SETTING

Aurora is situated in the Willamette Valley, which extends from Cottage Grove in the south to the Portland Basin in the north (Orr and Orr, 1999). The Willamette Valley is part of the Puget-Willamette Trough physiographic province, a forearc basin associated with the tectonically active Cascadia convergent margin. The lowland is generally an elongated alluvial plain bordered on the west by the Coast Ranges and on the east by the Cascade Mountains. A band of uplifted hills underlain by Tertiary Age volcanic and sedimentary rocks stretch between the foothills on both sides, interrupting the valley floor lowlands.

Alluvial sediments have been accumulating in the Willamette Valley for at least 20 million years, transported by tributaries from the Coast and Cascade ranges, foothill streams, and the upper Willamette River. Rivers from the Cascades commonly delivered coarser deposits, whereas the Willamette River and smaller streams brought generally finer gravel, sand, and silt. In addition, the Willamette Valley was back-flooded by catastrophic floods that had traveled down the Columbia River, caused by the drainage of large glacial lakes in western Montana (Allen et al., 1986). Many of these Missoula Floods occurred between approximately 15,500 and 12,700 years ago. Flood waters rose to an elevation of approximately 400 feet above MSL in the valley and deposited silt and fine sand over the surfaces below that level. Since then, fluvial processes have created a complex series of terraces, dropping from the foothills down to the current Willamette River channel.

Geologic mapping and local water well records indicate that the site is underlain by approximately 100 to 110 feet of unconsolidated Missoula flood deposits (Gannett and Caldwell, 1998; Burns et al., 1997; Price, 1967). The flood deposits are underlain by older, consolidated fluvial and lacustrine sediments that extend to approximately 600 feet BGS. The CRBG forms the bottom of the basin and underlies the valley fill sediments. The CRBG is middle Miocene (16.5 million to 15 million years before present) in age and consists of a series of basalt flows that originated from southeastern Washington and northeastern Oregon. The CRBG is considered the geologic basement unit for this report (Burns et al., 1997).

The Relative Earthquake Hazard Maps (Madin and Wang, 1999) assigns a Zone B (intermediate to high hazard) earthquake risk to the site (and southern portion of the airport).

4.2 SURFACE CONDITIONS

The approximately 16-acre site is located directly east of the Aurora Airport and is bound to the west by Airport Way NE. Based on historical images, the site was heavily forested until approximately 2017. The site was recently logged, and large stockpiles of tree stumps remain. The site has areas of exposed soil, light grass vegetation, and small shrubs.

There are numerous abandoned sheds and buildings across the site. In addition, some concrete building pads and walkways are present across the site, along with gravel access roads. Two houses are located along the southeast end of the property. A topographic survey was not available at the time of this report; however, the project area appears to be relatively flat based on field observations.

4.3 SUBSURFACE CONDITIONS

4.3.1 General

Our subsurface exploration program consisted of drilling one boring (B-1) to a depth of 101.5 feet BGS and advancing one CPT probe (CPT-1) to a depth of 114.5 feet BGS (refusal). The approximate locations of the explorations are shown on Figure 2. The boring log and laboratory test results are presented in Appendix A. The CPT data are presented in Appendix B. Logs of nearby wells in the site vicinity obtained from OWRD are presented in Appendix C.

In boring B-1 we encountered an approximately 12-inch-thick root zone. Soft to stiff clay with sand and minor silt was observed to approximately 12 feet BGS. Stiff to hard silt and sandy silt with interbeds of clay and sand was observed below the clay layer to approximately 58.5 feet BGS. Dense to very dense, silty sand was observed below the silt to approximately 82.5 feet BGS. Very stiff to hard clay was observed below the silty sand to the maximum depth explored of 101.5 feet BGS in boring B-1. Based on laboratory testing, the moisture content of the native soil varied from 24 to 45 percent at the time of our explorations.

The CPT indicates interbedded seams and layers of sand, silty sand, clay, and silt to a depth of 85 feet BGS overlying clay and very stiff fine-grained soil. Explorations from nearby sites are presented in Appendix E and indicate similar soil conditions. As stated in the "Project Understanding" section, additional shallow explorations are recommended across the 16-acre site prior to development of the AABC to verify soil conditions.

4.3.2 Groundwater

Due to the mud rotary drilling techniques, groundwater could not be measured directly in boring B-1. Pore water pressure dissipation from the CPT probe (CPT-1) indicates a static groundwater level of approximately 5 feet BGS at the time of our exploration. Our prior work in the area indicates perched groundwater and generally a high static groundwater level of approximately 8 feet BGS; however, it fluctuates as deep as approximately 20 feet BGS. The depth to groundwater may fluctuate in response to seasonal changes, prolonged rainfall, changes in

surface topography, and other factors not observed in this study. As encountered before, we anticipate that perched water may be present near the ground surface in the wet season or during extended periods of precipitation.

5.0 CONCLUSIONS

Based on the results of our subsurface explorations and engineering analyses, it is our opinion that the site can be developed as proposed. The primary geotechnical considerations for the project are summarized in the "Executive Summary." As discussed in Appendix D, our analysis indicates that total post-liquefaction settlement at the existing ground surface will be less than approximately 1 inch during a design-level earthquake. Our specific recommendations are provided in the following sections.

As noted in the "Introduction" section, future explorations will likely be needed for other areas of the proposed AABC. Future explorations will likely include test pits or shallow borings to better identify near-surface soil, including variability across the site with regard to site stripping and grubbing and pavement support.

6.0 DESIGN

6.1 GENERAL

The following sections provide our design recommendations for the development. All site preparation and structural fill should be prepared as recommended in the "Construction" section.

6.2 SHALLOW FOUNDATIONS

6.2.1 General

Based on the results of our explorations and analysis and the estimated building loads in the "Project Understanding" section, the proposed buildings can be supported by conventional spread footings resting on granular pads underlain by undisturbed native soil or structural fill overlying firm native soil. Foundations should not be established on undocumented fill, soft soil, or soil containing deleterious material. This material should be removed and replaced with granular pads. Our seismic design parameters are presented in Appendix D.

The fine-grained silt and clay that will be present at the base of footings is anticipated to be wet and easily disturbed. To protect the footing subgrade, granular pads should be a minimum of 6 inches thick and extend 6 inches beyond the margins of the footings for every foot excavated below the base grade of the footing. The granular pads should consist of imported granular material, as defined in the "Structural Fill" section. The imported granular material should be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557, or until well-keyed, as determined by one of our geotechnical staff. We recommend that a member of our geotechnical staff observe the prepared footing subgrade and the prepared granular pad.

6.2.2 Dimensions and Capacities

Continuous wall and isolated spread footings should be at least 18 and 24 inches wide, respectively. The bottom of exterior footings should be at least 18 inches below the lowest adjacent exterior grade. The bottom of interior footings should be established at least 12 inches below the base of the slab.

Footings bearing on subgrade prepared as recommended above should be sized based on an allowable bearing pressure of 2,500 psf. This is a net bearing pressure; the weight of the footing and overlying backfill can be ignored in calculating footing sizes. The recommended allowable bearing pressure applies to the total of dead plus long-term live loads and may be doubled for short-term loads such as those resulting from wind or seismic forces.

6.2.3 Resistance to Sliding

Lateral loads on footings can be resisted by passive earth pressure on the sides of the structure and by friction on the base of the footings. Our analysis indicates that the available passive earth pressure for footings confined by native soil and structural fill is 250 pcf, modeled as an equivalent fluid pressure. Adjacent floor slabs, pavement, or the upper 12-inch depth of adjacent, unpaved areas should not be considered when calculating passive resistance. The passive resistance should be reduced to 120 pcf below groundwater.

For footings in contact with native soil, a coefficient of friction equal to 0.30 may be used when calculating resistance to sliding. For footings in contact with granular fill, a coefficient of friction equal to 0.40 may be used when calculating resistance to sliding.

6.2.4 Settlement

Based on the anticipated foundation loads, post-construction static settlement of footings and floor slabs founded as recommended is anticipated to be less than 1 inch. Differential settlement between similarly loaded, newly constructed foundation elements should be approximately one-half of the total settlement.

As discussed in Appendix D, our analysis indicates that total post-liquefaction settlement at the existing ground surface will be negligible during a design-level earthquake.

6.2.5 Subgrade Observation

All footing and floor slab subgrades should be evaluated by a representative of GeoDesign to evaluate the bearing conditions. Observations should also confirm that all loose or soft material, organics, unsuitable fill, prior topsoil zones, and softened subgrades (if present) have been removed. Localized deepening of footing excavations may be required to penetrate deleterious material.

6.3 FLOOR SLABS

Satisfactory subgrade support for floor slabs supporting up to 250 psf area loading can be obtained provided the floor slabs are prepared as described in the "Construction" section. To help reduce moisture transmission and slab shifting, we recommend a minimum 6-inch-thick layer of floor slab base rock be placed and compacted over a subgrade that has been prepared in

conformance with the "Site Preparation" section. The floor slab base rock should meet the requirements in the "Structural Fill" section and be compacted to at least 95 percent of ASTM D1557.

The near-surface soil is generally fine grained and will tend to maintain high moisture content. In areas where moisture-sensitive floor slab and flooring will be installed, the installation of a vapor barrier is warranted in order to reduce the potential for moisture transmission through and efflorescence growth on the slab and flooring. In addition, flooring manufacturers often require vapor barriers to protect flooring and flooring adhesives and will warrant their product only if a vapor barrier is installed according to their recommendations.

If the project includes highly moisture-sensitive flooring, we recommend 10- or 15-mil vapor barriers, which are often required by flooring manufacturers. Selection and design of an appropriate vapor barrier should be based on discussions among members of the design team.

Slabs should be reinforced according to their proposed use and per the structural engineer's recommendations. Load-bearing concrete slabs may be designed assuming a modulus of subgrade reaction, k, of 150 psi per inch.

The design parameters provided above assume that the floor slabs are underlain by native soil, compacted structural fill, or cement-amended soil as discussed in the "Site Preparation" section. If encountered, deleterious material should be removed prior to compaction.

6.4 RETAINING STRUCTURES

6.4.1 Assumptions

Our retaining wall design recommendations are based on the following assumptions: (1) the walls are cantilevered walls, (2) the walls are less than 8 feet in height, (3) drainage is provided behind walls, (4) the retained soil has a slope flatter than 4H:1V, and (5) the ground surface at the toe of the wall has an inclination of flatter than 5H:1V. Re-evaluation of our recommendations will be required if the retaining wall design criteria for the project varies from these assumptions.

6.4.2 Wall Design Parameters

Permanent retaining structures free to rotate slightly around the base should be designed for active earth pressures using an equivalent fluid unit pressure of 38 pcf. If retaining walls are restrained against rotation during backfilling, they should be designed for an at-rest earth pressure of 58 pcf.

Seismic lateral forces can be calculated using a dynamic force equal to $7H^2$ pounds per linear foot of wall, where H is the wall height. The seismic force should be applied as a distributed load with the centroid located at 0.6H from the wall base. Footings for retaining walls should be designed as recommended for shallow foundations.

The design equivalent fluid pressure should be increased for walls that retain sloping soil. We recommend the above lateral earth pressures be increased using the factors in Table 1 when designing walls that retain sloping soil.

Table 1. Lateral Earth Pressure Increase Factors for Sloping Soil

Slope of Retained Soil (degrees)	Lateral Earth Pressure Increase Factor
0	1.00
5	1.06
10	1.12
20	1.33
25	1.52
30	2.27

If other surcharges (i.e., slopes steeper than 2H:1V, foundations, vehicles, etc.) are located within a horizontal distance of twice the height of the wall from the back of the wall, additional pressures will need to be accounted for in the wall design. Our office should be contacted for appropriate wall surcharges based on the actual magnitude and configuration of the applied loads.

6.4.3 Wall Drainage and Backfill

The above design parameters have been provided assuming drains will be installed behind walls to prevent hydrostatic pressures from developing. If a drainage system is not installed, our office should be contacted for revised design forces.

The backfill material placed behind the walls and extending a horizontal distance of ½H, where H is the height of the retaining wall, should consist of retaining wall select backfill placed and compacted in conformance with the "Structural Fill" section.

A minimum 6-inch-diameter, perforated collector pipe should be placed at the base of the walls. The pipe should be embedded in a minimum 2-foot-wide zone of angular drain rock that is wrapped in a drainage geotextile fabric and extends up the back of the wall to within 1 foot of the finished grade. The drain rock and drainage geotextile fabric should meet specifications provided in the "Materials" section. The perforated collector pipes should discharge at an appropriate location away from the base of the wall. The discharge pipe(s) should not be tied directly into stormwater drain systems, unless measures are taken to prevent backflow into the wall's drainage system.

Settlement of up to 1 percent of the wall height commonly occurs immediately adjacent to the wall as the wall rotates and develops active lateral earth pressures. Consequently, we recommend construction of flatwork adjacent to retaining walls be postponed at least four weeks after backfilling of the wall, unless survey data indicates that settlement is complete prior to that time.

6.5 PAVEMENTS

6.5.1 Design Assumptions and Parameters

Pavement should be installed on native subgrade or new engineered fills prepared in conformance with the "Site Preparation" and "Structural Fill" sections. Our preliminary pavement recommendations are based on the following assumptions:

- The top 12 inches of soil subgrade is compacted to at least 92 percent of its maximum dry density, as determined by ASTM D1557, or until proof rolling with heavy equipment indicates that is it firm and unyielding.
- Resilient moduli of 4,000 psi and 20,000 psi were assumed for the subgrade and base rock, respectively.
- An AC pavement design life of 20 years.
- Initial and terminal serviceability indices of 4.2 and 2.5, respectively.
- Reliability of 85 percent and standard deviation of 0.4.

Based on the conceptual site plan, we anticipate that new pavement will include AC drive aisles and automobile parking. In addition, we anticipate taxi lanes and staging areas for aircrafts and helicopters will be constructed with PCC pavement.

6.5.2 Preliminary Design Sections

Based on our initial explorations and the design assumptions above, we recommend a car parking pavement section of 3 inches of AC over approximately 8 inches of aggregate base. For AC access roads and drive aisles we anticipate pavement sections of between 3 and 4.5 inches of AC over 10 to 14 inches of aggregate base, depending on the type and frequency of truck traffic. The aggregate base thickness can be reduced to between 4 and 6 inches if the subgrade soil is cement amendment to at least 12 inches and achieves a minimum seven-day unconfined compressive strength of 100 psi.

The frequency and type of planes will have a large effect on the design pavement sections for taxiways and aircraft staging areas. For initial purposes we anticipate between 8 and 14 inches of PCC over 8 to 14 inches of aggregate base, depending on the type and frequency of aircraft. We should be contacted to provide pavement section recommendations when more information is available about types of aircrafts and anticipated number of trips.

We recommend completing additional explorations across the site to assist with final pavement design recommendations when more information is available.

6.5.3 Other Considerations

All thicknesses are intended to be the minimum acceptable. Construction traffic should be limited to non-building, unpaved portions of the site or haul roads. Construction traffic should not be allowed on new pavement. If construction traffic is to be allowed on newly constructed road sections, an allowance for this additional traffic will need to be made in the design pavement section.

Design of the recommended pavement sections is based on the assumption that construction will be completed during an extended period of dry weather. Wet weather construction could require an increased thickness of aggregate base as discussed in the "Construction Considerations" section. The pavement sections recommended above are for support of post-construction design traffic. The aggregate (with or without cement-amended subgrade) is designed to support construction traffic. Increased aggregate thicknesses will likely be required to support construction traffic as discussed in the " Construction Considerations" section.

To prevent strength loss during curing, cement-amended soil should be allowed to cure for at least four days prior to construction traffic or placing the base rock. Lastly, the amended subgrade should be protected with a minimum of 4 inches of base rock prior to construction traffic access.

The AC, PCC, aggregate base, and cement amendment should meet the requirements outlined in the "Materials" section.

6.6 DRAINAGE

Where possible, the finished ground surface around the buildings should be sloped away from the structures at a minimum 2 percent gradient for a distance of at least 5 feet. Downspouts or roof scuppers should discharge into a storm drain system that carries the collected water to an appropriate stormwater system. Trapped planter areas should not be created adjacent to the buildings without providing means for positive drainage (e.g., swales or catch basins).

6.7 PERMANENT SLOPES

Permanent cut and fill slopes should not exceed 2H:1V. Slopes within stormwater facilities should not exceed 3H:1V. Access roads and pavement should be located at least 5 feet from the top of cut and fill slopes. The setback should be increased to 10 feet for buildings. The slopes should be planted with appropriate vegetation to provide protection against erosion as soon as possible after grading. Surface water runoff should be collected and directed away from slopes to prevent water from running down the face of the slope.

7.0 CONSTRUCTION

7.1 SITE PREPARATION

7.1.1 Demolition

As discussed in the "Surface Conditions" section, existing houses, buildings, cabins, and outbuildings are present on the site. In addition, concrete walkways, water wells, septic tanks, and drain fields are present.

Demolition includes complete removal of existing site improvements within 5 feet of areas to receive new pavement, buildings, retaining walls, or engineered fills. Underground vaults, tanks, manholes, foundation elements, septic systems, drain tiles, and other subsurface structures should be removed from areas of new foundation elements. Utility lines should be completely removed when extending under footings or grouted full if left in place. Soil disturbed during demolition should be removed and replaced in accordance with the recommendations in the "Structural Fill" section. Water wells should be decommissioned in accordance with OWRD requirements.

Material generated during demolition should be transported off site for disposal or stockpiled in areas designated by the owner and in accordance with a Contaminated Media Management Plan (if available). In general, this material will not be suitable for re-use as engineered fill.

7.1.2 Grubbing and Stripping

Since the site was recently logged (2017 or 2018), we anticipate that the near-surface soil has been disturbed from tree removal and logging activities. We recommend additional explorations prior to development of the 16-acre site to better define the depth of disturbed material from past logging activities.

Trees and shrubs should be removed from fill areas. In addition, root balls should be grubbed out to the depth of the roots, which could exceed 3 feet BGS. Depending on the methods used to remove the root balls, considerable disturbance and loosening of the subgrade could occur during site grubbing. We recommend soil disturbed during grubbing operations be removed to expose firm, undisturbed subgrade. The resulting excavations should be backfilled with structural fill.

The existing topsoil and root zone should be stripped and removed from all fill areas. We observed an approximately 12-inch-thick root zone in our boring. Stripping depths are anticipated to vary across the site and we anticipate a stripping depth of approximately 3 to 6 inches. We recommend additional explorations be completed across the proposed development to better define variations in thickness of disturbed and topsoil material. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported off site for disposal (with prior approval by the owner) or used in landscaped areas in accordance with a Contaminated Media Management Plan (if available).

7.1.3 Subgrade Evaluation

Upon completion of stripping and subgrade stabilization, and prior to the placement of fill or pavement improvements, the exposed subgrade should be evaluated by proof rolling. The subgrade should be proof rolled with a fully loaded dump truck or similarly heavy, rubber tire construction equipment to identify soft, loose, or unsuitable areas. A member of our geotechnical staff should observe proof rolling to evaluate yielding of the ground surface. During wet weather, subgrade evaluation should be performed by probing with a foundation probe rather than proof rolling. Areas that appear soft or loose should be improved in accordance with subsequent sections.

7.2 SUBGRADE PROTECTION

The fine-grained soil present on this site is easily disturbed. If not carefully executed, site preparation and utility trench work can create extensive soft areas and significant repair costs can result. Earthwork planning, regardless of the time of year, should include considerations for minimizing subgrade disturbance.

If construction occurs during or extends into the wet season, or if the moisture content of the surficial soil is more than a couple percentage points above optimum, the subgrade will be susceptible to damage by construction traffic. Site stripping and cutting may need to be accomplished using track-mounted equipment. Likewise, the use of granular haul roads and staging areas will be necessary for support of construction traffic during the rainy season or when the moisture content of the surficial soil is more than a few percentage points above optimum. The base rock thickness for pavement areas is intended to support post-construction

design traffic loads. This design base rock thickness will likely not support construction traffic or pavement construction when the subgrade soil is wet. If construction is planned for periods when the subgrade soil is wet, staging and haul roads with increased thicknesses of base rock will be required.

The amount of staging and haul road areas, as well as the required thickness of granular material, will vary with the contractor's sequencing of a project and type/frequency of construction equipment and should, therefore, be the responsibility of the contractor. Based on our experience, between 12 and 18 inches of imported granular material is generally required in staging areas and between 18 and 24 inches in haul roads areas. The contractor should also be responsible for selecting the type of material or construction of haul roads and staging areas. A geotextile fabric can be placed as a barrier between the subgrade and imported granular material in areas of repeated construction traffic. The imported granular material, stabilization material, and geotextile fabric should meet the specifications in the "Materials" section.

As an alternative to thickened crushed rock sections, haul roads and utility work zones may be constructed using cement-amended subgrades overlain by a crushed rock wearing surface. If this approach is used, the thickness of granular material in staging areas and haul roads can typically be reduced to between 6 and 9 inches. This recommendation is based on an assumed minimum unconfined compressive strength of 100 psi for subgrade amended to a depth of 12 to 16 inches. The actual thickness of the amended material and imported granular material will depend on the contractor's means and methods and should be the contractor's responsibility. Cement amendment is discussed in the "Materials" section.

7.3 EXCAVATION

7.3.1 Excavation and Shoring

Temporary excavation sidewalls should stand vertical to a depth of approximately 4 feet, provided groundwater seepage is not observed in the sidewalls. Open excavation techniques may be used to excavate trenches with depths between 4 and 8 feet, provided the walls of the excavation are cut at a slope of 1.5H:1V and groundwater seepage is not present. At this inclination, the slopes may ravel and require some ongoing repair. Excavations should be flattened if excessive sloughing or raveling occurs. In lieu of large and open cuts, approved temporary shoring may be used for excavation support. A wide variety of shoring and dewatering systems are available. Consequently, we recommend that the contractor be responsible for selecting the appropriate shoring and dewatering systems.

If box shoring is used, it should be understood that box shoring is a safety feature used to protect workers and does not prevent caving. If the excavations are left open for extended periods of time, caving of the sidewalls may occur. The presence of caved material will limit the ability to properly backfill and compact the trenches. The contractor should be prepared to fill voids between the box shoring and the sidewalls of the trenches with sand or gravel before caving occurs.

If shoring is used, we recommend that the type and design of the shoring system be the responsibility of the contractor, who is in the best position to choose a system that fits the overall plan of operation. All excavations should be made in accordance with applicable OSHA and state regulations.

7.3.2 Trench Dewatering

The groundwater table was observed at approximately 5 feet BGS during our explorations, and perched water is anticipated near the surface after prolonged wet periods. Dewatering systems are best designed by the contractor. If not carefully designed, caving and "running" conditions are possible given the soil conditions. Removed water should be routed to a suitable discharge point.

If groundwater is present at the base of utility trench excavations, we recommend placing up to 12 inches of stabilization material at the base of the excavations. Trench stabilization material should meet the requirements in the "Structural Fill" section.

We note that these recommendations are for guidance only. Dewatering of excavations is the sole responsibility of the contractor, as the contractor is in the best position to select these systems based on their means and methods.

7.3.3 Safety

Excavations should be made in accordance with applicable OSHA and state regulations. While we have described certain approaches to trench excavation, it is the contractor's responsibility to select the excavation and dewatering methods, monitor the trench excavations for safety, and provide any shoring required to protect personnel and adjacent improvements. All trench excavations should be in accordance with applicable OSHA and state regulations.

7.4 TEMPORARY DRAINAGE

In addition to the erosion control measures (see "Erosion Control" section), during mass grading at the site, the contractor should be made responsible for temporary drainage of surface water as necessary to prevent standing water and/or erosion at the working surface. During rough and finished grading of the building site, the contractor should keep all footing excavations and building pads free of water.

7.5 MATERIALS

7.5.1 Structural Fill

7.5.1.1 General

Fill should be placed on subgrade that has been prepared in conformance with the "Site Preparation" section. A variety of material may be used as structural fill at the site. However, all material used as structural fill should be free of organic matter or other unsuitable material. A brief characterization of some of the acceptable materials and our recommendations for their use as structural fill is provided below.

7.5.1.2 On-Site Soil

The material at the site should be suitable for use as general structural fill provided it is properly moisture conditioned; free of debris, organic material, and particles over 4 inches in diameter; and meets the specifications provided in OSSC 00330.12 (Borrow Material).

Based on laboratory test results, the moisture content of the on-site soil will be significantly above the optimum required for compaction. Therefore, moisture conditioning (drying) will be required to use the on-site fine-grained soil for structural fill. Extended dry weather and sufficient area to dry the soil will be required to adequately condition the soil for use as structural fill. The on-site fine-grained soil should not be used as structural fill during the wet season. Note that during the summer the near-surface (within 2 to 3 feet BGS) soil can become dry and require the addition of water to moisture condition for compaction.

When used as structural fill, the on-site fine-grained soil should be placed in lifts with a maximum uncompacted thickness of 8 inches and compacted to not less than 92 percent of the maximum dry density, as determined by ASTM D1557.

7.5.1.3 Imported Granular Material

Imported granular material used as structural fill should be pit- or quarry-run rock, crushed rock, or crushed gravel and sand and should meet the specifications provided in OSSC 00330.14 (Selected Granular Backfill) or OSSC 00330.15 (Selected Stone Backfill). The imported granular material should also be angular, fairly well graded between coarse and fine material, have less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve, and have at least two fractured faces.

Imported granular material should be placed in lifts with a maximum uncompacted thickness of 12 inches and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557. During the wet season or when wet subgrade conditions exists, the initial lift should be approximately 18 inches in uncompacted thickness and should be compacted by rolling with a smooth-drum roller without using vibratory action.

7.5.1.4 Stabilization Material

Stabilization material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and should meet the specifications provided in OSSC 00330.16 (Stone Embankment Material). In addition, the material should have a maximum particle size of 6 inches, less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve, and at least two mechanically fractured faces. The material should be free of organic matter and other deleterious material. Stabilization material should be placed in lifts between 12 and 18 inches thick and compacted to a firm condition.

Where the stabilization material is used for staging or construction haul roads, a geotextile should be placed as a barrier between the soil subgrade and the imported granular material. The placement of the imported granular fill should be done in conformance with the specifications provided in OSSC 00331 (Subgrade Stabilization). The geotextile fabric should meet the specifications provided below for subgrade geotextiles. Geotextile is not required where stabilization material is used at the base of utility trenches.

7.5.1.5 Trench Backfill

Trench backfill placed beneath, adjacent to, and for at least 12 inches above utility lines (i.e., the pipe zone) should consist of well-graded granular material with a maximum particle size of 1½ inches and less than 7 percent by dry weight passing the U.S. Standard No. 200 sieve and should meet the specifications provided in OSSC 00405.13 (Pipe Zone Material). The pipe zone backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department.

Within roadway alignments, the remainder of the trench backfill up to the subgrade elevation should consist of well-graded granular material with a maximum particle size of 2½ inches and less than 7 percent by dry weight passing the U.S. Standard No. 200 sieve and should meet the specifications provided in OSSC 00405.14 (Trench Backfill; Class B, C, or D). This material should be compacted to at least 92 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department. The upper 3 feet of the trench backfill should be compacted to at least 95 percent of the maximum dry density, as determined by ASTM D1557.

Outside of structural improvement areas (e.g., roadway alignments or building pads) trench backfill placed above the pipe zone may consist of general fill material that is free of organics and material over 6 inches in diameter and meets the specifications provided in OSSC 00405.14 (Trench Backfill; Class A, B, C, or D). This general trench backfill should be compacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557, or as required by the pipe manufacturer or local building department.

7.5.1.6 Floor Slab Aggregate Base

Imported granular material used as base rock for building floor slabs should consist of ¾- or 1½-inch-minus material (depending on the application) and meet the requirements in OSSC 00641 (Aggregate Subbase, Base, and Shoulders). In addition, the aggregate should have less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve. The aggregate base should be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557

7.5.1.7 Pavement Aggregate Base

Imported granular material used as base rock for building floor slabs should consist of ¾- or 1½-inch-minus material (depending on the application) and meet the requirements in OSSC 00641 (Aggregate Subbase, Base, and Shoulders). In addition, the aggregate should have less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve. The aggregate base should be compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

7.5.1.8 Retaining Wall Select Backfill

Backfill material placed behind retaining walls and extending a horizontal distance of ½H, where H is the height of the retaining wall, should consist of select granular material that meets the requirements provided in OSSC 00510.12 (Granular Wall Backfill). We recommend the select granular wall backfill be separated from general fill, native soil, and/or topsoil using a geotextile fabric that meets the specifications provided below for drainage geotextiles.

The wall backfill should be compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D1557. However, backfill located within a horizontal distance of 3 feet from a retaining wall should only be compacted to approximately 90 percent of the maximum dry density, as determined by ASTM D1557. Backfill placed within 3 feet of the wall should be compacted in lifts less than 6 inches thick using hand-operated tamping equipment (such as a jumping jack or vibratory plate compactor). If flatwork (sidewalks or pavements) will be placed atop the wall backfill, we recommend that the upper 2 feet of material be compacted to 95 percent of the maximum dry density, as determined by ASTM D1557.

7.5.1.9 Drain Rock Material

Drain rock should consist of angular, granular material that meets the specifications provided in OSSC 00430.11 (Granular Drain Backfill Material) and the aggregate should have at least two fractured faces. The drain rock should be wrapped in a drainage geotextile that meets the specifications provided below for drainage geotextiles.

7.5.1.10 Retaining Wall Leveling Pad

Imported granular material placed at the base of retaining wall footings should consist of select granular material that meets the specifications provided in OSSC 00510.13 (Granular Structure Backfill). The granular material should meet either the 1"-0 or ¾"-0 aggregate size listed in OSSC Table 02630-1 – Grading Requirements for Dense-Graded Aggregate and have at least two mechanically fractured faces. The leveling pad material should be placed in a 6- to 12-inch lift and compacted to not less than 95 percent of the maximum dry density, as determined by ASTM D1557.

7.5.2 AC

7.5.2.1 ACP

The AC should be Level 2, ½-inch, dense ACP according to OSSC 00744 (Asphalt Concrete Pavement) and compacted to 91 percent of the theoretical maximum density of the mix, as determined by AASHTO T 209. The minimum and maximum lift thicknesses are 2.0 and 3.0 inches, respectively, for ½-inch ACP. Lift thicknesses desired outside these limits should be discussed with the design team prior to design or construction. Asphalt binder should be performance graded and conform to PG 64-22 or better.

7.5.2.2 Cold Weather Paving Considerations

In general, AC paving is not recommended during the cold weather (temperatures less than 40 degrees Fahrenheit). Compacting under these conditions can result in low compaction and premature pavement distress.

Each AC mix design has a recommended compaction temperature range that is specific for the particular AC binder used. In colder temperatures, it is more difficult to maintain the temperature of the AC mix as it can lose heat while stored in the delivery truck, as it is placed, and in the time between placement and compaction. In Oregon, the AC surface temperature during paving should be at least 40 degrees Fahrenheit for lift thickness greater than 2.5 inches and at least 50 degrees Fahrenheit for lift thickness between 2.0 and 2.5 inches.

If paving activities must take place during cold-weather construction as defined above, the project team should be consulted and a site meeting should be held to discuss ways to lessen low compaction risks.

7.5.3 PCC

The PCC should be Class 4000 with – 1½ paving concrete according to OSSC 02001 (Concrete). PCC pavement should have joints conforming to OSSC 00756.48 (Joints). In addition, the concrete should have a minimum flexural strength of 650 psi. The ratio of slab width to slab length should not exceed 1.25. Odd-shaped slabs should be reinforced with #4 rebar at 12 inches on centers. Maximum joint spacing should be 15 feet. Joints from adjacent panels should be aligned, and utility cut outs should either occur on joints or should be isolated from adjacent PCC pavement.

As discussed in the "Pavement" section, PCC thicknesses for aircraft taxiways and staging areas can be provided when types and frequency of aircrafts are known.

7.5.4 Geotextile Fabric

7.5.4.1 Subgrade Geotextile

The subgrade geotextile should meet the specifications provided in OSSC Table 02320-4 - Geotextile Property Values for Subgrade Geotextile (Separation). The geotextile should be installed in conformance with OSSC 00350 (Geosynthetic Installation). A minimum initial aggregate base lift of 6 inches is required over geotextiles. All drainage aggregate and stabilization material should be underlain by a subgrade geotextile. Geotextile is not required where stabilization material is used at the base of utility trenches.

7.5.4.2 Drainage Geotextile

Drainage geotextile should meet the specifications provided in OSSC Table 02320-1 - Geotextile Property Values for Drainage Geotextile. The geotextile should be installed in conformance with OSSC 00350 (Geosynthetic Installation). A minimum initial aggregate base lift of 6 inches is required over geotextiles.

7.5.5 Soil Amendment with Cement

7.5.5.1 General

As an alternative to the use of imported granular material for wet weather structural fill, an experienced contractor may be able to amend the on-site soil with portland cement to obtain suitable support properties. Successful use of soil amendment depends on the use of correct mixing techniques, soil moisture content, and amendment quantities. Soil amending should be conducted in accordance with the specifications provided in OSSC 00344 (Treated Subgrade). The amount of cement used during treatment should be based on an assumed soil dry unit weight of 100 pcf.

7.5.5.2 Subbase Stabilization

Specific recommendations based on exposed site conditions for soil amending can be provided if necessary. However, for preliminary design purposes, we recommend a target strength for cement-amended subgrade for building and pavement subbase (below aggregate base) soil of 100 psi. The amount of cement used to achieve this target generally varies with moisture

content and soil type. It is difficult to predict field performance of soil to cement amendment due to variability in soil response, and we recommend laboratory testing to confirm expectations. Generally, 5 percent cement by weight of dry soil can be used when the soil moisture content does not exceed approximately 20 percent. If the soil moisture content is in the range of 25 to 35 percent, 6 to 8 percent by weight of dry soil is recommended. The amount of cement added to the soil may need to be adjusted based on field observations and performance. Moreover, depending on the time of year and moisture content levels during amendment, water may need to be applied during tilling to appropriately condition the soil moisture content.

We recommend assuming a minimum cement ratio of 6 percent by dry weight; however, the cement-amending contractor should be responsible for selecting the cement content. If the soil moistures are in excess of 30 percent, a cement ratio of 7 percent may be needed.

We recommend cement-amending equipment be equipped with balloon tires to reduce rutting and disturbance of the fine-grained soil. A sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds should be used for initial compaction of the fine-grained soil without the use of vibratory action. A smooth-drum roller with a minimum applied linear force of 700 pounds per inch should be used for final compaction. The amended soil should be compacted to at least 92 percent of the achievable dry density at the moisture content of the material, as defined in ASTM D1557.

A minimum curing of four days is required between treatment and construction traffic access. Construction traffic should not be allowed on unprotected, cement-amended subgrade. To protect the cement-treated surfaces from abrasion or damage, the finished surface should be covered with 4 to 6 inches of imported granular material.

Treatment depths for subgrade beneath buildings and pavement, haul roads, and staging areas are typically on the order of 12, 16, and 12 inches, respectively. The crushed rock typically becomes contaminated with soil during construction. Contaminated base rock should be removed and replaced with clean rock in pavement areas. The actual thickness of the amended material and imported granular material for haul roads and staging areas will depend on the anticipated traffic, as well as the contractor's means and methods and, accordingly, should be the contractor's responsibility.

Cement amending should not be attempted when air temperature is below 40 degrees Fahrenheit or during moderate to heavy precipitation. Cement should not be placed when the ground surface is saturated or standing water exists.

7.5.5.3 Cement-Amended Structural Fill

On-site soil that would not otherwise be suitable for structural fill may be amended and placed as fill over a subgrade prepared in conformance with the "Site Preparation" section. The cement ratio for general cement-amended fill can generally be reduced by 1 percent (by dry weight). Typically, a minimum curing of four days is required between treatment and construction traffic access. Consecutive lifts of fill may be treated immediately after the previous lift has been amended and compacted (e.g., the four-day wait period does not apply). However, where the final lift of fill is a building or roadway subgrade, the four-day wait period is in effect.

7.5.5.4 Other Considerations

Portland cement-amended soil is hard and has low permeability. This soil does not drain well and it is not suitable for planting. Future planted areas should not be cement amended, if practical, or accommodations should be made for drainage and planting. Moreover, cement amending soil within building areas must be done carefully to avoid trapping water under floor slabs. We should be contacted if this approach is considered. Cement amendment should not be used if runoff during construction cannot be directed away from adjacent wetlands.

7.5.5.5 Specification Recommendations

We recommend that the following comments be included in the specifications for the project:

- In general, cement amending is not recommended during the cold weather (temperatures less than 40 degrees Fahrenheit) or during steady rainfall.
- Mixing Equipment
  - Use a pulverizer/mixer capable of uniformly mixing the cement into the soil to the design depth. Blade mixing will not be allowed.
  - Pulverize the soil-cement mixture such that 100 percent by dry weight passes a 1-inch sieve and a minimum of 70 percent passes a No. 4 sieve, exclusive of gravel or stone retained on these sieves. If water is required, the pulverizer should be equipped to inject water to a tolerance of ¼ gallon per square foot of surface area.
  - Use machinery that will not disturb the subgrade, such as using low-pressure "balloon" tires on the pulverizer/mixer vehicle. If subgrade is disturbed, the tilling/treatment depth shall extend the full depth of the disturbance.
  - Multiple "passes" of the tiller will likely be required to adequately blend the cement and soil mixture.
- Spreading Equipment
  - Use a spreader capable of distributing the cement uniformly on the ground to within 5 percent variance of the specified application rate.
  - Use machinery that will not disturb the subgrade, such as using low-pressure "balloon" tires on the spreader vehicle. If subgrade is disturbed, the tilling/treatment depth shall extend the full depth of the disturbance.
- Compaction Equipment
  - Use a static, sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds for initial compaction of fine-grained soil (silt and clay), or an alternate approved by the geotechnical engineer.

7.6 EROSION CONTROL

The site soil is susceptible to erosion; therefore, erosion control measures should be carefully planned and in place before construction begins. Surface water runoff should be collected and directed away from slopes to prevent water from running down the slope face. Erosion control measures (such as straw bales, sediment fences, and temporary detention and settling basins) should be used in accordance with local and state ordinances.

8.0 OBSERVATION OF CONSTRUCTION

Satisfactory foundation and earthwork performance depend to a large degree on quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during the subsurface exploration. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect if subsurface conditions change significantly from those anticipated.

We recommend that GeoDesign be retained to observe earthwork activities, including stripping, proof rolling of the subgrade and repair of soft areas, footing subgrade preparation, observing final proof rolling of the pavement subgrade and base rock, cement amending if necessary, and pavement placement and compaction and perform laboratory compaction and field moisture-density tests.

9.0 LIMITATIONS

We have prepared this report for use by Aron Faegre & Associates and members of the design and construction team for the proposed project. The data and report can be used for bidding or estimating purposes, but our report, conclusions, and interpretations should not be construed as warranty of the subsurface conditions and are not applicable to other nearby building sites.

Exploration observations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The site development plans and design details were preliminary at the time this report was prepared. When the design has been finalized and if there are changes in the site grades or location, configuration, design loads, or type of construction, the conclusions and recommendations presented may not be applicable. If design changes are made, we request that we be retained to review our conclusions and recommendations and to provide a written modification or verification.

The scope does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No warranty, express or implied, should be understood.

♦ ♦ ♦

We appreciate the opportunity to be of service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

GeoDesign, Inc.

Joe Westergreen, P.E. (Washington)
Project Engineer

George Saunders, P.E., G.E.
Principal Engineer



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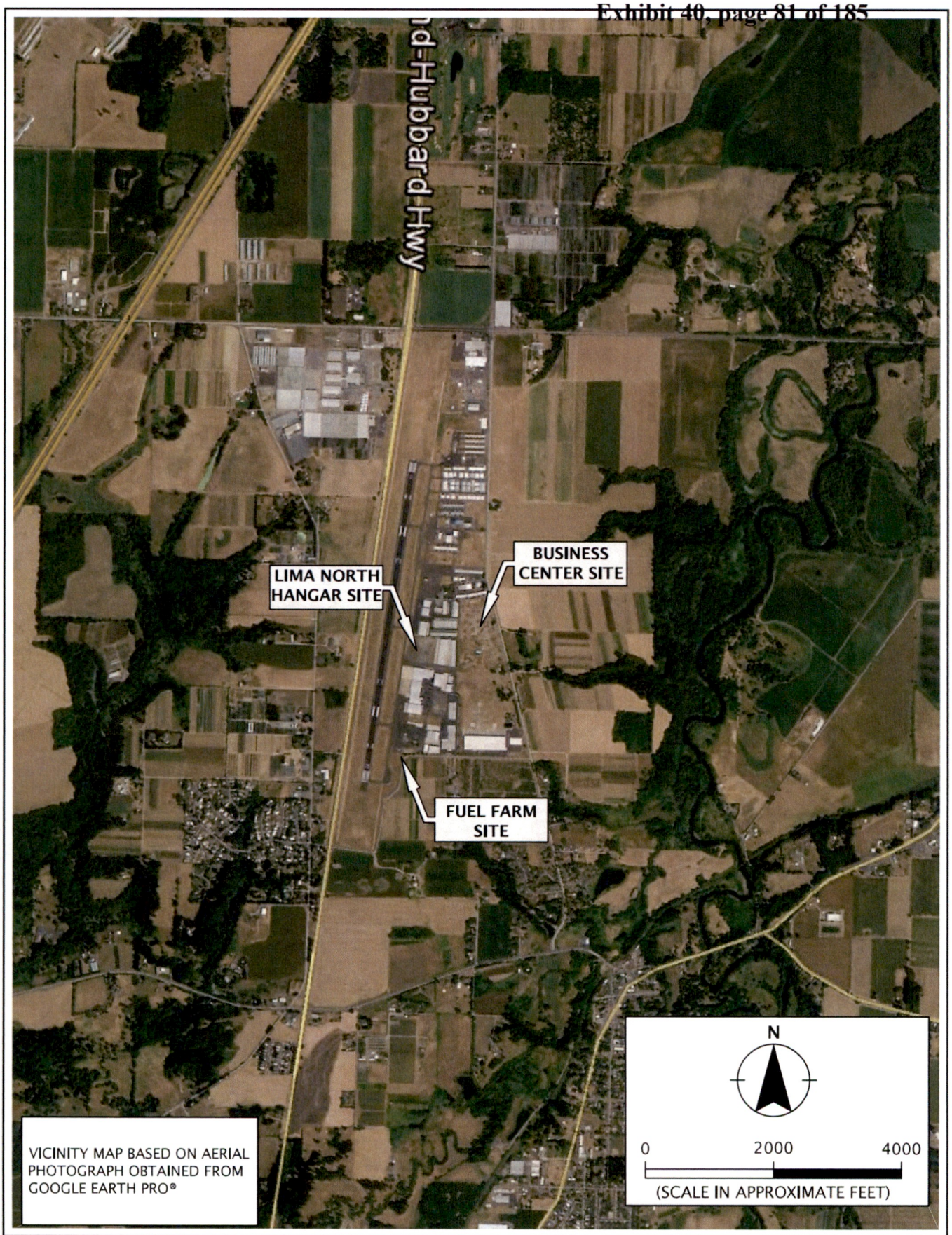
FIGURES



GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	ARONFA-1-01	**VICINITY MAP**	
	MAY 2019	AURORA AIRPORT BUSINESS CENTER AURORA, OR	**FIGURE 1**

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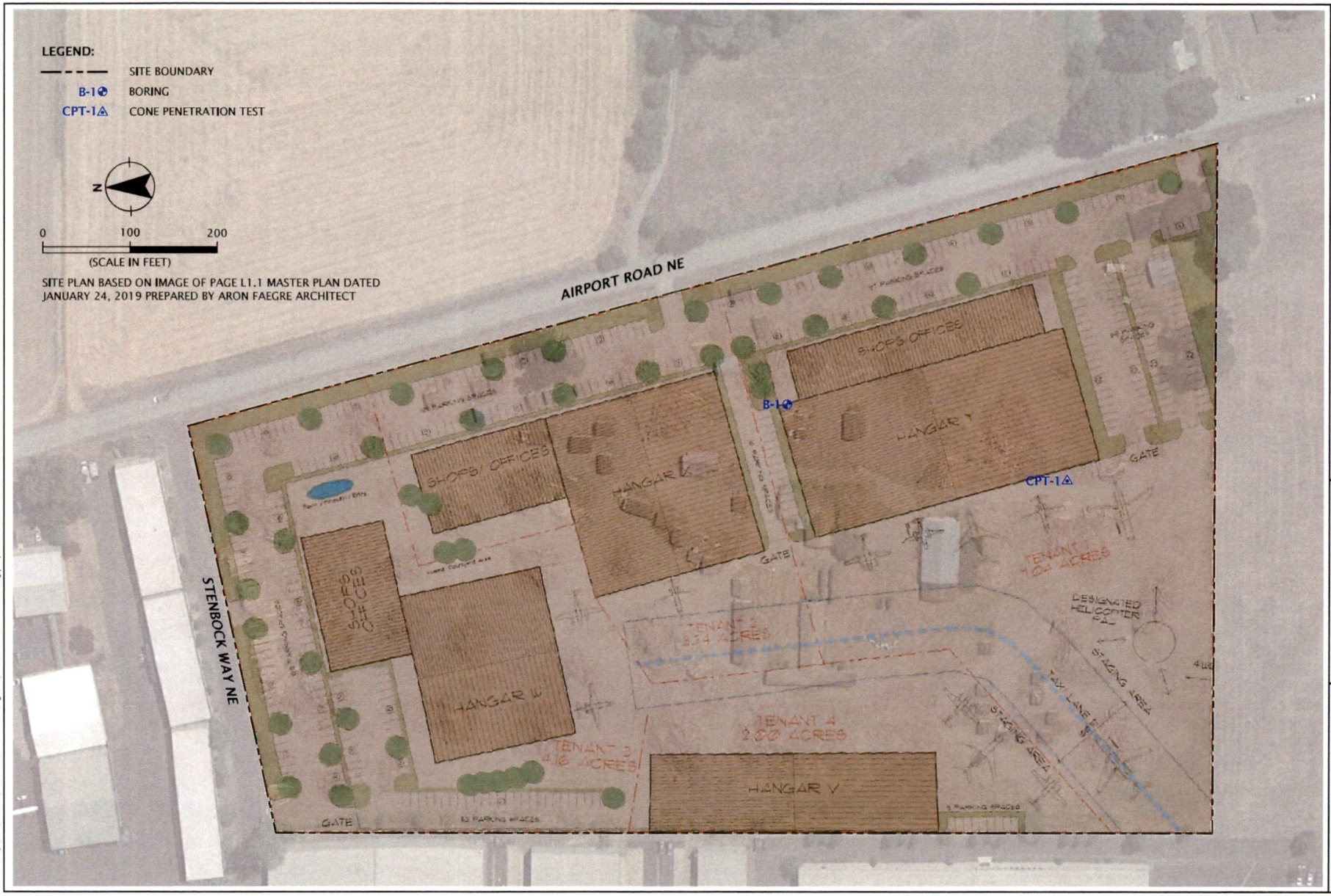
File Name: J:\A-D\AronFA\AronFA-1\AronFA-1-01\Figures\CAD\AronFA-1-01-VM01.dwg | Layout: FIGURE 1



SITE PLAN

AURORA AIRPORT BUSINESS CENTER
AURORA, OR

ARONFA-1-01

MAY 2019

FIGURE 2

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APPENDIX A

APPENDIX A

FIELD EXPLORATIONS

GENERAL

We explored subsurface conditions at the site by drilling one boring (B-1) to a depth of 101.5 feet BGS and completing one CPT probe (CPT-1) to a depth of 114.5 feet BGS. The boring was drilled on March 6, 2019 using a truck-mounted drill rig and mud rotary drilling techniques by Holt Services, Inc. of Vancouver, Washington. The exploration log is presented in this appendix. The CPT data are presented in Appendix B.

The approximate locations of the explorations are shown on Figure 2. Exploration locations were chosen based on preliminary site plan provided to our office Aron Faegre & Associates. The exploration locations were determined by pacing from existing site features and should be accurate implied by the methods used.

SOIL SAMPLING

Samples were collected from the boring using 1½-inch-inner diameter SPT split-barrel sampler in general accordance with ASTM D1586. The sampler was driven into the soil with a 140-pound hammer free-falling 30 inches. The sampler was driven a total distance of 18 inches. The number of blows required to drive the sampler the final 12 inches is recorded on the exploration log, unless otherwise noted. Samples were generally collected at 2.5- to 5-foot intervals throughout the depth of the boring. Sampling methods and intervals are shown on the exploration log.

The average efficiency of the automatic SPT hammer used by Holt Services, Inc. was 87 percent. The calibration testing results are presented at the end of this appendix.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the "Explorations Key" (Table A-1) and "Soil Classification System" (Table A-2), which are presented in this appendix. The exploration log indicates the depths at which the soils or their characteristics change, although the change actually could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration log.

LABORATORY TESTING

We visually examined soil samples collected from the exploration to confirm field classifications. We also performed the following laboratory testing.

MOISTURE CONTENT

We tested the natural moisture content of select soil samples in general accordance with ASTM D2216. The natural moisture content is a ratio of the weight of the water to soil in a test sample and is expressed as a percentage. The test results are presented in this appendix.

ATTERBERG LIMITS TESTING

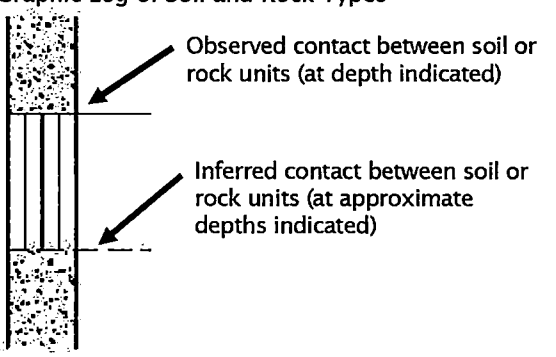
Atterberg limits (plastic and liquid limits) testing was performed on select soil samples in general accordance with ASTM D4318. The plastic limit is defined as the moisture content where the soil becomes brittle. The liquid limit is defined as the moisture content where the soil begins to act similar to a liquid. The plasticity index is the difference between the liquid and plastic limits. The test results are presented in this appendix.

PARTICLE-SIZE ANALYSES

Particle-size analysis was completed on select soil samples in general accordance with ASTM D1140. The test results are presented in this appendix.

SYMBOL	SAMPLING DESCRIPTION
	Location of sample collected in general accordance with ASTM D1586 using Standard Penetration Test with recovery
	Location of sample collected using thin-wall Shelby tube or Geoprobe® sampler in general accordance with ASTM D1587 with recovery
	Location of sample collected using Dames & Moore sampler and 300-pound hammer or pushed with recovery
	Location of sample collected using Dames & Moore sampler and 140-pound hammer or pushed with recovery
	Location of sample collected using 3-inch-O.D. California split-spoon sampler and 140-pound hammer with recovery
	Location of grab sample
	Rock coring interval
	Water level during drilling
	Water level taken on date shown

Graphic Log of Soil and Rock Types



GEOTECHNICAL TESTING EXPLANATIONS

ATT	Atterberg Limits	P	Pushed Sample
CBR	California Bearing Ratio	PP	Pocket Penetrometer
CON	Consolidation	P200	Percent Passing U.S. Standard No. 200 Sieve
DD	Dry Density		
DS	Direct Shear	RES	Resilient Modulus
HYD	Hydrometer Gradation	SIEV	Sieve Gradation
MC	Moisture Content	TOR	Torvane
MD	Moisture-Density Relationship	UC	Unconfined Compressive Strength
NP	Non-Plastic	VS	Vane Shear
OC	Organic Content	kPa	Kilopascal

ENVIRONMENTAL TESTING EXPLANATIONS

CA	Sample Submitted for Chemical Analysis	ND	Not Detected
P	Pushed Sample	NS	No Visible Sheen
PID	Photoionization Detector Headspace Analysis	SS	Slight Sheen
		MS	Moderate Sheen
ppm	Parts per Million	HS	Heavy Sheen

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EXPLORATION KEY

TABLE A-1

RELATIVE DENSITY - COARSE-GRAINED SOIL

Relative Density	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)
Very Loose	0 - 4	0 - 11	0 - 4
Loose	4 - 10	11 - 26	4 - 10
Medium Dense	10 - 30	26 - 74	10 - 30
Dense	30 - 50	74 - 120	30 - 47
Very Dense	More than 50	More than 120	More than 47

CONSISTENCY - FINE-GRAINED SOIL

Consistency	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)	Unconfined Compressive Strength (tsf)
Very Soft	Less than 2	Less than 3	Less than 2	Less than 0.25
Soft	2 - 4	3 - 6	2 - 5	0.25 - 0.50
Medium Stiff	4 - 8	6 - 12	5 - 9	0.50 - 1.0
Stiff	8 - 15	12 - 25	9 - 19	1.0 - 2.0
Very Stiff	15 - 30	25 - 65	19 - 31	2.0 - 4.0
Hard	More than 30	More than 65	More than 31	More than 4.0

PRIMARY SOIL DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOIL (more than 50% retained on No. 4 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (< 5% fines)	GW or GP	GRAVEL
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	GRAVEL with silt
			GW-GC or GP-GC	GRAVEL with clay
		GRAVEL WITH FINES (> 12% fines)	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SAND (<5% fines)	SW or SP	SAND
		SAND WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	SAND with silt
			SW-SC or SP-SC	SAND with clay
		SAND WITH FINES (> 12% fines)	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOIL (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50	ML	SILT
			CL	CLAY
			CL-ML	silty CLAY
			OL	ORGANIC SILT or ORGANIC CLAY
		Liquid limit 50 or greater	MH	SILT
			CH	CLAY
			OH	ORGANIC SILT or ORGANIC CLAY
HIGHLY ORGANIC SOIL			PT	PEAT

MOISTURE CLASSIFICATION

Term	Field Test
dry	very low moisture, dry to touch
moist	damp, without visible moisture
wet	visible free water, usually saturated

ADDITIONAL CONSTITUENTS

Secondary granular components or other materials such as organics, man-made debris, etc.

Percent	Silt and Clay In: Fine-Grained Soil	Silt and Clay In: Coarse-Grained Soil	Percent	Sand and Gravel In: Fine-Grained Soil	Sand and Gravel In: Coarse-Grained Soil
< 5	trace	trace	< 5	trace	trace
5 - 12	minor	with	5 - 15	minor	minor
> 12	some	silty/clayey	15 - 30	with	with
			> 30	sandy/gravelly	Indicate %

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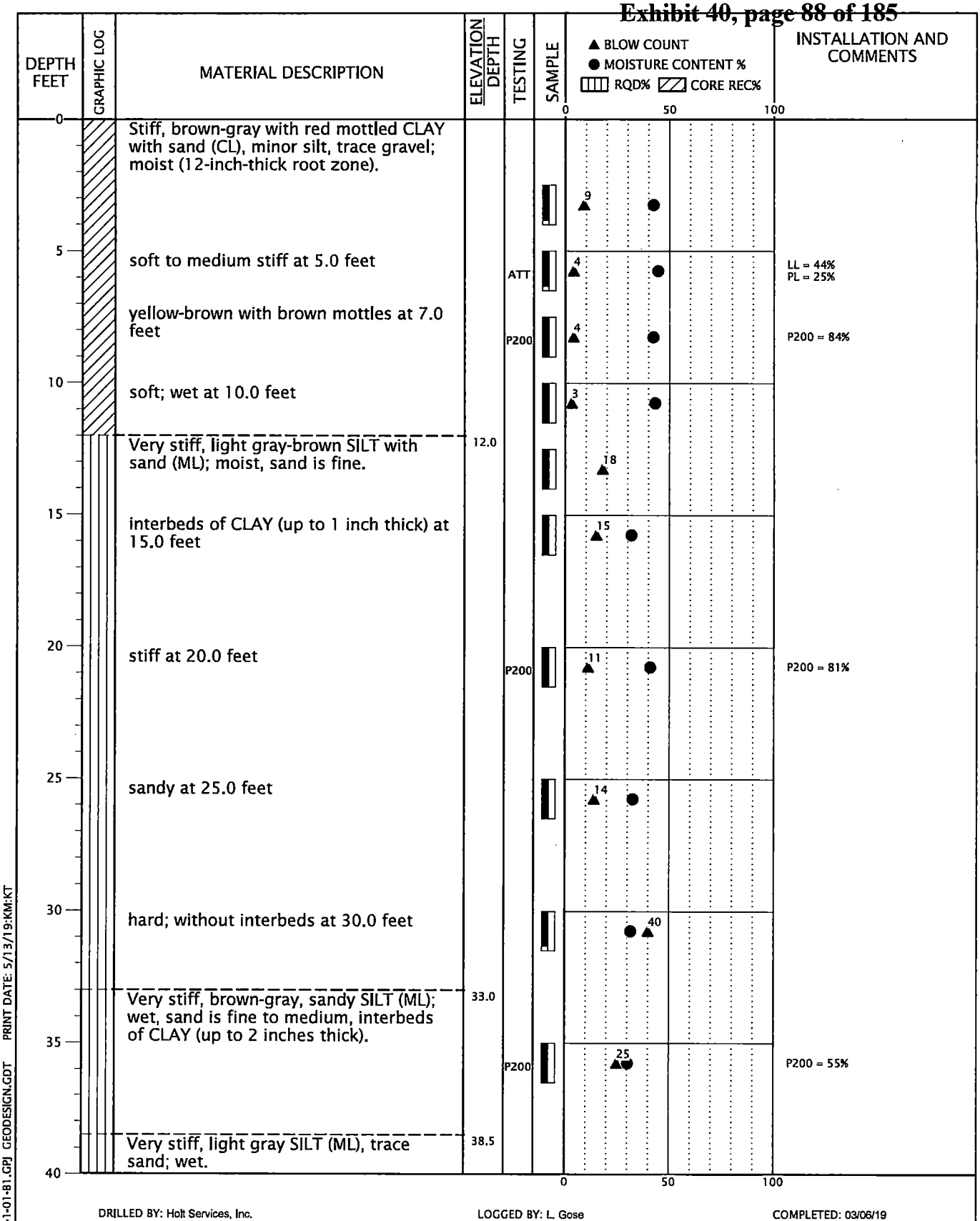
SOIL CLASSIFICATION SYSTEM

TABLE A-2



DRILLED BY: Holt Services, Inc. LOGGED BY: L. Gose COMPLETED: 03/06/19

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER:

BORING LOG ARONFA-1-01-B1.GPJ GEODESIGN.GDT PRINT DATE: 5/13/19:KM:KT

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BORING B-1

MAY 2019

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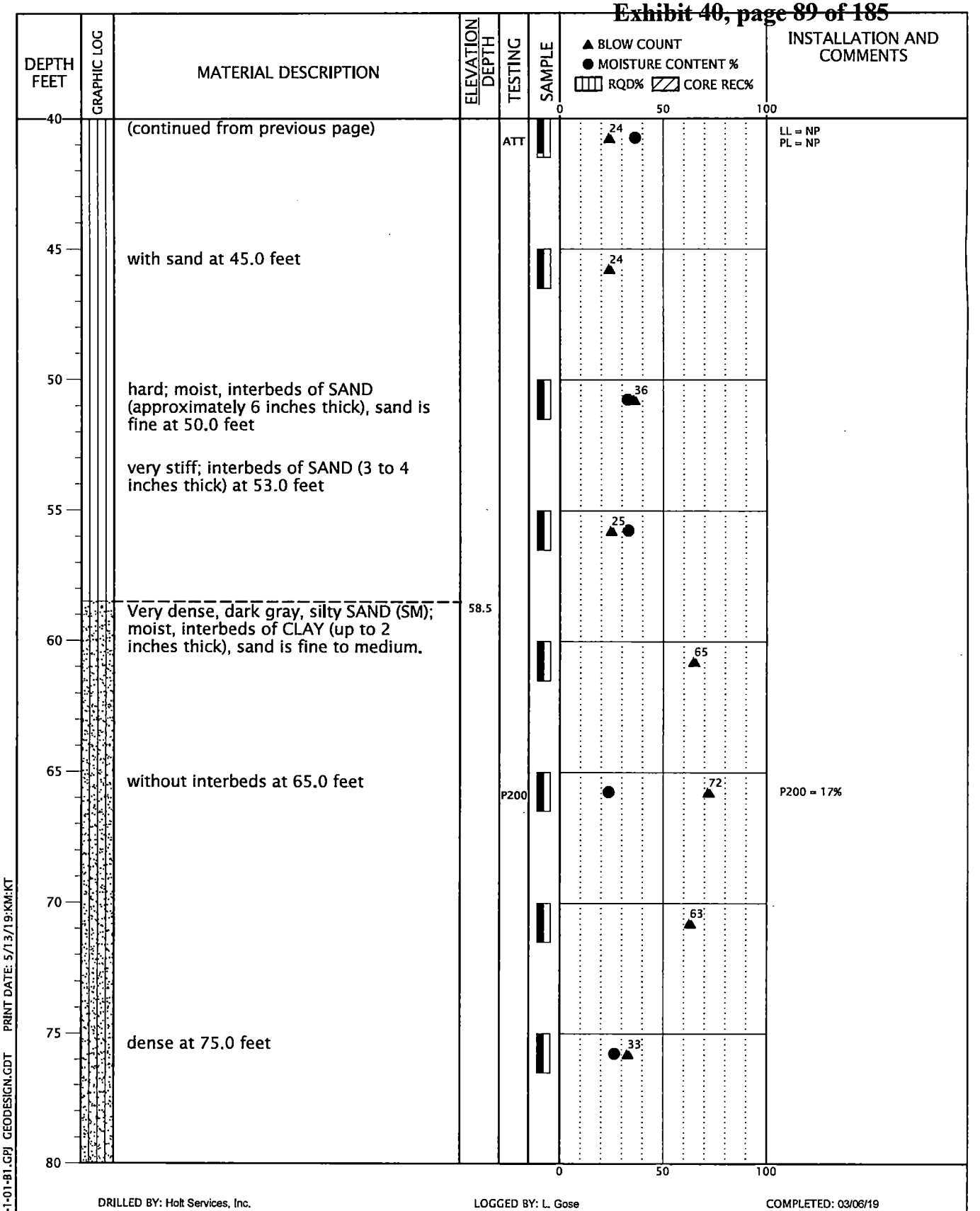
AURORA, OR

FIGURE A-1



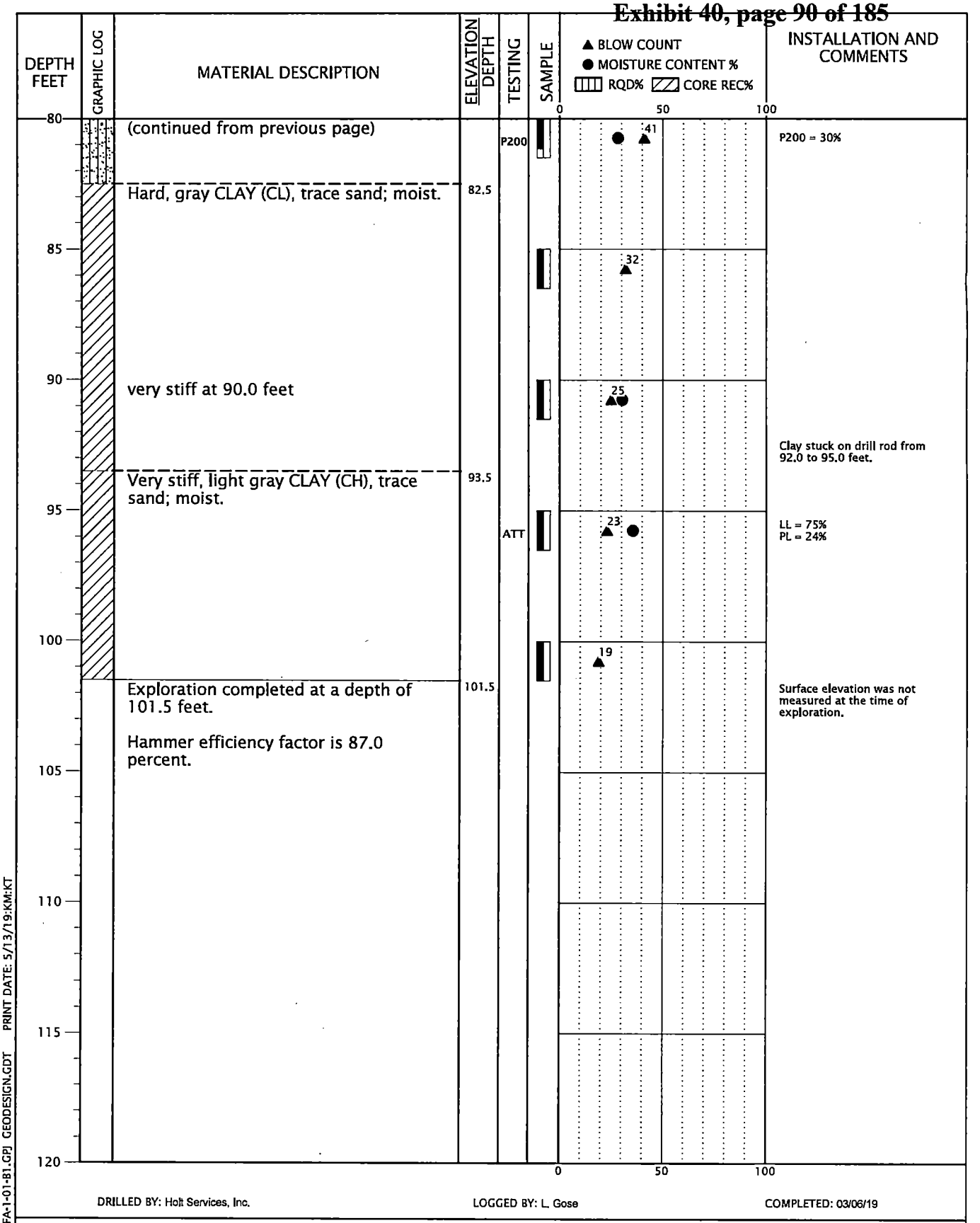
DRILLED BY: Holt Services, Inc. LOGGED BY: L. Gose COMPLETED: 03/06/19

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER:

BORING LOG ARONFA-1-01-B1.GPJ GEODESIGN.GDT PRINT DATE: 5/13/19:KM:KT

GEODESIGN INC
9450 SW Commerce Circle - Suite 300
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com

ARONFA-1-01	**BORING B-1** (continued)	
MAY 2019	AURORA AIRPORT BUSINESS CENTER AURORA, OR	**FIGURE A-1**



DRILLED BY: Holt Services, Inc. LOGGED BY: L. Gose COMPLETED: 03/06/19

BORING METHOD: mud rotary (see document text) BORING BIT DIAMETER:

BORING LOG ARONFA-1-01-B1.GPJ GEODESIGN.GDT PRINT DATE: 5/13/19:KM:KT

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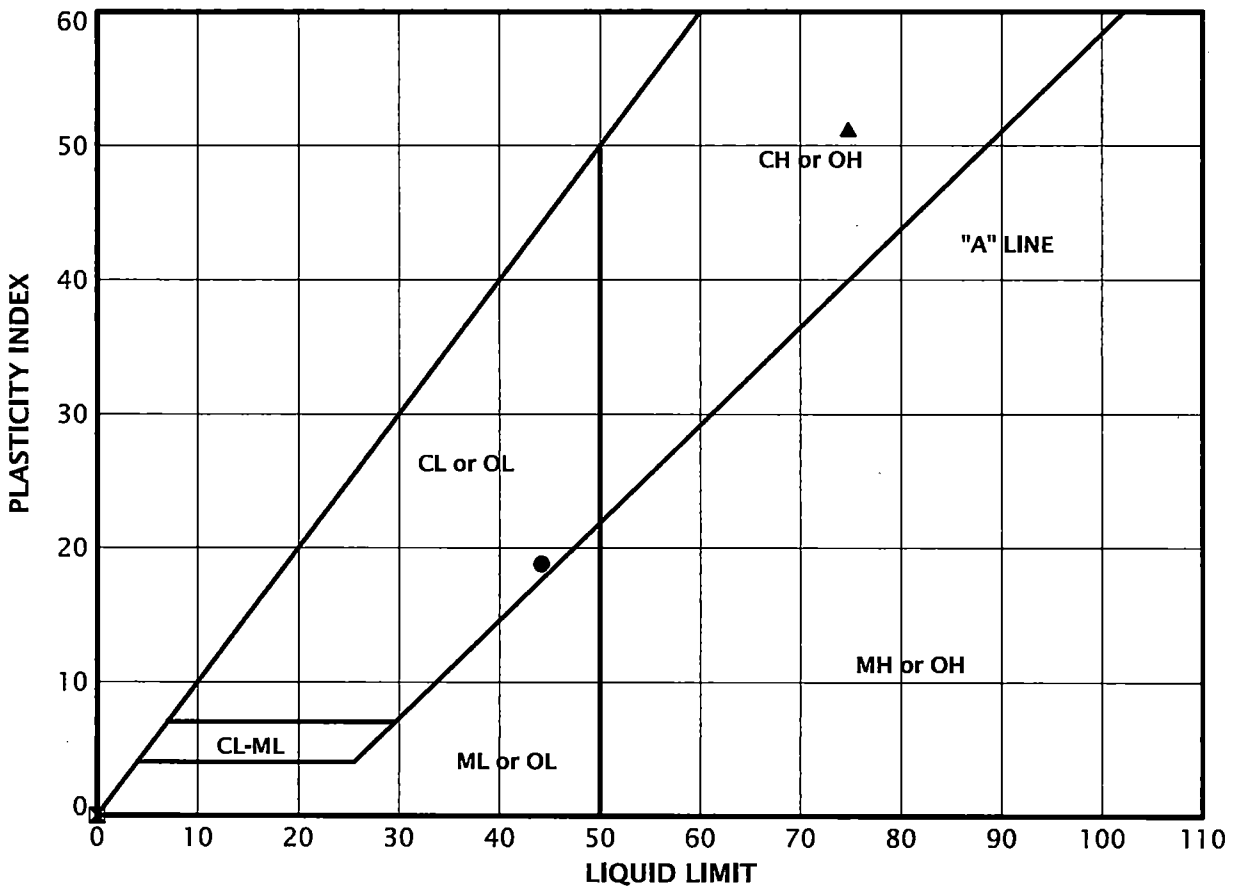
ARONFA-1-01

BORING B-1
(continued)

MAY 2019

AURORA AIRPORT BUSINESS CENTER
AURORA, OR

FIGURE A-1



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
●	B-1	5.0	45	44	25	19
⊠	B-1	40.0	36	NP	NP	NP
▲	B-1	95.0	36	75	24	51

ATTERBERG_LIMITS 7 ARONFA-1-01-B1.GPJ GEODESIGN.GDT PRINT DATE: 5/13/19:KT

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ARONFA-1-01

ATTERBERG LIMITS TEST RESULTS

MAY 2019

AURORA AIRPORT BUSINESS CENTER
AURORA, OR

FIGURE A-2

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-1	2.5		42							
B-1	5.0		45					44	25	19
B-1	7.5		42				84			
B-1	10.0		43							
B-1	15.0		32							
B-1	20.0		41				81			
B-1	25.0		33							
B-1	30.0		32							
B-1	35.0		30				55			
B-1	40.0		36					NP	NP	NP
B-1	50.0		33							
B-1	55.0		33							
B-1	65.0		24				17			
B-1	75.0		27							
B-1	80.0		28				30			
B-1	90.0		30							
B-1	95.0		36					75	24	51

LAB SUMMARY ARONFA-1-01-81.GPJ GEODESIGN.GDT PRINT DATE: 5/13/19:KT

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ARONFA-1-01

MAY 2019

SUMMARY OF LABORATORY DATA

AURORA AIRPORT BUSINESS CENTER
AURORA, OR

FIGURE A-3

Robert Miner Dynamic Testing, Inc.

Dynamic Measurements and Analyses for Deep Foundations

October 22, 2015

Mr. Dale Abernathy
Holt Services, Inc.
13000 Lakeholme Road Sw
Lakewood, WA 98498

Re: Penetration Test Energy Measurements
Bore Hole: 15-RD-01, October 19, 2015
Truck Mounted Rig 215, Mobile B60, 140lb ram, NW-J Rod
Seattle, Washington

RMDT Job No. 15F48

Dear Mr. Abernathy,

This letter presents energy transfer measurements made during Standard Penetration Tests for the drill hole and drill rig referenced above. Robert Miner Dynamic Testing, Inc. (RMDT) made dynamic measurements with a Pile Driving Analyzer® as a hammer advanced the NW rod during sampling with a split spoon sampler.

The purpose of RMDT's testing was the measurement of energy transferred to the drill rods. Measurements were made on a section of NW gauge rod at the top of the drill rod. Strain gages and accelerometers on the rod were connected to a Pile Driving Analyzer® (PDA) which generally processed acceleration and strain measurements from each hammer blow and stored both the measurements and computed results. Measurements and data processing generally followed the ASTM D 4633-10 standard. Energy transfer past the gage location, EFV, was computed by the PDA using force and velocity records as follows:

$$EFV = \int_a^b F(t)\ v(t)\ dt$$

The value "a" corresponds to the start of the record which is when the energy transfer begins and *"b"* is the time at which energy transferred to the rod reaches a maximum value. Appendix A contains more information on our measurement equipment and methods of analysis. The EFV energy calculation is identical to the EMX energy result discussed in Appendix A. The EFV and EMX values apply to the sensor location near the top of the rod.

TEST DETAILS

Testing occurred on October 19, 2015. Boring 15-RD-01 was advanced on the north shore of the Ballard Locks near of the locker room building of the Army Corps of Engineers Facility in Seattle, WA. During all measurements, a NW size rod was used to advance a standard split spoon sampler. The automatic hammer in use during our testing was manufactured by Mobile

Mailing Address: P.O. Box 340, Manchester, WA, 98353, USA **Phone:** 360-871-5480
Location: 2288 Colchester Dr. E., Ste A, Manchester, WA, 98353 **Fax:** 360-871-5483

Drill International and was reported to use a 140 lb ram. The drill rig was a truck-mounted Mobile B60 and referred to as Rig 215 by the operator (Licence No. WAB71109W) .

RESULTS

A summary of testing and monitoring results is given in Table 1. The tabulated results include the starting sample depth, the penetration resistance, the number of hammers blows in our data set, measured energy transfer, EFV, the computed transfer efficiency, ETR, and the hammer blow rate, BPM. Appendix B contains detailed numeric results for each individual test.

Energy measurements must be divided by the theoretical free fall energy of the hammer to obtain an efficiency. A 140 lb ram raised 30 inches above an impact surface has 350 lb-ft of potential energy. Thus, the transfer energy results for sampling with the 140 lb ram may be divided by 350 lb-ft to yield the ratio of the delivered energy to the nominal potential energy. This efficiency ratio, ETR, is given for each sample interval as a percent efficiency.

Table 1. Summary of Test Details and Results for the 140-lb ram and Split Spoon Sampler

Sample Name and Depth	Penetration Resistance (Blow/Set)	Number of Blows in Data Set	Average Transfer Energy EFV (lb-ft)	Average Transfer Efficiency ETR (percent)	Average Hammer Blow Rate BPM (blow/min)
27.5 ft Sample	5/1ft	5	299	85	39
35 ft Sample	4/1ft	4	297	85	45
45 ft Sample	35/1ft	35	303	87	45
55 ft Sample	32/1ft	32	305	87	49
60 ft Sample	32/1ft	31	310	89	44
Average for Split Spoon Samples:			**303**	**87**	**44**

5 sample returns were monitored while the 140 lb ram and standard split spoon sampler were in use. The overall average ETR and hammer blow rate was 87 percent and 44 blows per minute, respectively.

It was a pleasure to assist you and to participate on this project with the staff of Holt Services, Inc. Please do not hesitate to contact us if you or your client have any questions about this report.

Sincerely,

Robert Miner Dynamic Testing, Inc.



October 22, 2015

Andrew Banas, P.E.
Staff Engineer

APPENDIX B

APPENDIX B

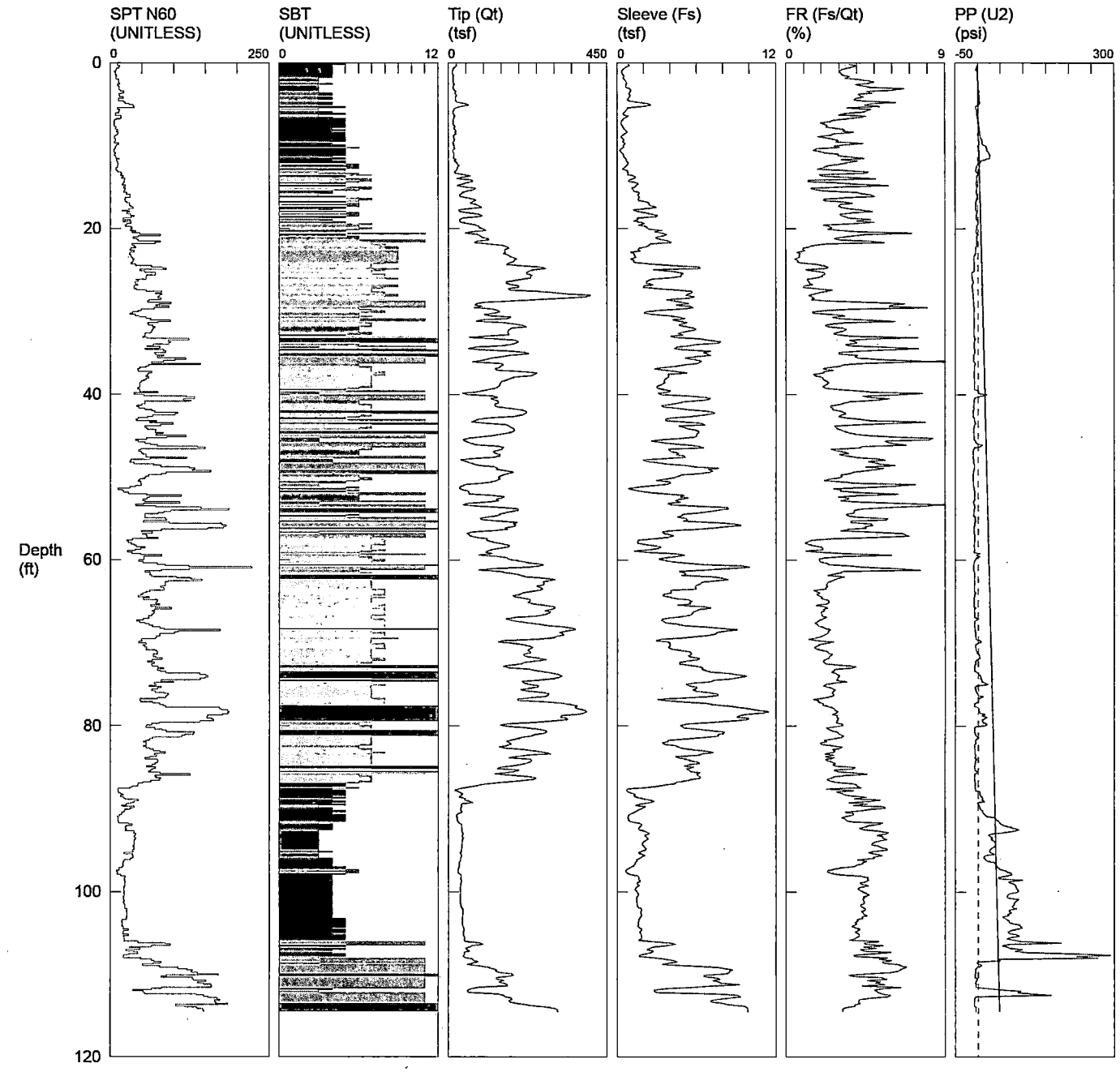
CONE PENETROMETER TESTING

Oregon Geotechnical Explorations performed a CPT probe (CPT-1) on March 8, 2019 using a seismic electronic cone penetrometer to a depth of 114.5 feet BGS. Shear wave velocity tests were completed at 1- to 2-meter intervals in CPT-1. The approximate location of the CPT probe is shown on Figure 2. The CPT data are presented in this appendix.

The CPT is an in situ test that provides characterizes subsurface stratigraphy. The testing includes advancing a 35.6-millimeter-diameter cone equipped with a load cell and a friction sleeve through the soil profile. The cone is advanced at a rate of approximately 2 centimeters per second. Tip resistance, sleeve friction, and pore pressure at are typically recorded at 0.1-meter intervals.

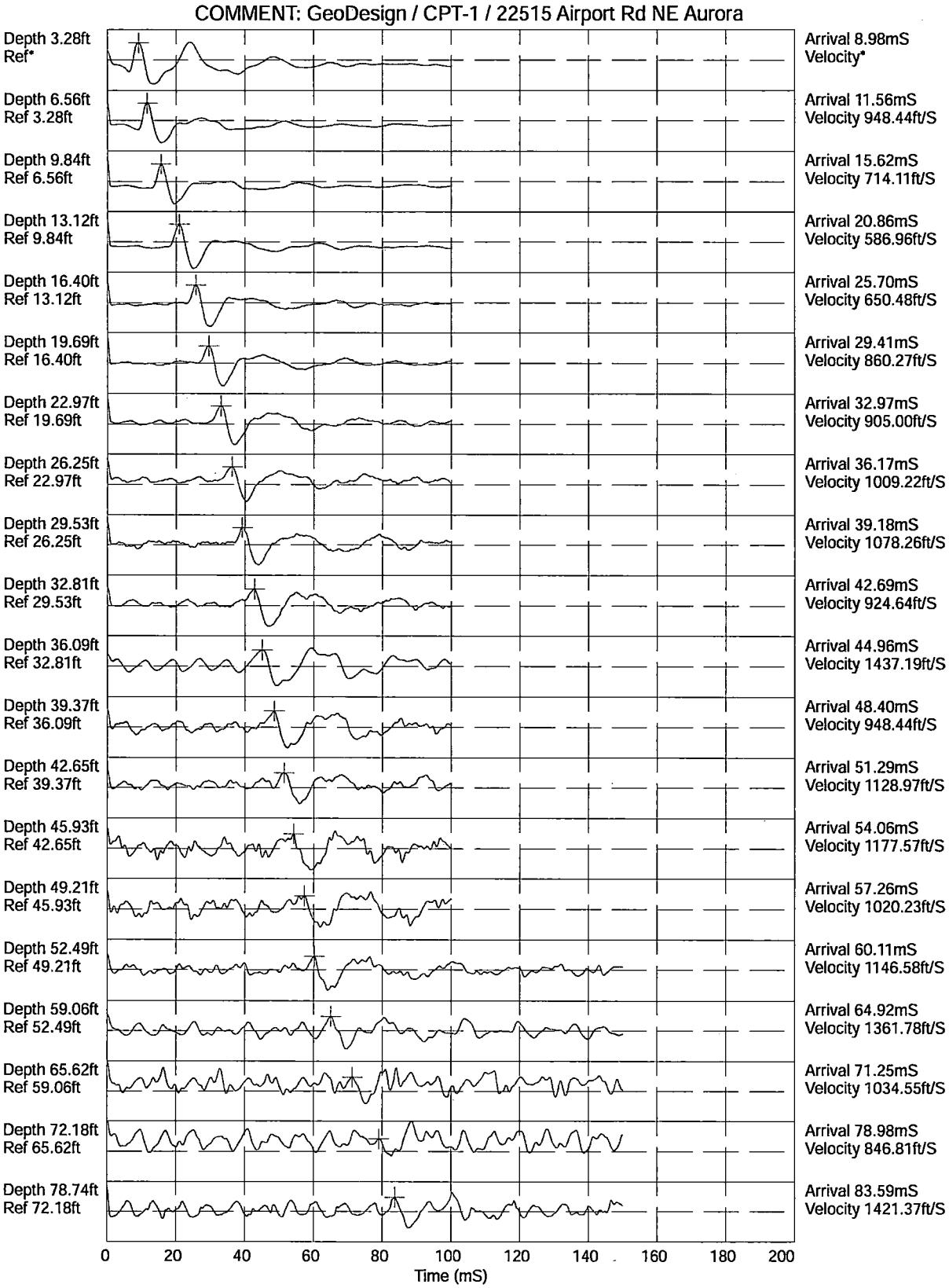
GeoDesign / CPT-1 / 22515 Airport Rd NE Aurora

OPERATOR: OGE BAK
CONE ID: DPG1211
HOLE NUMBER: CPT-1
TEST DATE: 3/8/2019 10:16:35 AM
TOTAL DEPTH: 114.501 ft

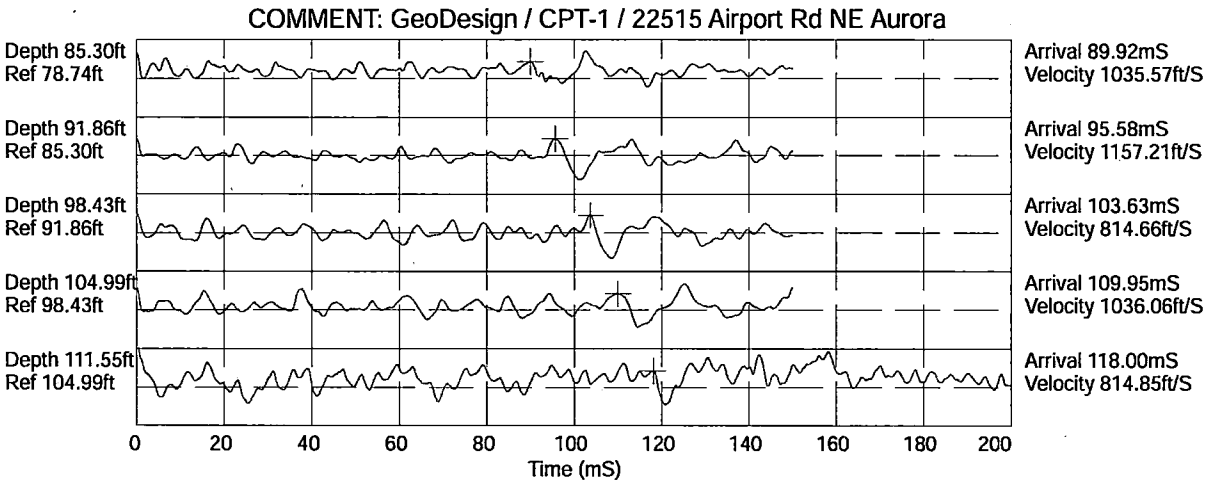


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983



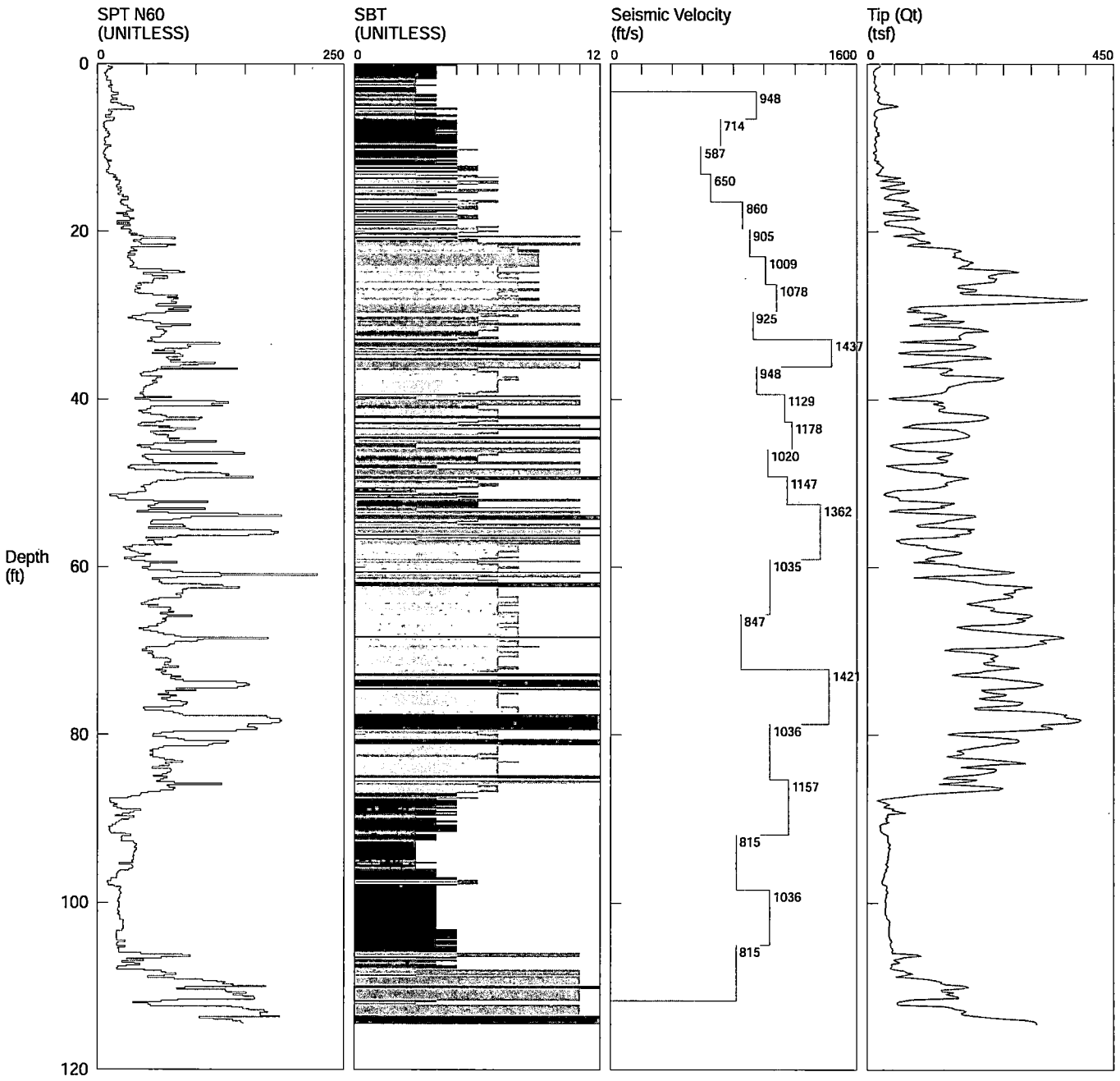
Hammer to Rod String Distance (ft): 4.27
* = Not Determined



Hammer to Rod String Distance (ft): 4.27
* = Not Determined

GeoDesign / CPT-1 / 22515 Airport Rd NE Aurora

OPERATOR: OGE BAK
CONE ID: DPG1211
HOLE NUMBER: CPT-1
TEST DATE: 3/8/2019 10:16:35 AM
TOTAL DEPTH: 114.501 ft



1 sensitive fine grained
2 organic material
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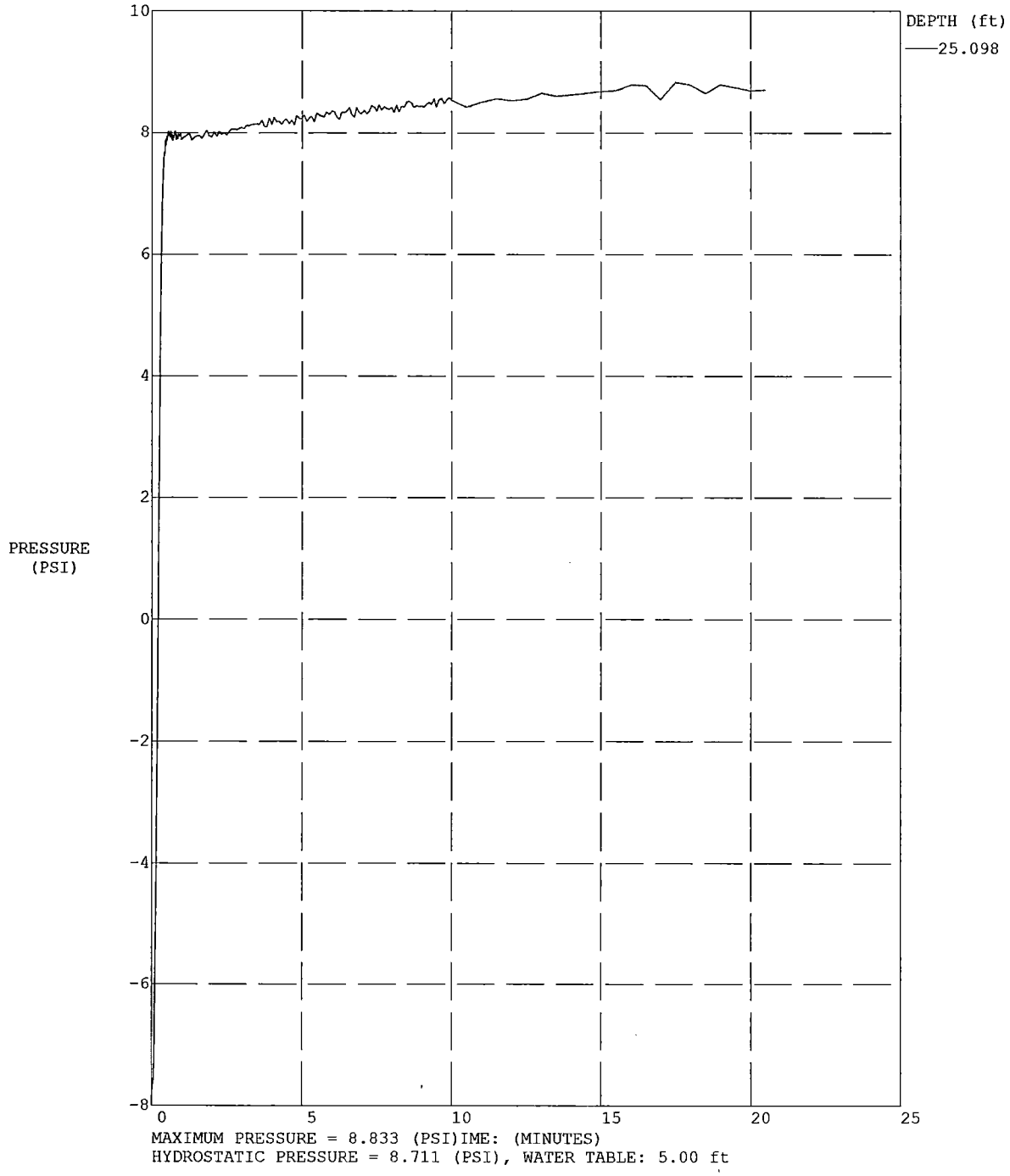
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983

COMMENT: GeoDesign / CPT-1 / 22515 Airport Rd NE Aurora

TEST DATE: 3/8/2019 10:16:35 AM



GeoDesign / CPT-1 / 22515 Airport Rd NE Aurora

OPERATOR: OGE BAK
CONE ID: DPG1211
HOLE NUMBER: CPT-1
TEST DATE: 3/8/2019 10:16:35 AM
TOTAL DEPTH: 114.501 ft

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
0.164	22.85	0.8188	3.583	0.846	11	5	clayey silt to silty clay
0.328	23.63	0.9442	3.995	-0.864	15	4	silty clay to clay
0.492	19.60	0.7407	3.780	-2.122	13	4	silty clay to clay
0.656	15.09	0.5101	3.380	-2.865	10	4	silty clay to clay
0.820	13.44	0.4274	3.180	-3.719	9	4	silty clay to clay
0.984	11.48	0.3482	3.034	-1.213	7	4	silty clay to clay
1.148	11.75	0.3641	3.098	-1.401	8	4	silty clay to clay
1.312	12.30	0.3893	3.165	-0.949	8	4	silty clay to clay
1.476	15.04	0.4799	3.192	-0.281	10	4	silty clay to clay
1.640	14.12	0.5113	3.620	-0.731	9	4	silty clay to clay
1.804	13.91	0.4686	3.370	-0.472	9	4	silty clay to clay
1.969	13.44	0.5345	3.978	-0.919	13	3	clay
2.133	13.31	0.6188	4.650	0.542	13	3	clay
2.297	13.57	0.6769	4.987	0.354	13	3	clay
2.461	15.39	0.7131	4.632	0.680	15	3	clay
2.625	16.74	0.6608	3.948	0.932	11	4	silty clay to clay
2.789	14.50	0.6519	4.494	1.276	14	3	clay
2.953	14.14	0.6710	4.744	1.351	14	3	clay
3.117	14.16	0.9459	6.679	1.406	14	3	clay
3.281	16.85	1.0067	5.975	1.549	16	3	clay
3.445	21.84	1.0027	4.590	2.737	21	3	clay
3.609	18.79	0.9161	4.875	2.147	18	3	clay
3.773	21.60	0.8898	4.119	2.496	14	4	silty clay to clay
3.937	22.99	0.9700	4.218	2.978	15	4	silty clay to clay
4.101	21.10	0.9272	4.394	3.058	20	3	clay
4.265	20.80	0.8325	4.001	3.219	13	4	silty clay to clay
4.429	19.85	0.7702	3.881	3.508	13	4	silty clay to clay
4.593	21.47	0.9492	4.422	3.754	21	3	clay
4.757	25.52	1.5914	6.235	4.068	24	3	clay
4.921	46.87	2.3094	4.927	4.171	30	4	silty clay to clay
5.085	56.49	2.5195	4.460	-0.015	36	4	silty clay to clay
5.249	38.79	2.0643	5.321	-3.659	37	3	clay
5.413	23.03	0.8006	3.476	-3.648	11	5	clayey silt to silty clay
5.577	15.88	0.7641	4.810	-3.362	15	3	clay
5.741	14.78	0.6853	4.638	-2.451	14	3	clay
5.906	13.26	0.5822	4.390	-2.581	13	3	clay
6.070	13.02	0.4498	3.454	-2.365	8	4	silty clay to clay
6.234	16.46	0.4931	2.996	-1.949	8	5	clayey silt to silty clay
6.398	18.09	0.8198	4.533	-1.341	17	3	clay
6.562	16.57	0.6993	4.219	-0.917	16	3	clay
6.726	14.19	0.4915	3.463	0.389	9	4	silty clay to clay
6.890	14.59	0.4033	2.764	0.738	7	5	clayey silt to silty clay
7.054	13.54	0.3392	2.505	1.127	6	5	clayey silt to silty clay
7.218	14.28	0.2801	1.961	1.569	7	5	clayey silt to silty clay

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
7.382	13.57	0.3071	2.264	1.966	6	5	clayey silt to silty clay
7.546	15.37	0.3627	2.360	2.446	7	5	clayey silt to silty clay
7.710	18.55	0.4222	2.276	2.950	9	5	clayey silt to silty clay
7.874	16.71	0.4714	2.822	3.345	8	5	clayey silt to silty clay
8.038	17.51	0.5836	3.334	3.892	11	4	silty clay to clay
8.202	21.74	0.7025	3.231	4.347	10	5	clayey silt to silty clay
8.366	18.99	0.7271	3.830	4.708	12	4	silty clay to clay
8.530	22.17	0.5884	2.654	4.952	11	5	clayey silt to silty clay
8.694	16.11	0.4126	2.561	5.258	8	5	clayey silt to silty clay
8.858	14.89	0.2700	1.813	5.944	7	5	clayey silt to silty clay
9.022	14.75	0.3480	2.359	6.556	7	5	clayey silt to silty clay
9.186	16.92	0.4559	2.694	8.819	8	5	clayey silt to silty clay
9.350	16.60	0.4934	2.972	9.313	8	5	clayey silt to silty clay
9.514	14.45	0.4119	2.850	9.416	7	5	clayey silt to silty clay
9.678	13.54	0.5899	4.357	10.162	13	3	clay
9.843	15.35	0.5177	3.373	11.109	10	4	silty clay to clay
10.007	16.00	0.4389	2.743	18.212	8	5	clayey silt to silty clay
10.171	16.34	0.4992	3.056	19.480	8	5	clayey silt to silty clay
10.335	17.93	0.3177	1.772	20.020	7	6	sandy silt to clayey silt
10.499	13.01	0.2048	1.574	19.224	6	5	clayey silt to silty clay
10.663	11.88	0.2293	1.931	22.077	6	5	clayey silt to silty clay
10.827	15.99	0.3616	2.261	24.234	8	5	clayey silt to silty clay
10.991	15.35	0.4601	2.998	25.909	7	5	clayey silt to silty clay
11.155	16.01	0.4733	2.955	26.993	8	5	clayey silt to silty clay
11.319	14.50	0.5245	3.617	26.446	9	4	silty clay to clay
11.483	14.26	0.6324	4.436	25.916	14	3	clay
11.647	21.67	0.6836	3.155	17.326	10	5	clayey silt to silty clay
11.811	16.80	0.6834	4.069	6.227	11	4	silty clay to clay
11.975	23.20	0.8001	3.449	6.684	11	5	clayey silt to silty clay
12.139	24.84	0.8151	3.282	1.748	12	5	clayey silt to silty clay
12.303	29.68	0.7631	2.572	-0.600	11	6	sandy silt to clayey silt
12.467	28.01	0.6335	2.262	-2.534	11	6	sandy silt to clayey silt
12.631	24.68	0.5209	2.110	-3.181	9	6	sandy silt to clayey silt
12.795	24.14	0.4308	1.784	-3.551	9	6	sandy silt to clayey silt
12.959	22.48	0.7557	3.361	-3.772	11	5	clayey silt to silty clay
13.123	16.86	0.7859	4.662	-3.553	16	3	clay
13.287	19.08	0.8452	4.430	0.927	18	3	clay
13.451	41.31	0.7883	1.908	1.451	16	6	sandy silt to clayey silt
13.615	61.74	1.2605	2.042	-1.369	20	7	silty sand to sandy silt
13.780	37.89	1.3644	3.601	-2.514	18	5	clayey silt to silty clay
13.944	24.01	1.2224	5.092	-2.067	23	3	clay
14.108	68.43	0.8848	1.293	-1.979	22	7	silty sand to sandy silt
14.272	67.48	0.8599	1.274	-2.644	22	7	silty sand to sandy silt
14.436	52.76	1.5091	2.861	-2.935	20	6	sandy silt to clayey silt
14.600	39.81	1.5871	3.987	-2.978	19	5	clayey silt to silty clay
14.764	24.68	1.4361	5.818	-2.629	24	3	clay
14.928	43.42	1.3492	3.107	-1.996	21	5	clayey silt to silty clay
15.092	76.66	1.1043	1.441	-2.566	24	7	silty sand to sandy silt
15.256	73.00	1.2404	1.699	-2.722	23	7	silty sand to sandy silt
15.420	55.24	1.2177	2.204	-2.835	21	6	sandy silt to clayey silt
15.584	40.47	1.6567	4.094	-2.835	26	4	silty clay to clay
15.748	38.61	1.6630	4.307	-1.908	25	4	silty clay to clay
15.912	31.86	1.5471	4.856	-2.016	31	3	clay

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
16.076	32.58	1.6423	5.041	-1.384	31	3	clay
16.240	49.96	1.6973	3.397	-0.904	24	5	clayey silt to silty clay
16.404	71.54	1.5692	2.193	-2.099	23	7	silty sand to sandy silt
16.568	76.22	1.6354	2.146	-2.930	24	7	silty sand to sandy silt
16.732	69.01	2.1210	3.073	-3.513	26	6	sandy silt to clayey silt
16.896	63.37	2.3992	3.786	-3.819	30	5	clayey silt to silty clay
17.060	78.06	2.4022	3.078	-3.669	30	6	sandy silt to clayey silt
17.224	86.91	2.6124	3.006	-3.970	33	6	sandy silt to clayey silt
17.388	94.05	2.9729	3.161	-4.050	36	6	sandy silt to clayey silt
17.552	60.14	2.1680	3.605	-4.151	29	5	clayey silt to silty clay
17.717	29.57	1.2458	4.213	-4.005	19	4	silty clay to clay
17.881	31.48	1.5433	4.903	-2.699	30	3	clay
18.045	53.38	2.0565	3.852	-2.026	26	5	clayey silt to silty clay
18.209	84.47	2.6087	3.088	-2.426	32	6	sandy silt to clayey silt
18.373	95.77	3.0356	3.170	-2.740	37	6	sandy silt to clayey silt
18.537	87.28	2.9191	3.344	-2.873	33	6	sandy silt to clayey silt
18.701	41.08	1.4908	3.629	-3.161	20	5	clayey silt to silty clay
18.865	33.52	1.6149	4.818	-2.870	32	3	clay
19.029	31.34	1.2557	4.007	-0.271	20	4	silty clay to clay
19.193	34.42	1.7193	4.996	0.660	33	3	clay
19.357	54.33	2.0660	3.802	1.120	26	5	clayey silt to silty clay
19.521	76.68	1.6342	2.131	-0.924	24	7	silty sand to sandy silt
19.685	87.16	2.1311	2.445	-2.180	33	6	sandy silt to clayey silt
19.849	88.00	2.2965	2.610	-1.436	34	6	sandy silt to clayey silt
20.013	100.54	2.3947	2.382	-2.674	32	7	silty sand to sandy silt
20.177	105.08	3.3703	3.207	-3.302	40	6	sandy silt to clayey silt
20.341	70.79	2.8174	3.980	-3.345	34	5	clayey silt to silty clay
20.505	47.87	3.4157	7.135	-2.519	46	3	clay
20.669	82.36	3.7190	4.516	-0.911	79	11	very stiff fine grained (*)
20.833	91.54	3.5035	3.827	-1.881	44	5	clayey silt to silty clay
20.997	94.27	2.9342	3.112	-2.272	36	6	sandy silt to clayey silt
21.161	109.79	3.0270	2.757	-2.328	42	6	sandy silt to clayey silt
21.325	115.06	3.4835	3.028	-2.401	44	6	sandy silt to clayey silt
21.490	82.24	3.9116	4.756	-2.426	79	11	very stiff fine grained (*)
21.654	73.85	4.1057	5.559	-2.182	71	11	very stiff fine grained (*)
21.818	108.07	2.4908	2.305	-1.215	34	7	silty sand to sandy silt
21.982	152.59	2.3925	1.568	-1.635	37	8	sand to silty sand
22.146	166.51	2.1969	1.319	-3.407	40	8	sand to silty sand
22.310	171.65	1.6920	0.986	-3.985	33	9	sand
22.474	159.75	1.5627	0.978	-4.444	31	9	sand
22.638	160.12	1.7140	1.070	-4.781	38	8	sand to silty sand
22.802	161.15	1.0154	0.630	-4.994	31	9	sand
22.966	156.35	1.2891	0.825	-5.351	30	9	sand
23.130	170.05	1.2671	0.745	-6.230	33	9	sand
23.294	173.65	1.3503	0.778	-8.500	33	9	sand
23.458	184.37	1.3857	0.752	-8.542	35	9	sand
23.622	193.58	1.0134	0.524	-8.492	37	9	sand
23.786	186.23	1.2563	0.675	-8.394	36	9	sand
23.950	185.02	1.1940	0.645	-8.090	35	9	sand
24.114	173.77	1.4602	0.840	-8.030	33	9	sand
24.278	166.24	3.0178	1.815	-7.965	40	8	sand to silty sand
24.442	205.13	4.4369	2.163	-7.631	65	7	silty sand to sandy silt
24.606	259.52	6.2334	2.402	-7.797	83	7	silty sand to sandy silt

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
24.770	277.01	6.2496	2.256	-7.784	88	7	silty sand to sandy silt
24.934	242.68	2.7288	1.124	-7.844	46	9	sand
25.098	229.01	4.0576	1.772	-7.807	55	8	sand to silty sand
25.262	221.47	4.7247	2.133	-11.870	71	7	silty sand to sandy silt
25.427	223.16	4.9969	2.239	-12.997	71	7	silty sand to sandy silt
25.591	236.70	4.8303	2.041	-12.608	57	8	sand to silty sand
25.755	233.57	4.8491	2.076	-12.261	56	8	sand to silty sand
25.919	232.56	3.8582	1.659	-11.957	56	8	sand to silty sand
26.083	212.51	2.5786	1.213	-11.616	41	9	sand
26.247	184.82	2.3149	1.253	-11.031	44	8	sand to silty sand
26.411	164.83	2.1845	1.325	-8.917	39	8	sand to silty sand
26.575	165.08	2.2101	1.339	-10.770	40	8	sand to silty sand
26.739	178.28	2.6768	1.501	-11.847	43	8	sand to silty sand
26.903	199.19	2.0589	1.034	-12.035	38	9	sand
27.067	198.45	1.9723	0.994	-11.847	38	9	sand
27.231	169.93	3.0243	1.780	-11.478	41	8	sand to silty sand
27.395	176.23	4.6243	2.624	-11.081	56	7	silty sand to sandy silt
27.559	253.22	5.6481	2.231	-11.209	81	7	silty sand to sandy silt
27.723	296.53	5.6406	1.902	-10.725	71	8	sand to silty sand
27.887	340.58	5.3653	1.575	-10.709	82	8	sand to silty sand
28.051	402.57	5.2210	1.297	-10.373	77	9	sand
28.215	390.85	5.8433	1.495	-10.273	75	9	sand
28.379	335.01	5.3992	1.612	-10.122	80	8	sand to silty sand
28.543	254.56	3.7326	1.466	-9.682	61	8	sand to silty sand
28.707	183.66	4.3033	2.343	-9.504	59	7	silty sand to sandy silt
28.871	99.63	4.9396	4.958	-9.348	95	11	very stiff fine grained (*)
29.035	79.94	5.3882	6.740	-9.356	77	11	very stiff fine grained (*)
29.199	74.95	4.4738	5.969	-9.135	72	11	very stiff fine grained (*)
29.364	95.64	5.5796	5.834	-8.424	92	11	very stiff fine grained (*)
29.528	72.14	5.7574	7.981	-8.450	69	11	very stiff fine grained (*)
29.692	127.03	4.8105	3.787	-8.078	49	6	sandy silt to clayey silt
29.856	137.26	3.1097	2.266	-8.583	44	7	silty sand to sandy silt
30.020	144.65	2.1800	1.507	-8.821	35	8	sand to silty sand
30.184	130.49	2.0378	1.562	-8.630	31	8	sand to silty sand
30.348	102.04	2.7759	2.720	-8.412	39	6	sandy silt to clayey silt
30.512	119.43	3.9781	3.331	-8.681	46	6	sandy silt to clayey silt
30.676	176.61	4.6702	2.644	-8.595	56	7	silty sand to sandy silt
30.840	168.32	5.1286	3.047	-8.450	64	6	sandy silt to clayey silt
31.004	97.99	4.2244	4.311	-8.603	94	11	very stiff fine grained (*)
31.168	77.95	4.8184	6.182	-8.264	75	11	very stiff fine grained (*)
31.332	153.30	5.2562	3.429	-8.108	59	6	sandy silt to clayey silt
31.496	189.44	4.8693	2.570	-8.327	60	7	silty sand to sandy silt
31.660	209.78	4.6874	2.234	-8.279	67	7	silty sand to sandy silt
31.824	220.74	5.3159	2.408	-8.279	70	7	silty sand to sandy silt
31.988	178.82	5.8003	3.244	-8.939	68	6	sandy silt to clayey silt
32.152	173.62	5.9553	3.430	-8.794	67	6	sandy silt to clayey silt
32.316	169.32	5.5654	3.287	-8.816	65	6	sandy silt to clayey silt
32.480	167.67	5.0514	3.013	-8.831	64	6	sandy silt to clayey silt
32.644	169.38	4.6039	2.718	-8.766	54	7	silty sand to sandy silt
32.808	171.03	4.9802	2.912	-8.643	55	7	silty sand to sandy silt
32.972	106.79	4.0664	3.808	-8.404	51	5	clayey silt to silty clay
33.136	60.16	4.4838	7.453	-7.453	58	11	very stiff fine grained (*)
33.301	129.16	6.2494	4.839	-6.149	124	11	very stiff fine grained (*)

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
33.465	190.98	6.9337	3.631	-6.948	91	12	sand to clayey sand (*)
33.629	198.27	7.8291	3.949	-7.423	95	12	sand to clayey sand (*)
33.793	192.81	7.7052	3.996	-7.571	92	12	sand to clayey sand (*)
33.957	177.96	6.0129	3.379	-7.937	68	6	sandy silt to clayey silt
34.121	151.65	5.4243	3.577	-8.239	58	6	sandy silt to clayey silt
34.285	81.28	4.5292	5.572	-8.068	78	11	very stiff fine grained (*)
34.449	57.60	4.3130	7.487	-7.900	55	3	clay
34.613	88.22	5.0250	5.696	-6.463	84	11	very stiff fine grained (*)
34.777	182.03	7.0917	3.896	-7.011	87	12	sand to clayey sand (*)
34.941	218.35	6.5376	2.994	-6.998	70	7	silty sand to sandy silt
35.105	226.69	6.8101	3.004	-7.842	72	7	silty sand to sandy silt
35.269	174.45	7.0636	4.049	-9.170	84	12	sand to clayey sand (*)
35.433	154.04	6.0232	3.910	-9.376	74	12	sand to clayey sand (*)
35.597	124.28	5.1401	4.136	-9.130	119	11	very stiff fine grained (*)
35.761	107.00	5.8477	5.465	-9.241	102	11	very stiff fine grained (*)
35.925	87.97	6.3600	7.229	-9.258	84	11	very stiff fine grained (*)
36.089	67.36	6.2739	9.314	-8.055	65	11	very stiff fine grained (*)
36.253	148.53	6.0607	4.081	-6.047	142	11	very stiff fine grained (*)
36.417	155.89	5.1156	3.282	-6.983	60	6	sandy silt to clayey silt
36.581	146.43	4.3935	3.000	-7.533	56	6	sandy silt to clayey silt
36.745	144.91	3.4976	2.414	-8.073	46	7	silty sand to sandy silt
36.909	133.35	2.8170	2.113	-7.864	43	7	silty sand to sandy silt
37.073	136.92	3.6710	2.681	-8.088	44	7	silty sand to sandy silt
37.238	203.89	4.4093	2.163	-8.156	65	7	silty sand to sandy silt
37.402	249.66	5.2678	2.110	-8.183	60	8	sand to silty sand
37.566	244.66	3.8375	1.568	-8.304	59	8	sand to silty sand
37.730	234.16	3.9028	1.667	-8.397	56	8	sand to silty sand
37.894	188.75	3.8588	2.044	-7.922	60	7	silty sand to sandy silt
38.058	175.87	3.7099	2.110	-7.897	56	7	silty sand to sandy silt
38.222	167.31	3.5950	2.149	-8.163	53	7	silty sand to sandy silt
38.386	153.57	3.5375	2.304	-7.792	49	7	silty sand to sandy silt
38.550	148.04	3.5967	2.429	-7.628	47	7	silty sand to sandy silt
38.714	146.95	3.4591	2.354	-7.719	47	7	silty sand to sandy silt
38.878	145.26	3.2045	2.206	-7.834	46	7	silty sand to sandy silt
39.042	142.61	2.9773	2.088	-7.849	46	7	silty sand to sandy silt
39.206	135.56	3.0123	2.222	-7.857	43	7	silty sand to sandy silt
39.370	119.13	3.3807	2.838	-8.040	46	6	sandy silt to clayey silt
39.534	98.81	4.0028	4.051	1.366	47	5	clayey silt to silty clay
39.698	78.02	3.8468	4.931	0.708	75	11	very stiff fine grained (*)
39.862	40.18	3.1090	7.737	1.690	38	3	clay
40.026	55.26	3.4384	6.222	19.686	53	3	clay
40.190	125.34	5.4675	4.362	7.526	120	11	very stiff fine grained (*)
40.354	138.88	6.8215	4.912	-6.345	133	11	very stiff fine grained (*)
40.518	120.80	7.0526	5.838	-7.694	116	11	very stiff fine grained (*)
40.682	132.69	6.5949	4.970	-8.018	127	11	very stiff fine grained (*)
40.846	141.79	5.1707	3.647	-8.462	54	6	sandy silt to clayey silt
41.011	141.63	4.6761	3.302	-8.643	54	6	sandy silt to clayey silt
41.175	130.99	4.0288	3.076	-8.482	50	6	sandy silt to clayey silt
41.339	131.10	3.3556	2.559	-9.185	42	7	silty sand to sandy silt
41.503	140.48	3.5455	2.524	-9.160	45	7	silty sand to sandy silt
41.667	170.32	4.5053	2.645	-8.630	54	7	silty sand to sandy silt
41.831	203.38	5.3924	2.651	-9.230	65	7	silty sand to sandy silt
41.995	218.14	6.7551	3.097	-10.278	70	7	silty sand to sandy silt

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
42.159	221.64	7.3522	3.317	-10.433	106	12	sand to clayey sand (*)
42.323	216.14	7.2865	3.371	-10.102	103	12	sand to clayey sand (*)
42.487	208.88	6.5415	3.132	-10.044	67	7	silty sand to sandy silt
42.651	183.50	5.5238	3.010	-10.263	59	7	silty sand to sandy silt
42.815	114.60	4.0168	3.505	-7.746	44	6	sandy silt to clayey silt
42.979	86.26	3.6581	4.241	-7.591	41	5	clayey silt to silty clay
43.143	75.84	3.6701	4.839	-7.483	73	11	very stiff fine grained (*)
43.307	65.22	5.1408	7.883	-6.154	62	11	very stiff fine grained (*)
43.471	103.47	6.2951	6.084	-5.323	99	11	very stiff fine grained (*)
43.635	164.65	6.6449	4.036	-7.021	79	12	sand to clayey sand (*)
43.799	169.38	4.6667	2.755	-8.131	54	7	silty sand to sandy silt
43.963	178.33	5.1086	2.865	-8.327	57	7	silty sand to sandy silt
44.127	183.62	5.3519	2.915	-9.235	59	7	silty sand to sandy silt
44.291	187.31	5.8619	3.130	-8.997	72	6	sandy silt to clayey silt
44.455	184.59	6.1647	3.340	-9.148	71	6	sandy silt to clayey silt
44.619	173.92	6.1668	3.546	-9.057	83	12	sand to clayey sand (*)
44.783	152.14	6.0165	3.954	-8.994	73	12	sand to clayey sand (*)
44.948	125.32	6.0211	4.805	-8.972	120	11	very stiff fine grained (*)
45.112	93.33	5.8825	6.303	-8.409	89	11	very stiff fine grained (*)
45.276	59.87	4.9776	8.314	-8.419	57	11	very stiff fine grained (*)
45.440	42.25	3.4208	8.097	-7.802	40	3	clay
45.604	45.69	2.5590	5.601	-4.869	44	3	clay
45.768	56.85	3.3163	5.833	-3.940	54	3	clay
45.932	66.61	4.0702	6.111	-1.921	64	11	very stiff fine grained (*)
46.096	77.69	5.2803	6.797	9.851	74	11	very stiff fine grained (*)
46.260	144.12	6.2265	4.320	5.316	138	11	very stiff fine grained (*)
46.424	155.60	6.5341	4.199	-8.015	149	11	very stiff fine grained (*)
46.588	151.86	3.8926	2.563	-8.748	48	7	silty sand to sandy silt
46.752	139.72	3.9383	2.819	-9.351	45	7	silty sand to sandy silt
46.916	126.86	4.1377	3.262	-10.227	49	6	sandy silt to clayey silt
47.080	132.04	4.6712	3.538	-10.486	51	6	sandy silt to clayey silt
47.244	146.39	4.4573	3.045	-10.185	56	6	sandy silt to clayey silt
47.408	145.74	5.0289	3.451	-10.210	56	6	sandy silt to clayey silt
47.572	126.09	5.1309	4.069	-10.488	121	11	very stiff fine grained (*)
47.736	66.14	3.4043	5.147	-10.165	63	11	very stiff fine grained (*)
47.900	34.81	1.9457	5.589	-9.745	33	3	clay
48.064	48.41	2.2638	4.677	-9.492	31	4	silty clay to clay
48.228	58.79	2.9716	5.054	-9.150	38	4	silty clay to clay
48.392	70.91	3.7996	5.358	-8.065	68	11	very stiff fine grained (*)
48.556	83.84	5.1668	6.163	-7.985	80	11	very stiff fine grained (*)
48.720	130.24	5.8783	4.513	-7.844	125	11	very stiff fine grained (*)
48.885	138.59	7.6748	5.538	-7.915	133	11	very stiff fine grained (*)
49.049	135.29	6.8939	5.095	-8.440	130	11	very stiff fine grained (*)
49.213	164.49	7.2310	4.396	-8.706	158	11	very stiff fine grained (*)
49.377	184.52	7.0520	3.822	-9.253	88	12	sand to clayey sand (*)
49.541	169.11	6.1046	3.610	-10.340	81	12	sand to clayey sand (*)
49.705	156.14	4.8513	3.107	-10.338	60	6	sandy silt to clayey silt
49.869	145.55	4.5991	3.160	-10.458	56	6	sandy silt to clayey silt
50.033	142.04	4.2918	3.022	-10.215	54	6	sandy silt to clayey silt
50.197	146.65	3.6062	2.459	-10.285	47	7	silty sand to sandy silt
50.361	137.17	2.9648	2.161	-9.979	44	7	silty sand to sandy silt
50.525	124.20	3.9429	3.175	-10.197	48	6	sandy silt to clayey silt
50.689	101.07	4.0300	3.987	-10.021	48	5	clayey silt to silty clay

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
50.853	50.88	3.7254	7.322	-9.913	49	3	clay
51.017	41.92	2.5873	6.172	-9.416	40	3	clay
51.181	32.72	1.6284	4.977	-8.653	31	3	clay
51.345	30.79	0.8344	2.710	-8.500	12	6	sandy silt to clayey silt
51.509	39.32	1.2275	3.122	-8.219	19	5	clayey silt to silty clay
51.673	55.12	1.7018	3.088	-6.938	21	6	sandy silt to clayey silt
51.837	57.96	2.4371	4.205	-6.953	28	5	clayey silt to silty clay
52.001	59.34	3.7735	6.359	-6.792	57	11	very stiff fine grained (*)
52.165	116.92	5.0511	4.320	-6.659	112	11	very stiff fine grained (*)
52.329	159.28	4.7634	2.991	-8.080	61	6	sandy silt to clayey silt
52.493	150.85	5.3532	3.549	-8.171	58	6	sandy silt to clayey silt
52.657	134.35	4.6646	3.472	-6.338	51	6	sandy silt to clayey silt
52.822	141.31	4.4090	3.120	-8.957	54	6	sandy silt to clayey silt
52.986	113.83	4.7888	4.207	-9.273	109	11	very stiff fine grained (*)
53.150	53.90	3.8157	7.080	-8.814	52	3	clay
53.314	41.48	4.1261	9.948	-7.799	40	3	clay
53.478	75.10	5.8617	7.805	-7.111	72	11	very stiff fine grained (*)
53.642	149.34	8.3324	5.580	-7.307	143	11	very stiff fine grained (*)
53.806	195.28	8.3802	4.291	-7.598	187	11	very stiff fine grained (*)
53.970	197.96	7.6276	3.853	-8.500	95	12	sand to clayey sand (*)
54.134	176.52	6.8414	3.876	-8.939	85	12	sand to clayey sand (*)
54.298	158.47	6.0394	3.811	-8.723	76	12	sand to clayey sand (*)
54.462	144.73	4.9266	3.404	-8.989	55	6	sandy silt to clayey silt
54.626	139.98	4.8752	3.483	-9.085	54	6	sandy silt to clayey silt
54.790	112.22	4.5383	4.044	-5.926	54	5	clayey silt to silty clay
54.954	90.52	5.2135	5.759	-6.345	87	11	very stiff fine grained (*)
55.118	93.18	5.3009	5.689	-6.300	89	11	very stiff fine grained (*)
55.282	136.66	5.0083	3.665	-5.451	52	6	sandy silt to clayey silt
55.446	194.91	7.2328	3.711	-6.481	93	12	sand to clayey sand (*)
55.610	183.86	8.7943	4.783	-7.071	176	11	very stiff fine grained (*)
55.774	190.58	9.3647	4.914	-7.387	183	11	very stiff fine grained (*)
55.938	187.24	8.3689	4.470	-8.314	179	11	very stiff fine grained (*)
56.102	159.89	7.2702	4.547	-8.558	153	11	very stiff fine grained (*)
56.266	168.96	6.0319	3.570	-8.633	81	12	sand to clayey sand (*)
56.430	127.39	3.9718	3.118	-8.269	49	6	sandy silt to clayey silt
56.594	69.27	3.4061	4.917	-8.507	66	11	very stiff fine grained (*)
56.759	52.92	3.5187	6.649	-7.716	51	3	clay
56.923	59.55	4.0291	6.766	-7.264	57	11	very stiff fine grained (*)
57.087	60.78	4.2284	6.957	-7.264	58	11	very stiff fine grained (*)
57.251	78.54	3.7494	4.774	-6.777	75	11	very stiff fine grained (*)
57.415	108.93	2.7409	2.516	-7.269	35	7	silty sand to sandy silt
57.579	108.13	1.5772	1.459	-7.375	26	8	sand to silty sand
57.743	117.92	1.5301	1.298	-7.965	28	8	sand to silty sand
57.907	138.97	1.5142	1.090	-7.945	33	8	sand to silty sand
58.071	156.70	1.9684	1.256	-8.158	38	8	sand to silty sand
58.235	173.12	2.6349	1.522	-8.296	41	8	sand to silty sand
58.399	167.89	3.3157	1.975	-7.897	54	7	silty sand to sandy silt
58.563	149.07	3.0998	2.079	-7.704	48	7	silty sand to sandy silt
58.727	122.62	2.5571	2.085	-7.192	39	7	silty sand to sandy silt
58.891	112.84	1.2708	1.126	-7.930	27	8	sand to silty sand
59.055	106.15	2.3236	2.189	-8.206	34	7	silty sand to sandy silt
59.219	124.22	4.3374	3.492	4.181	48	6	sandy silt to clayey silt
59.383	84.92	5.0625	5.962	-4.106	81	11	very stiff fine grained (*)

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
59.547	138.27	4.5401	3.283	3.586	53	6	sandy silt to clayey silt
59.711	166.90	3.5477	2.126	-3.905	53	7	silty sand to sandy silt
59.875	167.51	3.1437	1.877	-4.392	53	7	silty sand to sandy silt
60.039	189.36	3.5899	1.896	-6.629	45	8	sand to silty sand
60.203	213.67	4.2015	1.966	-7.802	51	8	sand to silty sand
60.367	231.11	5.2859	2.287	-8.957	74	7	silty sand to sandy silt
60.532	268.76	6.5404	2.434	-9.261	86	7	silty sand to sandy silt
60.696	259.01	9.4754	3.658	-9.426	124	12	sand to clayey sand (*)
60.860	232.88	10.0090	4.298	-9.524	223	11	very stiff fine grained (*)
61.024	130.25	8.3161	6.385	-10.182	125	11	very stiff fine grained (*)
61.188	84.80	6.4542	7.611	-9.205	81	11	very stiff fine grained (*)
61.352	143.77	4.6881	3.261	-8.482	55	6	sandy silt to clayey silt
61.516	164.72	5.0788	3.083	-7.970	63	6	sandy silt to clayey silt
61.680	193.21	5.1796	2.681	-7.294	62	7	silty sand to sandy silt
61.844	203.90	4.8527	2.380	-7.807	65	7	silty sand to sandy silt
62.008	218.60	7.2138	3.300	-8.171	105	12	sand to clayey sand (*)
62.172	264.94	7.8858	2.976	-8.377	127	12	sand to clayey sand (*)
62.336	301.37	8.3876	2.783	-8.618	144	12	sand to clayey sand (*)
62.500	285.95	7.5346	2.635	-8.068	91	7	silty sand to sandy silt
62.664	268.67	6.4029	2.383	-7.998	86	7	silty sand to sandy silt
62.828	270.66	6.3448	2.344	-7.967	86	7	silty sand to sandy silt
62.992	269.52	6.1258	2.273	-7.822	86	7	silty sand to sandy silt
63.156	249.64	5.8991	2.363	-7.972	80	7	silty sand to sandy silt
63.320	262.75	5.9274	2.256	-7.578	84	7	silty sand to sandy silt
63.484	266.22	5.9508	2.235	-7.762	85	7	silty sand to sandy silt
63.648	258.55	4.0552	1.568	-7.736	62	8	sand to silty sand
63.812	231.99	4.0379	1.741	-7.885	56	8	sand to silty sand
63.976	212.50	4.0649	1.913	-4.746	51	8	sand to silty sand
64.140	200.58	3.4611	1.726	-7.068	48	8	sand to silty sand
64.304	182.68	3.4525	1.890	-7.204	44	8	sand to silty sand
64.469	190.16	3.9044	2.053	-7.912	61	7	silty sand to sandy silt
64.633	216.96	4.3433	2.002	-8.437	52	8	sand to silty sand
64.797	231.99	5.3854	2.321	-8.480	74	7	silty sand to sandy silt
64.961	232.07	5.6618	2.440	-8.588	74	7	silty sand to sandy silt
65.125	225.38	5.4669	2.426	-8.362	72	7	silty sand to sandy silt
65.289	240.88	5.5141	2.289	-8.487	77	7	silty sand to sandy silt
65.453	268.05	4.5550	1.699	-8.417	64	8	sand to silty sand
65.617	298.19	6.5885	2.210	-8.927	71	8	sand to silty sand
65.781	302.15	7.0641	2.338	-5.419	96	7	silty sand to sandy silt
65.945	293.41	6.2158	2.118	-7.942	70	8	sand to silty sand
66.109	273.73	6.0048	2.194	-8.073	66	8	sand to silty sand
66.273	289.06	5.7810	2.000	-8.098	69	8	sand to silty sand
66.437	283.30	5.6834	2.006	-7.402	68	8	sand to silty sand
66.601	273.27	5.5939	2.047	-7.360	65	8	sand to silty sand
66.765	249.42	5.1539	2.066	-7.428	60	8	sand to silty sand
66.929	190.64	4.3575	2.286	-7.194	61	7	silty sand to sandy silt
67.093	163.70	3.4489	2.107	1.250	52	7	silty sand to sandy silt
67.257	176.05	3.3250	1.889	-3.679	42	8	sand to silty sand
67.421	193.61	3.5165	1.816	-7.051	46	8	sand to silty sand
67.585	224.98	3.6895	1.640	-7.418	54	8	sand to silty sand
67.749	255.53	4.5619	1.785	-7.890	61	8	sand to silty sand
67.913	281.74	5.1384	1.824	-7.611	67	8	sand to silty sand
68.077	324.41	6.6321	2.044	-6.983	78	8	sand to silty sand

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
68.241	353.32	7.9700	2.256	-6.747	85	8	sand to silty sand
68.406	360.30	9.0805	2.520	-6.411	173	12	sand to clayey sand (*)
68.570	335.05	8.0595	2.405	-6.006	107	7	silty sand to sandy silt
68.734	315.40	7.5638	2.398	-5.896	101	7	silty sand to sandy silt
68.898	323.81	7.4547	2.302	-4.871	78	8	sand to silty sand
69.062	327.20	7.0127	2.143	-5.037	78	8	sand to silty sand
69.226	305.81	6.0879	1.991	-4.623	73	8	sand to silty sand
69.390	296.55	5.0118	1.690	-4.510	71	8	sand to silty sand
69.554	254.59	3.3420	1.313	-3.952	49	9	sand
69.718	158.08	2.9333	1.856	4.417	50	7	silty sand to sandy silt
69.882	141.46	3.7859	2.676	6.986	45	7	silty sand to sandy silt
70.046	175.78	3.9859	2.268	-0.231	56	7	silty sand to sandy silt
70.210	211.04	3.9715	1.882	-5.632	51	8	sand to silty sand
70.374	229.50	3.9828	1.735	-5.595	55	8	sand to silty sand
70.538	238.93	3.8537	1.613	-5.399	57	8	sand to silty sand
70.702	231.86	4.0340	1.740	-4.560	56	8	sand to silty sand
70.866	224.96	4.6557	2.070	-3.822	72	7	silty sand to sandy silt
71.030	230.64	5.3868	2.336	-2.850	74	7	silty sand to sandy silt
71.194	232.96	5.5808	2.396	-1.898	74	7	silty sand to sandy silt
71.358	213.39	5.5792	2.615	2.657	68	7	silty sand to sandy silt
71.522	214.16	5.3860	2.515	3.063	68	7	silty sand to sandy silt
71.686	226.10	5.5313	2.446	3.566	72	7	silty sand to sandy silt
71.850	255.41	6.1927	2.425	4.188	82	7	silty sand to sandy silt
72.014	277.54	6.0635	2.185	-1.303	66	8	sand to silty sand
72.178	247.93	5.2498	2.117	-5.783	59	8	sand to silty sand
72.343	216.79	4.6871	2.162	-5.818	69	7	silty sand to sandy silt
72.507	204.57	4.7451	2.320	-5.635	65	7	silty sand to sandy silt
72.671	173.16	5.4626	3.155	-7.259	66	6	sandy silt to clayey silt
72.835	155.80	6.1452	3.944	-8.050	75	12	sand to clayey sand (*)
72.999	174.58	6.4900	3.718	-8.153	84	12	sand to clayey sand (*)
73.163	230.83	6.4095	2.777	-7.844	74	7	silty sand to sandy silt
73.327	248.81	6.7642	2.719	-8.151	79	7	silty sand to sandy silt
73.491	273.28	7.0794	2.591	-2.473	87	7	silty sand to sandy silt
73.655	295.07	8.3097	2.816	-0.392	141	12	sand to clayey sand (*)
73.819	314.60	9.2010	2.925	2.569	151	12	sand to clayey sand (*)
73.983	321.35	9.7824	3.044	5.030	154	12	sand to clayey sand (*)
74.147	312.16	9.1554	2.933	6.343	149	12	sand to clayey sand (*)
74.311	296.23	8.6994	2.937	7.174	142	12	sand to clayey sand (*)
74.475	252.16	7.2569	2.878	8.723	80	7	silty sand to sandy silt
74.639	208.94	7.1350	3.415	8.703	100	12	sand to clayey sand (*)
74.803	214.84	5.8294	2.713	17.429	69	7	silty sand to sandy silt
74.967	226.63	5.1955	2.292	21.419	72	7	silty sand to sandy silt
75.131	254.90	5.4443	2.136	-3.709	61	8	sand to silty sand
75.295	252.03	5.9841	2.374	-6.363	80	7	silty sand to sandy silt
75.459	230.49	6.0032	2.605	-6.052	74	7	silty sand to sandy silt
75.623	205.09	5.7380	2.798	-5.246	65	7	silty sand to sandy silt
75.787	221.09	5.9598	2.696	-3.787	71	7	silty sand to sandy silt
75.951	265.85	6.9407	2.611	-2.099	85	7	silty sand to sandy silt
76.115	284.47	7.6122	2.676	-0.696	91	7	silty sand to sandy silt
76.280	281.51	7.6068	2.702	0.567	90	7	silty sand to sandy silt
76.444	273.71	6.8845	2.515	10.770	87	7	silty sand to sandy silt
76.608	232.42	5.1056	2.197	4.161	74	7	silty sand to sandy silt
76.772	195.38	3.0356	1.554	0.613	47	8	sand to silty sand

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
76.936	198.73	3.6590	1.841	1.193	48	8	sand to silty sand
77.100	279.74	5.1839	1.853	-1.348	67	8	sand to silty sand
77.264	323.03	6.7889	2.102	-7.337	77	8	sand to silty sand
77.428	348.78	7.3024	2.094	-7.824	83	8	sand to silty sand
77.592	364.58	8.4997	2.331	-7.812	87	8	sand to silty sand
77.756	359.15	9.4059	2.619	1.072	172	12	sand to clayey sand (*)
77.920	365.15	10.0092	2.741	1.122	175	12	sand to clayey sand (*)
78.084	386.63	10.6573	2.756	2.320	185	12	sand to clayey sand (*)
78.248	390.87	11.4904	2.940	2.679	187	12	sand to clayey sand (*)
78.412	386.66	11.1145	2.875	3.907	185	12	sand to clayey sand (*)
78.576	369.77	9.7585	2.639	15.335	177	12	sand to clayey sand (*)
78.740	320.53	9.2779	2.895	8.427	153	12	sand to clayey sand (*)
78.904	318.07	9.0781	2.854	19.907	152	12	sand to clayey sand (*)
79.068	333.85	9.9499	2.980	15.003	160	12	sand to clayey sand (*)
79.232	337.82	9.8534	2.917	9.705	162	12	sand to clayey sand (*)
79.396	294.00	8.5114	2.895	10.132	141	12	sand to clayey sand (*)
79.560	242.77	6.8860	2.836	11.596	77	7	silty sand to sandy silt
79.724	168.72	5.3093	3.147	18.968	65	6	sandy silt to clayey silt
79.888	147.84	4.7907	3.240	17.552	57	6	sandy silt to clayey silt
80.052	174.53	4.9296	2.824	-5.846	56	7	silty sand to sandy silt
80.217	219.57	5.0547	2.302	-8.163	70	7	silty sand to sandy silt
80.381	256.52	6.2684	2.444	-7.955	82	7	silty sand to sandy silt
80.545	275.79	7.1270	2.584	-7.962	88	7	silty sand to sandy silt
80.709	277.67	8.1319	2.929	-7.307	133	12	sand to clayey sand (*)
80.873	272.69	8.0390	2.948	-6.667	131	12	sand to clayey sand (*)
81.037	245.28	7.6178	3.106	-5.313	117	12	sand to clayey sand (*)
81.201	235.01	7.6421	3.252	-4.296	113	12	sand to clayey sand (*)
81.365	209.99	6.5818	3.134	1.353	67	7	silty sand to sandy silt
81.529	195.73	5.2013	2.657	-2.981	62	7	silty sand to sandy silt
81.693	175.99	3.8133	2.167	-5.564	56	7	silty sand to sandy silt
81.857	165.31	3.8092	2.304	-5.650	53	7	silty sand to sandy silt
82.021	173.89	3.3870	1.948	-5.308	56	7	silty sand to sandy silt
82.185	176.61	3.5803	2.027	-6.657	56	7	silty sand to sandy silt
82.349	166.70	4.3693	2.621	-7.232	53	7	silty sand to sandy silt
82.513	145.46	4.6341	3.186	-7.094	56	6	sandy silt to clayey silt
82.677	163.44	4.9471	3.027	-6.413	63	6	sandy silt to clayey silt
82.841	214.29	5.6606	2.642	-6.890	68	7	silty sand to sandy silt
83.005	243.68	6.7215	2.758	-6.983	78	7	silty sand to sandy silt
83.169	270.60	7.2491	2.679	-6.923	86	7	silty sand to sandy silt
83.333	289.40	6.4282	2.221	-6.396	69	8	sand to silty sand
83.497	227.91	6.1525	2.699	-5.419	73	7	silty sand to sandy silt
83.661	196.55	4.4071	2.242	-6.144	63	7	silty sand to sandy silt
83.825	172.09	4.6960	2.729	-6.752	55	7	silty sand to sandy silt
83.990	232.93	5.2568	2.257	-2.137	74	7	silty sand to sandy silt
84.154	235.84	5.5131	2.338	-5.482	75	7	silty sand to sandy silt
84.318	231.00	6.0749	2.630	-5.901	74	7	silty sand to sandy silt
84.482	221.10	6.2181	2.812	-6.338	71	7	silty sand to sandy silt
84.646	206.88	5.5041	2.660	-6.727	66	7	silty sand to sandy silt
84.810	179.29	5.0781	2.832	-7.176	57	7	silty sand to sandy silt
84.974	148.15	5.7510	3.882	-7.372	71	12	sand to clayey sand (*)
85.138	139.44	5.2360	3.755	-6.893	67	12	sand to clayey sand (*)
85.302	200.07	5.4685	2.733	-6.606	64	7	silty sand to sandy silt
85.466	187.20	5.5112	2.944	-0.924	60	7	silty sand to sandy silt

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
85.630	163.14	6.2602	3.837	-2.441	78	12	sand to clayey sand (*)
85.794	131.65	6.0252	4.577	-6.408	126	11	very stiff fine grained (*)
85.958	185.76	6.1206	3.295	-6.431	71	6	sandy silt to clayey silt
86.122	229.60	6.2722	2.732	-7.548	73	7	silty sand to sandy silt
86.286	247.99	6.2615	2.525	-7.654	79	7	silty sand to sandy silt
86.450	241.20	5.6125	2.327	-7.252	77	7	silty sand to sandy silt
86.614	200.35	5.1106	2.551	-6.910	64	7	silty sand to sandy silt
86.778	158.51	4.4778	2.825	-6.521	51	7	silty sand to sandy silt
86.942	114.66	4.3702	3.811	-6.112	44	6	sandy silt to clayey silt
87.106	90.33	3.5885	3.973	-6.114	43	5	clayey silt to silty clay
87.270	71.70	2.9130	4.063	-6.443	34	5	clayey silt to silty clay
87.434	48.69	2.0760	4.264	-6.152	31	4	silty clay to clay
87.598	31.28	0.7167	2.291	-5.886	12	6	sandy silt to clayey silt
87.762	18.04	0.6914	3.832	-4.811	12	4	silty clay to clay
87.927	27.32	0.7796	2.853	3.927	13	5	clayey silt to silty clay
88.091	35.48	1.1178	3.150	4.168	17	5	clayey silt to silty clay
88.255	41.00	1.3317	3.248	4.266	20	5	clayey silt to silty clay
88.419	34.34	1.2440	3.623	5.261	16	5	clayey silt to silty clay
88.583	31.14	1.4171	4.551	9.522	20	4	silty clay to clay
88.747	49.09	1.8997	3.870	10.614	24	5	clayey silt to silty clay
88.911	45.93	2.4372	5.307	8.613	44	3	clay
89.075	58.20	2.7506	4.726	14.054	37	4	silty clay to clay
89.239	69.92	2.4863	3.556	-1.052	33	5	clayey silt to silty clay
89.403	38.71	1.7791	4.596	0.173	25	4	silty clay to clay
89.567	36.59	1.3943	3.811	2.348	18	5	clayey silt to silty clay
89.731	38.52	2.1091	5.475	3.423	37	3	clay
89.895	33.90	1.9081	5.629	4.324	32	3	clay
90.059	36.93	1.7133	4.639	6.305	24	4	silty clay to clay
90.223	34.09	1.4755	4.328	9.527	22	4	silty clay to clay
90.387	39.47	1.3203	3.345	10.752	19	5	clayey silt to silty clay
90.551	28.74	1.0930	3.803	12.515	18	4	silty clay to clay
90.715	23.36	0.8891	3.806	15.862	15	4	silty clay to clay
90.879	23.57	0.8072	3.425	18.858	11	5	clayey silt to silty clay
91.043	24.73	0.7798	3.153	38.014	12	5	clayey silt to silty clay
91.207	24.72	0.8223	3.326	39.870	12	5	clayey silt to silty clay
91.371	24.69	0.8472	3.432	41.801	12	5	clayey silt to silty clay
91.535	26.40	0.9524	3.607	46.285	13	5	clayey silt to silty clay
91.699	29.66	1.6197	5.460	48.498	28	3	clay
91.864	35.76	1.8565	5.192	52.684	34	3	clay
92.028	38.49	1.7953	4.665	58.205	25	4	silty clay to clay
92.192	37.47	1.6599	4.429	70.893	24	4	silty clay to clay
92.356	38.44	1.5970	4.155	80.149	25	4	silty clay to clay
92.520	38.02	1.6923	4.451	89.329	24	4	silty clay to clay
92.684	38.45	2.0329	5.287	78.861	37	3	clay
92.848	39.92	2.3168	5.803	56.317	38	3	clay
93.012	41.81	2.3755	5.682	30.423	40	3	clay
93.176	40.77	2.1074	5.169	23.054	39	3	clay
93.340	39.35	2.1558	5.479	27.619	38	3	clay
93.504	42.12	2.3046	5.471	31.533	40	3	clay
93.668	40.32	2.3006	5.705	29.379	39	3	clay
93.832	39.70	2.1375	5.384	33.635	38	3	clay
93.996	39.08	1.9645	5.027	37.196	37	3	clay
94.160	38.71	1.8941	4.893	38.820	37	3	clay

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
94.324	38.62	1.8753	4.856	39.086	37	3	clay
94.488	38.10	1.9987	5.246	38.120	36	3	clay
94.652	38.86	2.0944	5.390	32.857	37	3	clay
94.816	38.41	2.1900	5.702	29.424	37	3	clay
94.980	37.06	2.1188	5.717	26.160	35	3	clay
95.144	37.49	1.8377	4.902	25.489	36	3	clay
95.308	34.22	1.5989	4.672	29.427	22	4	silty clay to clay
95.472	36.16	1.8591	5.141	35.418	35	3	clay
95.636	37.93	2.0617	5.436	15.875	36	3	clay
95.801	36.79	1.8227	4.955	13.399	35	3	clay
95.965	33.92	1.6884	4.978	14.704	32	3	clay
96.129	35.58	1.4441	4.058	16.661	23	4	silty clay to clay
96.293	33.19	1.5107	4.551	20.397	21	4	silty clay to clay
96.457	31.23	1.3473	4.314	36.754	20	4	silty clay to clay
96.621	30.72	1.3336	4.342	38.260	20	4	silty clay to clay
96.785	31.80	1.2708	3.996	39.214	20	4	silty clay to clay
96.949	30.30	1.1763	3.882	42.388	19	4	silty clay to clay
97.113	29.45	0.9138	3.103	44.317	14	5	clayey silt to silty clay
97.277	28.38	0.7600	2.678	48.724	14	5	clayey silt to silty clay
97.441	27.15	0.6426	2.367	59.589	10	6	sandy silt to clayey silt
97.605	27.57	0.6468	2.346	64.774	11	6	sandy silt to clayey silt
97.769	28.89	0.7397	2.560	72.528	11	6	sandy silt to clayey silt
97.933	35.77	1.1096	3.102	73.603	17	5	clayey silt to silty clay
98.097	37.07	1.5585	4.204	59.433	24	4	silty clay to clay
98.261	35.75	1.6519	4.621	45.037	23	4	silty clay to clay
98.425	34.46	1.5818	4.591	48.696	22	4	silty clay to clay
98.589	36.39	1.6907	4.646	98.040	23	4	silty clay to clay
98.753	37.87	1.7190	4.540	67.240	24	4	silty clay to clay
98.917	35.35	1.4861	4.204	70.969	23	4	silty clay to clay
99.081	35.31	1.5249	4.319	82.040	23	4	silty clay to clay
99.245	35.32	1.6449	4.657	82.575	23	4	silty clay to clay
99.409	34.29	1.4865	4.335	84.154	22	4	silty clay to clay
99.573	33.46	1.3584	4.059	85.050	21	4	silty clay to clay
99.738	33.12	1.3637	4.118	87.727	21	4	silty clay to clay
99.902	33.76	1.4454	4.281	89.432	22	4	silty clay to clay
100.066	34.52	1.5225	4.411	83.436	22	4	silty clay to clay
100.230	34.38	1.5823	4.602	68.109	22	4	silty clay to clay
100.394	34.07	1.5992	4.694	65.409	22	4	silty clay to clay
100.558	33.60	1.4750	4.389	64.543	21	4	silty clay to clay
100.722	33.17	1.4694	4.430	65.480	21	4	silty clay to clay
100.886	33.54	1.4529	4.332	88.857	21	4	silty clay to clay
101.050	33.77	1.4847	4.396	85.460	22	4	silty clay to clay
101.214	33.12	1.4588	4.404	81.849	21	4	silty clay to clay
101.378	33.82	1.5032	4.445	80.360	22	4	silty clay to clay
101.542	35.62	1.5047	4.224	79.966	23	4	silty clay to clay
101.706	35.81	1.5149	4.231	76.290	23	4	silty clay to clay
101.870	36.48	1.5861	4.347	76.392	23	4	silty clay to clay
102.034	40.38	1.8103	4.483	84.950	26	4	silty clay to clay
102.198	41.43	1.8497	4.464	68.794	26	4	silty clay to clay
102.362	41.18	1.7536	4.258	69.108	26	4	silty clay to clay
102.526	40.88	1.7899	4.378	74.389	26	4	silty clay to clay
102.690	40.74	1.7962	4.408	64.844	26	4	silty clay to clay
102.854	40.41	1.8451	4.566	68.342	26	4	silty clay to clay

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
103.018	40.70	1.7541	4.310	54.409	26	4	silty clay to clay
103.182	39.09	1.6978	4.344	60.867	25	4	silty clay to clay
103.347	40.05	1.6178	4.039	64.724	19	5	clayey silt to silty clay
103.511	39.68	1.6062	4.048	69.045	19	5	clayey silt to silty clay
103.675	40.52	1.5842	3.910	68.099	19	5	clayey silt to silty clay
103.839	39.54	1.5849	4.008	79.938	19	5	clayey silt to silty clay
104.003	40.56	1.5898	3.920	92.493	19	5	clayey silt to silty clay
104.167	41.36	1.5433	3.732	92.719	20	5	clayey silt to silty clay
104.331	42.37	1.6759	3.956	97.565	20	5	clayey silt to silty clay
104.495	44.50	1.8603	4.180	87.235	28	4	silty clay to clay
104.659	44.66	1.8251	4.087	71.963	21	5	clayey silt to silty clay
104.823	42.68	1.6756	3.926	66.632	20	5	clayey silt to silty clay
104.987	42.63	1.7322	4.063	69.354	20	5	clayey silt to silty clay
105.151	43.16	1.7919	4.152	84.041	28	4	silty clay to clay
105.315	44.14	1.8297	4.145	90.427	21	5	clayey silt to silty clay
105.479	46.56	1.8637	4.003	72.297	22	5	clayey silt to silty clay
105.643	46.14	1.7848	3.868	64.789	22	5	clayey silt to silty clay
105.807	45.02	1.6198	3.597	82.100	22	5	clayey silt to silty clay
105.971	46.13	2.4281	5.264	93.716	44	3	clay
106.135	89.78	3.9839	4.437	183.271	86	11	very stiff fine grained (*)
106.299	98.45	4.4319	4.501	67.611	94	11	very stiff fine grained (*)
106.463	67.62	3.7228	5.506	53.487	65	11	very stiff fine grained (*)
106.627	61.90	2.7150	4.386	64.433	30	5	clayey silt to silty clay
106.791	48.72	2.4905	5.112	70.554	47	3	clay
106.955	53.19	2.2554	4.241	97.774	25	5	clayey silt to silty clay
107.119	59.84	2.6772	4.474	81.726	38	4	silty clay to clay
107.284	44.49	2.6439	5.943	105.405	43	3	clay
107.448	45.69	2.1661	4.741	221.436	29	4	silty clay to clay
107.612	44.32	1.6981	3.832	292.113	21	5	clayey silt to silty clay
107.776	42.05	1.6645	3.959	217.107	20	5	clayey silt to silty clay
107.940	50.24	2.8757	5.724	263.503	48	3	clay
108.104	68.38	3.6044	5.271	42.582	65	11	very stiff fine grained (*)
108.268	71.81	4.2730	5.950	48.894	69	11	very stiff fine grained (*)
108.432	83.22	4.5474	5.464	0.163	80	11	very stiff fine grained (*)
108.596	70.63	3.9317	5.567	-3.181	68	11	very stiff fine grained (*)
108.760	53.58	3.4026	6.351	5.022	51	3	clay
108.924	81.24	5.2922	6.514	7.977	78	11	very stiff fine grained (*)
109.088	111.83	7.6272	6.820	-2.285	107	11	very stiff fine grained (*)
109.252	125.94	8.2287	6.534	-5.004	121	11	very stiff fine grained (*)
109.416	135.96	8.7695	6.450	-4.899	130	11	very stiff fine grained (*)
109.580	134.06	8.4797	6.325	-5.780	128	11	very stiff fine grained (*)
109.744	144.52	8.4878	5.873	-5.095	138	11	very stiff fine grained (*)
109.908	178.90	8.1979	4.582	-6.114	171	11	very stiff fine grained (*)
110.072	184.91	6.5592	3.547	-6.436	89	12	sand to clayey sand (*)
110.236	169.64	6.5659	3.870	-6.466	81	12	sand to clayey sand (*)
110.400	135.96	7.3725	5.423	-5.966	130	11	very stiff fine grained (*)
110.564	136.31	7.7804	5.708	-0.691	131	11	very stiff fine grained (*)
110.728	157.33	7.2458	4.605	-3.817	151	11	very stiff fine grained (*)
110.892	144.24	7.7243	5.355	-4.447	138	11	very stiff fine grained (*)
111.056	154.72	7.8269	5.059	-5.009	148	11	very stiff fine grained (*)
111.221	165.84	9.2855	5.599	-3.819	159	11	very stiff fine grained (*)
111.385	167.24	7.1844	4.296	-4.645	160	11	very stiff fine grained (*)
111.549	85.93	5.5833	6.497	-3.784	82	11	very stiff fine grained (*)

Depth ft	Tip (Qt) (tsf)	Sleeve (Fs) (tsf)	FR (Fs/Qt) (%)	PP (U2) (psi)	SPT N60 (UNITLESS)	Zone	Soil Behavior Type UBC-1983
111.713	67.43	3.6860	5.466	22.926	65	11	very stiff fine grained (*)
111.877	55.93	2.8006	5.007	57.264	36	4	silty clay to clay
112.041	54.62	2.8153	5.154	94.557	52	3	clay
112.205	56.75	2.9613	5.219	88.483	54	3	clay
112.369	141.77	7.7607	5.474	120.411	136	11	very stiff fine grained (*)
112.533	154.36	9.1288	5.914	161.408	148	11	very stiff fine grained (*)
112.697	160.94	9.3193	5.791	-5.143	154	11	very stiff fine grained (*)
112.861	176.44	8.5165	4.827	-6.601	169	11	very stiff fine grained (*)
113.025	180.51	7.5068	4.159	-7.666	173	11	very stiff fine grained (*)
113.189	171.96	7.0689	4.111	-7.536	165	11	very stiff fine grained (*)
113.353	173.67	7.1459	4.115	-7.581	166	11	very stiff fine grained (*)
113.517	193.42	8.0569	4.166	-7.787	185	11	very stiff fine grained (*)
113.681	216.32	8.4513	3.907	-7.995	104	12	sand to clayey sand (*)
113.845	247.15	9.5875	3.879	-7.699	118	12	sand to clayey sand (*)
114.009	286.06	9.8366	3.439	-4.261	137	12	sand to clayey sand (*)
114.173	305.79	9.8763	3.230	-4.894	146	12	sand to clayey sand (*)
114.337	308.87	9.8826	3.200	-4.691	148	12	sand to clayey sand (*)
114.501	309.52	9.8926	3.196	-4.783	148	12	sand to clayey sand (*)

APPENDIX C

APPENDIX C

OWRD WELL LOGS

Well logs of four wells near the site vicinity are presented in this appendix.

CLAC 69756 Exhibit 40, page 169 of 1856

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

WELL I.D. # L 109344

START CARD # 209483

Instructions for completing this report are on the last page of this form.

(1) LAND OWNER Well Number
Name Leasco/Helicopter Transport Services
Address 14497 NE Kell Rd
City Aurora State OR Zip 97002

(2) TYPE OF WORK ☐ New Well
☑ Deepening ☑ Alteration (repair/recondition) ☐ Abandonment ☐ Conversion

(3) DRILL METHOD
☐ Rotary Air ☐ Rotary Mud ☑ Cable ☐ Auger ☐ Cable Mud
☐ Other

(4) PROPOSED USE
☑ Domestic ☐ Community ☑ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION Special Construction: ☐ Yes ☑ No
Depth of Completed Well 155'8" ft.
Explosives used: ☐ Yes ☑ No Type Amount

BORE HOLE Diameter	From	To	SEAL Material	From	To	Sacks or Pounds
10	0	94	bentonite	0	21	23 sacks
			cement	21	90	97 sacks
6	94	159				

How was seal placed: Method ☐ A ☐ B ☑ C ☐ D ☐ E
☑ Other bentonite placed dry
Backfill placed from 155'8" ft. to 159 ft. Material 10/20 CSS sand
Gravel placed from 89 ft. to 155'8" ft. Size of gravel 10/20&8/12

(6) CASING/LINER

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6	+1	110	.250	☑	☐	☑	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
	riser 4"	88	108.5ss	sch10	☑	☐	☑	☑
Liner:	4	124	138.5	sch40	☐	☑	☑	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☑ Outside ☐ None
Final location of shoe(s) 110'

(7) PERFORATIONS/SCREENS
☐ Perforations Method
☑ Screens Type v-wire Material s.s.

From	To	Slot Size	Number	Diameter	Tele/pipe size	Casing	Liner
108.5	124	.040		4	ps	☐	☐
138.5	154	.020		4	ps	☐	☐
154	155.5	tail	4"pvc	w/cap		☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☑ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
47	24		2.5 hours

Temperature of water 53 Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL (legal description)
County MARION
Tax Lot 100 Lot
Township 4 S Range 1 W WM
Section 11 NE 1/4 NE 1/4
Lat ° ' " or (degrees or decimal)
Long ° ' " or (degrees or decimal)
Street Address of Well (or nearest address)
same

(10) STATIC WATER LEVEL
83 ft. below land surface. Date 5-20-13
ft. below land surface. Date
Artesian pressure lb. per square inch Date

(11) WATER BEARING ZONES
Depth at which water was first found 109

From	To	Estimated Flow Rate	SWL
109	123	45	83
126	154	45	83

(12) WELL LOG Ground Elevation

Material	From	To	SWL
sand grey & brown med fine	61		
layered with grey silt		76	
silt grey dense	76	83	
clay grey	83	109	
cemented gravel grey & brown	109	114	
sand black with some gravel &	114		
sand red		118	
sand & gravel grey blk med cmtd	118	123	
clay grey/green	123	126	
clay tan sandy	126	146	
clay w/sand streaks med fine brn	146	154	
clay grey sticky	154	159	
original well CLACK64390			
was completely removed & new			
well drilled in same location			

Date Started 5-1-13 Completed 5-20-13

(unbonded) Water Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number Date

Signed

(bonded) Water Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 688 Date 5-24-13

Signed Steven M. Stadel

ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER 06/16/2004

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

Westerberg Drilling, Inc
36728 S. Kropf Rd.
Molalla, OR 97038

WELL I.D. # L 109344

START CARD # 209483

Instructions for completing this report are on the last page of this form.

(1) LAND OWNER Well Number
Name Leasco/Hellcopter Transport Services
Address 14497 NE Keil Rd
City Aurora State OR Zip 97002

(2) TYPE OF WORK ☐ New Well
☑ Deepening ☑ Alteration (repair/recondition) ☐ Abandonment ☐ Conversion

(3) DRILL METHOD
☐ Rotary Air ☐ Rotary Mud ☑ Cable ☐ Auger ☐ Cable Mud
☐ Other

(4) PROPOSED USE
☑ Domestic ☐ Community ☑ Industrial ☐ Irrigation
☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION Special Construction: ☐ Yes ☑ No
Depth of Completed Well 155'8" ft.
Explosives used: ☐ Yes ☑ No Type Amount

BORE HOLE Diameter	From	To	SEAL Material	From	To	Sacks or Pounds
10	0	94	bentonite	0	21	23 sacks
			cement	21	90	97 sacks
6	94	159				

How was seal placed: Method ☐ A ☐ B ☑ C ☐ D ☐ E
☑ Other bentonite placed dry
Backfill placed from 155'8" ft. to 159 ft. Material 10/20 CSS sand
Gravel placed from 89 ft. to 155'8" ft. Size of gravel 10/20&8/12

(6) CASING/LINER

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6	+1	110	.250	☑	☐	☑	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
	riser 4"	88	108.5ss	sch10	☑	☐	☑	☑
Liner:	4	124	138.5	sch40	☐	☑	☑	☐
					☐	☐	☐	☐

Drive Shoe used ☐ Inside ☑ Outside ☐ None
Final location of shoe(s) 110'

(7) PERFORATIONS/SCREENS
☐ Perforations Method
☑ Screens Type v-wire Material S.S.

From	To	Slot Size	Number	Diameter	Tele/pipe size	Casing	Liner
108.5	124	.040		4	ps	☐	☐
138.5	154	.020		4	ps	☐	☐
154	155.5	tail	4"pvc	w/cap		☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour
☑ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
47	24		2.5 hours

Temperature of water 53 Depth Artesian Flow Found
Was a water analysis done? ☐ Yes By whom
Did any strata contain water not suitable for intended use? ☐ Too little
☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other
Depth of strata:

(9) LOCATION OF WELL (legal description)
County Clackamas
Tax Lot 100 Lot
Township 4 S Range 1 W WM
Section 11 NE 1/4 NE 1/4

Lat ° ' " or (degrees or decimal)
Long ° ' " or (degrees or decimal)

Street Address of Well (or nearest address)
same

(10) STATIC WATER LEVEL
83 ft. below land surface. Date 5-20-13
ft. below land surface. Date
Artesian pressure lb. per square inch Date

(11) WATER BEARING ZONES
Depth at which water was first found 109

From	To	Estimated Flow Rate	SWL
109	123	45	83
126	154	45	83

(12) WELL LOG Ground Elevation

Material	From	To	SWL
sand grey & brown med fine	61		
layered with grey silt		76	
silt grey dense	76	83	
clay grey	83	109	
cemented gravel grey & brown	109	114	
sand black with some gravel &	114		
sand red		118	
sand & gravel grey blk med cmtd	118	123	
clay grey/green	123	126	
clay tan sandy	126	146	
clay w/sand streaks med fine brn	146	154	
clay grey sticky	154	159	
original well CLACK64390			
was completely removed & new			
well drilled in same location			

Date Started 5-1-13 Completed 5-20-13

(unbonded) Water Well Constructor Certification
I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

RECEIVED
MAY 31 2013
SALEM, OR

WWC Number Date
Signed

(bonded) Water Well Constructor Certification
I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 688 Date 5-24-13
Signed Steven N. Stadele

ORIGINAL – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER 06/16/2004

SKYLES DRILLING, INC.

Skyles Drilling, Inc.
1169 Molalla Ave.
Oregon City, OR 97045
656-2683

RECEIVED
JUN - 2 1995
WATER RESOURCES DEPT.
SALEM, OREGON

16 MART 19675 Exhibit 40, page 121 of 185 6/1/w/11 aa

STATE OF OREGON WATER WELL REPORT

(as required by ORS 537.765)

Instructions for completing this report are on the last page of this form.

(START CARD) # 78136

(1) OWNER:

Well Number 01

Name Jack Hogan

Address 2575 Palisades Crest

City Lake Oswego State Or. Zip 97034

(2) TYPE OF WORK

[X] New Well [ ] Deepening [ ] Alteration (repair/recondition) [ ] Abandonment

(3) DRILL METHOD:

[X] Rotary Air [ ] Rotary Mud [ ] Cable [ ] Auger

[ ] Other

(4) PROPOSED USE:

[X] Domestic [ ] Community [ ] Industrial [ ] Irrigation

[ ] Thermal [ ] Injection [ ] Livestock [ ] Other

(5) BORE HOLE CONSTRUCTION:

Special Construction approval [ ] Yes [X] No Depth of Completed Well 59 ft.

Explosives used [ ] Yes [X] No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
10"	0	26	Hole Plug	26	2	12 sacks
6"	26	67	Bent	2	0	1 sack

How was seal placed: Method [ ] A [ ] B [ ] C [ ] D [ ] E

[X] Other Poured in Dry

Backfill placed from ft. to ft. Material

Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6"	+1½	58	250	[X]	[ ]	[X]	[ ]
					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
					[ ]	[ ]	[ ]	[ ]
Liner:	4"	2½	49	160#	[ ]	[X]	[X]	[ ]
					[ ]	[ ]	[ ]	[ ]

Final location of shoe(s) 58'

(7) PERFORATIONS/SCREENS:

[ ] Perforations Method

[X] Screens Type slotted Material PVC

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
49	59	.020		4		[ ]	[X]
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]
						[ ]	[ ]

(8) WELL TESTS: Minimum testing time is 1 hour

[ ] Pump [ ] Bailer [X] Air [ ] Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
70		55	1 hr.
40		41	¼ Hr

Temperature of water 58° Depth Artesian Flow Found

Was a water analysis done? [X] Yes By whom driller no iron

Did any strata contain water not suitable for intended use? [ ] Too little

[ ] Salty [ ] Muddy [ ] Odor [ ] Colored [ ] Other

Depth of strata:

(9) LOCATION OF WELL by legal description:

County Marion Latitude Longitude

Township 4 South N or S Range 1 West E or W. WM.

Section 11 NE 1/4 NE 1/4

Tax Lot 40403 Lot 612 Block Subdivision

Street Address of Well (or nearest address) 14397 Keil Rd. NE Aurora, Or.

(10) STATIC WATER LEVEL:

9 ft. below land surface. Date 5-26-95

Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:

Depth at which water was first found 4'

From	To	Estimated Flow Rate	SWL
4	16	20+	4
60	64	70	9

(12) WELL LOG:

Ground Elevation

Material	From	To	SWL
Soil Brown	0	4	
Clay Brown Sandy w/small seams of sand brown clayish (between 4'to	4 20'	51	
Clay gray sandy	51	60	
Sand Black fine	60	64	9
Clay Gray	64	67	

Date started 5-26-95 Completed 5-26-95

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number 1601

Signed Date 5-30-95

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 1592

Signed Date 5-30-95

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

MAR1

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

54677 WELL I.D.# _____

(START CARD) # 119064

Instructions for completing this report are on the last page of this form.

(1) OWNER: Well Number _____

Name George Jacobsen

Address 2700 SE Tacoma St

City Portland State Or Zip 97202

(2) TYPE OF WORK

☒ New Well ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:

☐ Rotary Air ☐ Rotary Mud ☒ Cable ☐ Auger

☐ Other _____

(4) PROPOSED USE:

☒ Domestic ☐ Community ☐ Industrial ☐ Irrigation

☐ Thermal ☐ Injection ☐ Livestock ☐ Other _____

(5) BORE HOLE CONSTRUCTION:

Special Construction approval ☐ Yes ☐ No Depth of Completed Well 130 ft.

Explosives used ☐ Yes ☐ No Type _____ Amount _____

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
10	1	32	Bentonite	1	32	16 sacks
6	32	130				

How was seal placed: Method ☐ A ☐ B ☐ C ☐ D ☐ E

☒ Other Granular Bentonite method

Backfill placed from _____ ft. to _____ ft. Material _____

Gravel placed from _____ ft. to _____ ft. Size of gravel _____

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	6	0	130	.25	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Final location of shoe(s) 130

(7) PERFORATIONS/SCREENS:

☐ Perforations Method _____

☐ Screens Type _____ Material _____

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
						☐	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour

☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.
38	8		3 hr

Temperature of water 52 Depth Artesian Flow Found _____

Was a water analysis done? ☐ Yes By whom _____

Did any strata contain water not suitable for intended use? ☐ Too little

☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other _____

Depth of strata: _____

(9) LOCATION OF WELL by legal description:

County Marion Latitude _____ Longitude _____

Township 4S N or S Range 1W E or W. WM.

Section 11 SW 1/4 NE 1/4

Tax Lot 400 Lot _____ Block _____ Subdivision _____

Street Address of Well (or nearest address) _____

14757 Keil Rd NE

(10) STATIC WATER LEVEL:

58 ft. below land surface. Date March 3

Artesian pressure _____ lb. per square inch. Date _____

(11) WATER BEARING ZONES:

Depth at which water was first found 9

From	To	Estimated Flow Rate	SWL
9	130		58

(12) WELL LOG:

Ground Elevation _____

Material	From	To	SWL
Soil	1	3	
Clay, brown, silty	3	23	
Clay, brown	23	56	
Clay, grey	56	114	
Cemented Gravel	114	119	
Sand & Gravel, black	119	130	

RECEIVED
MAR 31 2000
WATER RESOURCES DEPT.
SALEM, OREGON

Date started Feb17 Completed March 3, 2000

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number _____

Signed _____ Date _____

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 243

RECEIVED WELL I.D.# 26728

MAR 1 4 2001 ~~Exhibit 40, page 123 of 185~~

WATER RESOURCES DEPT. (START CARD) # 13022E

SALEM, OREGON

STATE OF OREGON
WATER SUPPLY WELL REPORT
(as required by ORS 537.765)

Mar 55054

Instructions for completing this report are on the last page of this form.

(1) OWNER: Well Number

Name HD Aviation

Address 4401 NE Kerl Rd

City Aurora State Or Zip 97002

(2) TYPE OF WORK

☒ New Well ☐ Deepening ☐ Alteration (repair/recondition) ☐ Abandonment

(3) DRILL METHOD:

☐ Rotary Air ☐ Rotary Mud ☒ Cable ☐ Auger

☐ Other

(4) PROPOSED USE:

☐ Domestic ☐ Community ☒ Industrial ☐ Irrigation

☐ Thermal ☐ Injection ☐ Livestock ☐ Other

(5) BORE HOLE CONSTRUCTION:

Special Construction approval ☐ Yes ☐ No Depth of Completed Well 257 ft.

Explosives used ☐ Yes ☐ No Type Amount

HOLE Diameter	From	To	SEAL Material	From	To	Sacks or pounds
12	1	32	Bentonite	1	32	21 sacks
8	32	257				

How was seal placed: Method ☐A ☐B ☐C ☐D ☐E

☒ Other Granular Bentonite method

Backfill placed from ft. to ft. Material

Gravel placed from ft. to ft. Size of gravel

(6) CASING/LINER:

	Diameter	From	To	Gauge	Steel	Plastic	Welded	Threaded
Casing:	8	0	250	.25	☒	☐	☒	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
					☐	☐	☐	☐
Liner:					☐	☐	☐	☐
					☐	☐	☐	☐

Final location of shoe(s) 250

(7) PERFORATIONS/SCREENS: Drive Down 'Star'

☒ Perforations Method

☐ Screens Type Material

From	To	Slot size	Number	Diameter	Tele/pipe size	Casing	Liner
159	169	2/16	240			☒	☐
						☐	☐
						☐	☐
						☐	☐
						☐	☐

(8) WELL TESTS: Minimum testing time is 1 hour

☒ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Yield gal/min	Drawdown	Drill stem at	Time
			1 hr.
30	48		2 hr

Temperature of water 53 Depth Artesian Flow Found

Was a water analysis done? ☐ Yes By whom

Did any strata contain water not suitable for intended use? ☐ Too little

☐ Salty ☐ Muddy ☐ Odor ☐ Colored ☐ Other

Depth of strata:

RECEIVED
AUG 11 2000
WATER RESOURCES DEPT.
SALEM, OREGON

(9) LOCATION OF WELL by legal description:

County Marion Latitude Longitude

Township 4S N or S Range 1W E or W. WM.

Section 11 Se 1/4 Ne 1/4

Tax Lot 200 Lot Block Subdivision

Street Address of Well (or nearest address)

(10) STATIC WATER LEVEL:

78 ft. below land surface. Date June 21

Artesian pressure lb. per square inch. Date

(11) WATER BEARING ZONES:

Depth at which water was first found 9

From	To	Estimated Flow Rate	SWL
9	257		78
9	23	PB	9
90	241		78

(12) WELL LOG:

Ground Elevation

Material	From	To	SWL
Soil	1	3	
Clay, brown, silty	3	23	
Clay, brown	23	56	
Clay, grey	56	114	
Cemented Gravel	114	126	
Gravel, loose, clayey	126	127	
Clay, grey	127	151	
Clay, greenish	151	176	
Clay, grey	176	206	
Clay, dk grey, silty	206	215	
Clay, grey	215	221	
Clay, lt blue	221	229	
Clay, grey	229	235	
Silty, dark grey	235	241	
Clay, grey	241	257	

Date started April 19 Completed July 10, 2000

(unbonded) Water Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

WWC Number

Signed Date

(bonded) Water Well Constructor Certification:

I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

WWC Number 743

Signed Date 8-9-00

ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

APPENDIX D

APPENDIX D

SITE-SPECIFIC SEISMIC HAZARD EVALUATION

INTRODUCTION

The information in this appendix summarizes the results of a site-specific seismic hazard evaluation for the proposed AABC in Aurora, Oregon. This seismic hazard evaluation was performed in accordance with the requirements of ASCE 7-16. We understand the project will consist of a new approximately 16-acre development, and we understand the future development will likely include an essential facility on the southeast portion.

SITE CONDITIONS

REGIONAL GEOLOGY AND SUBSURFACE CONDITIONS

The regional geology in the area and site subsurface conditions are discussed in the main report.

SEISMIC SETTING

Earthquake Source Zones

Three scenario earthquakes were considered for this study consistent with the local seismic setting. Two of the possible earthquake sources are associated with the CSZ, and the third event is a shallow, local crustal earthquake that could occur in the North American Plate. The three earthquake scenarios are discussed below.

Regional Events

The CSZ is the region where the Juan de Fuca Plate is being subducted beneath the North American Plate. This subduction is occurring in the coastal region between Vancouver Island and northern California. Evidence has accumulated suggesting that this subduction zone has generated eight great earthquakes in the last 4,000 years, with the most recent event occurring approximately 300 years ago (Weaver and Shedlock, 1991). The fault trace is mapped approximately 50 to 120 km off the Washington Coast.

Two types of subduction zone earthquakes are possible and considered in this study:

1. An interface event earthquake on the seismogenic part of the interface between the Juan de Fuca Plate and the North American Plate on the CSZ. This source is capable of generating earthquakes with a moment magnitude M_w 9.0 or greater.
2. A deep intraplate earthquake on the seismogenic part of the subducting Juan de Fuca Plate. These events typically occur at depths of between 30 and 60 km. This source is capable of generating an event with a moment magnitude of up to 8.0.

Local Events

An earthquake could occur on a local fault near the site within the design life of the facility. Figure D-1 shows the locations of faults with potential Quaternary movement within a 20-mile radius of the site. Figure D-2 shows the interpreted locations of seismic events that occurred

between 1833 and 2014 (USGS, 2014). The closest local faults in the site vicinity are the Canby-Molalla and Newberg faults. Table D-1 presents the closest mapped distance and mapped length of these faults.

Table D-1. Significant Crustal Faults

Source	Closest Mapped Distance[1] (miles)	Mapped Length[1] (km)
Canby-Molalla	5.5	50
Newberg	9.5	5

1. Reported by USGS (USGS, 2019)

CODE-BASED SEISMIC DESIGN PARAMETERS

Sites with a potential for liquefaction are considered a Site Class F site. ASCE 7-16 Section 20.3.1 requires a site-specific ground motion analysis be completed for structures with a fundamental period (T) greater than 0.5 second that are located within a Site Class F. If structures have a fundamental period of less than 0.5 second, seismic design parameters can be determined using the pre-liquefaction class. Structures for the project are expected to have fundamental period of less than 0.5 second. Analysis indicates that liquefaction will not be a design consideration for the project. Irrespective of the liquefaction risk or fundamental period of the anticipated structures, a site-specific seismic evaluation has been requested because the project may include an essential facility and the airport may be used as a critical facility after a seismic event.

If code-based parameters are used, a site classification of D would be appropriate based on shear wave velocity testing in CPT-1. Code-based seismic design criteria in accordance with ASCE 7-16 are summarized in Table D-2.

Table D-2. Seismic Design Parameters

Seismic Design Parameter	Short Period (T_s = 0.2 second)	1 Second Period (T_1 = 1.0 second)
MCE Spectral Acceleration	S_s = 0.807 g	S_1 = 0.379 g
Site Class	D	
Site Coefficient	F_a = 1.177	F_v = 1.921
Adjusted Spectral Acceleration	S_{MS} = 0.950 g	S_{M1} = 0.728 g
Design Spectral Response Acceleration Parameters	S_{DS} = 0.633 g	S_{D1} = 0.485 g

Parameters correspond to Site Class D per ASCE 7-16. A site-specific analysis is required for the project.

SITE RESPONSE ANALYSIS

RISK TARGETED BEDROCK SPECTRUM

A probabilistic bedrock spectrum for the site was determined using the computer program EZ-FRISK 8.0 and the 2014 USGS fault source parameters. The ground motion models and weighting in the analysis are consistent with the 2014 USGS fault source parameters. Near-source effects were included in the analysis per Bayless and Somerville (2013). We determined the spectral accelerations for the outcropping bedrock response spectrum for periods ranging from 0 to 10 seconds. The response spectrum is consistent with a shear wave velocity equal to 760 meters per second. Table D-3 presents a summary of values used to compute the MCE target bedrock response spectrum.

Table D-3. Target Bedrock Spectrum

Period (seconds)	MCE Target Bedrock Spectral Acceleration (g)
0.01	0.369
0.02	0.391
0.03	0.422
0.05	0.495
0.075	0.644
0.1	0.764
0.15	0.842
0.2	0.808
0.25	0.749
0.3	0.704
0.4	0.615
0.5	0.534
0.75	0.409
1	0.334
1.5	0.235
2	0.181
3	0.116
4	0.0873
5	0.0667
7.5	0.0397
10	0.0294

BASE GROUND MOTIONS

Six recorded base ground motions were selected to represent the local seismic setting. Based on deaggregation at the PGA, ground motions are generally equally controlled by CSZ (approximately 55 percent) and crustal events (approximately 40 percent of hazard, predominately gridded sources). The remainder is deep background seismicity. Based on the

deaggregation results, we selected three time histories for the CSZ and three time histories for the crustal event. Table D-4 provides the ground motions selected for this study. The base motions were spectrally matched to the MCE target spectrum using EZ-FRISK 8.0.

Table D-4. Selected Ground Motions

Ground Motion/Recording Station	Magnitude	Distance (km)	Component
CSZ Zone Records			
Tohoku – Tsukuba City Hall	9.0	106.9	004
Maule – Curico Hospital	8.8	76.3	EW
Tokachi-oki – Estacion de Medicisn	8.29	65.8	EW
Crustal Zone Records			
Chi-Chi, Taiwan – CHY065	7.62	9	E
Kobe, Japan - Abeno	6.9	1.0	000
Darfield, New Zealand - DFHS	7.0	11.86	S73W

SITE CONDITION MODELING

An equivalent-linear analysis was conducted on the six spectrally matched acceleration time histories to determine the site response. The site response analysis was performed using DEEPSOIL version 7.0 software and the soil parameters described in Table D-5.

The input soil models used in analysis are based on the findings of our subsurface exploration program, shear wave velocity testing from the CPT, a review of well logs, and our experience in the site vicinity.

Three cases were analyzed for each profile to capture the epistemic uncertainty at the site. Profile 1 used the shear wave velocities in Table D-5. Profile 2 reduced the shear wave velocities in Table D-5 at the site by 20 percent (i.e., divide by 1.25). Profile 3 increased the shear wave velocities in Table D-5 by 25 percent (i.e., multiply by 1.25). A weighted average of the results of the site response (Profile 1 = 0.6, Profile 2 = 0.2, and Profile 3 = 0.2) were taken as the site response spectra for the site.

Table D-5. Input Soil Profile

Depth Interval (feet)	Subsurface Unit	Shear Wave Velocity (fps)	Modulus Reduction Curve	Damping Curve
0 to 12	Medium Stiff to Stiff Silt and Clay	650 to 750	Vucetic and Dobry, 1991	Vucetic and Dobry, 1991
12 to 58	Stiff to Very Stiff Silt with Sand	900 to 1,100	Vucetic and Dobry, 1991	Vucetic and Dobry, 1991
58 to 82	Very Dense Sand	1,200 to 1,400	Seed and Idriss, 1970	Seed and Idriss, 1970
85 to 400[1]	Very Stiff to Hard Clay	800 to 1,300	Vucetic and Dobry, 1991	Vucetic and Dobry, 1991

1. Input ground motion is at a depth of 400 feet BGS.
2. Groundwater assumed at a depth of 5 feet BGS.

Because the ground motion models used in the hazard calculation compute the average horizontal component of ground motions, scale factors were applied to adjust the site response results to the maximum rotated component as described in ASCE 7-16 (C21.2). According to ASCE 7-16 Supplement 1, a scale factor of 1.1 should be used for periods of 0.2 second and shorter, a scale factor of 1.3 should be used for periods of 1.0 second, and a scale factor of 1.5 was used for periods greater than 5.0 seconds (with averaging in between 0.2 and 1.0 second and between 1.0 second and 1.5 seconds).

The results of the site response were also modified with risk coefficients using Method 2 outlined in ASCE 7-16 Section 21.2.1.2. The intent of this is to achieve a uniform 1 percent probability of collapse in a 50-year period. A risk coefficient of $C_{RS} = 0.884$ was applied to the spectrum at periods of 0.2 second or less and a risk coefficient of $C_{R1} = 0.875$ was applied to the spectrum at periods greater than 1.0 second. Linear interpolation was used to compute risk coefficients between periods of 0.2 and 1.0 second.

The acceleration response spectra for the site response analysis with maximum rotated component and risk coefficients are presented on Figure D-3.

PROBABILISTIC MCE_R RESPONSE SPECTRUM

Per ASCE 7-16 Section 21.1.3, the recommended PSHA site-specific MCE_R shall not be lower than the MCE_R response spectrum of the base motion multiplied by the average SAR obtained from the site response analysis. The SAR for the site is shown on Figure D-4. The upper envelope of the TSA and ESA events were multiplied by the SAR to determine the MCE_R. Figure D-5 provides the probabilistic site-specific MCE_R spectrum for the site (upper envelope of SAR multiplied by the target bedrock spectrum in Table D-3).

DETERMINISTIC MCE_R RESPONSE SPECTRUM

The deterministic approach considers the maximum ground acceleration that may occur at the site as a result of a characteristic earthquake on all known active faults in the region. ASCE 7-16

Section 21.2.2 requires that the spectral response at each period be calculated as an 84th percentile 5 percent damped spectral response acceleration in the direction of maximum horizontal response. However, the lower limit is computed in accordance with ASCE 7-16 Figure 21.2-1 where:

1. For Site Classes A, B, and C: F_a and F_v are determined using Tables 11.4-1 and 11.4-2, with the value of S_s taken as 1.5 and the value S_1 taken and 0.6
2. For Site Class D: F_a is 1.0 and F_v is 2.5
3. For Site Class E and F: F_a is 1.0 and F_v is 4.0

Figure D-5 shows the deterministic lower limit as prescribed by ASCE 7-16 Section 21.2.2. Since the code-prescribed deterministic lower limit is greater than the probabilistic results, a deterministic analysis of individual faults is not necessary.

SITE-SPECIFIC MCE_R RESPONSE SPECTRUM

As outlined in ASCE 7-16 Section 21.2.3, the site-specific MCE_R shall be taken as the lesser of the probabilistic MCE_R and the deterministic MCE_R. Figure D-6 shows the site-specific design response spectrum.

DESIGN RESPONSE SPECTRUM

In accordance with ASCE 7-16 Section 21.3, the design response spectrum is two-thirds of the MCE_R at all periods; however, the design response spectrum at any period shall not be taken less than 80 percent of S_a determined in accordance with ASCE 7-16 Section 11.4.6, where F_a and F_v are determined as follows:

1. For Site Classes A, B, and C: F_a and F_v are determined using Tables 11.4-1 and 11.4-2, respectively
2. For Site Class D: F_a is determined using Table 11.4-1 and F_v is taken as 2.4 for $S_1 < 0.2$ or 2.5 for $S_1 \geq 0.2$
3. For Site Class E: F_a is determined using Table 11.4-1 for $S_S < 1.0$ or taken as 1.0 for $S_S \geq 1.0$ and F_v is taken as 4.2 for $S_1 \leq 0.1$ or 4.0 for $S_1 > 0.1$

DESIGN ACCELERATION PARAMETERS

The parameter S_{DS} is taken as 90 percent of the maximum spectral acceleration from the site-specific design response spectrum at any period within the range of 0.2 second to 5.0 seconds. The parameter S_{D1} shall be taken as the maximum value of the product, TS_a, for periods from 1.0 second to 2.0 seconds for sites with $Vs_{30} > 1{,}200$ fps and for periods from 1.0 second to 5.0 seconds for sites with $Vs_{30} \leq 1{,}200$ fps. Figure D-6 shows the design response spectrum for ASCE 7-16.

The values of S_{MS} and S_{M1} shall be taken as 1.5 times S_{DS} and S_{D1} but shall not be less than 80 percent of the values determined in accordance with ASCE 7-16 Section 11.4.3 for S_{MS} and S_{M1} and ASCE 7-16 Section 11.4.5 for S_{DS} and S_{D1}. Therefore, the site-specific design parameters are as follows:

- S_{DS} = 0.558 g
- S_{D1} = 0.837 g
- S_{MS} = 0.0.507 g
- S_{M1} = 0.0.760 g

FAULT SURFACE RUPTURE

The closest mapped fault is more than 5 miles northeast of the site as described in Table D-1. Consequently, it is our opinion that the probability of surface fault rupture beneath the site is low.

LIQUEFACTION

Liquefaction is caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. In general, loose, saturated sand soil with low silt and clay content is most susceptible to liquefaction. Silty soil with low plasticity is also susceptible to liquefaction or strain softening under relatively higher levels of ground shaking.

We performed liquefaction analysis using the CPT results in accordance with Boulanger and Idriss (2014) employing the depth weighting methods from Cetin (2009). The CPT probe provides continuous soil strength data for the full depth of penetration. The two strength parameters obtained are tip resistance and frictional resistance along the probe.

Based on our analysis, we estimate total post-liquefaction settlement at the existing ground surface will negligible during a design-level earthquake. We anticipate differential settlement across a 100-foot span will be less than approximately one-half of the total liquefaction settlement.

LATERAL SPREADING

Lateral spreading is a liquefaction-related seismic hazard and occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Liquefied soil adjacent to an open face can flow toward the open face, resulting in lateral ground displacement. The primary difference between a conventional slope stability failure and lateral spreading is that no distinct failure plane is formed during a lateral spreading event.

Because minimal liquefaction is predicted and there are no open faces near the site, lateral spreading is not a design consideration.

GROUND MOTION AMPLIFICATION

Soil capable of significantly amplifying ground motions beyond the levels determined by our site-specific seismic study were not encountered during our subsurface explorations. The main report provides a detailed description of the subsurface conditions encountered.

LANDSLIDE

Earthquake-induced landsliding generally occurs in steeper slopes comprised of relatively weak soil deposits. The site and surrounding area are relatively flat, and seismically induced landslides are not considered a site hazard.

SETTLEMENT

Settlement due to earthquakes is most prevalent in relatively deep deposits of dry, clean sand. We do not anticipate that seismic-induced settlement or liquefaction-induced settlement will be a design consideration during design levels of ground shaking.

SUBSIDENCE/UPLIFT

CSZ earthquakes can cause vertical tectonic movements. The movements reflect coseismic strain release accumulation associated with interplate coupling in the CSZ. Based on our review of the literature, the locked zone of the CSZ is located in excess of 50 miles from the site. Consequently, we do not anticipate that subsidence or uplift is a significant design concern.

LURCHING

Lurching is a phenomenon generally associated with very high levels of ground shaking, which cause localized failures and distortion of the soil. The anticipated ground accelerations shown on the figures in this appendix are below the threshold required to induce lurching of the site soil.

SEICHE AND TSUNAMI

The site is inland and elevated away from tsunami inundation zones and away from large bodies of water that may develop seiches. Seiches and tsunamis are not considered a hazard in the site vicinity.

REFERENCES

ASCE, 2016. Minimum Design Loads for Buildings and Other Structures. ASCE Standard ASCE/SEI 7-016. American Society of Civil Engineers.

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Cetin, K.O., Bilge, H.T., Wu, J., Kammerer, A.M., and Seed R.B. (2009). Probabilistic Model for the Assessment of Cyclically Induced Reconsolidation (Volumetric) Settlements. *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE. 135(3), 387-398.

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USGS, 2019. www.usgs.gov.

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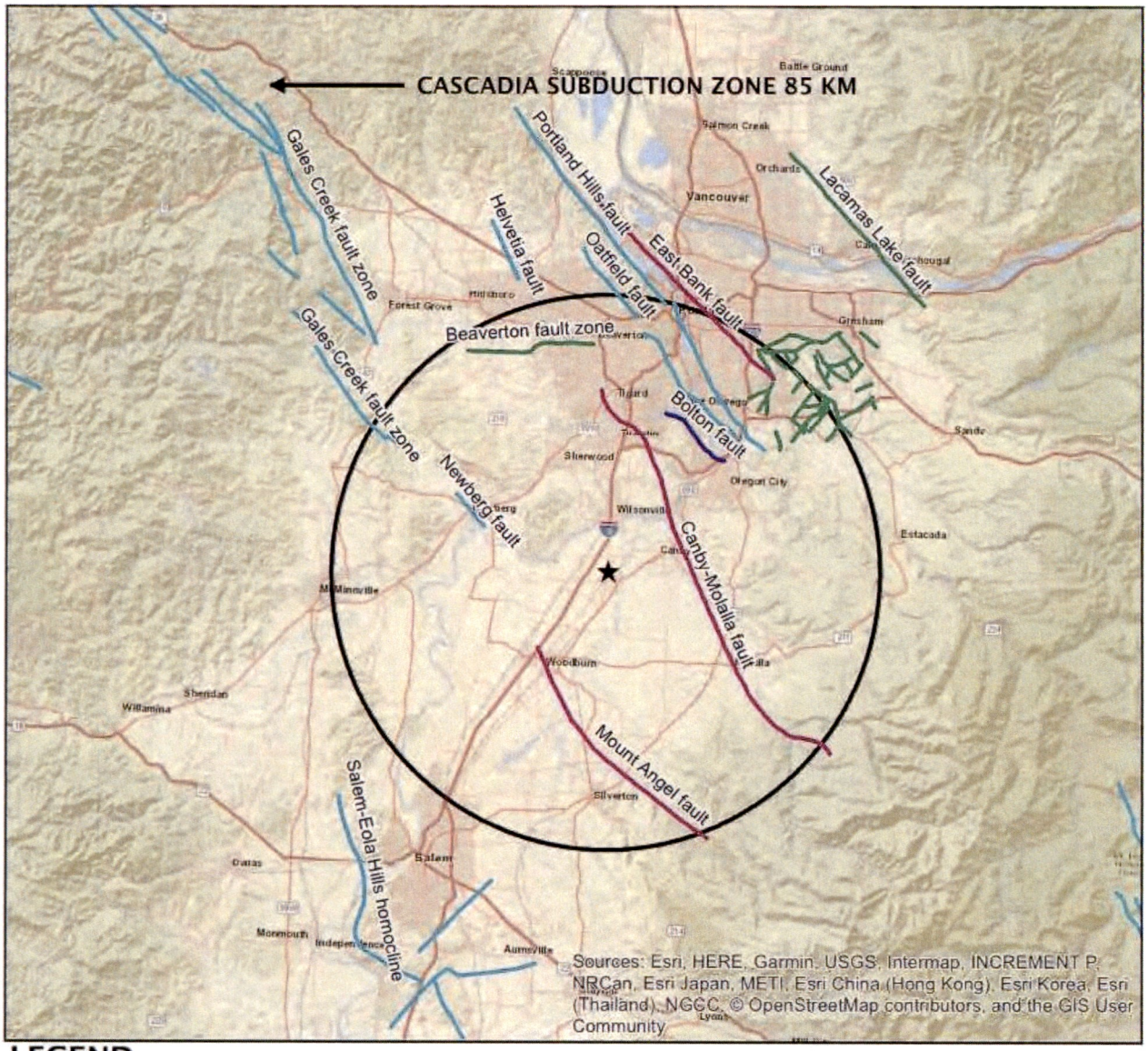


LEGEND

★ SITE LOCATION

20 MILE RADIUS

USGS QUATERNARY FAULTS

AGE

- <150
- <15,000
- <130,000
- <750,000
- <1,600,000
- Class B

N

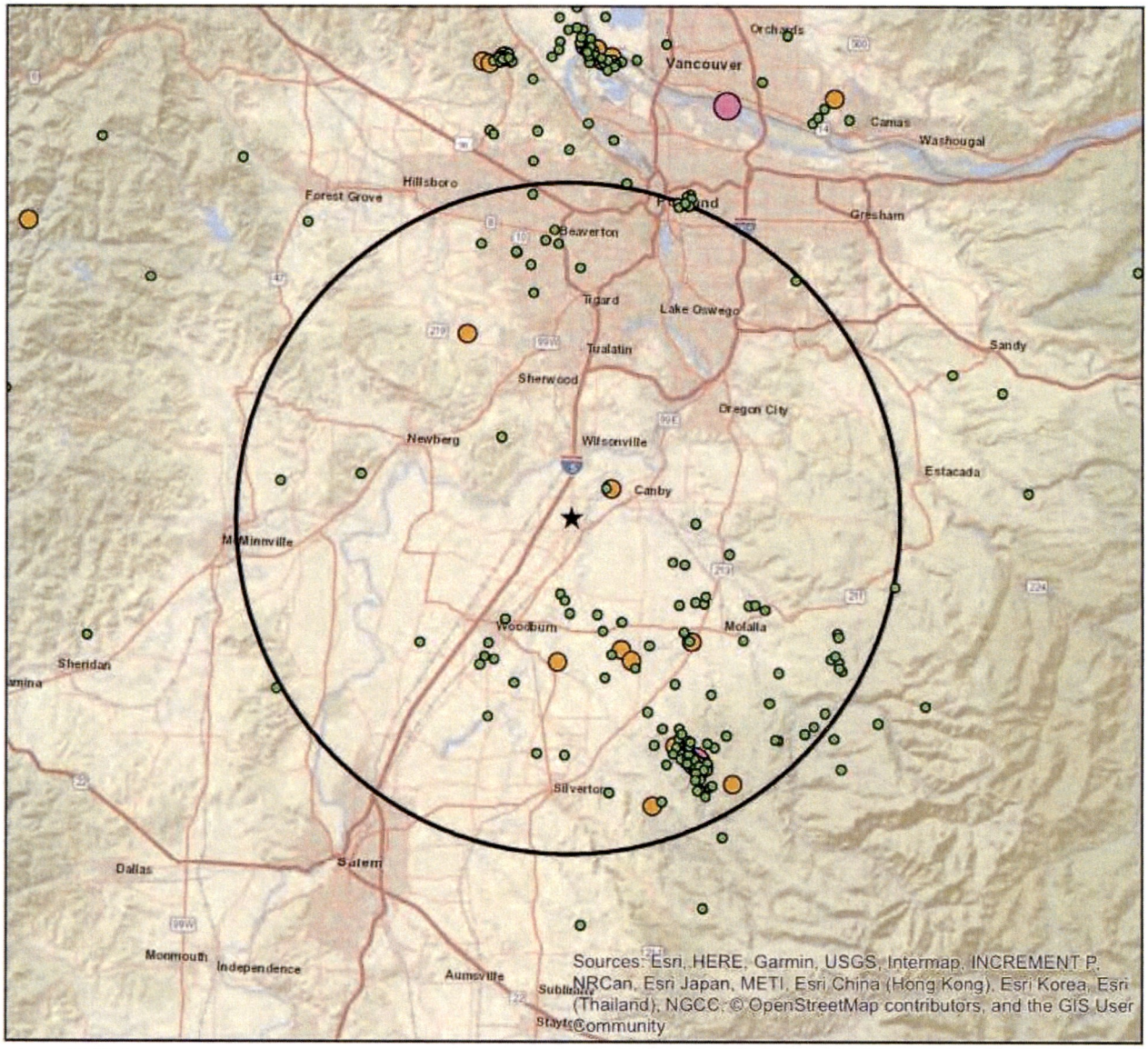
0 5 10

Miles

QUATERNARY FAULT DATA FROM USGS (2018); https://services.arcgis.com/v01gqwM5QqNysAAi/arcgis/rest/services/Qfaults_2018/FeatureServer

GeoDesign Inc 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	ARONFA-1-01	**QUATERNARY FAULT MAP**	
	MAY 2019	AURORA AIRPORT BUSINESS CENTER AURORA, OR	**FIGURE D-1**

AronFA-1-01-FD1_D2.docx Print Date: 5/13/19



LEGEND

★ SITE LOCATION

20 MILE RADIUS

EARTHQUAKE MAGNITUDE

- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0
- > 6.0

N

0 5 10

Miles

USGS, 2018, Earthquake Hazards Program, US Earthquake Information by State, U. S. Geological Survey, Available: http://earthquake.usgs.gov/earthquakes/search.

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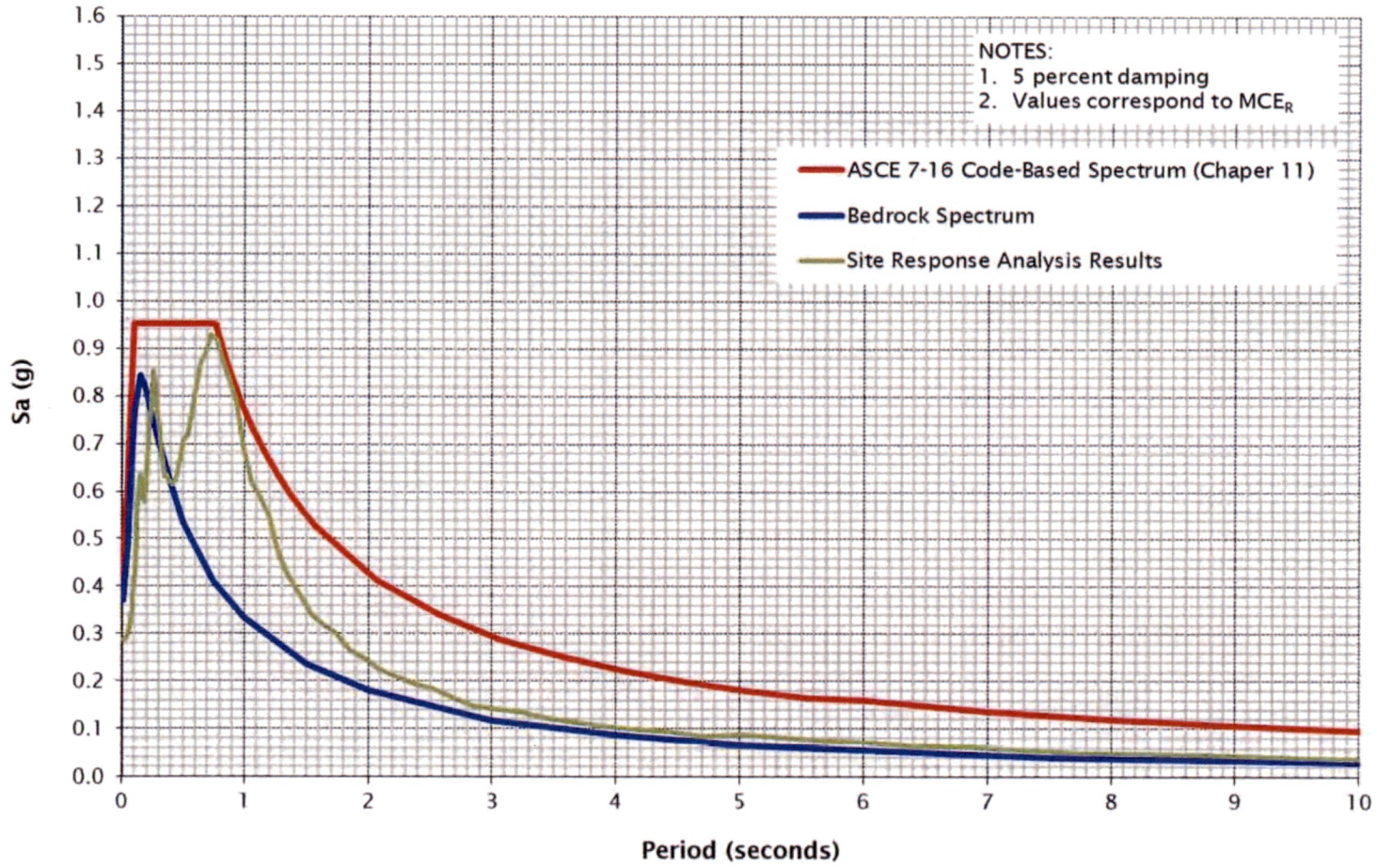
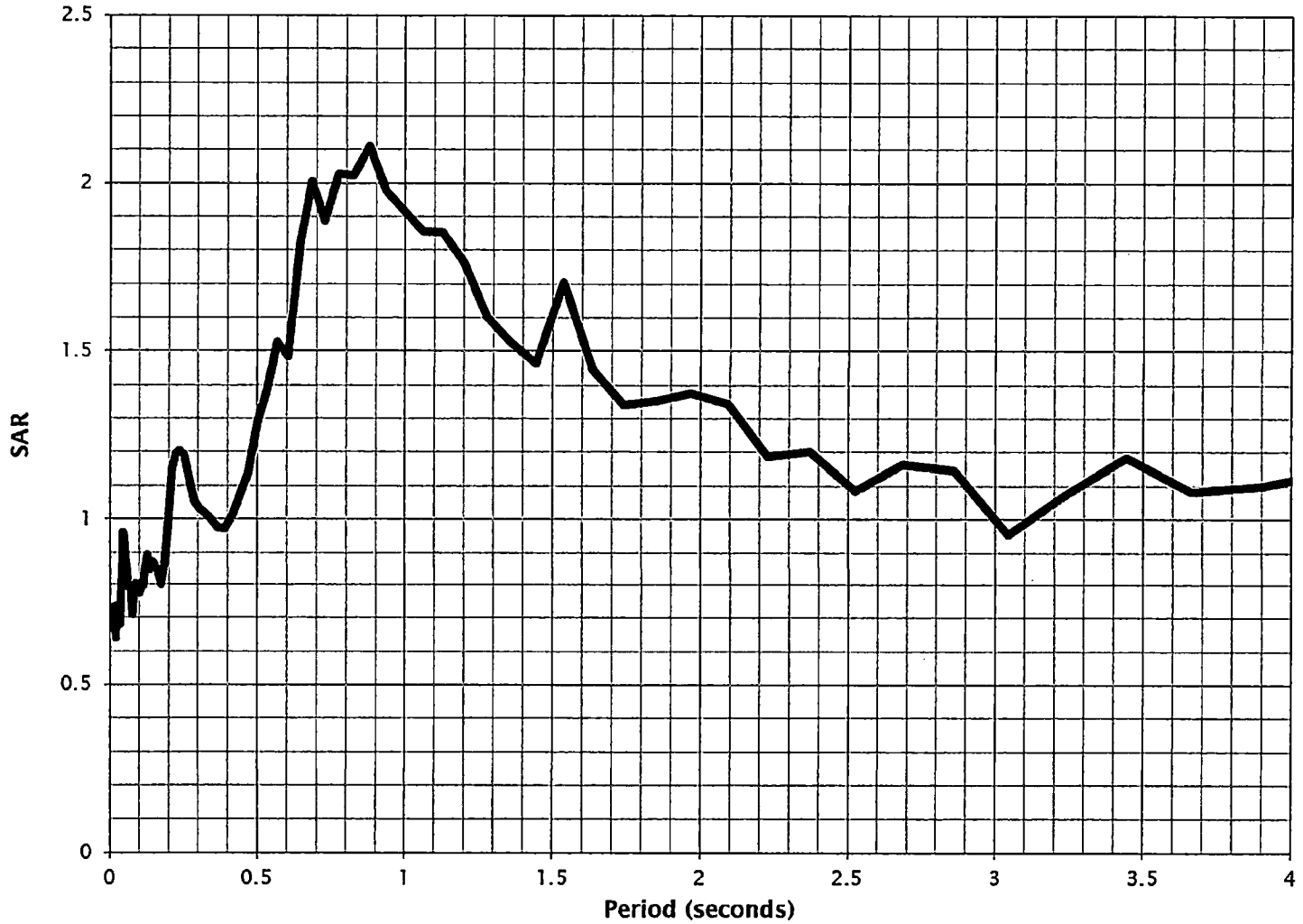
	MAY 2019	AURORA AIRPORT BUSINESS CENTER AURORA, OR	**FIGURE D-2**

AronFA-1-01-FD1_D2.docx Print Date: 5/13/19

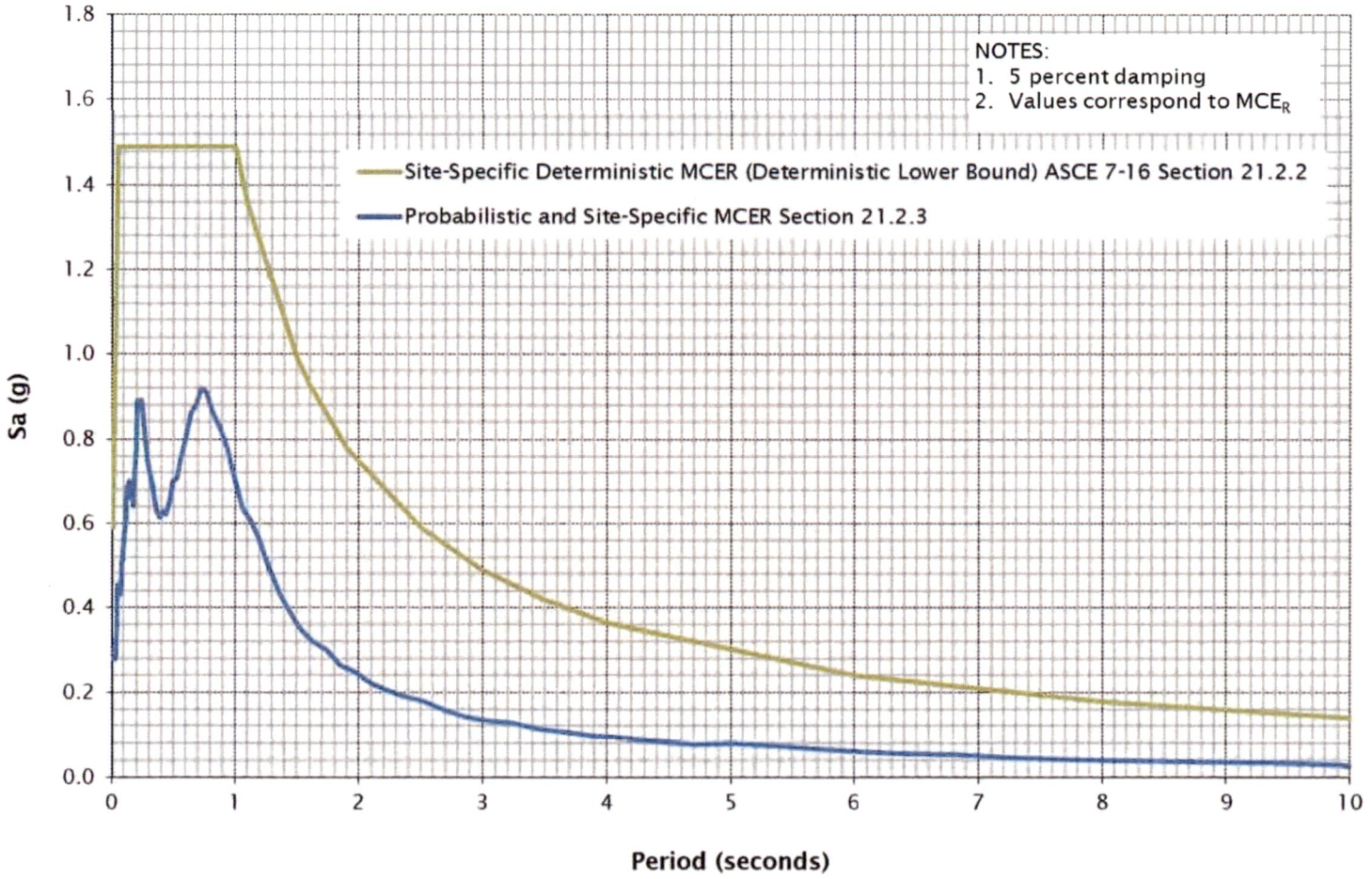


GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	ARONFA-1-01	**SITE RESPONSE SPECTRA**
	MAY 2019	AURORA AIRPORT BUSINESS CENTER AURORA, OR — **FIGURE D-3**

AronFA-1-01-FD3_D6.docx Print Date: 5/13/19

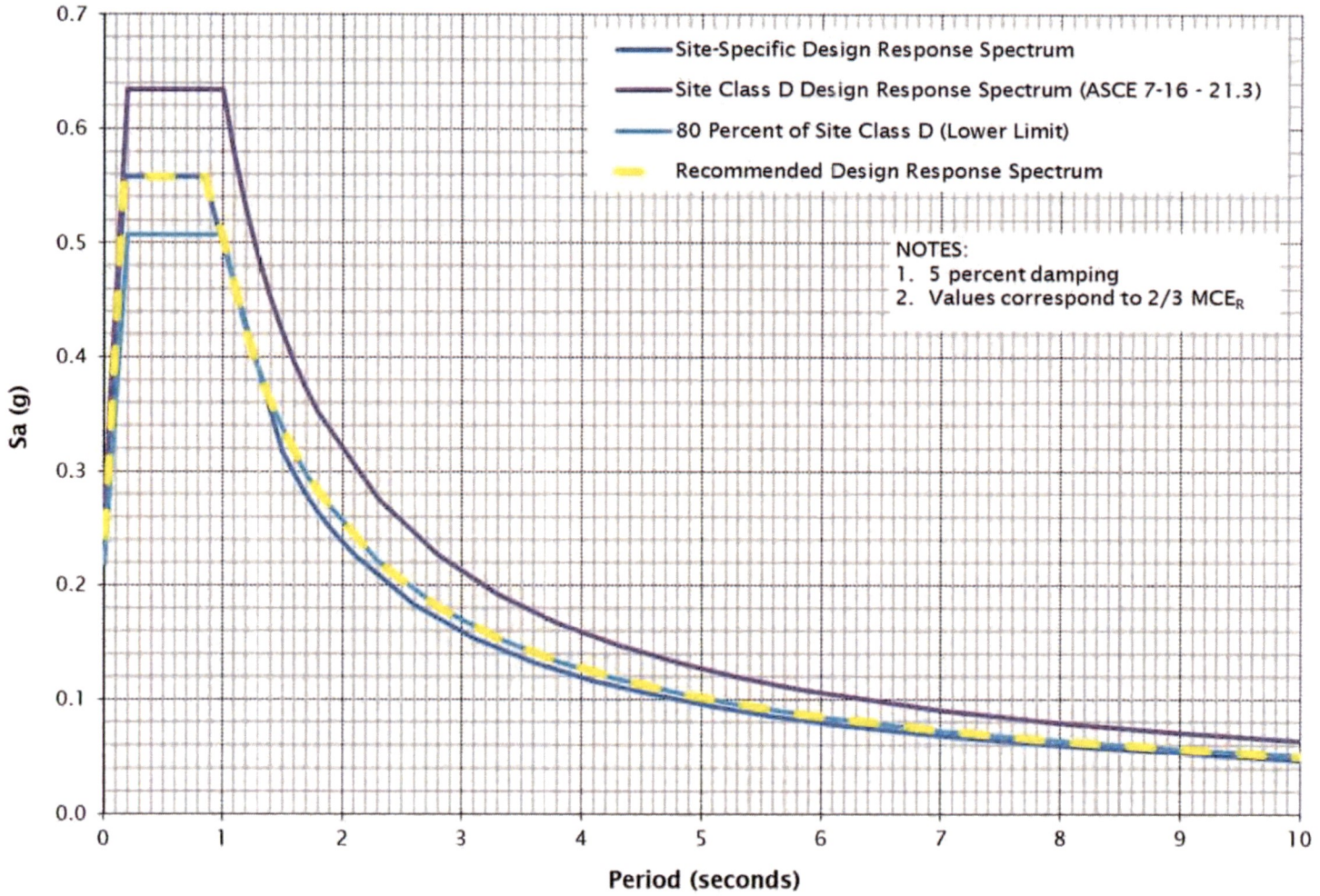


GeoDesign Inc 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	ARONFA-1-01	SAR PLOT	
	MAY 2019	AURORA AIRPORT BUSINESS CENTER AURORA, OR	FIGURE D-4



GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	ARONFA-1-01	**SITE-SPECIFIC RESPONSE SPECTRA**	
	MAY 2019	AURORA AIRPORT BUSINESS CENTER AURORA, OR	**FIGURE D-5**

AronFA-1-01-FD3_D6.docx Print Date: 5/13/19



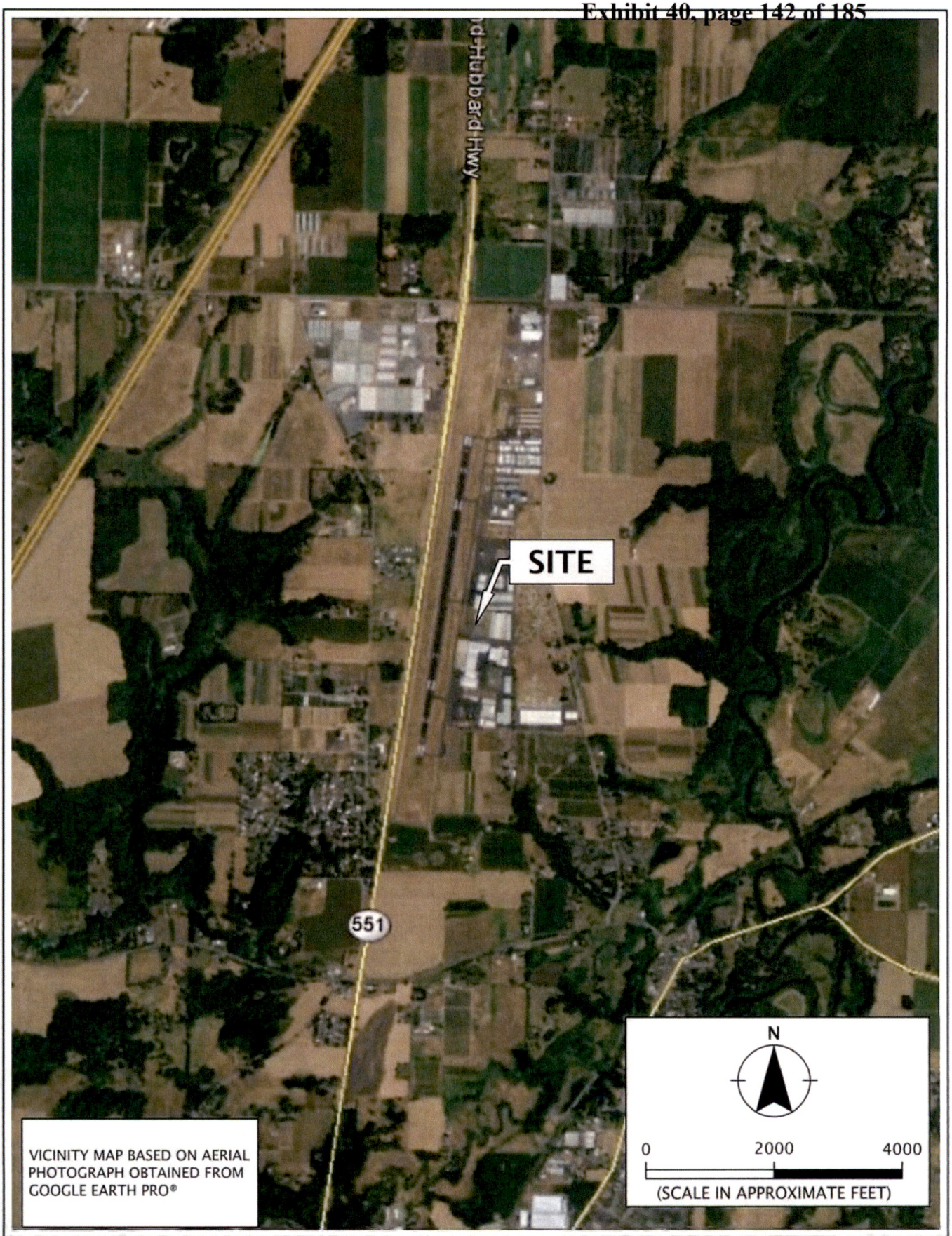
GeoDesign Inc 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	ARONFA-1-01	**DESIGN RESPONSE SPECTRUM**	
	MAY 2019	AURORA AIRPORT BUSINESS CENTER AURORA, OR	**FIGURE D-6**

APPENDIX E

APPENDIX E

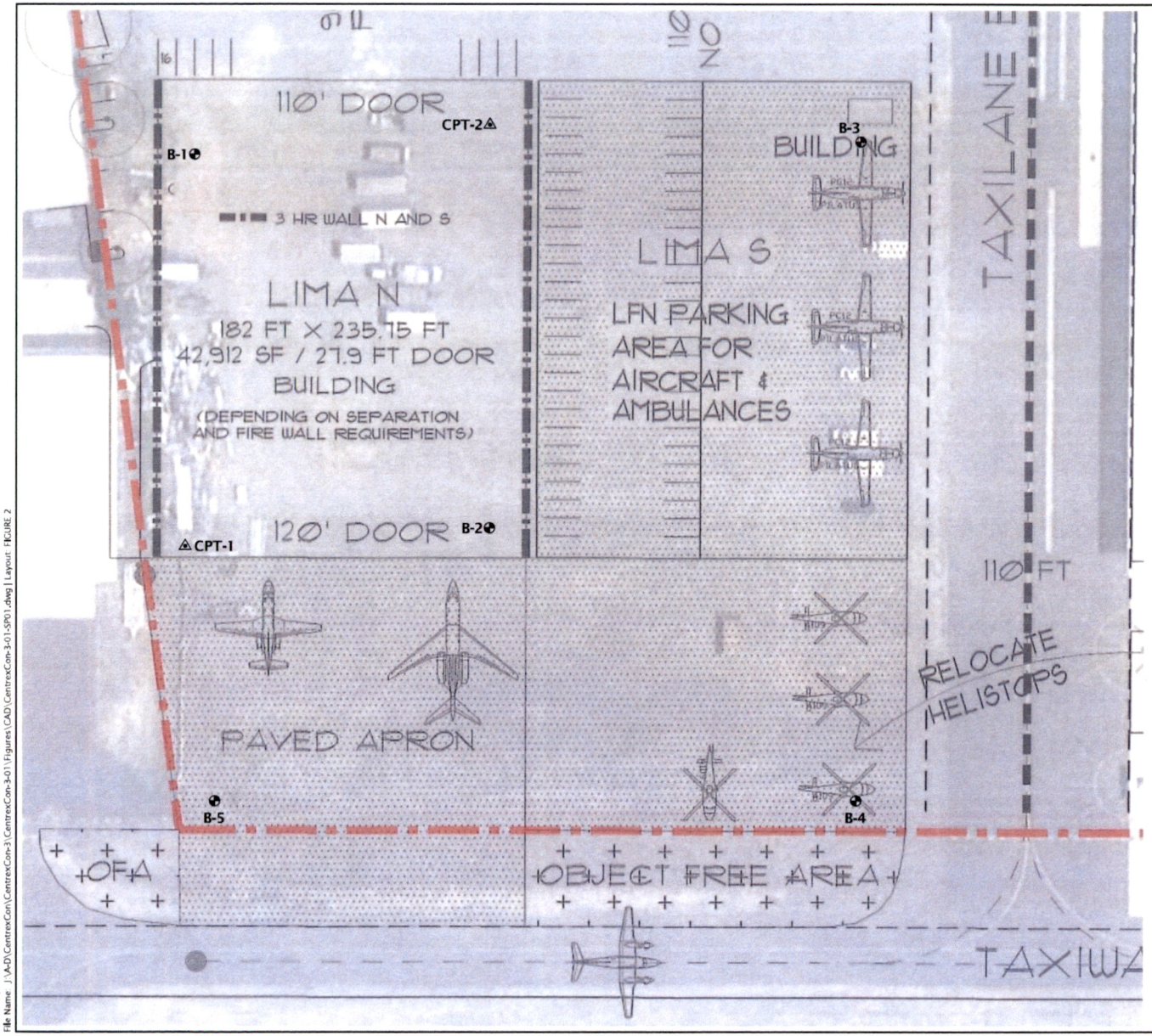
FIELD EXPLORATIONS (OFF SITE)

The results of the borings and CPT probes completed on the nearby Lima North Hangar and fuel farm site are presented in this appendix. The locations of the sites relative to the AABC site are shown on Figure 1.



GeoDesign Inc 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CENTREXCON-3-01	**VICINITY MAP**
	JANUARY 2019	LIMA NORTH HANGAR AURORA, OR — **FIGURE 1**

Printed By: mmiller | Print Date: 1/17/2019 11:43:02 AM
File Name: J:\A-D\CentrexCon\CentrexCon-3\CentrexCon-3-01\Figures\CAD\CentrexCon-3-01-VM01.dwg | Layout: FIGURE 1



LEGEND:

B-1	BORING
CPT-1	CONE PENETRATION TEST

N

0 50 100

(SCALE IN FEET)

SITE PLAN BASED ON IMAGE OF PAGE L1.0
MASTER SITE PLAN DATED 1/5/2018
PREPARED BY ARON FAEGRE ARCHITECT

SITE PLAN

LIMA NORTH HANGAR
AURORA, OR

FIGURE 2

CENTREXCON-3-01

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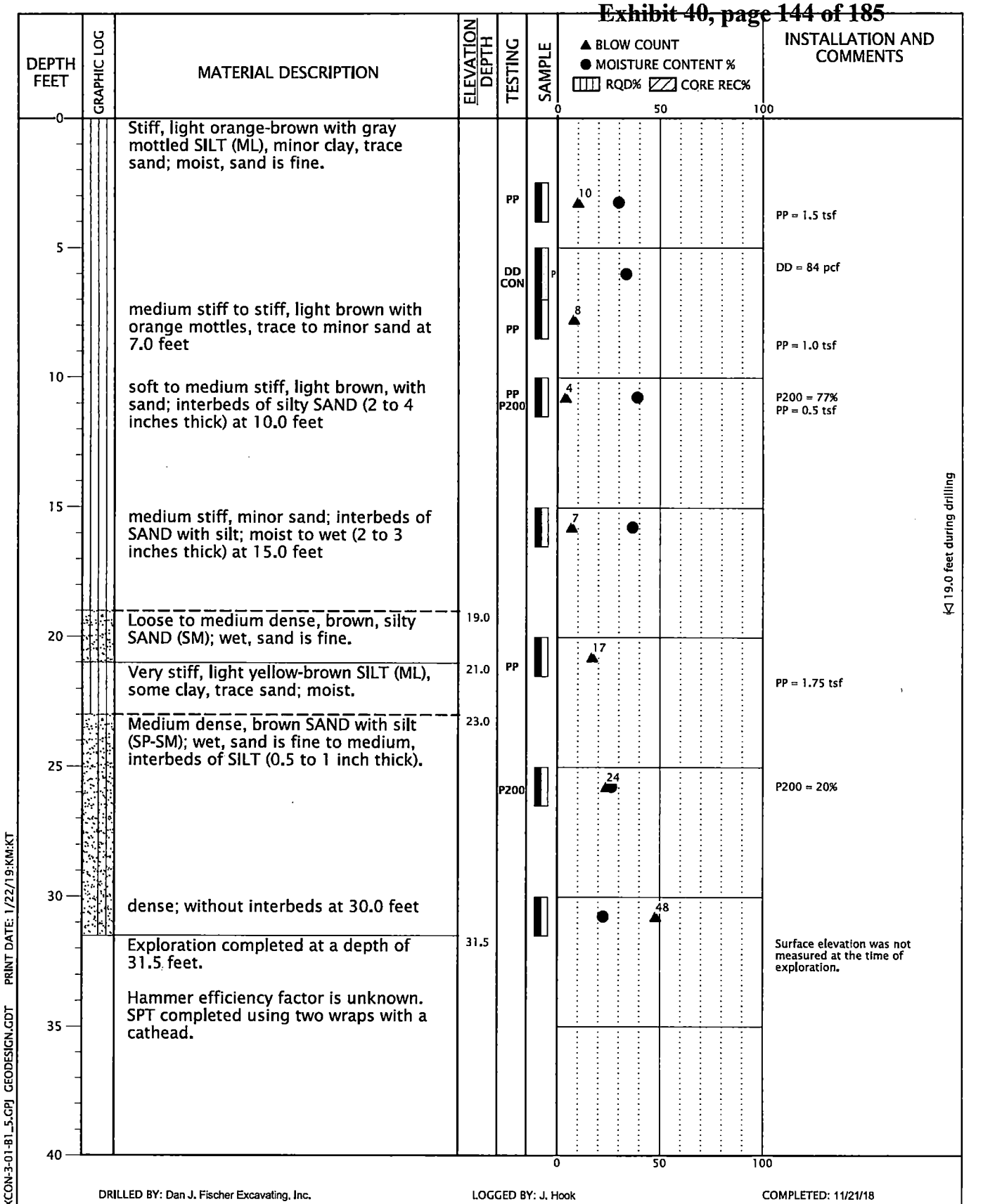
Printed By: mmiller | Print Date: 1/17/2019 11:43:09 AM
File Name: J:\A-D\CentrexCon\CentrexCon-3\CentrexCon-3-01\Figures\CAD\CentrexCon-3-01-SP01.dwg | Layout: FIGURE 2



DRILLED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: J. Hook COMPLETED: 11/21/18

BORING METHOD: solid-stem auger (see document text) BORING BIT DIAMETER: 4 inches

BORING LOG CENTREXCON-3-01-B1_5.GPJ GEODESIGN.GDT PRINT DATE: 1/22/19:KM:KT

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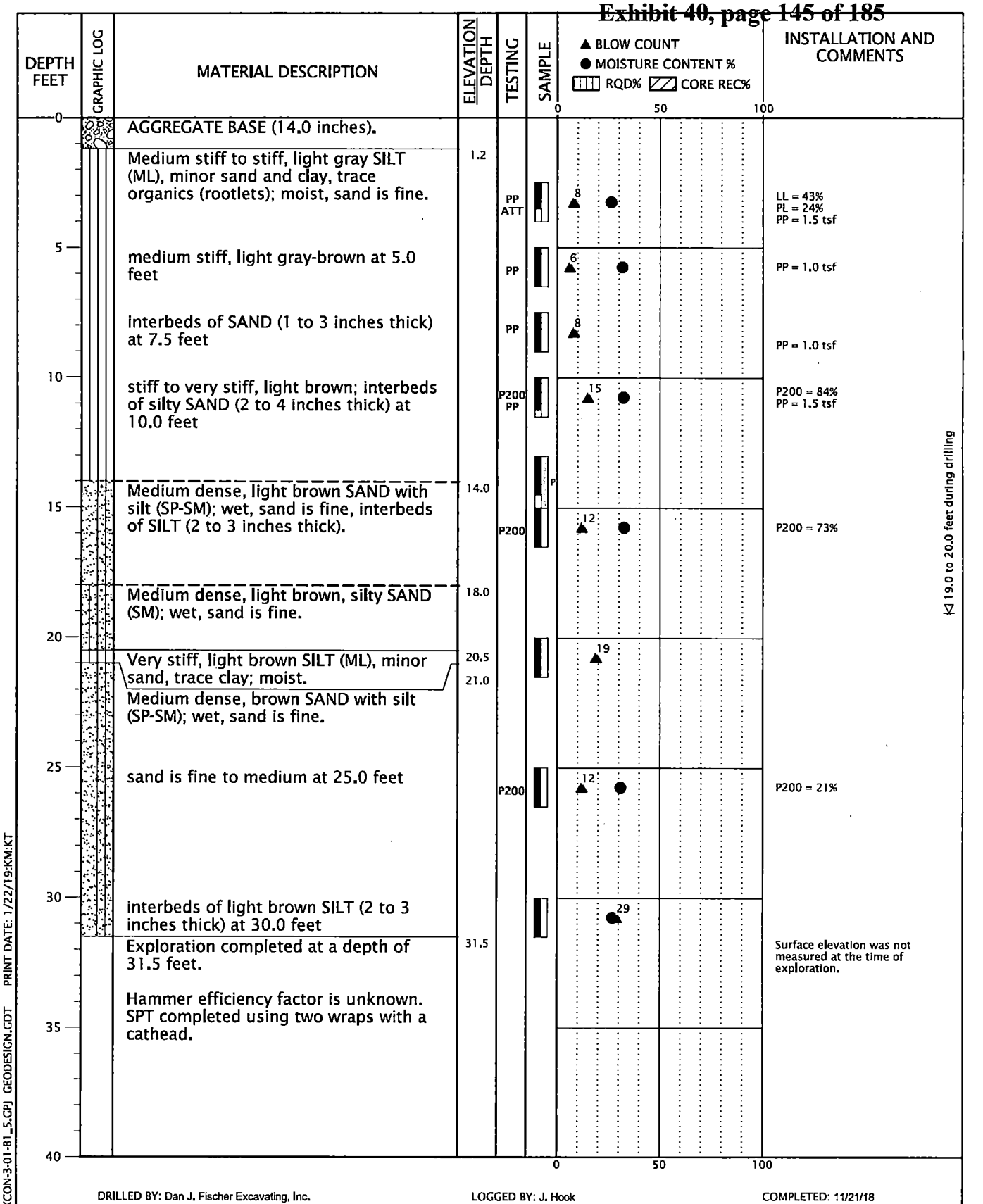
CENTREXCON-3-01

BORING B-1

JANUARY 2019

LIMA NORTH HANGAR
AURORA, OR

FIGURE A-1



DRILLED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: J. Hook COMPLETED: 11/21/18

BORING METHOD: solid-stem auger (see document text) BORING BIT DIAMETER: 4 inches

BORING LOG CENTREXCON-3-01-B1_5.GPJ GEODESIGN.GDT PRINT DATE: 1/22/19:KM:KT

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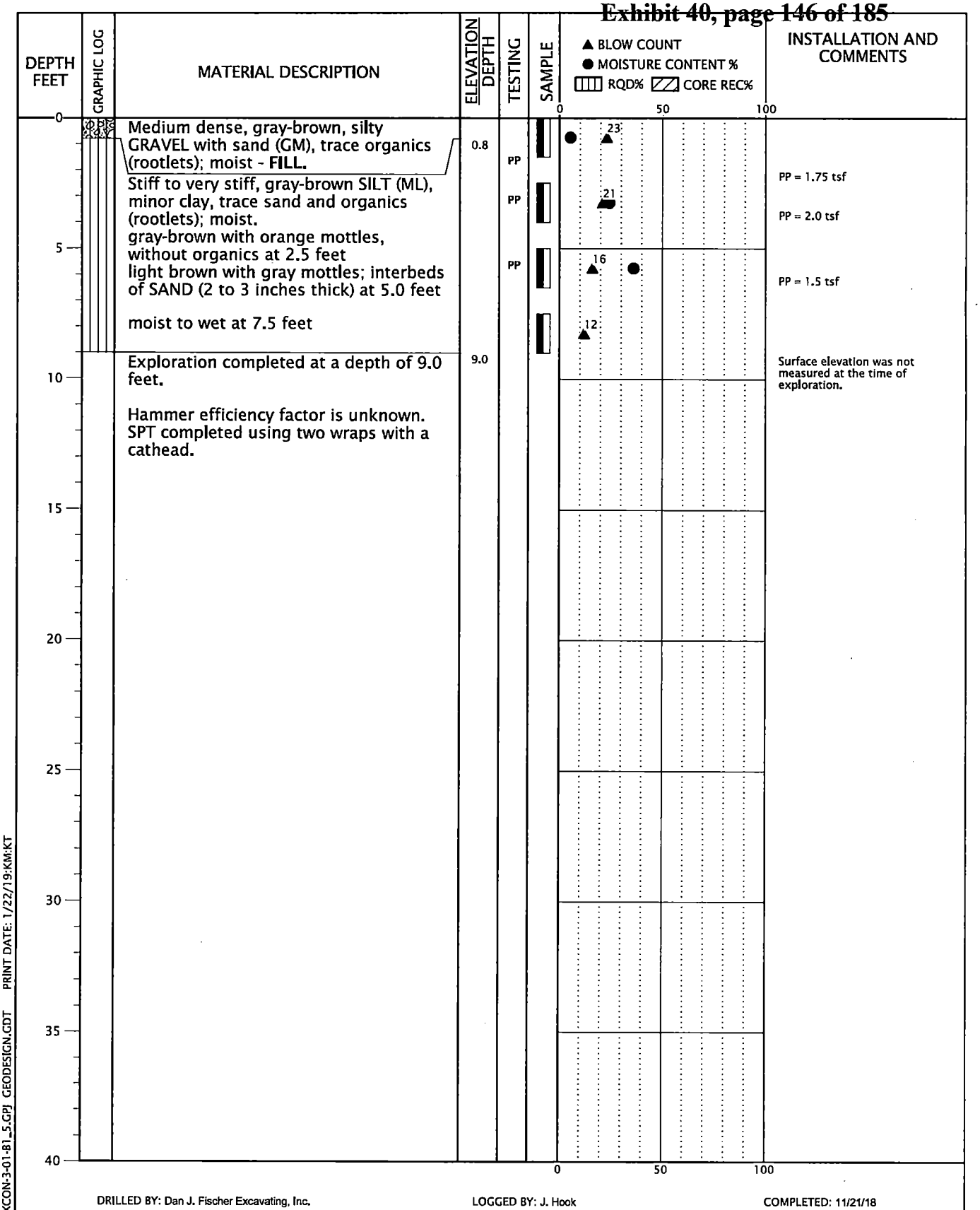
CENTREXCON-3-01

BORING B-2

JANUARY 2019

LIMA NORTH HANGAR
AURORA, OR

FIGURE A-2



DRILLED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: J. Hook COMPLETED: 11/21/18

BORING METHOD: solid-stem auger (see document text) BORING BIT DIAMETER: 4 inches

BORING LOG CENTREXCON-3-01-B1_5.GPJ GEODESIGN.GDT PRINT DATE: 1/22/19:KM:KT

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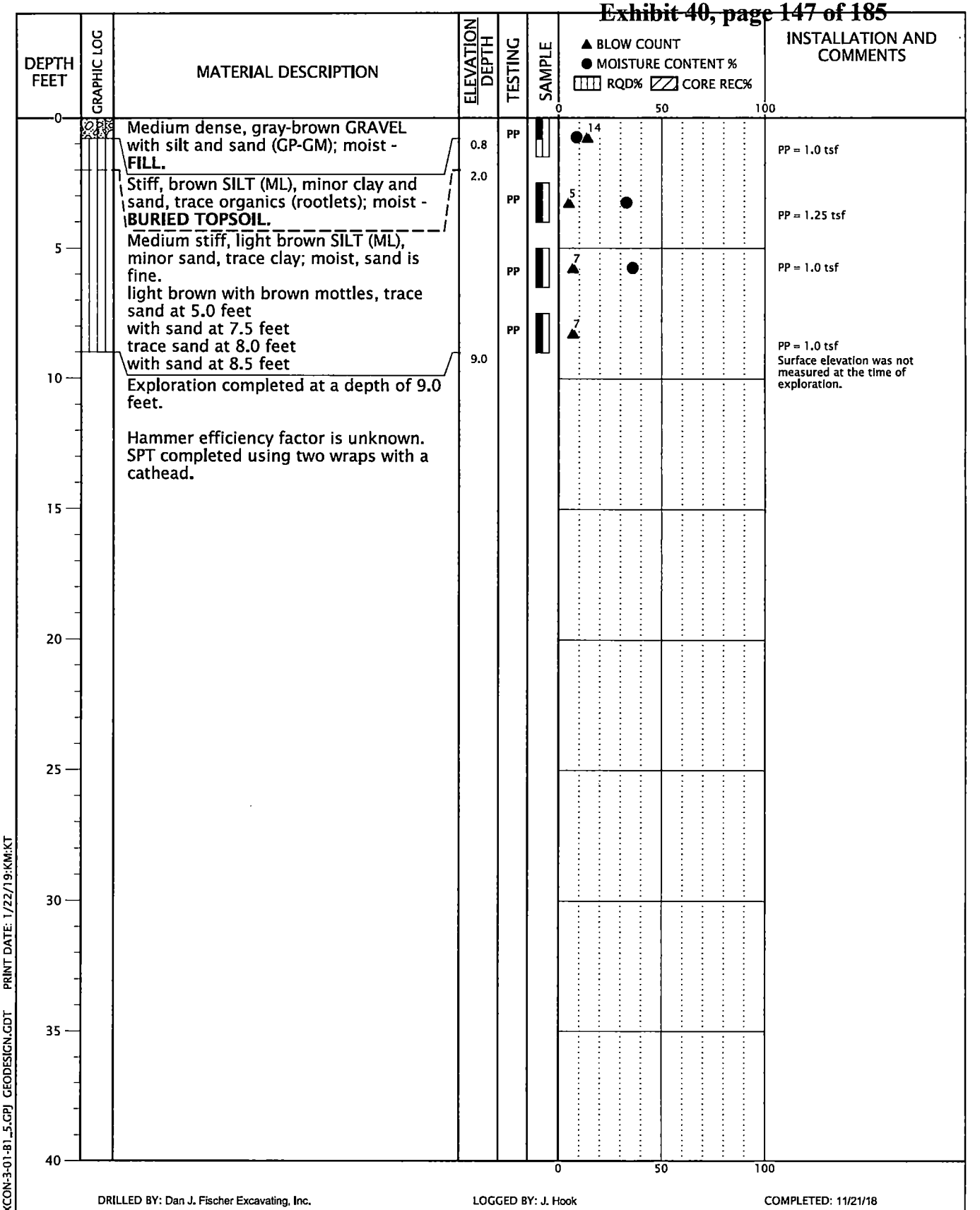
CENTREXCON-3-01	**BORING B-3**	
JANUARY 2019	LIMA NORTH HANGAR AURORA, OR	**FIGURE A-3**



DRILLED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: J. Hook COMPLETED: 11/21/18

BORING METHOD: solid-stem auger (see document text) BORING BIT DIAMETER: 4 inches

BORING LOG CENTREXCON-3-01-81_5.GPJ GEODESIGN.GDT PRINT DATE: 1/22/19:KM:KT

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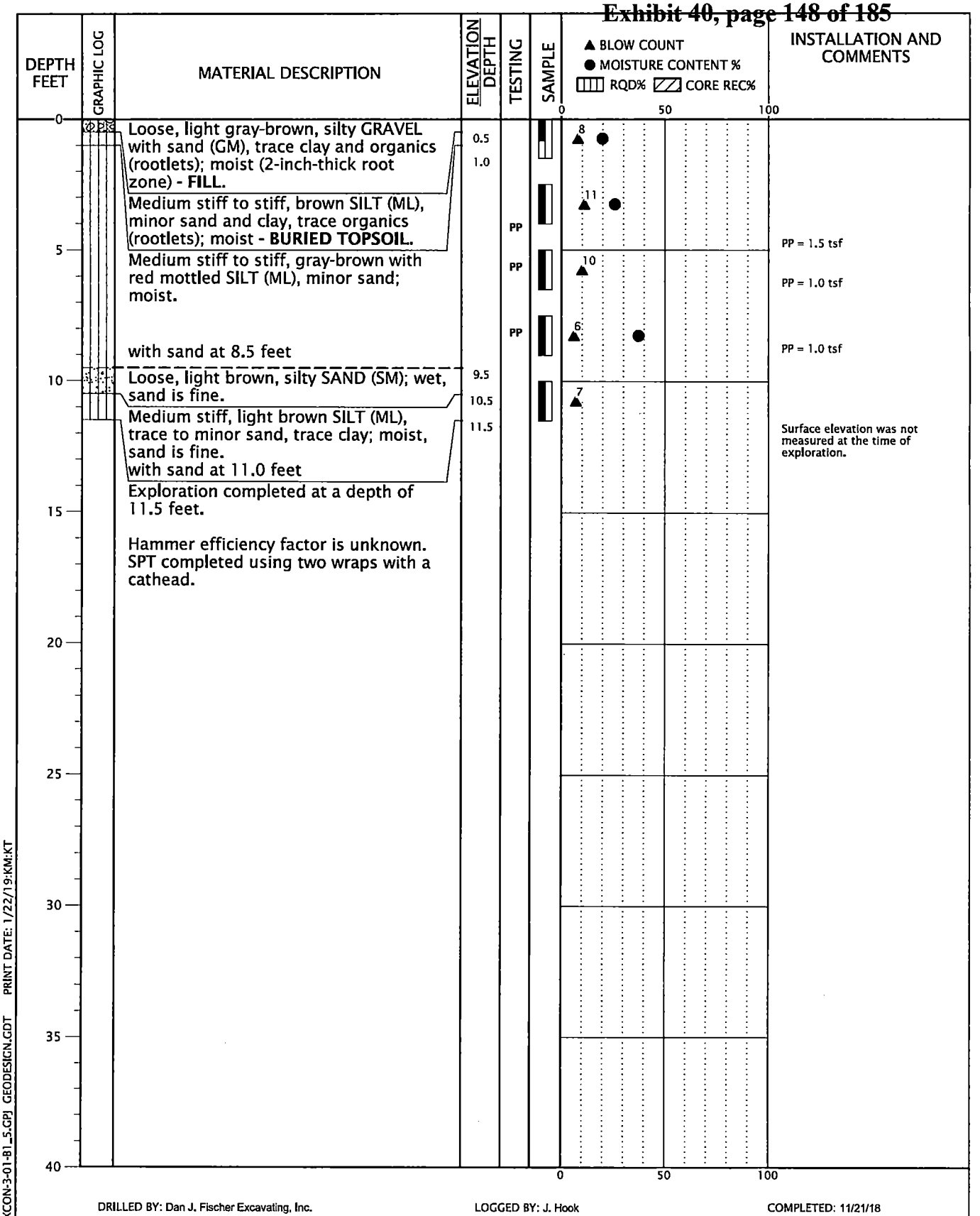
CENTREXCON-3-01	**BORING B-4**	
JANUARY 2019	LIMA NORTH HANGAR AURORA, OR	**FIGURE A-4**



DRILLED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: J. Hook COMPLETED: 11/21/18

BORING METHOD: solid-stem auger (see document text) BORING BIT DIAMETER: 4 inches

BORING LOG CENTREXCON-3-01-B1_5.GPJ GEODESIGN.GDT PRINT DATE: 1/22/19:KM:KT

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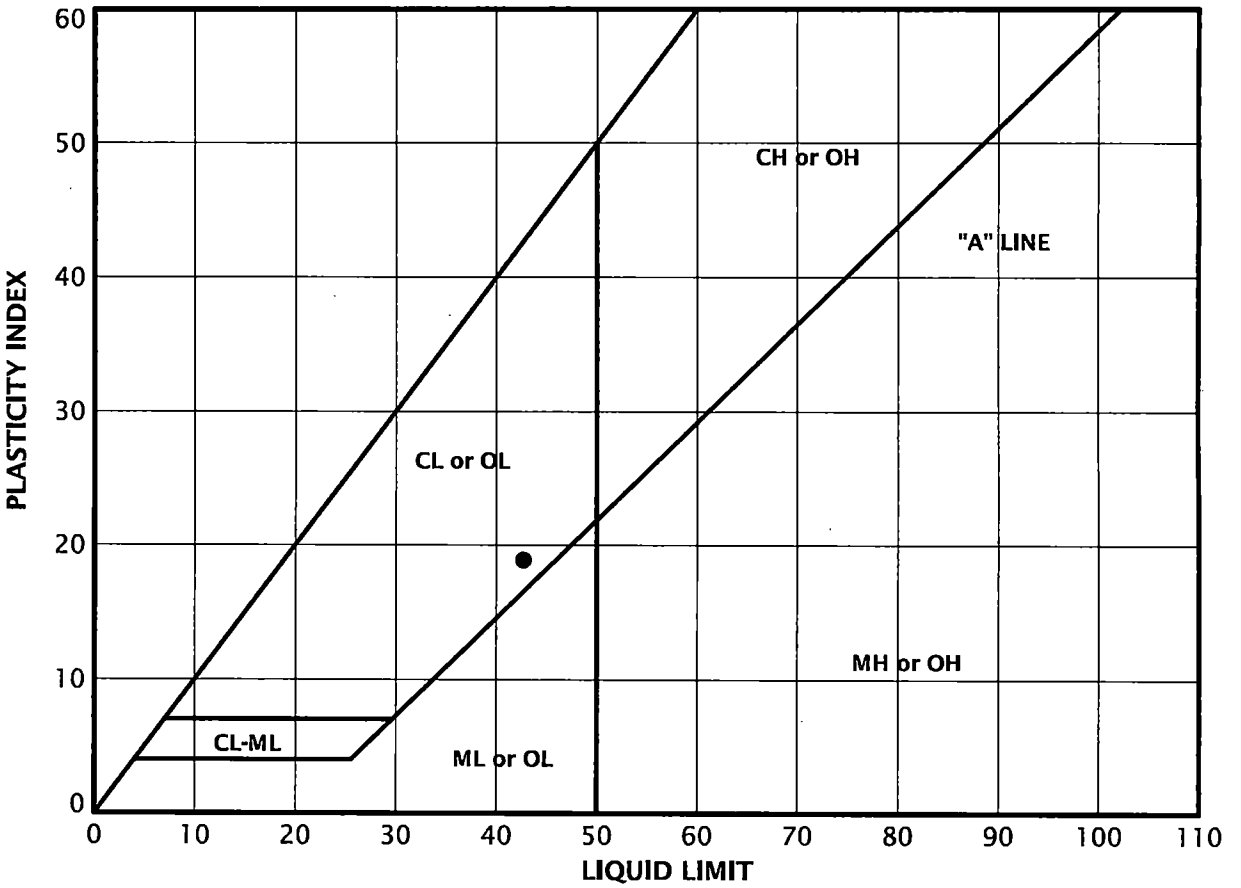
CENTREXCON-3-01	**BORING B-5**	
JANUARY 2019	LIMA NORTH HANGAR AURORA, OR	**FIGURE A-5**



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
●	B-2	2.5	26	43	24	19

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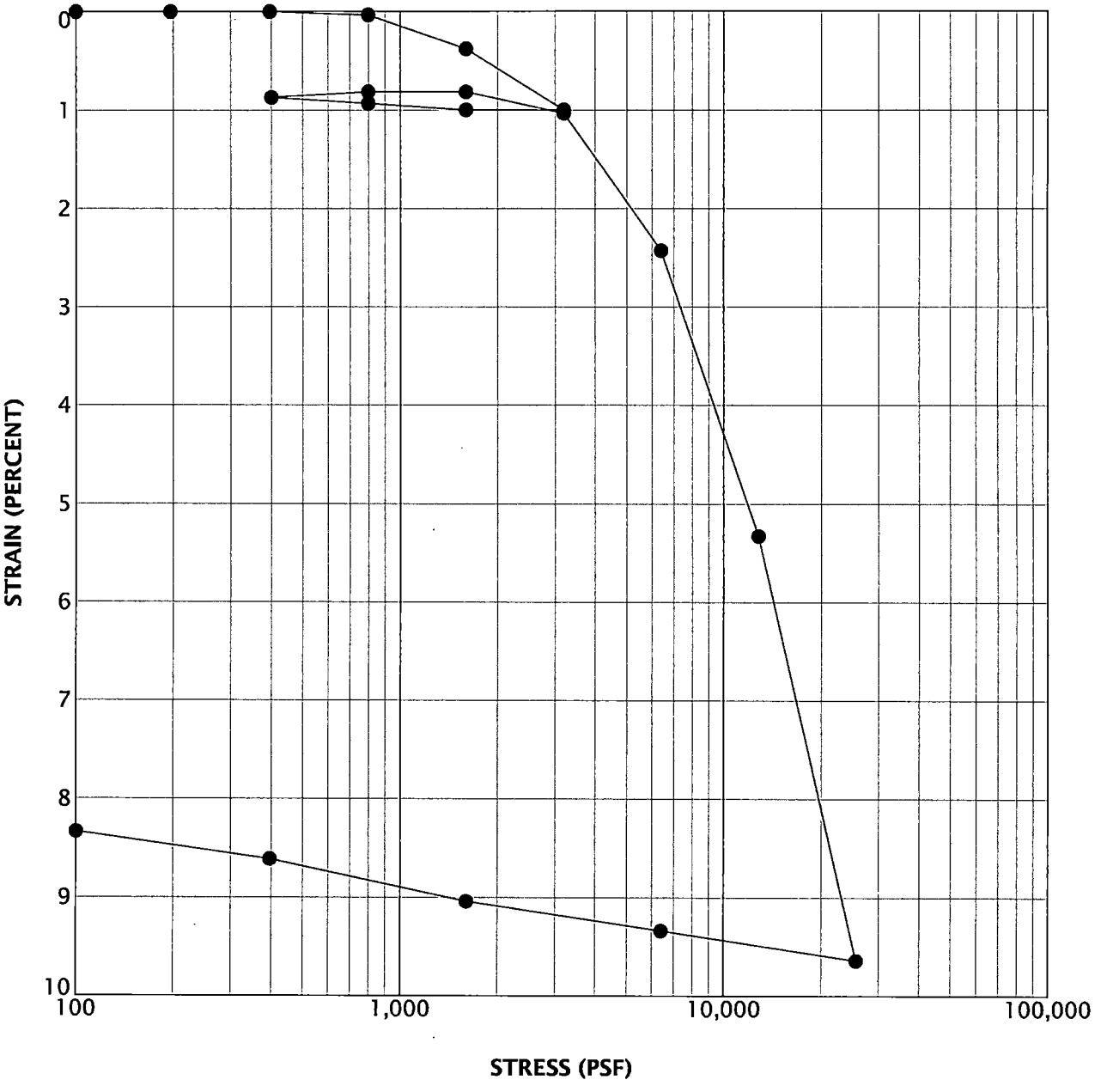
CENTREXCON-3-01	**ATTERBERG LIMITS TEST RESULTS**	
JANUARY 2019	LIMA NORTH HANGAR AURORA, OR	**FIGURE A-6**

ATTERBERG_LIMITS 7 CENTREXCON-3-01-B1_5.GPJ GEODESIGN.GDT PRINT DATE: 1/17/19:KM



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)
●	B-1	5.0	34	84

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CENTREXCON-3-01	**CONSOLIDATION TEST RESULTS**	
JANUARY 2019	LIMA NORTH HANGAR AURORA, OR	**FIGURE A-7**

CONSOL_STRAIN_100K CENTREXCON-3-01-81_5.GPJ GEODESIGN.GDT PRINT DATE: 1/17/19:KM

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-1	2.5		30							
B-1	5.0		34	84						
B-1	10.0		39				77			
B-1	15.0		37							
B-1	25.0		26				20			
B-1	30.0		22							
B-2	2.5		26					43	24	19
B-2	5.0		32							
B-2	10.0		32				84			
B-2	15.0		33				73			
B-2	25.0		31				21			
B-2	30.0		27							
B-3	0.0		5							
B-3	2.5		24							
B-3	5.0		36							
B-4	0.0		9							
B-4	2.5		33							
B-4	5.0		36							
B-5	0.0		20							
B-5	2.5		26							
B-5	7.5		37							

LAB SUMMARY CENTREXCON-3-01-B1_5.GPJ GEODESIGN.GDT PRINT DATE: 1/17/19:KM

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CENTREXCON-3-01

SUMMARY OF LABORATORY DATA

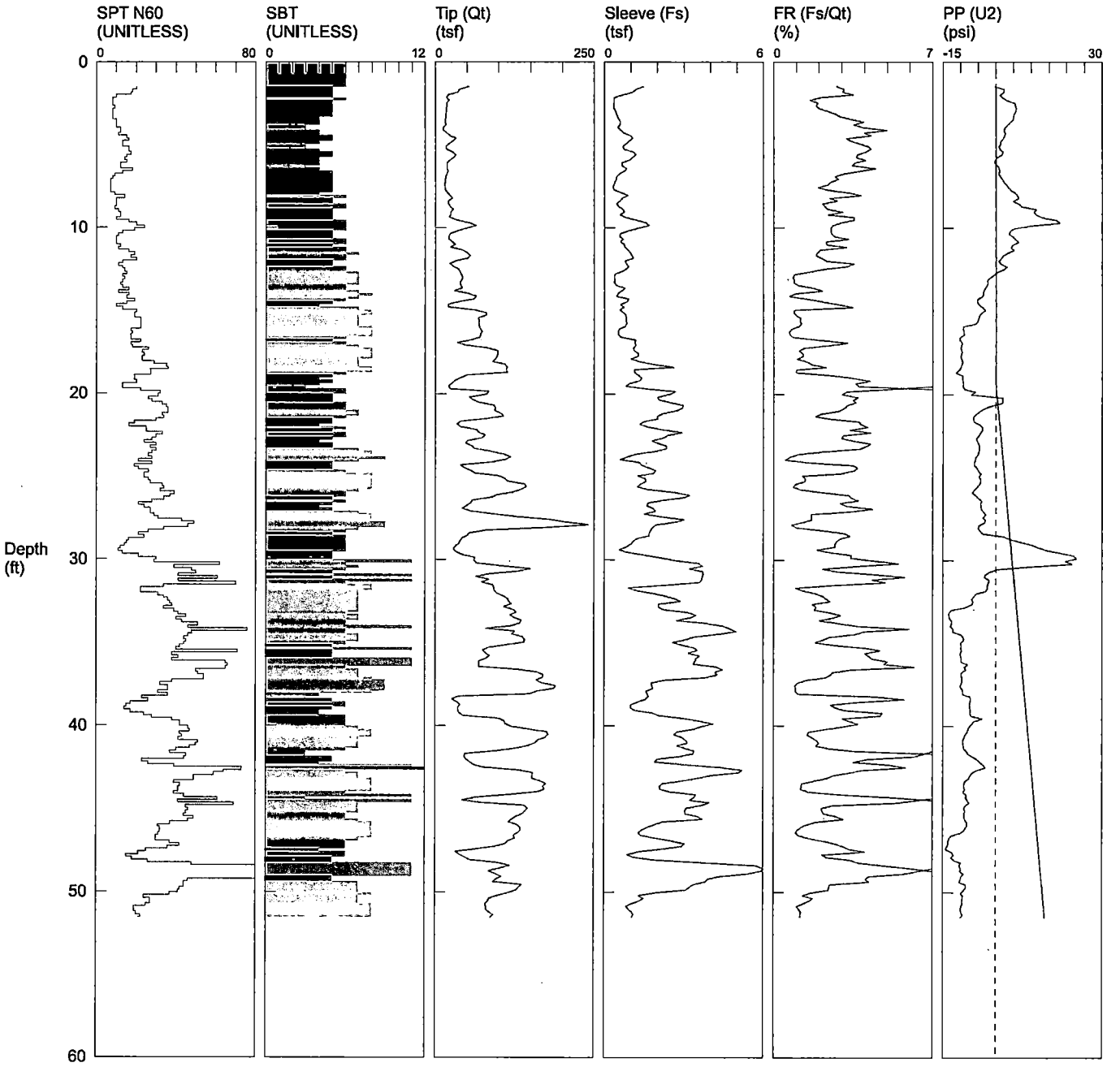
JANUARY 2019

LIMA NORTH HANGAR
AURORA, OR

FIGURE A-8

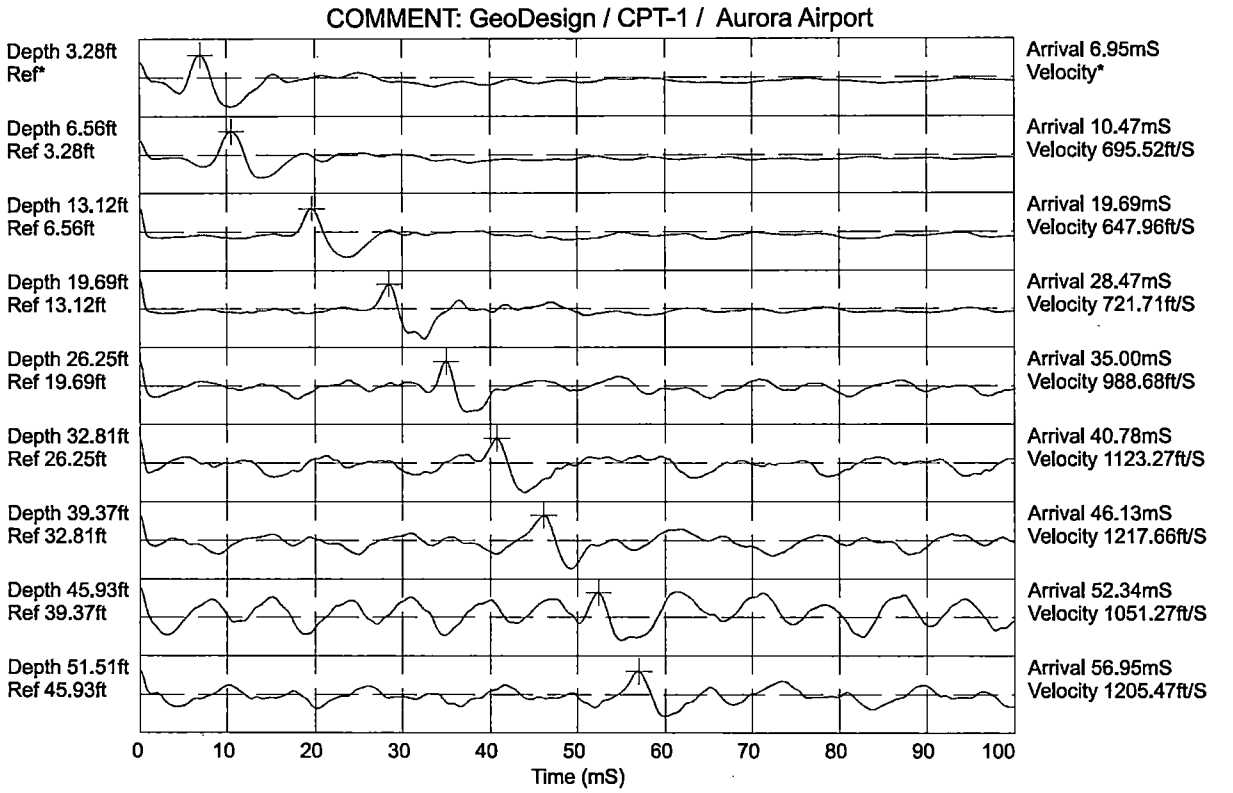
GeoDesign / CPT-1 / Aurora Airport

OPERATOR: OGE BAK
CONE ID: DPG1386
HOLE NUMBER: CPT-1
TEST DATE: 11/21/2018 8:52:39 AM
TOTAL DEPTH: 51.509 ft

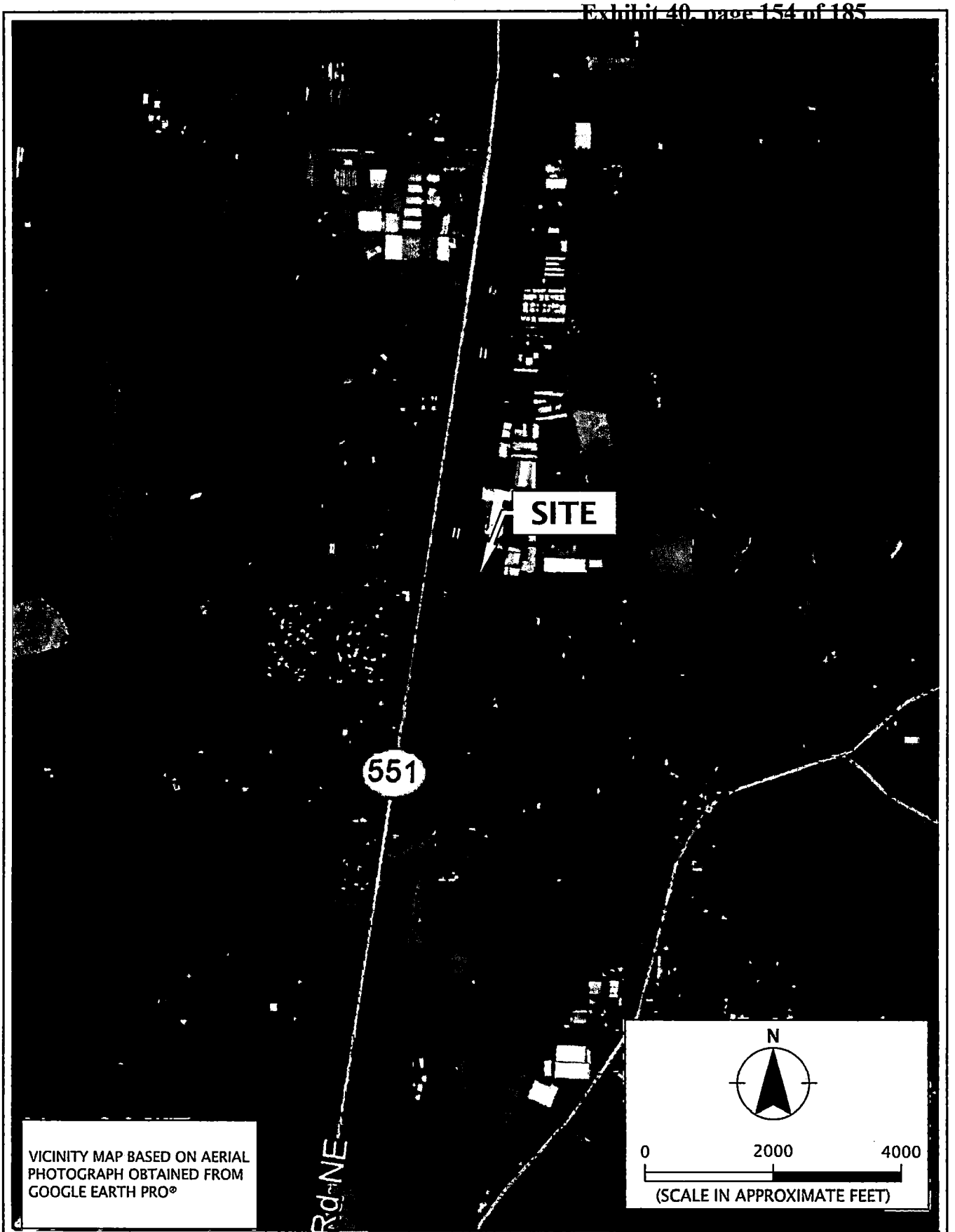


1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty clay
6 sandy silt to clayey silt
7 silty sand to sandy silt
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983



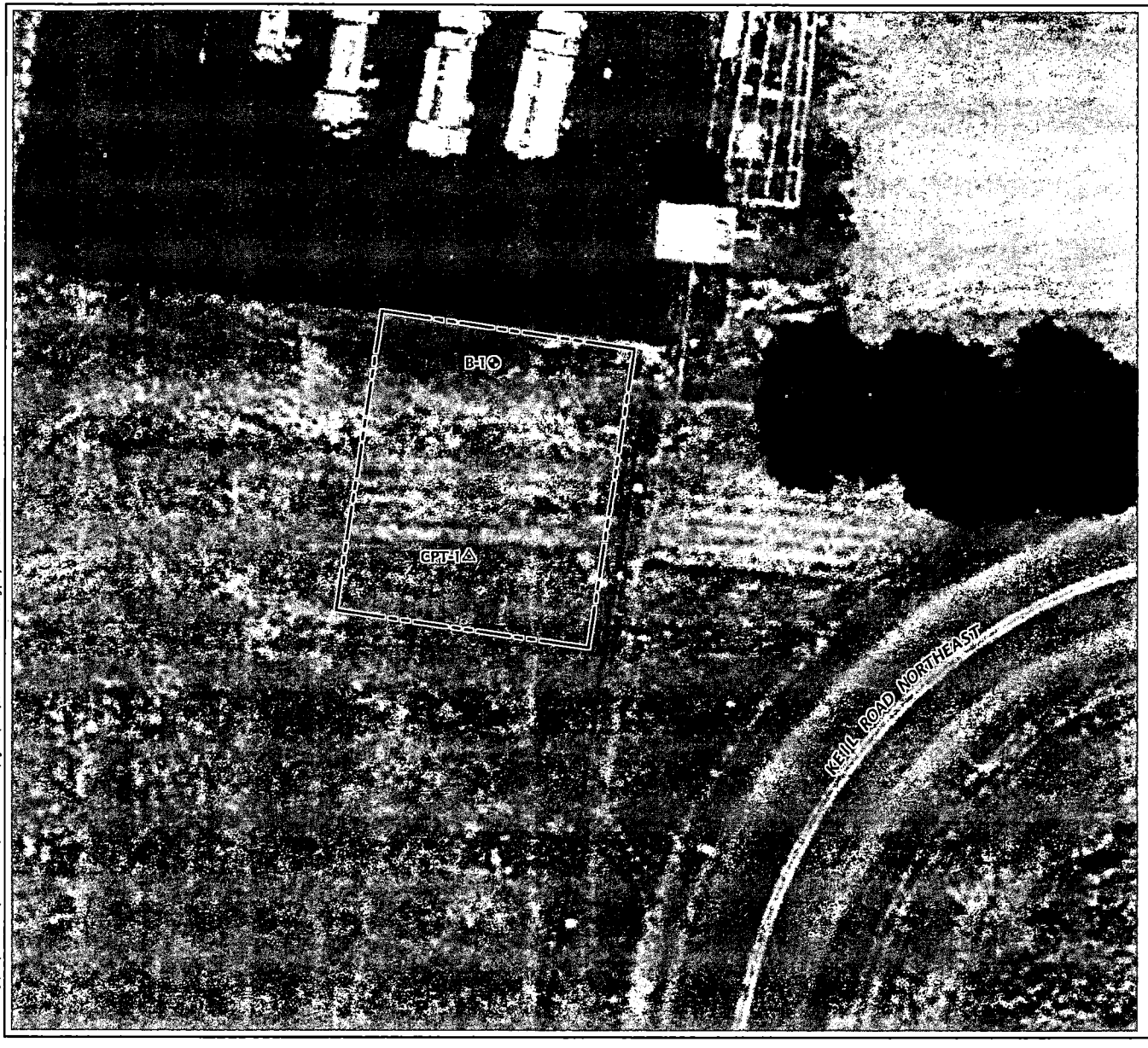
Hammer to Rod String Distance (ft): 4.27
* = Not Determined



VICINITY MAP BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®

GEODESIGN INC 9450 SW Commerce Circle • Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CENTEREXCON-4-01	VICINITY MAP	
	MARCH 2019	AURORA AIRPORT FUEL FARM AURORA, OR	FIGURE 1

Printed By: mmiller | Print Date: 3/6/2019 4:52:23 PM
File Name: J:\A-D\CentrexCon\CentrexCon-4\CentrexCon-4-01\Figures\CAD\CentrexCon-4-01-VM01.dwg | Layout: FIGURE 1



LEGEND:

- SITE BOUNDARY
- B-1 BORING
- CPT-1 CONE PENETRATION TEST

N

0 20 40

(SCALE IN FEET)

SITE PLAN BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®, MARCH 6, 2019

SITE PLAN

AURORA AIRPORT FUEL FARM
AURORA, OR

CENTEREXCON-4-01

MARCH 2019

FIGURE 2

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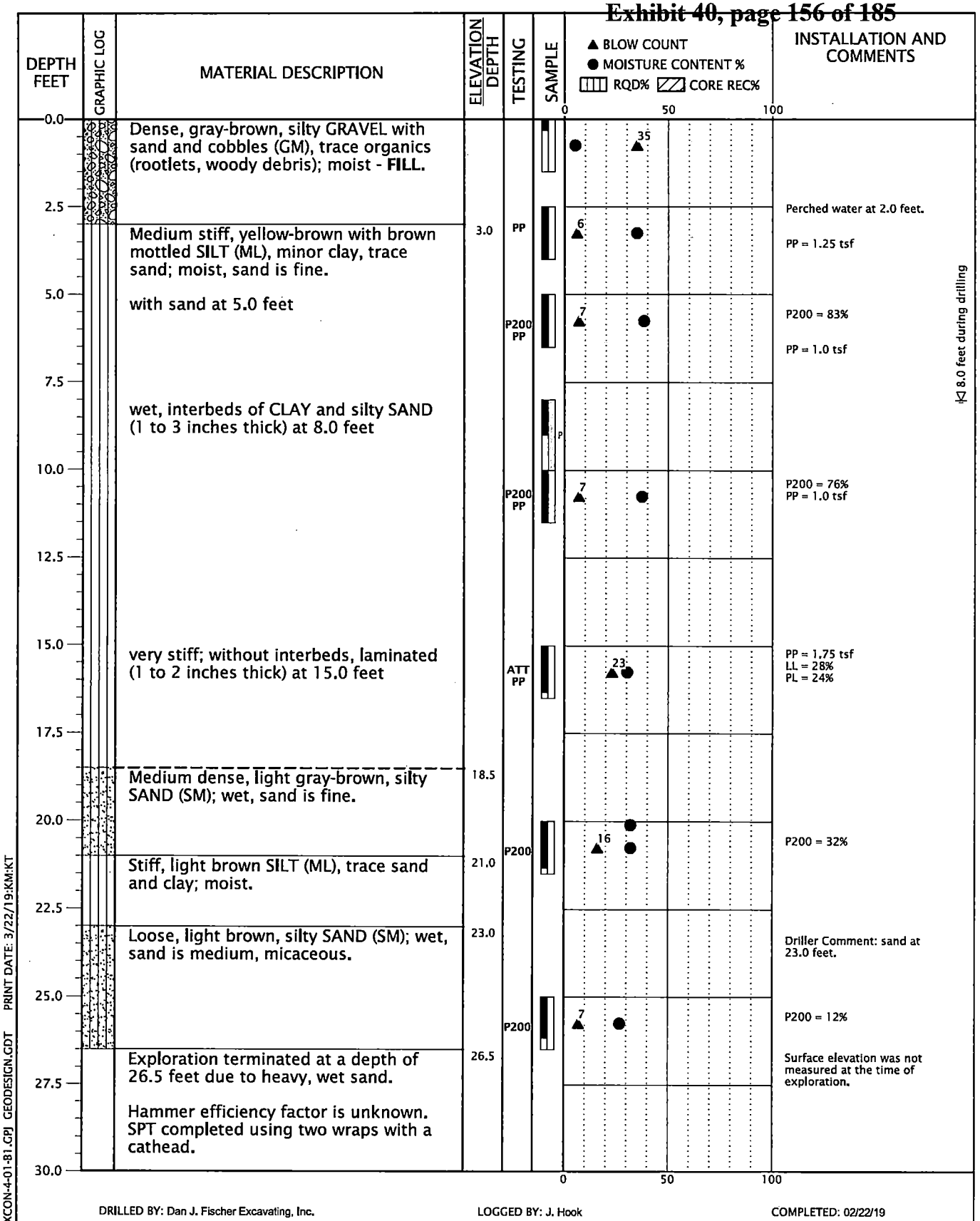
Printed By: mmiller | Print Date: 3/6/2019 4:52:25 PM
File Name: J:\A-D\CentrexCon\CentrexCon-4\CentrexCon-4-01\Figures\CAD\CentrexCon-4-01-SP01.dwg | Layout: FIGURE 2



DRILLED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: J. Hook COMPLETED: 02/22/19

BORING METHOD: solid-stem auger (see document text) BORING BIT DIAMETER: 4 inches

BORING LOG CENTREXCON-4-01-B1.GPJ GEODESIGN.GDT PRINT DATE: 3/22/19:KM:KT

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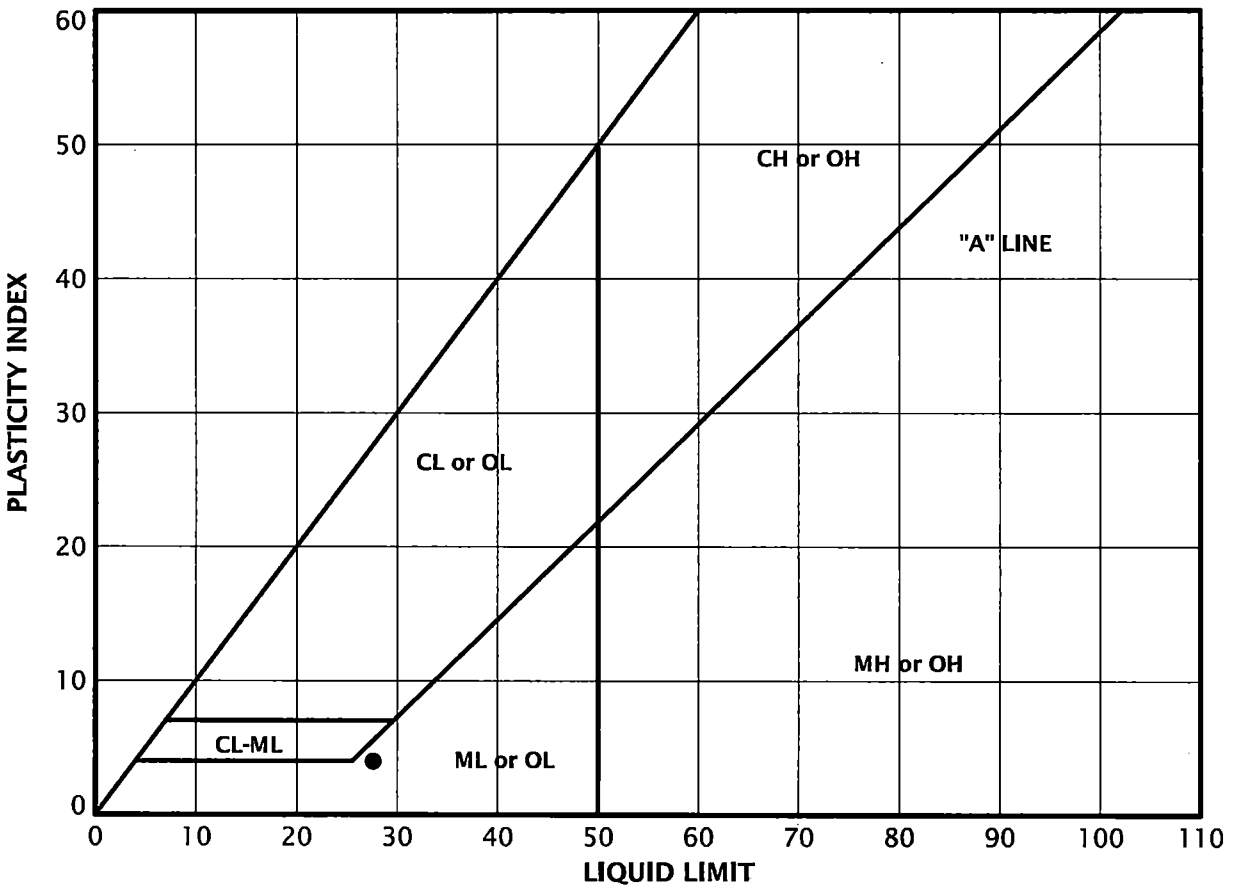
CENTREXCON-4-01

BORING B-1

MARCH 2019

AURORA AIRPORT FUEL FARM
AURORA, OR

FIGURE A-1



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
●	B-1	15.0	30	28	24	4

ATTERBERG_LIMITS 7 CENTREXCON-4-01-B1.GPJ GEODESIGN.GDT PRINT DATE: 3/13/19:KM

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CENTREXCON-4-01	**ATTERBERG LIMITS TEST RESULTS**	
MARCH 2019	AURORA AIRPORT FUEL FARM AURORA, OR	**FIGURE A-2**

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-1	0.0		5							
B-1	2.5		35							
B-1	5.0		38				83			
B-1	10.0		37				76			
B-1	15.0		30					28	24	4
B-1	20.0		32				32			
B-1	20.1		32							
B-1	25.0		27				12			

LAB SUMMARY CENTREXCON-4-01-81.GPJ GEODESIGN.GDT PRINT DATE: 3/13/19:KM

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CENTREXCON-4-01

SUMMARY OF LABORATORY DATA

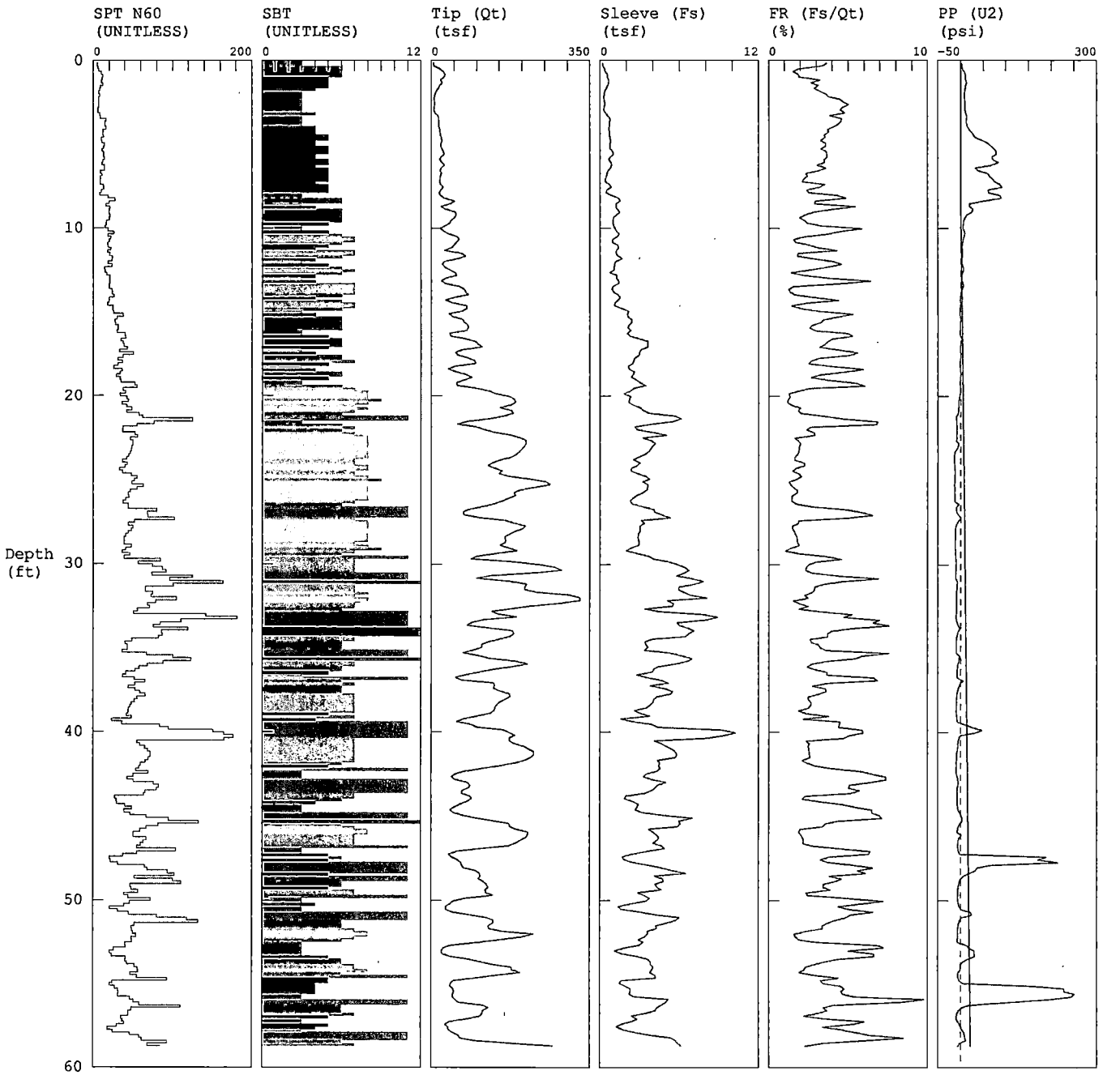
MARCH 2019

AURORA AIRPORT FUEL FARM
AURORA, OR

FIGURE A-3

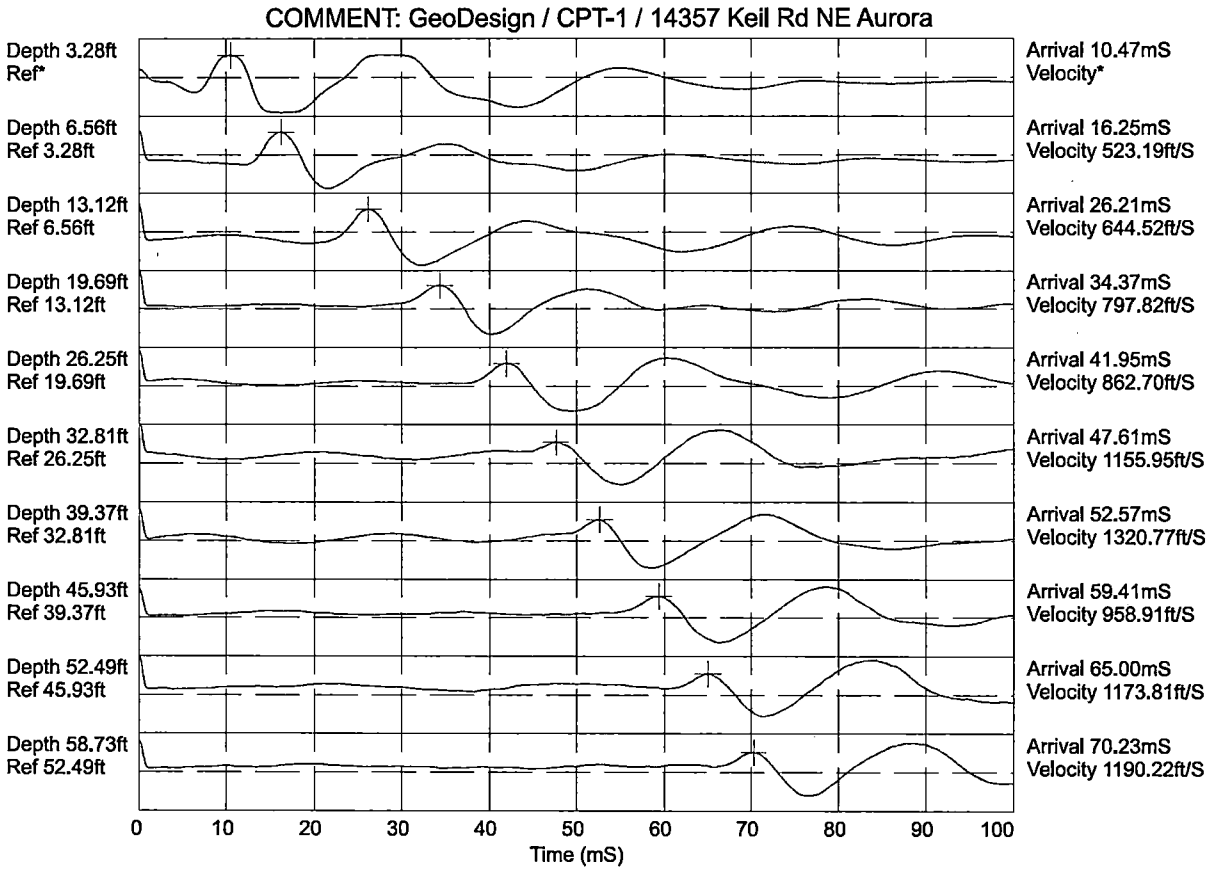
GeoDesign / CPT-1 / 14357 Keil Rd NE Aurora

OPERATOR: OGE DMM
CONE ID: DPG1323
HOLE NUMBER: CPT-1
TEST DATE: 2/18/2019 8:34:35 AM
TOTAL DEPTH: 58.727 ft



1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty c
6 sandy silt to clayey s
7 silty sand to sandy sil
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983



Hammer to Rod String Distance (ft): 1.97
* = Not Determined

Attachment D – 2010 Downstream Analysis and Detention Design (HTS)

GROUP MACKENZIE

STORMWATER REPORT

DOWNSTREAM ANALYSIS AND DETENTION DESIGN
Helicopter Transport Services

To
Marion County
Department of Public Works

For
Helicopter Transport Services
Aurora, OR

Prepared
June 9, 2010

Project Number
2100114.00

GROUP MACKENZIE
Since 1960
RiverEast Center, 1515 SE Water Ave #100, Portland, OR 97214
PO Box 14310 Portland, OR 97293
T 503.224.9560 360.695.7879 F 503.228.1285 groupmackenzie.com

GROUP MACKENZIE

1. INTRODUCTION

This project proposes to construct a 134,903 sf building to house a company, Helicopter Transport Services. Site improvements include grading, drainage, utility, and parking areas to serve the facility. One new approach to Keil Road and outdoor helicopter storage pads (80'x80' concrete pads) are proposed.

The proposed site is comprised of Parcels 100 and 400 of map located at the NW corner of the intersection of Keil Road and Airport Road, adjacent to the Southend Airpark. The proposed site runoff will route into a new onsite detention facility and then discharge into an existing drainage system along Airport Road.

The proposed drainage system follows the pre-established design criteria developed specifically to accomplish the detention (flow control) requirements established by Marion County.

2. PURPOSE

The purpose of this report is to demonstrate the compliance of the proposed drainage improvements with Marion County Public Works-Land Development Engineering Requirements. The post-developed 10-yr runoff rate will be discharged at the existing 5-yr runoff rate.

Conveyance calculations are completed for the project using the Rational Method for the 10-year event for on-site pipes.

Ditch conveyance calculations are provided for the Keil Road ditch, which is proposed to be regraded as part of the project.

A downstream analysis is provided for the downstream storm system along Airport Road to the southeast of the site. There are two downstream culverts, which are analyzed.

3. DESIGN ASSUMPTIONS AND METHODOLOGY

Standards	Marion County Engineering Standards (MC)	
Method:	Rational Method, using ODOT Hydraulics Manual (ODOT) And Marion County IDF Curve	
Design Storm:	Pre-Developed:	MC 5-year
	Developed:	MC 10-year
	Intensity:	MC Table I-D Curves
Time of Concentration:	Kinematic Wave Equation, 10 min. minimum, MC	
Runoff Coefficients:	MC Table 10	

4. EXISTING SITE CONDITIONS

The existing site consists of mainly pasture land and a few small structures, which are to be removed as necessary upon development. The site is very mildly sloped to the SE into two drainage ditches along the north side of Keil Road and west side of Airport Road. The drainage path crosses Keil Rd with an 18" diameter culvert. The runoff then flows south along the ditch along the west side of Airport Road, about 200' south to a 24" diameter culvert. This culvert flows east across Airport road into a significant deep, drainage swale.

The site is adjacent to the Southend Airpark, which consists of several properties of mostly built out condition. The Southend Airpark drains to the Keil Road ditch, which runs along the southern frontage of the project site. A drainage study dated August, 1999 by De Hass and Associates established the drainage capacity for the Keil Road ditch at 7.27 cfs. This accepted capacity for the ditch has dictated the stormwater detention requirements for the Southend Airpark. This project proposes to route the proposed runoff from the property into a detention facility, which will discharge into the Keil Road at the NW corner of intersection of Keil Road and Airport Road. Thus bypassing flow from the ditch along the property frontage. The ditch along Keil Road is proposed to be regraded to meet the Marion County street standards.

4. DETENTION CALCULATION SUMMARY

EXISTING CONDITIONS

Area Description	Area (AC)	Runoff Coefficent, C
Pasture	27.93	0.20
Total	27.93	0.20 combined

Time of Concentration, Tc = 32 minutes calculated using the SCS method see attached calculation sheet

Rainfall Intensity, i = 0.62 in/hr (5-yr rainfall intensity)

Q (flow rate) = C x I x A

Q = (0.20)(0.62)(27.93)

Q = 3.46 cfs = existing 5-yr runoff

PROPOSED CONDITIONS

Area Description	Area (AC)	Runoff Coefficent, C
Impervious*	22.34	0.90
Pervious	5.59	0.20
Total	27.93	0.76 combined

*80% impervious coverage for proposed condition, includes pavement, roof area.
Pervious area is landscape areas, parking islands.

GROUP MACKENZIE

10-yr proposed runoff to be detained to 5-yr existing runoff using rational method routing calculation. Required Pond Volume is 56,232 cf with 58,236 provided with the pond area indicated on the plan.

Orifice Calculation:

Allowed outflow is 3.24 cfs for 10-yr event

$Q = CA(2gh)^{1/2}$

$Q = Q_{allow} = 4.37$ cfs
C = 0.62
A = Cross sectional area of orifice
g = 32.2 ft/s^2
h = hydraulic head from max water elevation to center of orifice

$3.29 = (0.62)A(2(32.2)(4'))^{1/2}$

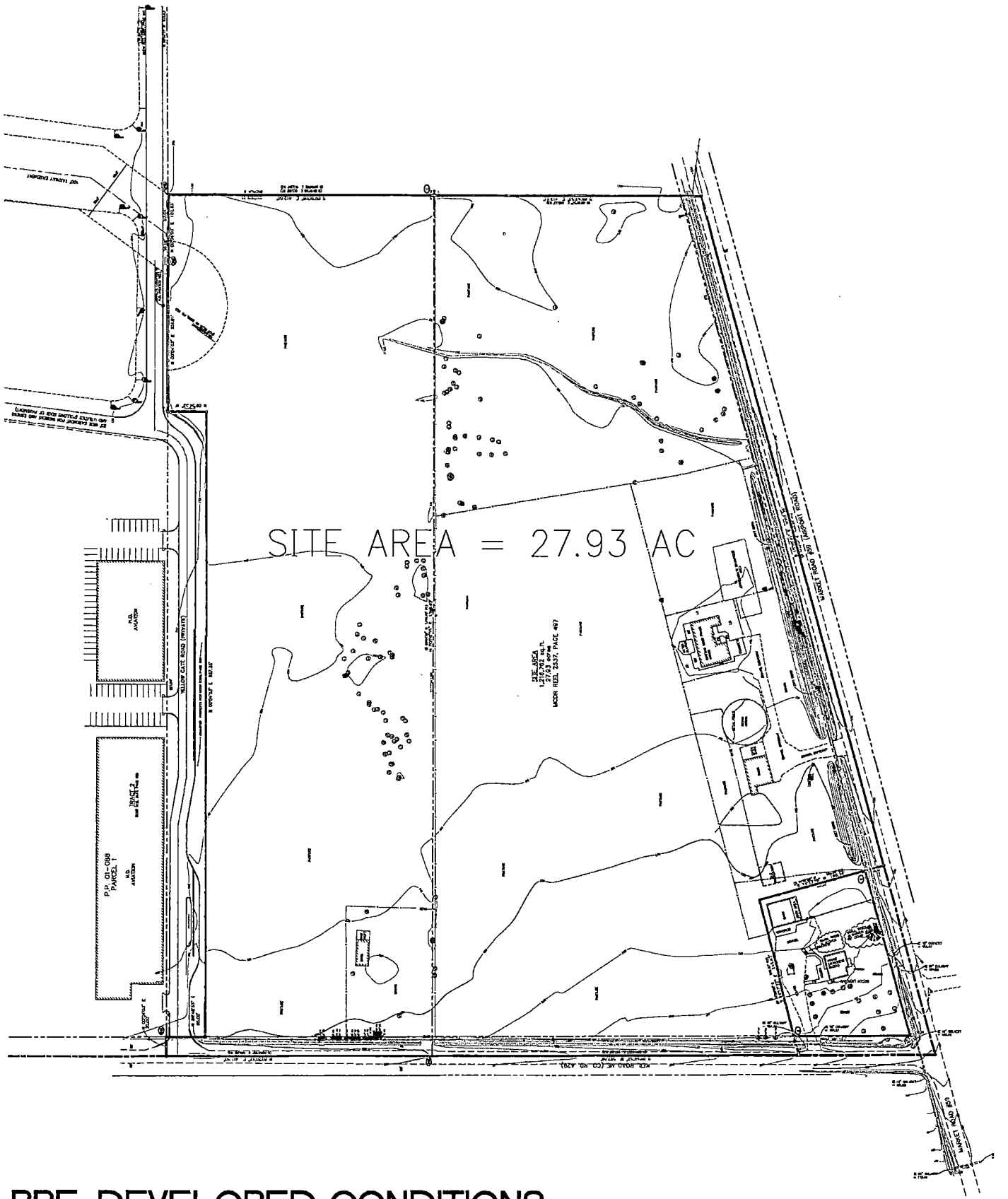
A = 0.353 sf

$A = \pi d^2/4$

d = 8.04" use **8"** diameter orifice plate for construction

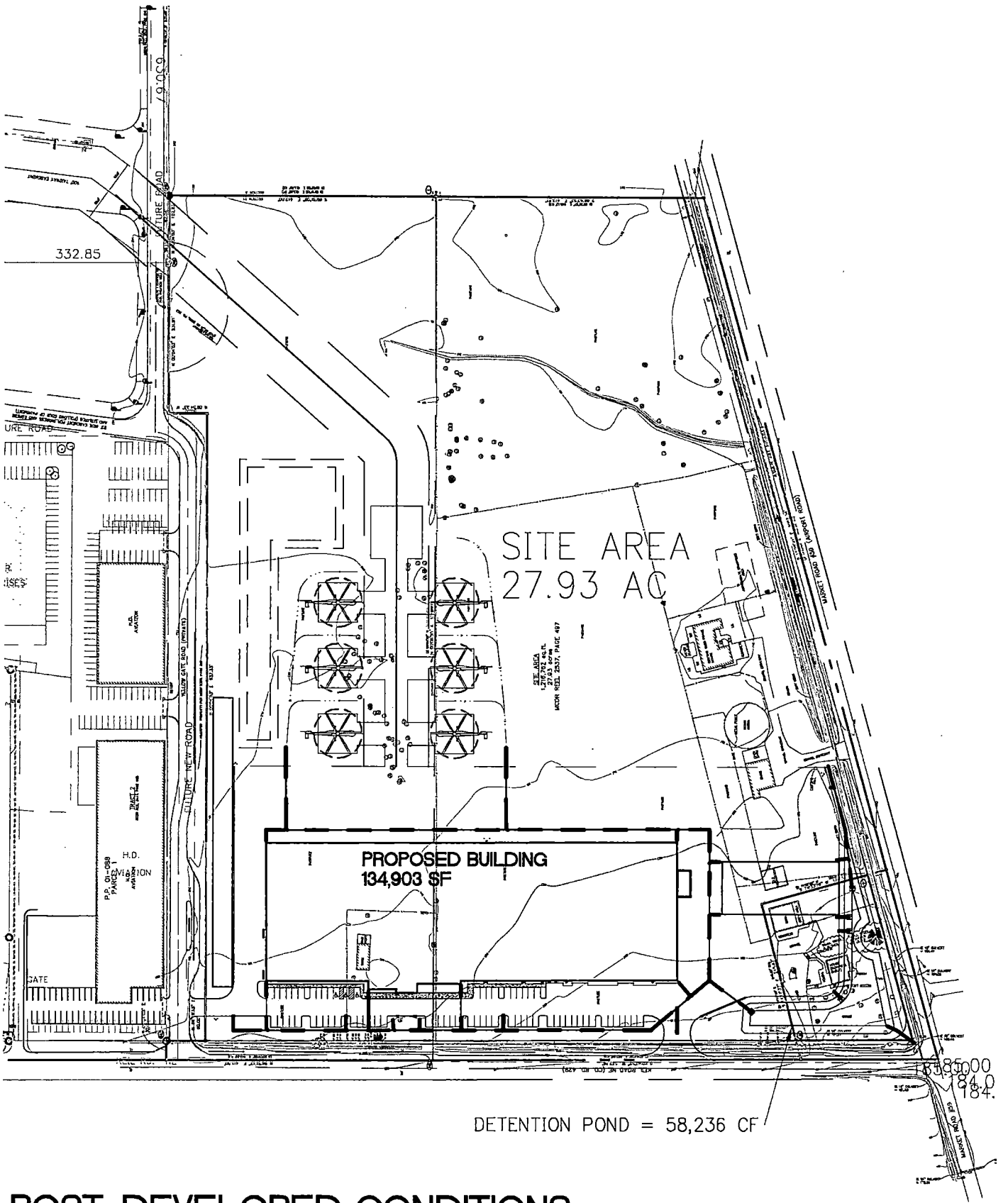
The orifice will be housed within a ditch inlet set with the lower rim elevation at pond bottom elevation. The ditch inlet will drain to a manhole which will outfall to the existing drainage ditches near the intersection of Airport Road and Keil Road.

See attached pre and post-developed site diagrams, pond routing calculation, and pond volume calculation.



PRE-DEVELOPED CONDITIONS

SCALE: 1=200'



POST-DEVELOPED CONDITIONS

SCALE: 1=200'

ODOT Methodology
Helicoptor Transport Services- Detention Design
Project #2090040.01
Proposed Condition: 10-year Storm restricted to 5-year release rate

Date: 29-Jul-09
Detention System

Time (min.)	CA (Ac)	Intensity (in/hr)	Inflow (cfs)	Inflow Vol. (cf)	Outflow (cfs)	Outflow Vol. (cf)	Req'd Storage (cf)	
10	21.22	1.25	26.53	15915.00	3.46	2076.00	13839.00	
11	21.22	1.22	25.89	17086.34	3.46	2283.60	14802.74	
12	21.22	1.16	24.62	17722.94	3.46	2491.20	15231.74	
13	21.22	1.10	23.34	18206.76	3.46	2698.80	15507.96	
14	21.22	1.07	22.71	19072.54	3.46	2906.40	16166.14	
15	21.22	1.04	22.07	19861.92	3.46	3114.00	16747.92	
16	21.22	1.01	21.43	20574.91	3.46	3321.60	17253.31	
17	21.22	0.98	20.80	21211.51	3.46	3529.20	17682.31	
18	21.22	0.96	20.37	22000.90	3.46	3736.80	18264.10	
19	21.22	0.94	19.95	22739.35	3.46	3944.40	18794.95	
20	21.22	0.92	19.52	23426.88	3.46	4152.00	19274.88	
21	21.22	0.90	19.10	24063.48	3.46	4359.60	19703.88	
22	21.22	0.88	18.67	24649.15	3.46	4567.20	20081.95	
23	21.22	0.86	18.25	25183.90	3.46	4774.80	20409.10	
24	21.22	0.85	18.04	25973.28	3.46	4982.40	20990.88	
25	21.22	0.84	17.82	26737.20	3.46	5190.00	21547.20	
26	21.22	0.82	17.40	27144.62	3.46	5397.60	21747.02	
27	21.22	0.81	17.19	27844.88	3.46	5605.20	22239.68	
28	21.22	0.80	16.98	28519.68	3.46	5812.80	22706.88	
29	21.22	0.78	16.55	28799.78	3.46	6020.40	22779.38	
30	21.22	0.76	16.13	29028.96	3.46	6228.00	22800.96	
35	21.22	0.73	15.49	32530.26	3.46	7266.00	25264.26	
40	21.22	0.70	14.85	35649.60	3.46	8304.00	27345.60	
45	21.22	0.67	14.22	38386.98	3.46	9342.00	29044.98	
50	21.22	0.63	13.37	40105.80	3.46	10380.00	29725.80	
60	21.22	0.58	12.31	44307.36	3.46	12456.00	31851.36	
70	21.22	0.56	11.88	49909.44	3.46	14532.00	35377.44	
80	21.22	0.52	11.03	52965.12	3.46	16608.00	36357.12	
90	21.22	0.50	10.61	57294.00	3.46	18684.00	38610.00	
100	21.22	0.48	10.19	61113.60	3.46	20760.00	40353.60	
150	21.22	0.42	8.91	80211.60	3.46	31140.00	49071.60	
200	21.22	0.37	7.85	94216.80	3.46	41520.00	52696.80	
250	21.22	0.34	7.21	108222.00	3.46	51900.00	56322.00	<<<<<
300	21.22	0.31	6.58	118407.60	3.46	62280.00	56127.60	
350	21.22	0.28	5.94	124773.60	3.46	72660.00	52113.60	
400	21.22	0.27	5.73	137505.60	3.46	83040.00	54465.60	
450	21.22	0.25	5.31	143235.00	3.46	93420.00	49815.00	
500	21.22	0.23	4.88	146418.00	3.46	103800.00	42618.00	

Helicopter Transport Services Detention Pond Volume
By: MJS
Date: 6/2/2010

Fullsize pond buildout

ELEV (ft)	AREA (sf)	VOL (cf)	CUM. VOL (cf)
83	9147	0	0
87	19971	58236	58236

Time of Concentration Calculations for HTS Site
Aurora, Oregon

Pre-Developed

Un-developed

Total area = **27.41** Acres

5-year storm event

Sheet flow

First assume Tc = 20 min I = 0.74 in/hr

$$Tc = \frac{K*(L^{0.6})*n^{0.6}}{I^{0.4} * S^{0.3}}$$

L= 150 ft

n = 0.13

S = 0.015 ft/ft

K = 0.93

Tc1 = 21.98 min

Tc1 = 20 min

Shallow Concentrated Flow

Length = 600 ft

Slope = 0.015 ft/ft

Velocity = 0.6 ft/sec *from Soil Conservation Svc. Handbook

Determine Tc2 = 16.67 min

Tc = Tc1+Tc2= 38.6 min Then, I = **0.59** in/hr

Q = CIA Cw = **0.27**

Q = 4.37 cfs

Project name: **Helicopter Transport Services** **Project number:** **2100114.00**

10 year/24-hour storm event

By: mjs Checked:

Date: 06/03/10 Date:

n = 0.013

RD = Roof Drain MH = Manhole

CI = Curb Inlet WQ = Water Quality

AD= Area Drain O/W = Oil Water Separator

Link	Inlet	Pipe	Time(min)	Total Time(min)	Intensity(in/hr)	Incr. Area(Ac)	Coef. Of Runoff	Incr. Equiv.(CxA)	Total Equiv. Area	**Runoff (cfs)**	Slope(%)	Diameter (in)	Pipe Area (sf)	Hydraulic Radius^2/3	**Capacity (cfs)**	Velocity(fps)	Runoff/Capacity (ratio)
	RD 1		10	10.00	1.20	0.370	0.9	0.33	0.33	**0.40**	0.5	8	0.349	0.303	**0.85**	2.44	0.47
	AD1		10	10.00	1.20	0.870	0.2	0.17	0.17	**0.21**	0.3	10	0.545	0.351	**1.20**	2.19	0.17
1			10	10.00	1.20		0.9	0.00	0.51	**0.61**	0.5	10	0.545	0.351	**1.54**	2.83	0.39
	AD 2		10	10.00	1.20	1.170	0.9	1.05	1.05	**1.26**	0.3	10	0.545	0.351	**1.20**	2.19	1.06
2			10	10.00	1.20		0.9	0.00	1.56	**1.87**	0.5	12	0.785	0.397	**2.51**	3.19	0.75
	RD 3		10	10.00	1.20	0.810	0.9	0.73	0.73	**0.87**	0.5	10	0.545	0.351	**1.54**	2.83	0.57
3			10	10.00	1.20		0.9	0.00	2.29	**2.75**	0.5	15	1.227	0.461	**4.55**	3.71	0.60
	RD 5		10	10.00	1.20	0.080	0.9	0.07	0.07	**0.09**	0.5	10	0.545	0.351	**1.54**	2.83	0.06
4			10	10.00	1.20		0.9	0.00	2.36	**2.83**	0.5	15	1.227	0.461	**4.55**	3.71	0.62
	RD 7		10	10.00	1.20	0.080	0.9	0.07	0.07	**0.09**	0.5	10	0.545	0.351	**1.54**	2.83	0.06
5			10	10.00	1.20		0.9	0.00	2.43	**2.92**	0.5	15	1.227	0.461	**4.55**	3.71	0.64
	CB 7		10	10.00	1.20	0.320	0.9	0.29	0.29	**0.35**	0.5	10	0.545	0.351	**1.54**	2.83	0.22
	RD 2		10	10.00	1.20	0.370	0.9	0.33	0.33	**0.40**	0.5	8	0.349	0.303	**0.85**	2.44	0.47
6			10	10.00	1.20		0.9	0.00	0.62	**0.75**	0.5	10	0.545	0.351	**1.54**	2.83	0.48
	CB 6		10	10.00	1.20	0.200	0.9	0.18	0.18	**0.22**	0.5	10	0.545	0.351	**1.54**	2.83	0.14
7			10	10.00	1.20		0.9	0.00	0.80	**0.96**	0.5	10	0.545	0.351	**1.54**	2.83	0.62
	RD 9		10	10.00	1.20	0.010	0.9	0.01	0.01	**0.01**	0.5	6	0.196	0.250	**0.40**	2.01	0.03
8			10	10.00	1.20		0.9	0.00	0.81	**0.97**	0.5	10	0.545	0.351	**1.54**	2.83	0.63
	RD 10		10	10.00	1.20	0.020	0.9	0.02	0.02	**0.02**	0.5	6	0.196	0.250	**0.40**	2.01	0.05
9			10	10.00	1.20		0.9	0.00	0.83	**0.99**	0.5	10	0.545	0.351	**1.54**	2.83	0.64
	RD 11		10	10.00	1.20	0.030	0.9	0.03	0.03	**0.03**	0.5	6	0.196	0.250	**0.40**	2.01	0.08
10			10	10.00	1.20		0.9	0.00	0.86	**1.03**	0.5	10	0.545	0.351	**1.54**	2.83	0.66
	RD 12		10	10.00	1.20	0.010	0.9	0.01	0.01	**0.01**	0.5	6	0.196	0.250	**0.40**	2.01	0.03
11			10	10.00	1.20		0.9	0.00	0.86	**1.04**	0.5	10	0.545	0.351	**1.54**	2.83	0.67
	CB 5		10	10.00	1.20	0.410	0.9	0.37	0.37	**0.44**	0.5	10	0.545	0.351	**1.54**	2.83	0.29

Project name: **Helicopter Transport Services** **Project number:** **2100114.00**

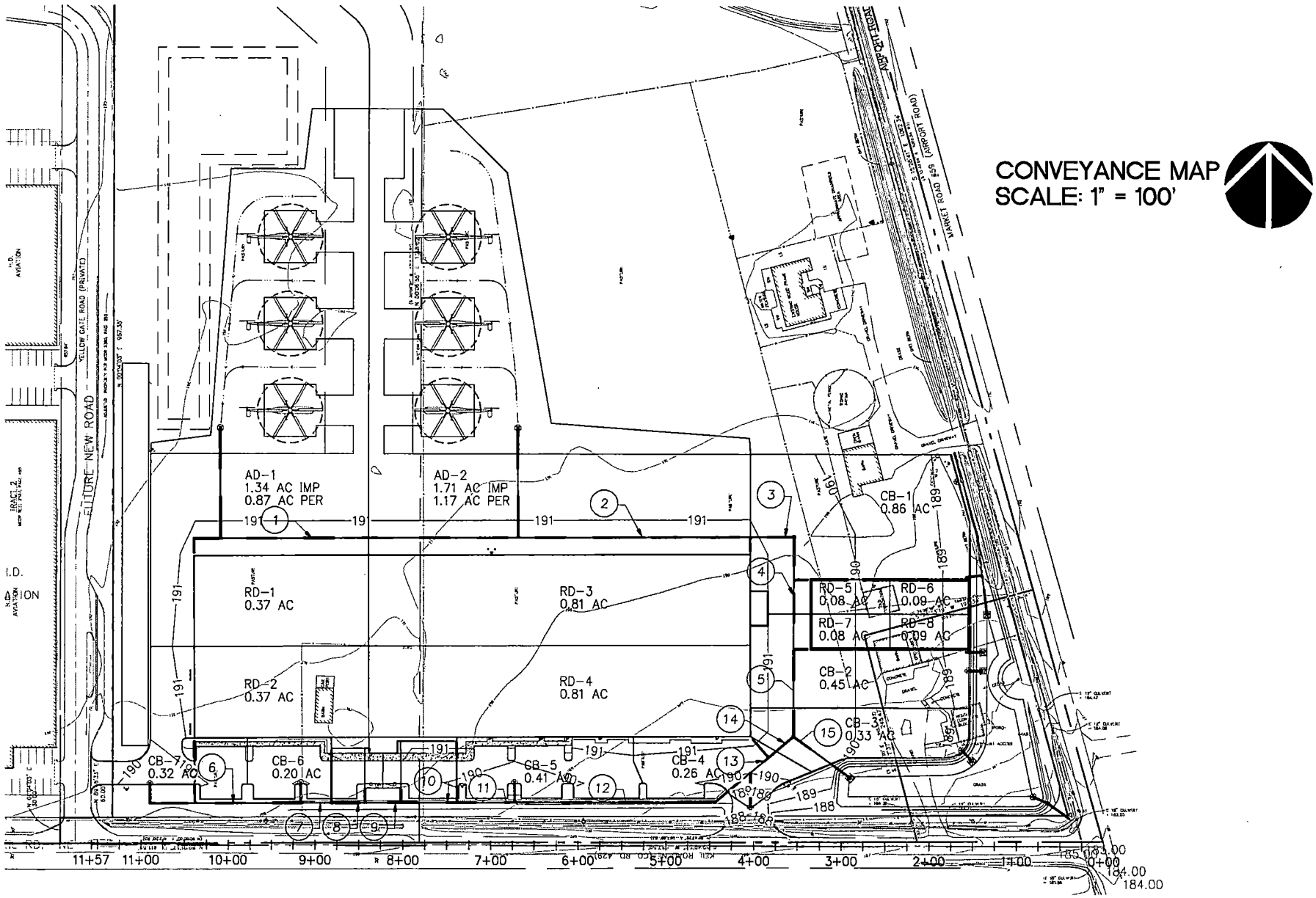
10 year/24-hour storm event

By: mjs Checked: RD = Roof Drain MH = Manhole

Date: 06/03/10 Date: CI = Curb Inlet WQ = Water Quality

n = 0.013 AD= Area Drain O/W = Oil Water Separator

Link	Inlet	Pipe	Time(min)	Total Time(min)	Intensity(in/hr)	Incr. Area(Ac)	Coef. Of Runoff	Incr. Equiv.(CxA)	Total Equiv. Area	**Runoff (cfs)**	Slope(%)	Diameter (in)	Pipe Area (sf)	Hydraulic Radius^2/3	**Capacity (cfs)**	Velocity(fps)	Runoff/Capacity (ratio)
12			10	10.00	1.20		0.9	0.00	1.23	**1.48**	0.5	12	0.785	0.397	**2.51**	3.19	0.59
	CB 4		10	10.00	1.20	0.260	0.9	0.23	0.23	**0.28**	0.5	10	0.545	0.351	**1.54**	2.83	0.18
13			10	10.00	1.20		0.9	0.00	1.47	**1.76**	0.5	12	0.785	0.397	**2.51**	3.19	0.70
	RD 4		10	10.00	1.20	0.810	0.9	0.73	0.73	**0.87**	0.5	10	0.545	0.351	**1.54**	2.83	0.57
14			10	10.00	1.20		0.9	0.00	2.20	**2.64**	0.5	15	1.227	0.461	**4.55**	3.71	0.58
15	14+5		10	10.00	1.20		0.9	0.00	4.63	**5.55**	0.5	18	1.767	0.520	**7.40**	4.19	0.75
	CB 1		10	10.00	1.20	0.860	0.9	0.77	0.77	**0.93**	0.5	10	0.545	0.351	**1.54**	2.83	0.60
	RD 6		10	10.00	1.20	0.090	0.9	0.08	0.08	**0.10**	0.5	10	0.545	0.351	**1.54**	2.83	0.06
	RD 8		10	10.00	1.20	0.090	0.9	0.08	0.08	**0.10**	0.5	10	0.545	0.351	**1.54**	2.83	0.06
	CB 2		10	10.00	1.20	0.450	0.9	0.41	0.41	**0.49**	0.5	10	0.545	0.351	**1.54**	2.83	0.31
	CB 3		10	10.00	1.20	0.330	0.9	0.30	0.30	**0.36**	0.5	10	0.545	0.351	**1.54**	2.83	0.23
Keil Road Driveway Culvert										**7.27**	0.5	18	1.767	0.520	**7.40**	4.19	0.98


CONVEYANCE MAP
SCALE: 1" = 100'
FUTURE NEW ROAD
YELLOW GATE ROAD (PRIVATE)
MARKET ROAD #55 (AIRPORT ROAD)
AD-1
1.34 AC IMP
0.87 AC PER
AD-2
1.71 AC IMP
1.17 AC PER
CB-1
0.86 AC
RD-1
0.37 AC
RD-2
0.37 AC
RD-3
0.81 AC
RD-4
0.81 AC
RD-5
0.08 AC
RD-6
0.09 AC
RD-7
0.08 AC
RD-8
0.09 AC
CB-2
0.45 AC
CB-3
0.33 AC
CB-4
0.26 AC
CB-5
0.41 AC
CB-6
0.20 AC
CB-7
0.32 AC
11+57
11+00
10+00
9+00
8+00
7+00
6+00
5+00
4+00
3+00
2+00
1+00
0+00
185.00
184.00
184.00

GROUP MACKENZIE

5. DOWNSTREAM ANALYSIS

There are two culverts downstream from the project site. Culvert #1 crosses Keil Road at the intersection of Airport Road. This culvert is an 18" ADS plastic culvert sloped at 1.2%. This culvert is undersized for the tributary basin of 110 acres. The design storm is the 25-year event.

$Q = C \times i \times A$

C = 0.20 assumes existing site upstream provide detention

i = 0.78 in/hr (25-year intensity)

A = 110 acres

$Q = 0.2 * 0.78 * 110$

Q = 17.16 cfs

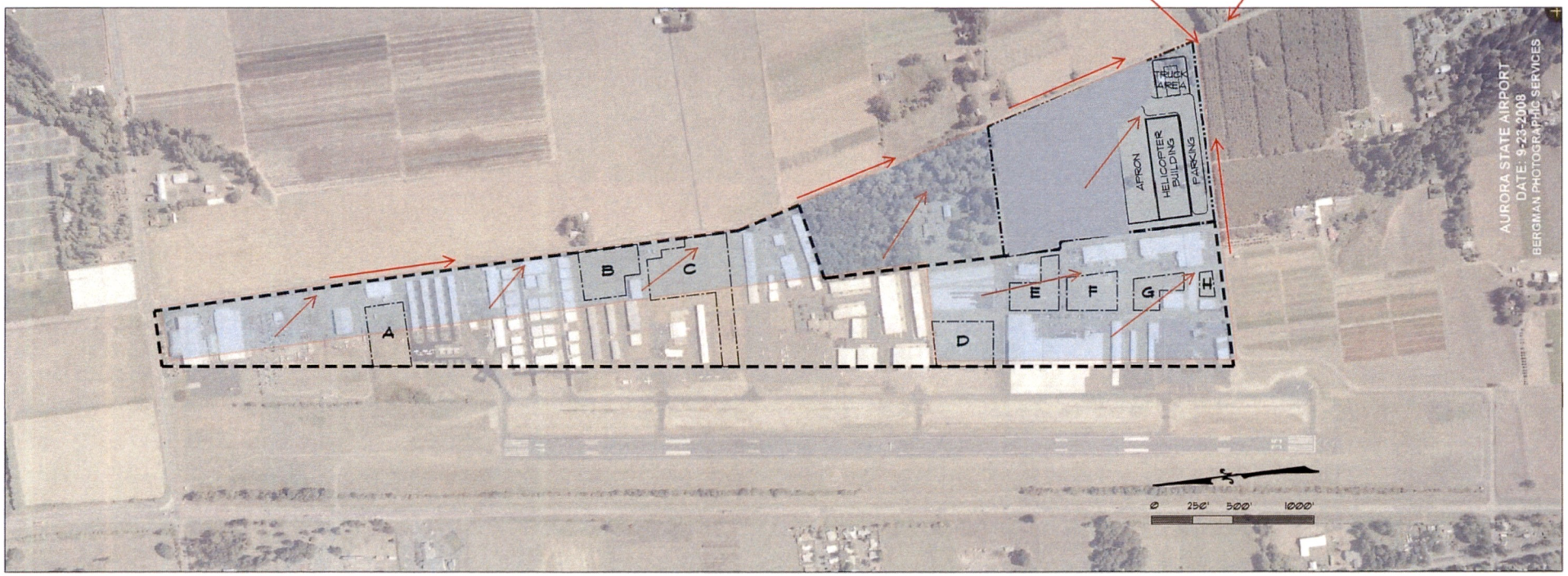
Culvert capacity = 15.0 cfs (See attached culvert calculations)

Use a 24" diameter culvert, capacity = 18.0 cfs > 17.16 cfs

Culvert #2 is a 24" diameter pipe sloped at 5.45%. This pipe's capacity is 37 cfs > 17.16 cfs. This culvert is adequate.

Helicopter Transport Services
Downstream Storm Basin Map

Total Area = 110.0 AC



VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

NO.	DATE	BY	APPR	REVISIONS

ARON FAEGRE and ASSOCIATES
520 S.W. Yamhill, Roofgarden 1
Portland, Oregon - 97204
(503)222-2546 - fax. (503)222-6529
faegre@onemain.com

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SCALE:
AF	MB	AF	600' = 1"

DATE: JUNE 2, 2009
PROJECT: Helicopter Transport 6-02-09

AURORA STATE AIRPORT (UAO)

HELICOPTER TRANSPORT SERVICES LLC
STUDY OF OPEN SPACES POTENTIALLY AVAILABLE FOR DEVELOPMENT

DRAWING
SITE MP

Culvert Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc.

Monday, Aug 3 2009

Cir Culvert

Invert Elev Dn (ft)	= 181.58
Pipe Length (ft)	= 60.00
Slope (%)	= 1.12
Invert Elev Up (ft)	= 182.25
Rise (in)	= 18.0
Shape	= Cir
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.013
Inlet Edge	= Projecting
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.5

Embankment

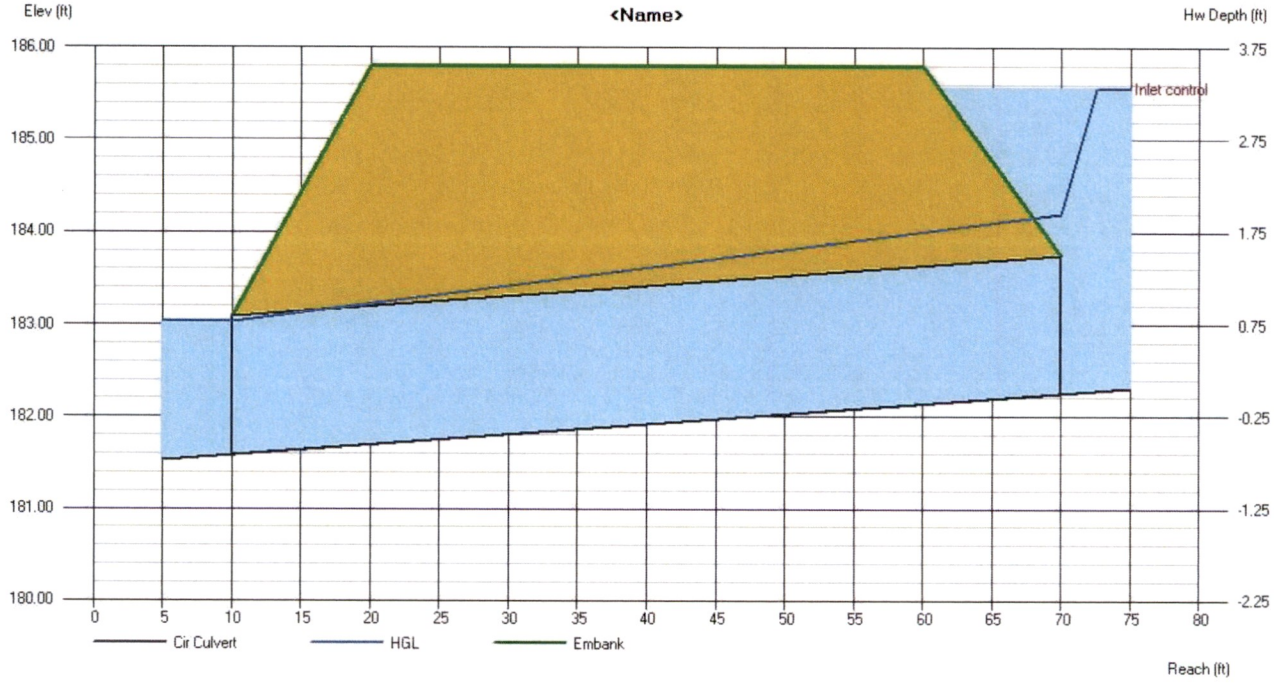
Top Elevation (ft)	= 185.80
Top Width (ft)	= 40.00
Crest Width (ft)	= 5.00

Calculations

Qmin (cfs)	= 2.00
Qmax (cfs)	= 30.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 15.00
Qpipe (cfs)	= 15.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 8.57
Veloc Up (ft/s)	= 8.49
HGL Dn (ft)	= 183.03
HGL Up (ft)	= 184.20
Hw Elev (ft)	= 185.56
Hw/D (ft)	= 2.21
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc.

Cir Culvert

Invert Elev Dn (ft)	= 181.58
Pipe Length (ft)	= 60.00
Slope (%)	= 1.12
Invert Elev Up (ft)	= 182.25
Rise (in)	= 18.0
Shape	= Cir
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.013
Inlet Edge	= Projecting
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.5

Embankment

Top Elevation (ft)	= 185.80
Top Width (ft)	= 40.00
Crest Width (ft)	= 5.00

Calculations

Qmin (cfs)	= 2.00
Qmax (cfs)	= 30.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 15.00
Qpipe (cfs)	= 15.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 8.57
Veloc Up (ft/s)	= 8.49
HGL Dn (ft)	= 183.03
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Hw Elev (ft)	= 185.56
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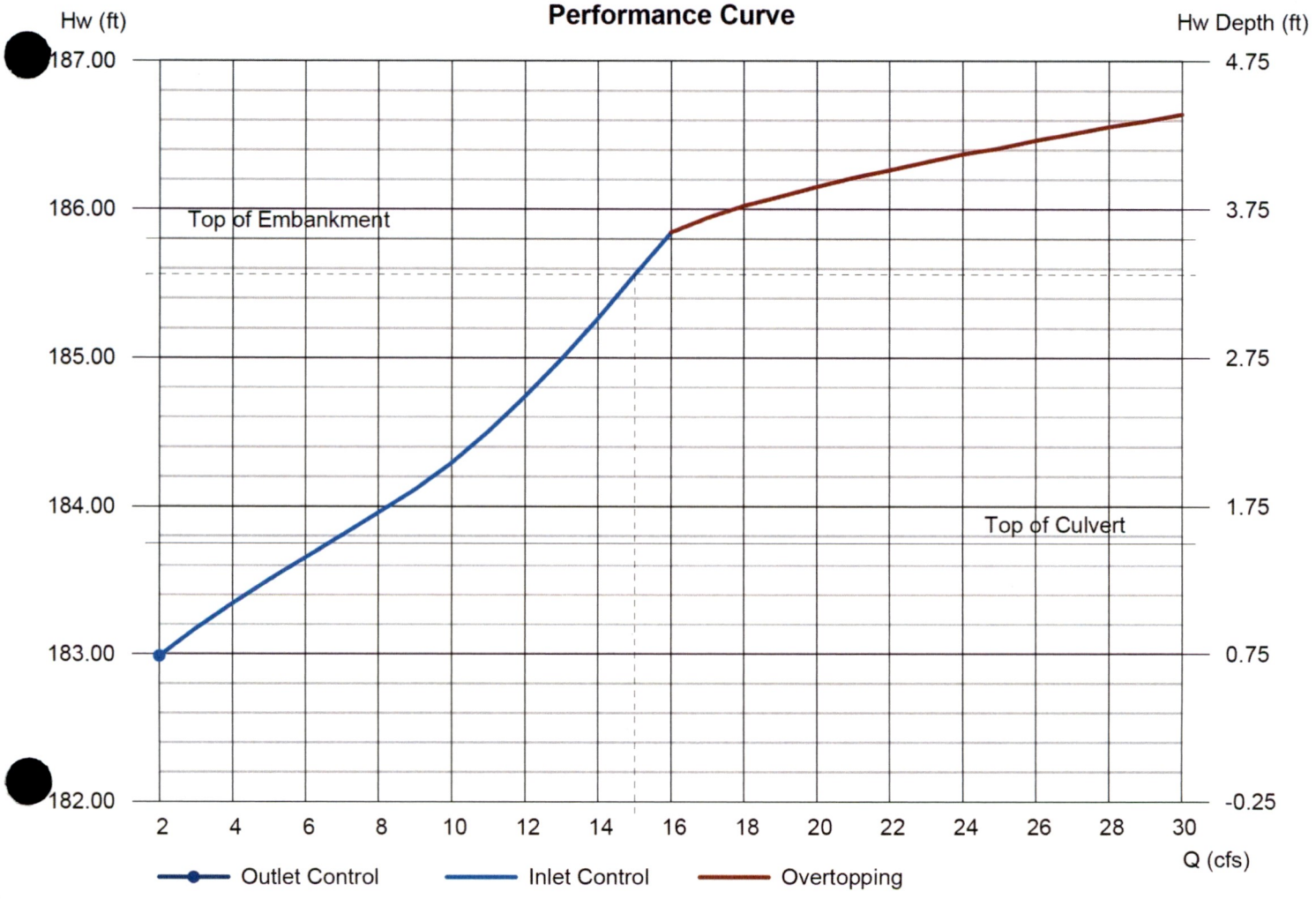


Culvert Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc.

Cir Culvert

Invert Elev Dn (ft)	= 172.98
Pipe Length (ft)	= 47.00
Slope (%)	= 5.45
Invert Elev Up (ft)	= 175.54
Rise (in)	= 24.0
Shape	= Cir
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.013
Inlet Edge	= Projecting
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.5

Embankment

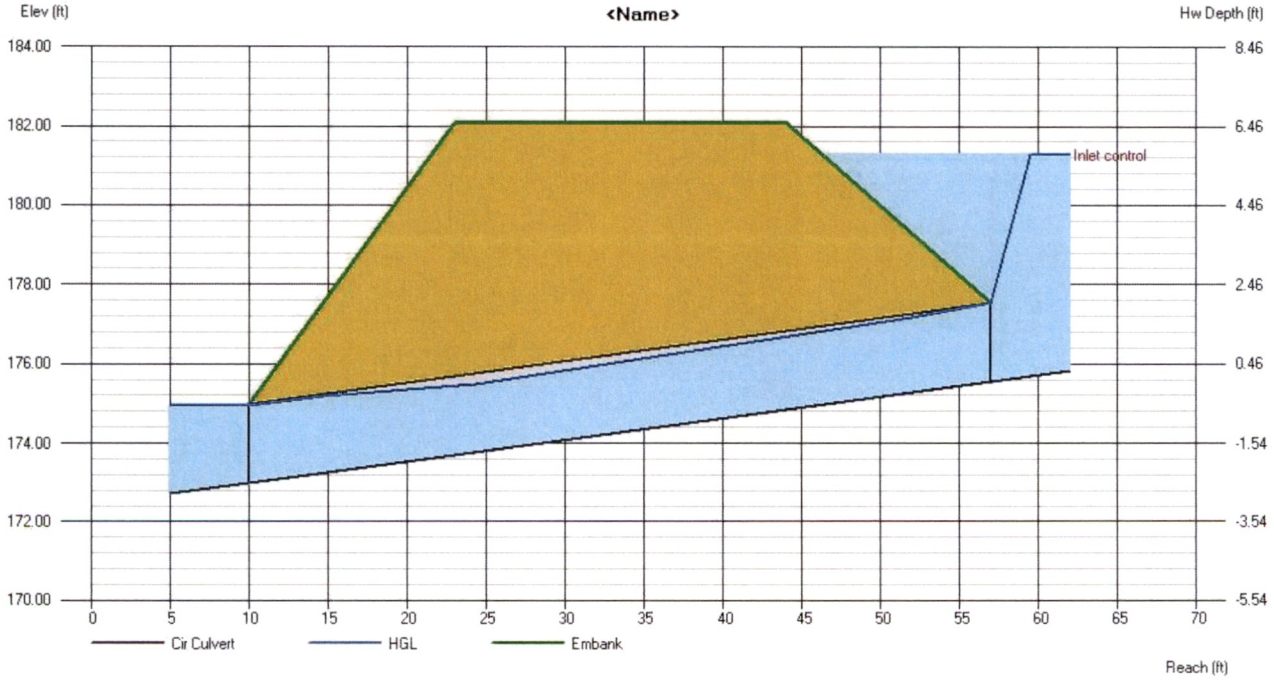
Top Elevation (ft)	= 182.10
Top Width (ft)	= 21.00
Crest Width (ft)	= 5.00

Calculations

Qmin (cfs)	= 3.00
Qmax (cfs)	= 50.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 37.00
Qpipe (cfs)	= 37.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 11.82
Veloc Up (ft/s)	= 11.89
HGL Dn (ft)	= 174.95
HGL Up (ft)	= 177.48
Hw Elev (ft)	= 181.26
Hw/D (ft)	= 2.86
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. Monday, Aug 3 2009

Cir Culvert

Invert Elev Dn (ft)	= 172.98
Pipe Length (ft)	= 47.00
Slope (%)	= 5.45
Invert Elev Up (ft)	= 175.54
Rise (in)	= 24.0
Shape	= Cir
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.013
Inlet Edge	= Projecting
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.5

Embankment

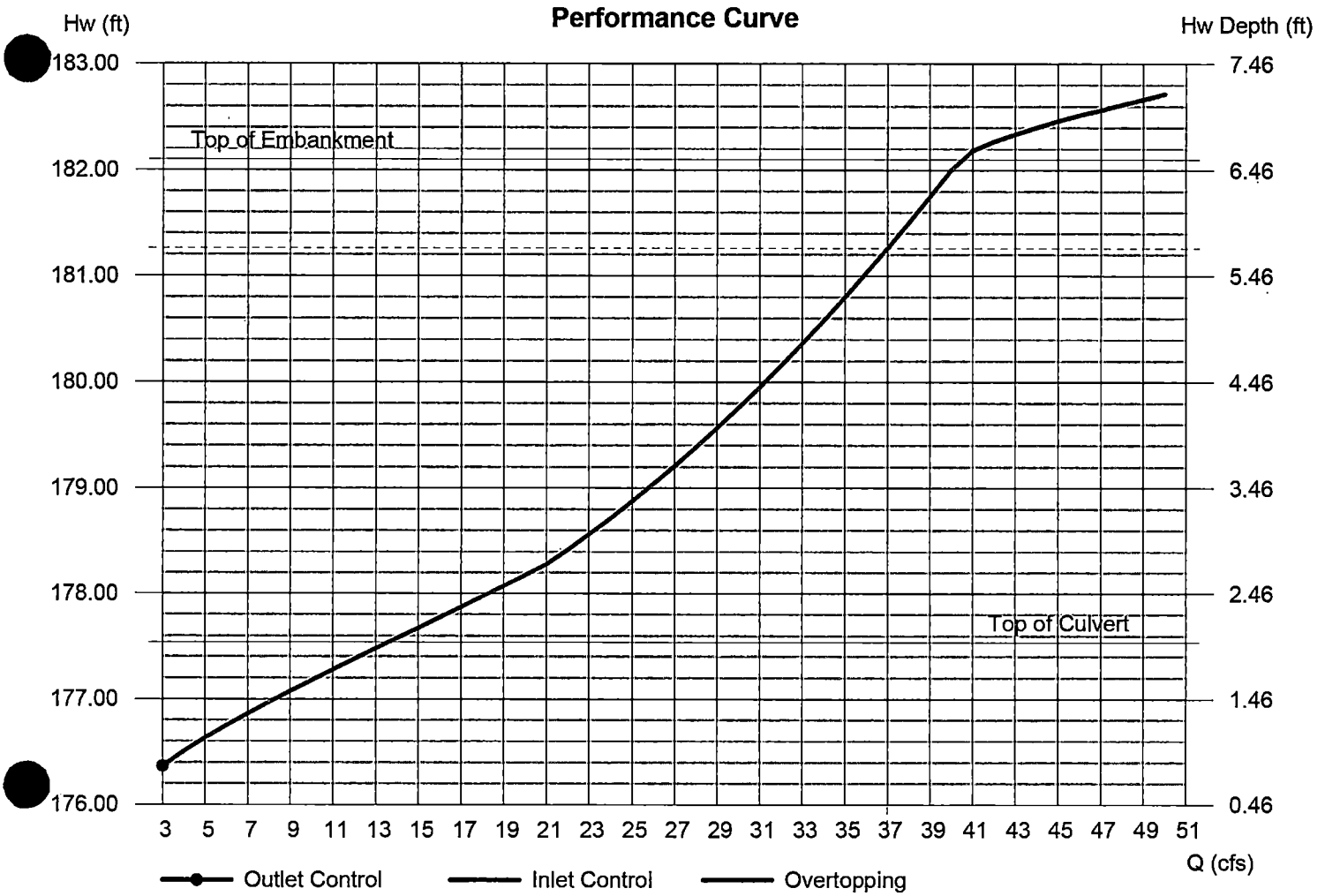
Top Elevation (ft)	= 182.10
Top Width (ft)	= 21.00
Crest Width (ft)	= 5.00

Calculations

Qmin (cfs)	= 3.00
Qmax (cfs)	= 50.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 37.00
Qpipe (cfs)	= 37.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 11.82
Veloc Up (ft/s)	= 11.89
HGL Dn (ft)	= 174.95
HGL Up (ft)	= 177.48
Hw Elev (ft)	= 181.26
Hw/D (ft)	= 2.86
Flow Regime	= Inlet Control



Culvert Report

Cir Culvert

Invert Elev Dn (ft)	= 181.58
Pipe Length (ft)	= 60.00
Slope (%)	= 1.12
Invert Elev Up (ft)	= 182.25
Rise (in)	= 24.0
Shape	= Cir
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.013
Inlet Edge	= Projecting
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.5

Embankment

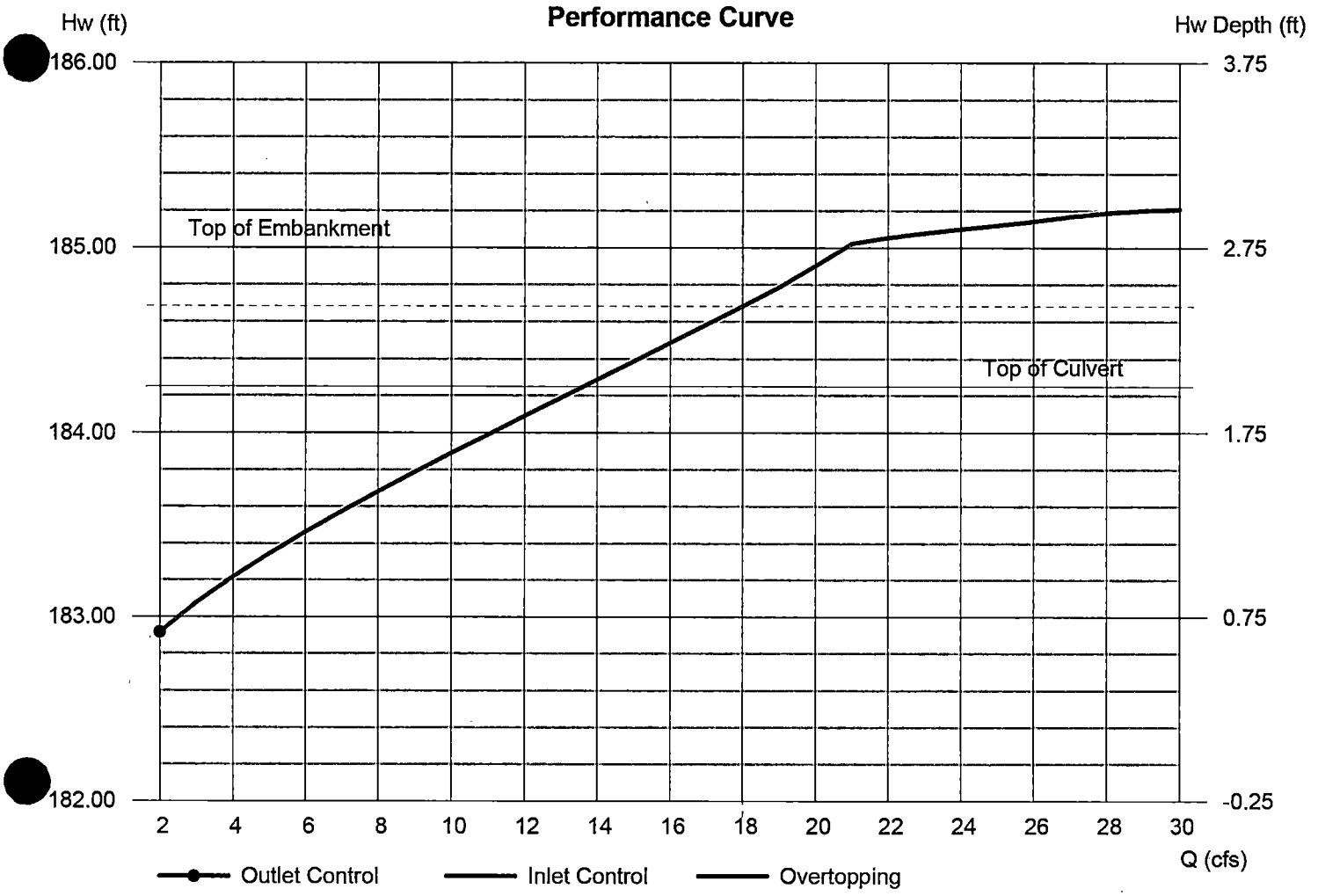
Top Elevation (ft)	= 185.00
Top Width (ft)	= 10.00
Crest Width (ft)	= 25.00

Calculations

Qmin (cfs)	= 2.00
Qmax (cfs)	= 30.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 18.00
Qpipe (cfs)	= 18.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 6.13
Veloc Up (ft/s)	= 6.96
HGL Dn (ft)	= 183.35
HGL Up (ft)	= 183.78
Hw Elev (ft)	= 184.69
Hw/D (ft)	= 1.22
Flow Regime	= Inlet Control



6. KEIL ROAD and AIRPORT ROAD DITCH

The ditch that runs along the northern edge of Keil Road along the property frontage was graded as part of the Southend Airpark Improvements. The ditch conveys the runoff from the Airpark has outlined in the DeHaas and Associates Report dated from August 1999. The conveyance capacity of this ditch was set at 7.27 cfs. The Southend Airpark drainage system was designed according to the limited flow capacity of the ditch. As part of the Helicopter Transport Services project the ditch is to be regraded to meet cross slope standards set by Marion County.

The existing ditch is a vee shaped ditch with side slopes that vary from 0.67:1 to 2: 1 (H:V). The proposed cross section is a vee shaped ditch with a 4:1 fore slope and a 1-1/2:1 back slope. The revised ditch capacity is greater than the originally designed 7.27 cfs. At a depth of 1.6 feet the proposed flow capacity is 14.75 cfs. Calculations use a manning's n value of 0.026 for vegetated ditch.

Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2008 by Autodesk, Inc. Tuesday, Jun 8 2010

Keil Road and Airport Road Ditch

Triangular

Side Slopes (z:1)	= 4.00, 1.50
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 187.00
Slope (%)	= 0.20
N-Value	= 0.026

Calculations

Compute by:	Q vs Depth
No. Increments	= 10

Highlighted

Depth (ft)	= 1.60
Q (cfs)	= 14.75
Area (sqft)	= 7.04
Velocity (ft/s)	= 2.10
Wetted Perim (ft)	= 9.48
Crit Depth, Yc (ft)	= 0.98
Top Width (ft)	= 8.80
EGL (ft)	= 1.67

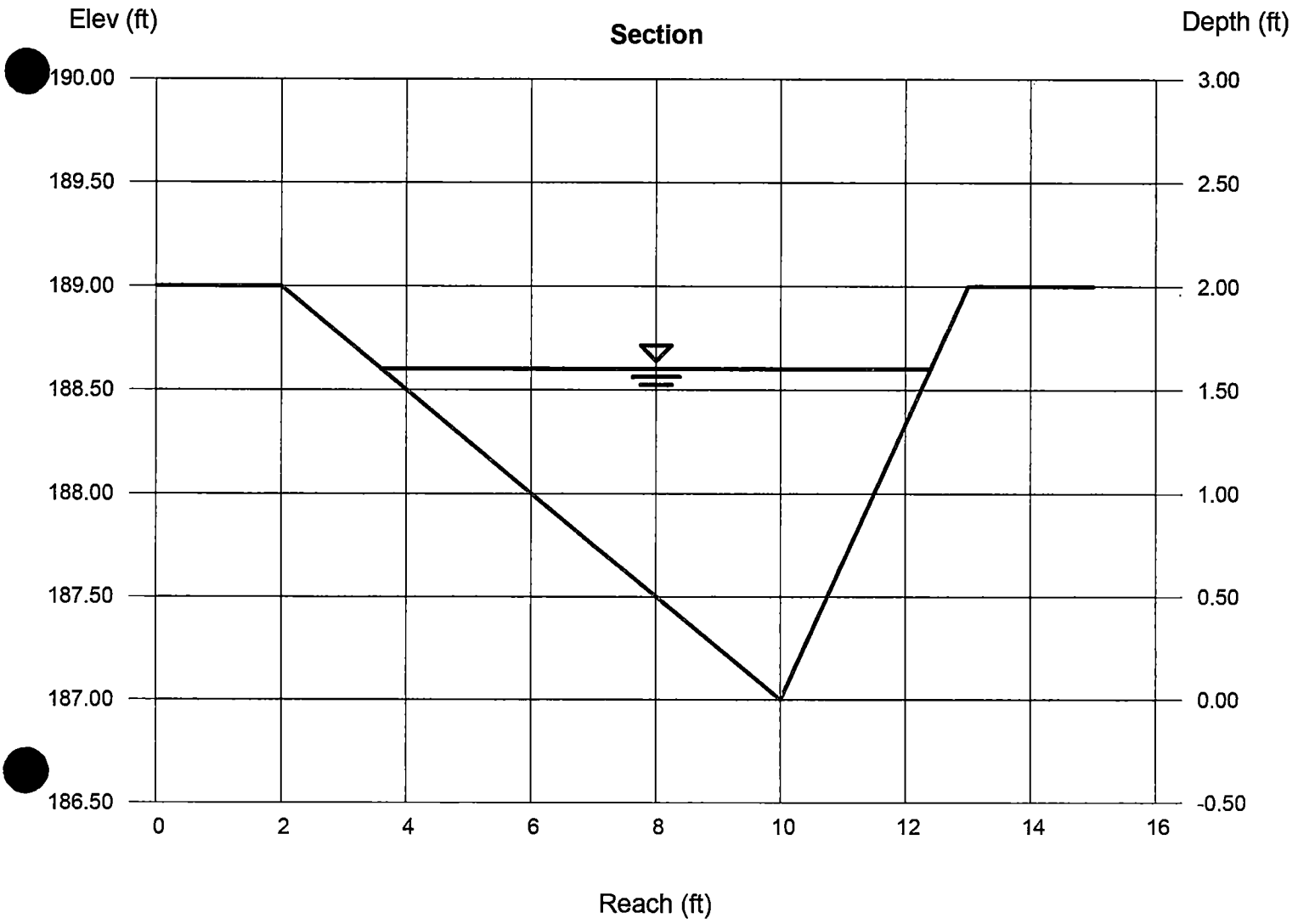
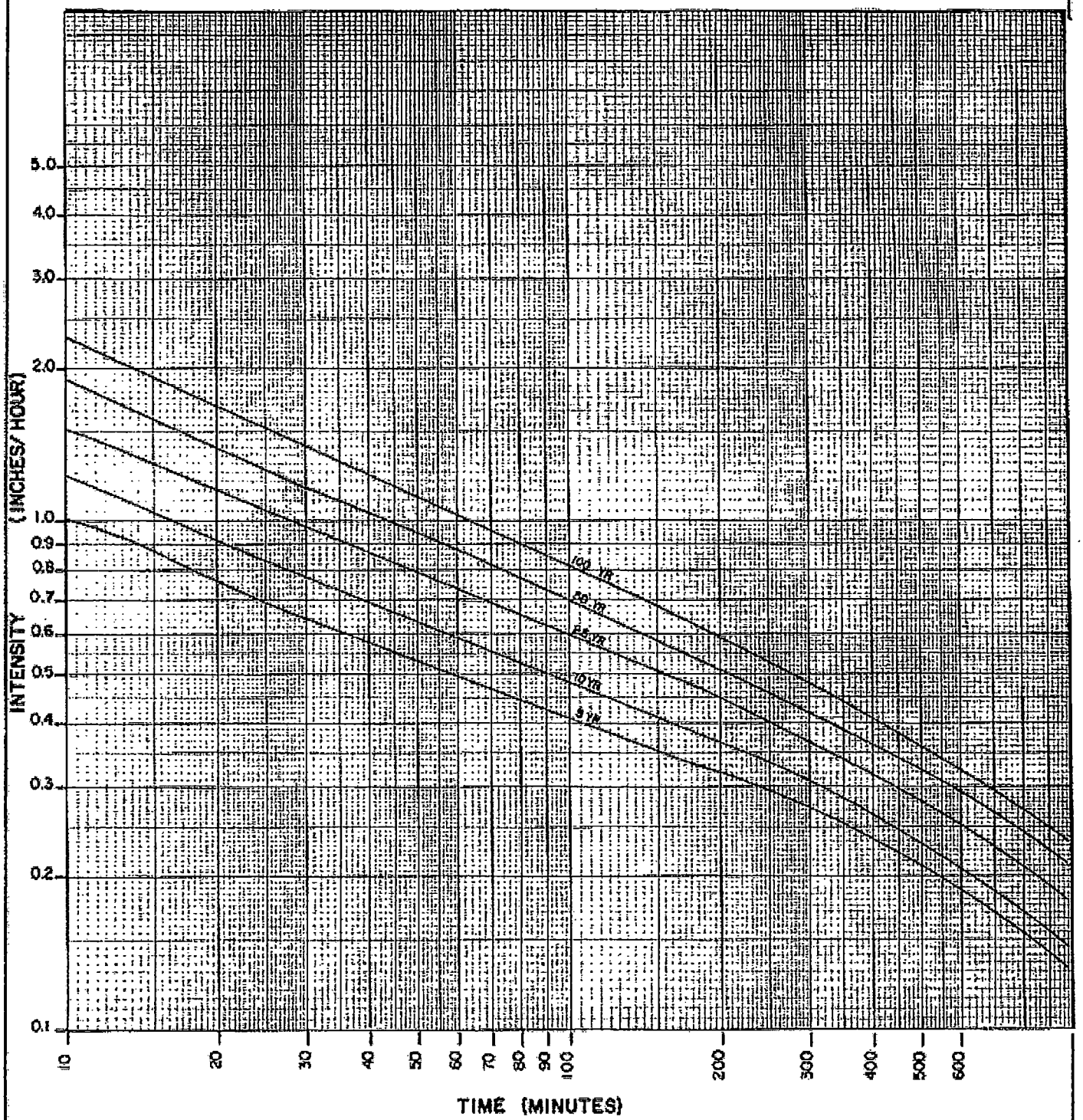


TABLE 10

RUNOFF COEFFICIENTS

Soil Cover	Flat Terrain s<2%	Rolling Terrain 2%<s<10%	Steep Terrain s>10%
Relatively high permeability (lawns, pasture, woods)	0.20	0.25	0.30
Moderate impermeability			
1) Single-family residential in urban areas, except corner lots with duplex potential	0.40	0.45	0.50
2) Gravel parking lots	0.50	0.55	0.60
3) Mobile home parks	0.60	0.65	0.70
4) Multi-family residential, zero-lot-line single-family residential and potential duplex lots in Single-family residential	0.70	0.75	0.80
High impermeability (roofs and paved areas)	0.90	0.90	0.90

RAINFALL INTENSITY-DURATION CURVES FOR MARION COUNTY



Source: U.S. Geological Survey
Water Resources Investigation
for Salem, Oregon

MARION COUNTY, OREGON DEPARTMENT OF PUBLIC WORKS	
RAINFALL INTENSITY-DURATION CURVES	
DATE: 1/18/83	STD. DWG. NO. 27

ENVIRONMENTAL
MANAGEMENT
SYSTEMS, INC.

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Suite B-112
Milwaukie, OR 97222

15 December 2023
Report # 23-0083

Aron Faegre, AIA, PE, ASLA13200 Fielding Road
Lake Oswego, OR 97034

REGARDING:

2515 Airport Rd NE, Aurora, OR 97002
T: 4S, R: 1W, Section 02D, TL: 800 & 900
Wastewater Treatment Feasibility

Dear Mr. Faegre,

The purpose of this letter is to demonstrate that the proposed site plan (Attachment A – Proposed Site Plan) can satisfy the Marion County and Oregon Department of Environmental Quality (DEQ) requirements for the proposed development. Per Marion County and DEQ requirements, the actual application for a permit for a wastewater treatment system cannot occur until after Marion County approves the conditional use permit. The following information is provided to show that in my professional opinion, based on 45 years of designing and getting permits for wastewater treatment systems, this development plan will be able to have such a system.

On October 12, 2018 our company, Environmental Management Systems, Inc. (EMS) did a site evaluation of the subject site. On July 28 and August 16, 2023 EMS again performed studies to identify the possibility of onsite wastewater treatment options for new facilities on this site. All of these studies have determined that the site does not appear to have soils appropriate for a traditional on-site septic tank and drainfield. However for cases like this where the existing soils are not usable, Marion County and DEQ has multiple options for wastewater treatment and reuse, or disposal. In the sections below we describe the wastewater treatment options that can be used for the proposed development.

All of these options are of course subject to Department of Environmental Quality (DEQ) review as a next stage of review, following the land use approval being requested. These further evaluations cannot be reviewed by DEQ until after the planning land use approvals are received. These future reviews may include new County level permits, DEQ Water Pollution Control Facility (WPCF) Permit, or a Re-Use permit.

Based on my 45 years of experience as an Oregon Registered Environmental Health Specialist with direct and ongoing experience in onsite wastewater treatment system siting, design, inspection and permitting, it is my professional opinion that several DEQ

approvable options are available for this project, including but not limited to the following:

Option A. Holding Tanks. OAR 340-071-0340. This involves collecting wastewater in holding tanks to be pumped and hauled offsite.

A1. This may be accomplished individually with permits for each building where sewage flows will not exceed 200 gallons per day, or

A2. May be accomplished by a combined system greater than 200 gallons per day with septic tanks, flowing to a common Holding Tank permitted directly through DEQ via a Water Pollution Control Facility (WPCF) permit.

Option B. New WPCF Permit.
Permitting on the subject property through a separate Water Pollution Control Facility permit. This option could have two different ways for compliance:

B1. This may be accomplished with a treatment system on the property and the effluent piped to a drainfield on a different property. This is permitted by DEQ.

B2. EMS has evaluated the site and soils for this option and believes that a permit could be issued by DEQ for a system that incorporates Highly Treated and Disinfected Effluent, pumping to a Raised Bed Treatment and dispersal area on the property. This would be raised to achieve at least 24 inches of effective soil media above the highest period of fluctuating Permanent Water Table. It is likely that DEQ Staff will require a Hydro-Geologic study to determine design criteria. The feasibility of this approach would need to be approved by DEQ and has not yet been discussed with DEQ staff.

Option C. Alternative Water Use Permit.
Treatment and reuse of the wastewater may be permitted for irrigation, toilet flushing, wash-down water, fire suppression or other beneficial purposes in accord with OAR 340-divisions 041 and 055 governing beneficial uses and recycling, or

Option D. NPDES Permit.
Permitting via a Federal National Pollutant Discharge Elimination System. This may be possible to allow discharge to subsurface constructed wetlands. No creation of surface water would be allowed that would attract birds.

Option E. Connection to an existing system.
Excess capacity exists within existing systems at HDSE and/or Columbia Helicopters that can accommodate additional treated effluent from the NCMVH facility. This option requires a single ownership entity to be the permittee as previously accomplished pursuant to combining wastewater treatment for both HD Aviation and South-End Aviation, to form the HDSE system, or a similar ownership arrangement with Columbia Helicopters, which we have been advised has excess capacity. This excess capacity

will need to be confirmed. This option if exercised would require additional land use approvals.

Notes about Holding Tanks

An appropriate solution for this project may be to start with each of the new buildings discharging to holding tanks, which will allow actual flow volumes and sewage strength to be monitored. When onsite soils are not usable, DEQ does allow onsite holding tanks. The DEQ WPCF application form has holding tanks listed as one of the application options. In the past Marion County has approved holding tanks as the permanent solution for onsite septic for the Aurora Airpark Aviation Condominium Association multiple hangars that are located directly to the west of the subject property on approximately 5 acres of land.

To further demonstrate that DEQ does approve these facilities we can provide permit documents and letters of approval for other facilities we have been involved with that used WPCF permits for holding tanks in Clackamas, Columbia, and Tillamook Counties. Oregon Administrative Rules Section 340-071-0340 allows holding tanks to serve this purpose. Under those rules the county regulators are allowed to approve them for up to 200 gpd flows, while higher flows the application must go directly to DEQ as a WPCF permit application.

Holding Tanks are inexpensive to install, but expensive to pump so are usually considered less desirable. However, these can and should be designed to be consistent with other options that take longer to evaluate and to gain approvals.

We understand that in the past, the City of Wilsonville objected to the use of holding tanks in Marion County, asserting that holding tanks are limited to 200 gallons per day. That limitation only applies to permits issued at the local level, rather than permits issued directly by DEQ for Water Pollution Control Facilities.

Existing HDSE System.

The existing onsite wastewater treatment system serving the HDSE Sewer System consists of numerous septic tanks which receive flow from different hanger buildings. Effluent is treated by two AX100 recirculating textiles filters that have a treatment capacity of 2,500 gpd each (5,000 gpd total). At the time that the treatment units were installed in 2005, the units were approved for 5,000 gpd each (10,000 gpd total). In spite of the fact that this system has performed well, DEQ will likely want an upgrade to current standards in order to approve additional flow. The addition of two more AX100's is proposed to increase the treatment capacity to 10,000 gallons per day. Treated effluent is pumped to a 3,000 lineal foot drainfield which has a DEQ-WPCF permitted capacity of 10,000 gallons per day. That system was designed by EMS, approved by DEQ and installed in 2000 for a 5,000 gallon per day use and upgraded to 10,000 gpd capacity with DEQ approval in 2004. There have never been any issues with the ability of the drainfield to operate effectively and within permit parameters. In fact, the system has excess capacity and justification would be provided to obtain approval from DEQ to

add the flow from the proposed development to be added to the existing system. The following describes the existing capacity and projected flow.

Existing HDSE Operational Experience.

Ongoing operations, monitoring, and maintenance of the system has been performed by Septic Technologies (Septech), a certified maintenance provider. Monthly flow data for 2022 is in Table 1, (Attached). In 2022, the average daily flow for the system was 2,495 gallons per day which amounts to 25% of the system's maximum capacity (10,000 gpd).

The proposed development includes the addition of. The expected occupancy of the proposed development is tabulated in Tables 2 through 4 , Attached. The proposed increase in flow to the system is estimated using a flow factor of 15 gpd per person, as specified for day workers at offices in Table 2 of Oregon Administrative Rules for Onsite Wastewater Treatment Systems (OAR 340-071). We have also considered the flow based on parking spaces and the relationship to actual flow in HDSE.

The peak increase in flow from the proposed development is 3,526 gpd, with a new total peak flow projected at 8,516 gpd and half of that being the average expected. This average flow of 4,258 gpd is about 43% of the existing system's capacity. Currently the system is only operating at one quarter of its capacity on average and has never exhibited failures. Professional monitoring is provided via telemetry for alarms and quarterly inspections by Septic Technologies. EMS has also been involved with this system as needed throughout its existence.

EMS recommends the addition of 2 Advantex AX 100 units to come into compliance with the revised sizing criteria for those items. The addition of the new facility is not expected to exceed this capacity with an average total discharge of 43 % of the system's capacity. DEQ requires that the permit maximum not exceed 100% and the average remain approximately 50% of the system's capacity. Experience shows that in cases where flows consistently exceed 75% of maximum, problems tend to increase.

Notes About Pumps.

It is important to note that DEQ approved recirculating systems, per OAR 340-071 rules, allow the use of pumps in septic systems. These pumps are small and do not qualify as "force mains." These recirculating types of systems are not urban or municipal systems – there is no force main or pump station used with them.

Cumulative Impacts.

No significant cumulative impacts are expected because:

a. If holding tanks are utilized then all sanitary materials are removed from the site and processed by an urban sanitary processing plant. Thus, there physically can be no impacts locally.

b. If a WPCF permit is applied for and received, it has to meet the high level of treatment and professional monitoring required by DEQ and State regulations which ensures there are no cumulative impacts. The effluent discharged to the drainfield is highly treated to become clear water with an average Biochemical Oxygen Demand of 10 mg/L (PPM) and Total Suspended Solids of 10.2 mg/L according to DEQ Discharge Monitoring Reports. These results are much better than the WPCF required level of 20 mg/L. Bacteria is not required to be tested, however, the effluent is also disinfected with Ultra Violet Light prior to discharge, with an expected efficacy of 99%. These systems have been in place for over 23 years without significant issues regarding treatment and final dispersal.

c. In our professional opinion, there will not be any cumulative effects of the proposed future development that would be in violation of state or federal environmental standards. Our understanding is that Marion County and Oregon DEQ standards are in compliance with applicable state and federal standards and our sanitary infrastructure will be in compliance with those local standards.

If you have any questions, please feel free to contact this office.

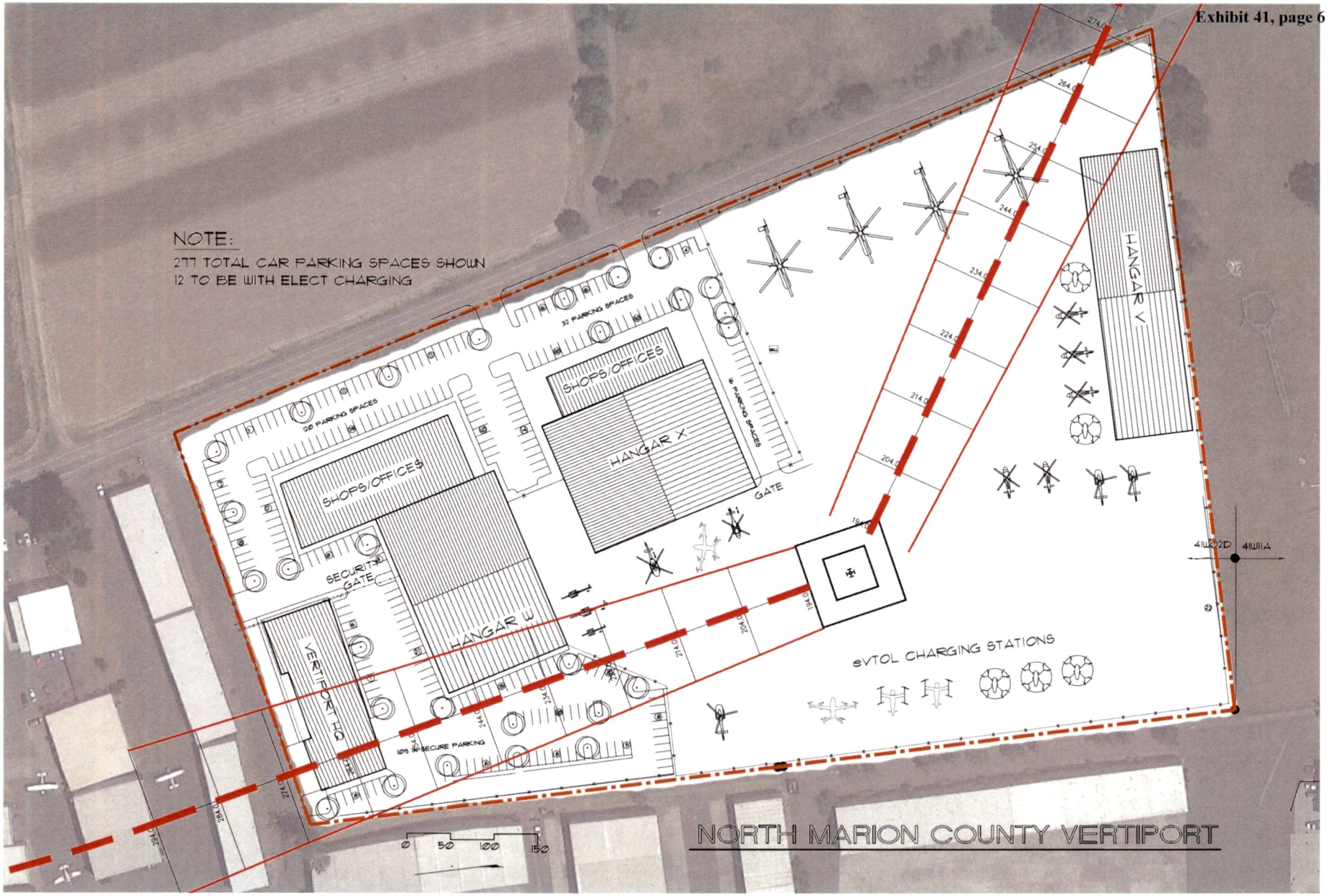
Sincerely,

R. Sweeney

Robert F. Sweeney, MS, REHS
President,
ENVIRONMENTAL MANAGEMENT SYSTEMS, Inc.

Attachments:

A. Proposed Site Plan
B. Tables 1 through 4.



ARON FAEGRE ARCHITECT
13200 FIELDING RD.
LAKE OSWEGO
OREGON
97034
503-980-1469

REGISTERED ARCHITECT
ARON FAEGRE
LAKE OSWEGO OREGON
STATE OF OREGON

NORTH MARION COUNTY VERTIPORT

SITE PLAN

AIRPORT ROAD - AURORA, OREGON

SITE PLAN

DATE: 12-15-2023

CHECKED BY: AF

REVISIONS

PAGE: L1.0

Evaluation of Proposed Combination of the Wastewater Flows from Existing HDSE and Future NMCVH Onsite Wastewater Treatment Systems. August 2023

EMS ENVIRONMENTAL MANAGEMENT SYSTEMS, INC.
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www.envmgtsys.com
4080 SE International Way
Suite B-112
Milwaukie, OR 97222

Table 1 - 4 Monthly Flows (gallons per day)*

Table 1 - 2019 HDSE Monthly Flows (gallons per day)*	HDSE 2019 Monthly Flows (gpd)		HDSE 2020 Monthly Flows (gpd)		HDSE 2021 Monthly Flows (gpd)				HDSE 2022 Monthly Flows (gpd)				HDSE Corrected Average Flow for 2022 (gpd)
January	3,349		1413	Min	2977		2977		5958		*	Omitted	
February	3,690	Max	1516		2131	Min	2131		4442		*	Omitted	
March	3,167		1916		3615		3615		7856	max	*	Omitted	
April	3,085		1525		3631		3631		4814		*	Omitted	
May	2,648		1508		2436		2436		4953		*	Omitted	
June	1,741		2130		3721	omitted	*		2909		2909		Leaking Plumbing Fixed
July	1,627		2741	Max	3962	omitted	*		2816		2816		
August	2,328		1893		4070	omitted	*		1861		1861		
September	1,300		1666		3705	omitted	*		1890		1890		
October	1,595				5354	omitted	*		1833		1833		
November	1,380		2358		7655	omitted	*		1777	Min	1777		
December	1,275	Min	2233		3873	omitted	*		2065		2065		
AVERAGE	**2,265**	22.7%of Max	**1,900**	19% of Maximum	**3,928**	39.3% of Max	**2,958**	29.58%	**3598**	356%Max	**2164**	21.6%Max	

Corrected Average Flow	
2495	**gpd**
Jan - May 21 + Jun 22 to Dec 22	

Percent of Permit Max:

***Flow data provided by O&M Provider Septic Technologies (Septech)**

* **Plumbing Leakage, but still within Permit Max. Jan - May 21 + Jun to Dec 22 were used as more accurate current data.**

Table 2 - Proposed Increase in Flow

Building #	# of employees	Flow Factor* (gpd)	Expected Peak (gpd)	Expected Average (gpd)
A.	10	15	150	75
B.	10	15	150	75
C.	10	15	150	75
D.	10	15	150	75
E.	10	15	150	75
F.	10	15	150	75
G.	10	15	150	75
H.	10	15	150	75
I.	10	15	150	75
TOTAL	**90**		**1,350**	**675**

*OAR 340-071 Table 2 - Day workers at offices

Table 3 - Proposed System Capacity (WPCF Permit Max = 10,000 gpd & 5,000 gpd Average Flow)

	Peak Flow	Average Flow	% Peak Capacity	% Average Capacity
Existing System Use	4,990	2,495	25%	49.9%
Proposed Flow Increase	1,350	675	7%	13.5%
TOTAL	6,340	3,170	32%	63.4%
	10000	**5000**		
Proposal Complies with DEQ WPCF?	**YES**	**YES**		

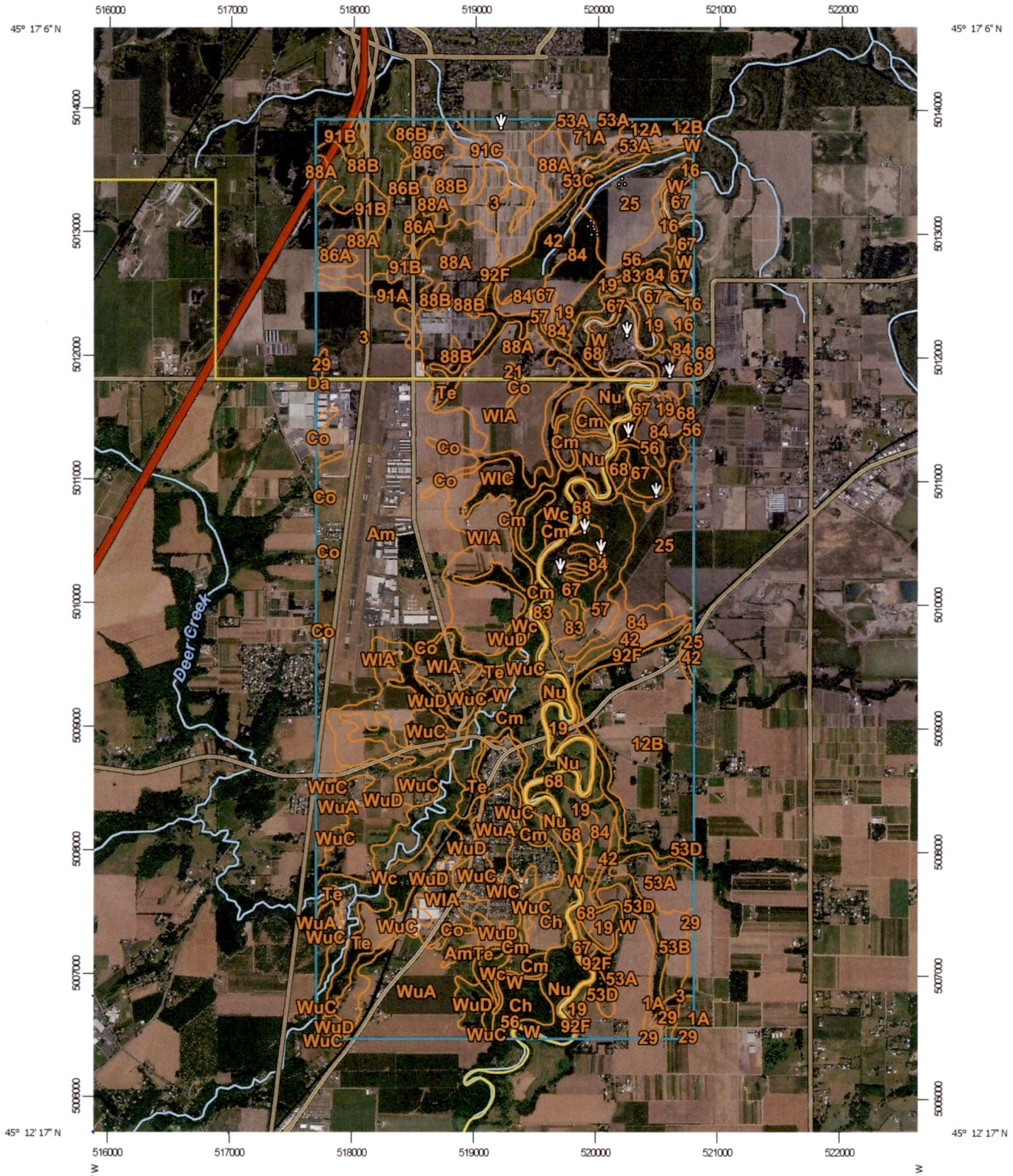
Table 4 - Proposed Increase in Flow Based on Parking Spaces.

	GPD/Space		1,900 gpd Average Flow 2020 DMR			Proposal Complies with DEQ WPCF?	Remaining Peak Flow Capacity
	Average	Peak	Peak Flow = 2x Average Flow			YES	6,200
Average Flow 2020	1,900	3800	**WPCF Peak Design Flow**	**10,000**	**GPD**		

	GPD/Space		2265 gpd Average Flow 2019 DMR			
Parking Spaces	**Average**	**Peak**	Peak Flow = 2x Average Flow			
392	5.78	11.56	4530	gpd Peak Design Flow		
277	5.78	11.56	3202	Peak Design Flow NMCVH		
669	5.78	11.56	7732	Design Flow HDSE + NMCVH		
	Avg GPD	Peak GPD	Assuming Same as 2019 / space			YES	2,268
HDSE + NMCVH	3866	7732	w/ added 277 spaces for NMCVH			Percent of MAX WPCF Permit Remaining	23%

	GPD/Space		2495 gpd Average Flow 2021&22 DMRs			
Parking Spaces	**Average**	**Peak**	Peak Flow = 2x Average Flow			
392	6.37	12.73	4990	gpd Peak Design Flow		
277	6.37	12.73	3526	Peak Design Flow NMCVH		
669	6.37	12.73	8516	Design Flow HDSE + NMCVH		
	Avg GPD	Peak GPD	Assuming Same as 2022 / space			YES	1,484
HDSE + NMCVH	4258	8516	w/ added 277 spaces for NMCVH			Percent of MAX WPCF Permit Remaining	15%

Soil Map—Clackamas County Area, Oregon, and Marion County Area, Oregon



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Survey Areas
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 19, Sep 14, 2022

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 20, Sep 14, 2022

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 19, 2015—Apr 18, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1A	Aloha silt loam, 0 to 3 percent slopes	18.4	0.3%
3	Amity silt loam	149.8	2.6%
12A	Canderly sandy loam, 0 to 3 percent slopes	16.7	0.3%
12B	Canderly sandy loam, 3 to 8 percent slopes	294.3	5.2%
16	Chehalis silt loam	10.4	0.2%
19	Cloquato silt loam	110.9	1.9%
21	Concord silt loam	2.3	0.0%
25	Cove silty clay loam	241.3	4.2%
29	Dayton silt loam	13.2	0.2%
42	Humaquepts, ponded	102.0	1.8%
53A	Latourell loam, 0 to 3 percent slopes	172.8	3.0%
53B	Latourell loam, 3 to 8 percent slopes	37.6	0.7%
53C	Latourell loam, 8 to 15 percent slopes	2.7	0.0%
53D	Latourell loam, 15 to 30 percent slopes	60.3	1.1%
56	McBee silty clay loam	60.7	1.1%
57	McBee variant loam	94.2	1.6%
67	Newberg fine sandy loam	261.0	4.6%
68	Newberg loam	53.2	0.9%
71A	Quatama loam, 0 to 3 percent slopes	33.9	0.6%
83	Wapato silt loam	24.6	0.4%
84	Wapato silty clay loam	170.9	3.0%
86A	Willamette silt loam, 0 to 3 percent slopes	24.3	0.4%
86B	Willamette silt loam, 3 to 8 percent slopes	80.3	1.4%
86C	Willamette silt loam, 8 to 15 percent slopes	8.7	0.2%
88A	Willamette silt loam, wet, 0 to 3 percent slopes	300.1	5.3%
88B	Willamette silt loam, wet, 3 to 7 percent slopes	243.9	4.3%
91A	Woodburn silt loam, 0 to 3 percent slopes	42.2	0.7%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
91B	Woodburn silt loam, 3 to 8 percent slopes	51.9	0.9%
91C	Woodburn silt loam, 8 to 15 percent slopes	39.3	0.7%
92F	Xerochrepts and Haploxerolls, very steep	110.8	1.9%
W	Water	97.9	1.7%
Subtotals for Soil Survey Area		**2,930.4**	**51.3%**
Totals for Area of Interest		**5,711.2**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Am	Amity silt loam	660.0	11.6%
Ch	Chehalis silty clay loam	105.5	1.8%
Cm	Cloquato silt loam	173.6	3.0%
Co	Concord silt loam	35.8	0.6%
Da	Dayton silt loam	0.7	0.0%
Nu	Newberg fine sandy loam	137.3	2.4%
Te	Terrace escarpments	223.9	3.9%
W	Water	68.2	1.2%
Wc	Wapato silty clay loam	159.4	2.8%
WlA	Willamette silt loam, 0 to 3 percent slopes	447.4	7.8%
WlC	Willamette silt loam, 3 to 12 percent slopes	38.0	0.7%
WuA	Woodburn silt loam, 0 to 3 percent slopes	242.9	4.3%
WuC	Woodburn silt loam, 3 to 12 percent slopes	261.8	4.6%
WuD	Woodburn silt loam, 12 to 20 percent slopes	226.4	4.0%
Subtotals for Soil Survey Area		**2,780.7**	**48.7%**
Totals for Area of Interest		**5,711.2**	**100.0%**

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Agricultural Productivity Ratings for Soils of the Willamette Valley

EC 1105 / October 1982

Oregon State University Extension Service



Agricultural Productivity Ratings for Soils of the Willamette Valley

by
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Development of productivity ratings for Oregon soils began in 1976 with the help of a small grant from the OSU Agricultural Research Foundation. Additional support has been provided since then by the OSU Extension Service.

We owe special thanks to Cheung Lau, who did much of the initial thinking, and to Bill Rogers and Michael Pauly, who worked on the project in its later phases.

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Introduction

This circular is written for farmers, Extension agents, farmland appraisers, realtors, land use planners, and all citizens interested in wise land use. The ratings given in table 1 rank all soils of the Willamette Valley in terms of their native productivity potential. They also indicate the relative extent to which fertilizers, drainage, and irrigation can improve productivity.

The circular explains how productivity ratings can help farmers make soil management decisions tailored to the soil resources on their own farms. It tells how appraisers and realtors can use productivity ratings to establish fair sale prices or rental rates. Assessors can use the ratings to set equalized tax rates based on the actual resource quality of a parcel of land. The circular explains how planners and county commissioners can use productivity ratings to help them make difficult decisions when choosing among competing uses for agricultural land.

As a matter of record, the circular also includes an explanation of the procedures used to derive the ratings and the mathematics used to check their accuracy. The ratings and their uses, however, can be easily understood without reference to the technical material in the appendixes.

Productivity ratings are numbers that indicate the relative value of a soil for agricultural use. The number scale runs from 0 to 100. High numbers indicate a combination of high yield potentials and wide diversity of adapted crops. Low numbers generally indicate lower yields and less diversity. A few soils, however, may have low ratings because they are suited for only one or two crops, yet the yields of those crops could be quite acceptable.

Productivity ratings are calculated by evaluating the effect of various soil properties like texture, depth, drainage, and fertility on the growth and yield of agricultural crops. If actual yield data were available for all crops grown (over 100) on all soils (over 80) in the valley, we wouldn't need to determine productivity ratings by any other method. There is very little yield information for specific soils, however, so productivity ratings are the next best thing.

The Soil Conservation Service does provide yield estimates for a few major crops on some of the more common soils. These estimates were used as targets for ratings determined from soil properties. By using the available data to calibrate the procedure, we can then use it with confidence to calculate productivity ratings for many other soils for which little or no yield information is available. Details of the calculation and calibration of the ratings are spelled out in the appendixes.

Productivity ratings are useful tools for evaluating soil resource quality and planning for the best use of agricultural land. Most farms or parcels of land have several different kinds of soils. Productivity ratings provide an objective way of identifying the best soils, the worst soils, and the soils of intermediate value.

They can—and should—be used in conjunction with soil surveys to see how much good soil there is, or how much poor soil. In this way, they can be used to help determine a fair purchase price, or a fair rental fee, for a piece of agricultural land.

Similarly, they can be used to formulate equalized tax assessment rates, the better soils being taxed at higher rates than the poorer soils. The overall productivity of a parcel can also be used to help decide whether the parcel should be preserved for agricultural use or whether the productivity is low enough that it would be appropriate to subdivide into smaller lots.

Farmers can use the ratings to see how much gain in productivity they might achieve by draining wet soils or irrigating droughty ones. The applications are discussed more thoroughly in the chapter beginning on page 11.

Productivity Ratings

Agricultural productivity ratings for soils of the Willamette Valley are given in table 1. Soils included and the meanings of the numbers listed are explained in the sections that follow.

Soils

The table lists virtually all soils on the flood plains and terraces of the main valley floor, as well as soils on the higher terraces and low foothills at the margins of the valley. It does not list soils of the Cascades, the Coast Range, or the interior valleys of either mountain range. It does not include organic soils, nor does it include miscellaneous land types like terrace escarpments or riverwash. Soils on slopes steeper than 30% are excluded also.

Soils are listed alphabetically by soil type. A soil type is a soil series (e.g., Willamette) plus the texture of the surface soil (e.g., silt loam). Soil types, along with the slope phases on which they occur, form the names of most of the mapping units used in soil surveys of the valley. The table includes ratings for every single-phase soil mapping unit identified in the soil surveys of Benton, Clackamas, Lane, Linn, Marion, Polk, Washington, and Yamhill counties.

Only the mapping units of complexes (e.g., Ritner-Price complex, 12 to 30% slopes) and undifferentiated soils (e.g., Steiwer and Chehulpum soils, 3 to 40% slopes) are omitted. In both cases, it would be appropriate to use ratings for the more limiting soil to express the productivity of the mapping unit.

Native productivity

Highly productive soils are deep, fertile, well drained, medium-textured soils that receive adequate precipitation to support high yields of agricultural crops. Such soils are given the maximum productivity rating of 100. Penalty points are deducted from the maximum if the soil is shallow, acid, wet, gravelly, droughty, or if any other property adversely affects crop growth. The native productivity rating is the balance that remains after all penalty points have been subtracted from 100.

Native productivity ratings allow comparisons among soils before considering any kind of management inputs like fertilizer, lime, drainage, or irrigation. Note that the range of values runs from 0 to 75. The maximum value is for Willamette silt loam, 0 to 3% slopes. Willamette loses 5 points because it is a little too acid for some crops, and it loses 20 points because of moisture stress caused by lack of rainfall during Oregon's dry summers.

Minimum values occur when a soil has so many things wrong with it that all the penalties add up to 100 points or more. Zero productivity does *not* mean that nothing will grow on the soil. Even soils like Camas, Helmick, and Witzel will support some grasses that could be used for native pasture or hay. Zero values do emphasize that the numbers in table 1 are *ratings,* not absolute values of yield potential. By comparison with other soils, however, these soils have the lowest productivity, whereas Willamette and Chehalis have the highest.

Table 1. Agricultural Productivity Ratings for Willamette Valley Soils

Soil type	Slope	Native productivity	Corrections for			Max. Productivity	
			Amendments	Drainage	Irrigation	Dryland	Irrigated
Abiqua silty clay loam	0-3%	70	+5	0	+20	75	95
	3-5%	70	+5	0	+20	75	95
Abiqua silty clay loam, occasionally flooded	0-3%	67	+5	0	+20	72	92
Aloha silt loam	0-3%	42	+11	+18	+22	71	93
	3-7%	39	+11	+18	+22	68	90
	8-15%	30	+11	+18	+22	59	81
Amity silt loam	0-3%	55	0	+18	+20	73	93
Awbrig silty clay loam	0-3%	0	+19	+3	+13	22	35
Bashaw silty clay loam	0-3%	20	+11	0	+9	31	40
Bashaw clay and silty clay	0-3%	20	+11	0	+9	31	40
	3-12%	14	+11	0	+9	25	34
Bellpine silty clay loam	3-12%	30	+20	0	+24	50	74
	12-20%	27	+20	0	+15	47	62
	20-30%	21	+20	0	0	41	41
Bellpine cobbly silty clay loam	2-30%	11	+23	0	0	34	34
Borges silty clay loam	0-8%	22	+15	+11	+6	48	54
Bornstedt silt loam	0-8%	40	+21	+8	+25	69	94
	8-15%	34	+21	+8	+16	63	79
	15-30%	28	+21	+8	0	57	57
Briedwell silt loam	0-3%	28	+14	0	+46	42	88
	0-7%	28	+14	0	+46	42	88
	3-12%	25	+14	0	+46	39	85
	7-12%	25	+14	0	+46	39	85
	7-20%	22	+14	0	+46	36	82
	12-20%	22	+14	0	+46	36	82
Briedwell gravelly loam	0-7%	28	+14	0	+46	42	88
Briedwell cobbly loam	0-7%	26	+15	0	+47	41	88
Briedwell stony silt loam	0-7%	22	+16	0	+31	38	69
	7-12%	19	+16	0	+31	35	66
	12-20%	16	+16	0	+31	32	63
Briedwell extremely stony loam	0-7%	12	+18	0	0	30	30
Camas gravelly sandy loam	0-3%	0	+19	0	+39	19	58
Carlton silt loam	0-7%	65	+5	+9	+20	79	99
	7-12%	62	+5	+9	+20	76	96
	12-20%	59	+5	+9	+20	73	93
Cascade silt loam	3-8%	22	+19	+13	+19	54	73
	7-12%	19	+19	+13	+19	51	70
	8-15%	13	+19	+13	+19	45	64
	12-20%	13	+19	+13	+19	45	64
	15-30%	5	+19	+13	0	37	37
	20-30%	5	+19	+13	0	37	37
Cascade silt loam, stony substratum	3-8%	22	+19	+13	+19	54	73
	8-15%	13	+19	+13	+19	45	64
	15-30%	5	+19	+13	0	37	37
Cazadero silty clay loam	0-7%	45	+16	0	+12	61	73
	7-12%	42	+16	0	+12	58	70
	12-20%	39	+16	0	+12	55	67
Chapman loam	0-3%	69	+7	0	+24	76	100
Chapman loam, occasionally flooded	0-3%	66	+7	0	+24	73	97
Chehalem silt loam, silty clay loam	3-12%	44	+5	+10	+24	59	83
Chehalis silt loam, silty clay loam (non-flooded)	0-3%	75	+5	0	+20	80	100
Chehalis silt loam, silty clay loam (occ. overflow)	0-3%	72	+5	0	+20	77	97
Chehulpum silt loam	3-12%	42	+15	0	+8	57	65
	12-35%	33	+15	0	0	48	48
Clackamas gravelly loam	0-3%	26	+13	+10	+37	49	86
Clackamas gravelly silt loam	0-3%	26	+13	+10	+37	49	86
Clackamas silt loam	0-3%	31	+11	+10	+34	52	86
Cloquato silt loam	0-3%	69	+6	0	+22	75	97
Coburg silty clay loam	0-3%	60	+5	+8	+20	73	93

Soil type	Slope	Native productivity	Corrections for Amendments	Corrections for Drainage	Corrections for Irrigation	Max. Productivity Dryland	Max. Productivity Irrigated
Coburg silty clay loam, occasionally flooded	0-3%	57	+5	+8	+20	70	90
Concord silt loam	0-3%	25	+16	+8	+21	49	70
Conser silty clay loam	0-3%	30	+11	+8	+21	49	70
Cornelius silt loam	3-8%	40	+16	+8	+25	64	89
	8-15%	34	+16	+8	+16	58	74
	15-30%	28	+16	+8	0	52	52
Cornelius variant silt loam	0-3%	30	+12	+20	+17	62	79
	3-7%	27	+12	+20	+17	59	76
	7-12%	24	+12	+20	+17	56	73
Cottrell silty clay loam	2-8%	35	+16	+7	+12	58	70
	8-15%	29	+16	+7	+12	52	64
	15-30%	23	+16	+7	0	46	46
Courtney gravelly silty clay loam	0-3%	0	+24	+4	+30	28	58
Cove silty clay loam	0-3%	2	+12	+4	+13	18	31
Cove silty clay loam, thick surface	0-2%	2	+12	+4	+13	18	31
silty clay loam, fan	2-7%	0	+12	+4	+13	16	29
clay	0-2%	2	+12	+4	+13	18	31
Dayton silt loam	0-3%	10	+22	+4	+27	36	63
Dayton silt loam, thick surface	0-3%	10	+22	+4	+27	36	63
Dayton silt loam, clay substratum	0-3%	10	+22	+4	+27	36	63
Delena silt loam	3-12%	14	+21	+8	+10	43	53
Dixonville silty clay loam	3-12%	48	+11	0	+26	59	85
	12-20%	45	+11	0	+17	56	73
	12-30%	39	+11	0	0	50	50
	20-30%	39	+11	0	0	50	50
Dupee silt loam	3-12%	37	+11	+11	+18	59	77
	3-20%	33	+11	+11	+18	55	73
	12-20%	33	+11	+11	+18	55	73
Hardscrabble silt loam	2-7%	17	+16	+8	+8	41	49
	7-20%	8	+16	+8	+8	32	40
Hazelair silty clay loam and silt loam	2-7%	18	+14	+3	+7	35	42
	3-12%	15	+14	+3	+7	32	39
	7-20%	11	+14	+3	+7	28	35
	12-20%	11	+14	+3	+7	28	35
	20-30%	4	+14	+3	0	21	21
Hazelair silty clay loam, acid variant	2-7%	15	+17	+3	+7	35	42
Hazelair silty clay loam, eroded	2-15%	9	+16	+2	+8	27	35
Helmick silt loam	3-12%	0	+22	+5	+9	27	36
	12-20%	0	+21	+5	+8	26	34
	20-50%	0	+15	+4	0	19	19
Helvetia silt loam	0-12%	57	+5	+8	+20	70	90
	3-8%	60	+5	+8	+20	73	93
	7-12%	57	+5	+8	+20	70	90
	8-15%	54	+5	+8	+20	67	87
	12-20%	54	+5	+8	+20	67	87
	15-30%	48	+5	+8	0	61	61
	20-30%	48	+5	+8	0	61	61
Hillsboro loam	0-3%	70	+5	0	+20	75	95
	3-7%	70	+5	0	+20	75	95
	7-12%	67	+5	0	+20	72	92
	12-20%	64	+5	0	+20	69	89
Holcomb silt loam	0-3%	28	+13	+8	+21	49	70
Holcomb silty clay loam	0-3%	23	+13	+8	+21	44	65
Huberly silt loam	0-3%	15	+26	+8	+26	49	75
Hullt clay loam	2-7%	42	+16	0	+22	58	80
	2-12%	39	+16	0	+22	55	77
	7-20%	36	+16	0	+22	52	74
	20-30%	30	+16	0	0	46	46
	2-30%	30	+16	0	0	46	46

Soil type	Slope	Native productivity	Corrections for Amendments	Drainage	Irrigation	Max. Productivity Dryland	Irrigated
Jory silty clay loam,	2-7%	48	+15	0	+20	63	83
silt loam, and	2-12%	45	+15	0	+20	60	80
clay loam	7-12%	45	+15	0	+20	60	80
	12-20%	42	+15	0	+20	57	77
	20-30%	36	+15	0	0	51	51
Jory stony silt loam	3-8%	28	+22	0	+17	50	67
	8-15%	22	+22	0	+17	44	61
	15-30%	16	+22	0	0	38	38
Kinton silt loam	2-7%	37	+16	+8	+26	61	87
	3-8%	37	+16	+8	+26	61	87
	7-12%	34	+16	+8	+16	58	74
	8-15%	31	+16	+8	+16	55	71
	12-20%	31	+16	+8	+16	55	71
	20-30%	25	+16	+8	0	49	49
Labish silty clay loam	0-1%	0	+21	+6	+17	27	44
Labish mucky clay	0-1%	0	+21	+6	+17	27	44
Lacomb silty clay loam	2-7%	25	+21	0	+26	46	72
	7-15%	19	+21	0	+16	40	56
Latourell loam	0-3%	70	+10	0	+20	80	100
	3-8%	70	+10	0	+20	80	100
	8-15%	64	+10	0	+20	74	94
	15-30%	58	+10	0	0	68	68
Laurelwood silt loam	3-7%	67	+11	0	+22	78	100
	3-12%	64	+11	0	+22	75	95
	7-12%	64	+11	0	+22	75	95
	12-20%	61	+11	0	+22	72	92
	20-30%	55	+11	0	0	66	66
Linslaw loam	0-3%	25	+20	+10	+20	55	75
Malabon silty clay loam	0-3%	70	+5	0	+20	75	95
Malabon silty clay loam, occasionally flooded	0-3%	67	+5	0	+20	72	92
Malabon variant loam	0-3%	37	+20	0	+20	57	77
Marcola cobbly silty clay loam	2-7%	4	+16	+6	+31	26	57
McAlpin silty clay loam	0-3%	50	+5	+11	+16	66	82
	3-6%	48	+5	+11	+16	64	80
McBee silty clay loam	0-3%	55	+5	+9	+20	69	89
McBee variant loam	0-3%	39	+1	+18	+22	58	80
Melbourne silty clay loam	2-7%	43	+20	0	+20	63	83
	7-12%	40	+20	0	+20	60	80
	12-20%	37	+20	0	+20	57	77
	20-30%	31	+20	0	0	51	51
Multnomah silt loam	0-3%	32	+26	0	+26	58	84
	15-30%	20	+26	0	0	46	46
Natroy silty clay loam	0-3%	10	+11	0	+9	21	30
Natroy silty clay	0-3%	10	+11	0	+9	21	30
Nekia silty clay loam,	2-7%	30	+21	0	+26	51	77
silt loam, and	2-12%	27	+21	0	+26	48	74
clay loam	7-12%	27	+21	0	+26	48	74
	12-20%	24	+21	0	+16	45	61
	20-30%	18	+21	0	0	39	39
Nekia stony silty clay loam	2-12%	7	+28	0	+23	35	58
Nekia very stony silty clay loam	2-30%	0	+28	0	0	28	28
Newberg sandy loam, fine sandy loam, loam, and silt loam	0-3%	57	+7	0	+33	64	97
Noti loam	0-3%	0	+35	+10	+8	45	53
Oxley gravelly silt loam	0-3%	13	+13	+10	+32	36	68
Panther silty clay loam	2-12%	0	+12	+4	+9	16	25
	4-20%	0	+11	+4	+8	15	23
Pengra silt loam	1-4%	35	+12	+3	+9	50	59
Philomath silty clay	3-12%	15	+8	0	+11	23	34
	12-45%	3	+8	0	0	11	11
Philomath cobbly silty clay	3-12%	5	+11	0	+13	16	29
	12-45%	0	+10	0	0	10	10

Soil type	Slope	Native productivity	Corrections for Amendments	Drainage	Irrigation	Net productivity Dryland	Irrigated
Philomath stony silty clay	3-12%	0	+14	0	+14	14	28
	12-45%	0	+13	0	0	13	13
Pilchuck fine sand, fine sandy loam	0-3%	10	+20	0	+40	30	70
Powell silt loam	0-3%	20	+24	+13	+20	57	77
	0-8%	17	+24	+13	+20	54	74
	3-8%	17	+24	+13	+20	54	74
	8-15%	8	+24	+13	+20	45	65
	15-30%	0	+24	+13	0	37	37
Price silty clay loam	3-12%	36	+22	0	+24	58	82
	12-20%	33	+22	0	+24	55	79
	20-30%	27	+22	0	0	49	49
Quatama loam	0-3%	65	+5	+9	+20	79	99
	3-8%	65	+5	+9	+20	79	99
	7-12%	62	+5	+9	+20	76	96
	8-15%	59	+5	+9	+20	73	93
	12-20%	59	+5	+9	+20	73	93
	15-30%	53	+5	+9	0	67	67
Rickreall silty clay loam	3-12%	20	+23	0	+7	43	50
	12-20%	17	+23	0	+7	40	47
	20-50%	0	+23	0	0	23	23
Ritner gravelly silty clay loam	3-12%	0	+27	0	+26	27	53
	12-30%	0	+25	0	0	25	25
Ritner cobbly silty clay loam	2-12%	0	+28	0	+26	28	54
	3-30%	0	+26	0	0	26	26
	12-30%	0	+26	0	0	26	26
Salem gravelly silt loam, and gravelly loam	0-3%	55	+12	0	+26	67	93
Salkum silty clay loam, and silt loam	2-8%	35	+21	0	+22	56	78
	7-12%	32	+21	0	+22	53	75
	8-16%	29	+21	0	+22	50	72
	6-20%	29	+21	0	+22	50	72
Salkum silty clay loam, basin	0-6%	35	+21	0	+22	56	78
Santiam silt loam	0-3%	52	+11	+6	+18	69	87
	3-6%	52	+11	+6	+18	69	87
	0-7%	52	+11	+6	+18	69	87
	7-12%	49	+11	+6	+18	66	84
	6-15%	46	+11	+6	+18	63	81
	12-20%	46	+11	+6	+18	63	81
Saum silt loam	2-7%	53	+14	0	+28	67	95
	3-8%	53	+14	0	+28	67	95
	7-12%	50	+14	0	+28	64	92
	8-15%	47	+14	0	+28	61	89
	12-20%	47	+14	0	+28	61	89
	15-30%	41	+14	0	0	55	55
	20-30%	41	+14	0	0	55	55
Sifton gravelly loam	0-3%	22	+32	0	+17	54	71
Sifton variant gravelly clay loam	0-3%	20	+13	0	+27	33	60
Silverton silt loam	2-12%	48	+11	0	+26	59	85
	12-20%	45	+11	0	+17	56	73
Stayton silt loam	0-7%	20	+33	0	+7	53	60
Steiwer silty clay loam, loam, and silt loam	3-6%	55	+10	0	+24	65	89
	3-12%	52	+10	0	+24	62	86
	5-20%	49	+10	0	+15	59	74
	12-20%	49	+10	0	+15	59	74
	20-30%	43	+10	0	0	53	53
	20-50%	35	+10	0	0	45	45
Steiwer silty clay loam, basalt substratum	5-20%	49	+10	0	+15	59	74
	20-30%	43	+10	0	0	53	53
Steiwer silt loam, acid variant	3-20%	39	+15	0	+15	54	69
Suver silty clay loam	3-12%	2	+27	+5	+9	34	43
	12-20%	0	+26	+5	+9	33	42
	20-30%	0	+24	+4	0	28	28

Soil type	Slope	Native productivity	Corrections for			Max. Productivity	
			Amendments	Drainage	Irrigation	Dryland	Irrigated
Veneta loam, silt loam	0-7%	45	+16	+3	+25	64	89
	0-12%	42	+16	+3	+16	61	77
	7-20%	39	+16	+3	+16	58	74
	12-20%	39	+16	+3	+16	58	74
Veneta loam, loamy subsoil variant	2-7%	55	+15	0	+24	70	94
	7-20%	49	+15	0	+15	64	79
	20-30%	43	+15	0	0	58	58
Veneta variant silt loam	0-7%	50	+15	+4	+24	69	93
Verboort silty clay loam	0-3%	5	+17	+4	+27	26	53
Waldo silty clay loam, silt loam	0-3%	17	+9	+12	+31	38	69
Wapato silt loam, silty clay loam	0-3%	20	+8	+16	+29	44	73
Wapato gravelly silty clay loam	0-3%	13	+10	+16	+33	39	72
Whiteson silt loam	0-3%	8	+15	+4	+26	27	53
Willakenzie silty clay loam, clay loam	2-12%	47	+15	0	+24	62	86
	12-20%	44	+15	0	+15	59	74
	20-30%	38	+15	0	0	53	53
Willakenzie silty clay loam, moderately shallow	2-7%	50	+15	0	+24	65	89
	7-20%	44	+15	0	+15	59	74
Willamette silt loam	0-3%	75	+5	0	+20	80	100
	3-7%	75	+5	0	+20	80	100
	3-12%	72	+5	0	+20	77	97
	7-12%	72	+5	0	+20	77	97
	12-20%	69	+5	0	+20	74	94
Willamette silt loam, wet	0-3%	65	+5	+9	+20	79	99
	3-7%	65	+5	+9	+20	79	99
Willamette silt loam, gravelly substratum	0-3%	62	+9	0	+23	71	94
Witham silty clay loam, silty clay	2-7%	12	+5	+8	+8	25	33
Witzel cobbly silt loam	3-12%	8	+21	0	+14	29	43
Witzel very stony silt loam, very cobbly loam	3-12%	0	+21	0	+14	21	35
	3-30%	0	+21	0	0	21	21
Woodburn silt loam	0-3%	65	+5	+8	+16	78	94
	0-7%	65	+5	+8	+16	78	94
	3-12%	62	+5	+8	+16	75	91
	7-12%	62	+5	+8	+16	75	91
	12-20%	59	+5	+8	+16	72	88
Yamhill silt loam	2-7%	55	+10	0	+24	65	89
	7-12%	52	+10	0	+24	62	86
	12-20%	49	+10	0	+15	59	74
	20-30%	43	+10	0	0	53	53
Yamhill silt loam, moderately shallow	2-7%	55	+10	0	+24	65	89
	7-20%	49	+10	0	+15	59	74

Corrections

Most farmers don't depend solely on native productivity to sustain crop yields. They improve upon existing conditions by adding fertilizer and lime, draining wet soils, and irrigating dry soils. Table 1 shows how much they can increase native productivity ratings by each management practice taken independently. Corrections simply add back some or all of the points previously deducted in deriving the native productivity score.

Amendments. Penalty points are deducted for low native fertility, for excessive soil acidity, and for anything like shallow depth or coarse fragments that reduce the volume of soil from which plant roots can extract nutrients. These limitations can be partially or completely overcome by adding fertilizer and/or lime to the soil.

The actual amounts of lime or fertilizer needed in any given situation can only be determined through a careful soil testing program. Besides differences in native fertility, different crop requirements and different prior fertilization practices must be considered in making a lime or fertilizer recommendation.

Oregon State University, through its Soil Testing Laboratory and its network of county Extension agents, is well equipped to provide sound, up-to-date advice on how much fertilizer or lime to add to a given soil for a given crop. Several reputable commercial laboratories are also equipped to test soil for lime and fertilizer requirements.

Numbers in the "Amendments" column of table 1 are not specific fertilizer recommendations. They are ratings corrections that show how many points can be added to the native productivity score to make up for some or all of the penalty points previously deducted for nutrient deficiencies.

Some general inferences can be made from the magnitudes of these corrections. Most of the small corrections (less than 10 points) are associated with soils having relatively few inherent deficiencies (native productivity 50 or more). These deficiencies are easy to correct. Adding the necessary amendments will likely be profitable.

These same soils are also likely to respond favorably to very intensive fertility management. Thus fertilizer applications well

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AURORA STATE AIRPORT

MASTER PLAN COPY

1976-1995

FINAL DRAFT

OREGON STATE DIVISION OF AERONAUTICS

FEBRUARY 1976

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PREFACE

The preparation of this airport master planning project was financed in part through a planning grant from the Federal Aviation Administration, Department of Transportation, under the provisions of the Airport and Airway Development Act of 1970, (Public Law 91-258), as amended.

ACKNOWLEDGEMENTS

Names, titles, agencies to be checked and added later.

H2M HILL

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MASTER PLAN

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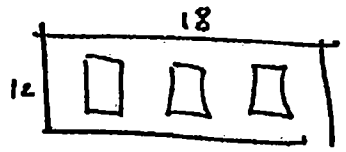

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GLOSSARY OF ABBREVIATIONS USED IN MASTER PLAN

BT	Basic Transport, a category of airport serving BT aircraft, which are all airplanes of 12500 to 60000 pounds maximum gross take off weight; also includes turbojets under 12500 pounds.
DG	Dual Gear Aircraft
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FBO	Fixed Base Operator; FBO's provide aviation services at airports.
GA	General Aviation, including all types of aviation except Air carriers and Military.
GU	General Utility, a category of airport serving GU Aircraft, which are all airplanes under 12500 pounds maximum gross take off weight.
IFR	Instrument Flight Rules; Required in controlled airspace with a visibility less than 3 miles and/or celings lower than 1000 feet.
MALSF	Medium Intensity Approach Lighting System with sequence flashers; for use during instrument weather (IFR).
MLS	Microwave Landing System. It is used to provide horizontal and vertical guidance to landing aircraft during low visibility weather.
NDB	Non-directional Beacon. It is an electronic beacon providing direction guidance to aircraft.

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NEF	Noise Exposure Forecast. It is used as guidance for predicting human response to aircraft noise.
OSDA	Oregon State Aeronautics Division, Oregon State Department of Transportation.
SG	Single Gear Aircraft
SMSA	Standard Metropolitan Statistical Area. It is a standard area used to measure, compare, and predict socio-economic trends in metropolitan areas.
VASI	Visual Approach Slope Indicator
VFR	Visual Flight Rules. They can be used when the visibility is greater than 3 miles and the ceiling is higher than 1000 feet.
VOR/DME	Very high frequency Omni-directional Radio range/Distance Measuring Equipment. It is an instrument approach procedure using VORTAC.
VORTAC	Very high frequency Omni-directional Radio range with TACAN (an aid used by the Military).

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INTRODUCTION

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INTRODUCTION

Throughout recent years changing patterns of aviation activities at the Aurora State Airport have made it difficult for the Oregon Division of Aeronautics to maintain a responsive program for improvement. Short term needs have been met, but there has been no long range development plan for the airport.

There have been a long series of changes in the fixed base operations at the airport. These changes and replacements have affected the services to the airport user and sometimes even the nature of the airport's growing traffic.

Even while airport traffic was on a steady increase there have been periodic occurrences of crisis situtations for which there was little time for advance planning. Revenues to the owner, the Oregon Division of Aeronautics, have fluctuated, and financial planning has been difficult for the State.

Now the airport is one of the busiest general aviation airports in Oregon. Traffic includes a full range of general aviation equipment. Aurora State Airport serves portions of several counties, both rural and urban, and a wide variety of business and private users. Figure 1 shows the airport.

Many of the airport's facilities require improvements appropriate to the present and predicted air traffic. Also today's unprecedented emphasis on environmental compatibility and land use planning demands response from the airport community.

In May 1975 the Oregon Division of Aeronautics, Department of Transportation, retained CH2M HILL as airport consultants to prepare a master plan for the Aurora State Airport. This Master Plan provides the community at large and public agencies with a means to understand the airport's significance and to implement plans and programs related to the airport.

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OBLIQUE PHOTOGRAPH

AURORA STATE AIRPORT - 1976

FIGURE 1

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The Master Plan describes the kind and magnitude of development needed for aviation services and facilities and provides an orderly schedule for development through 1995. The plan also endeavors to preserve and improve the airport through economical solutions that remain compatible with regional development and responsive to community wishes.

Objectives accomplished and included in the Master Plan are:

- Preparation of an inventory of facilities and conditions and a collection of data essential to understanding the airport.
- Development of aviation forecasts and a determination of the airport's role in the airport system.
- An analysis of airport space and facilities requirements.
- Presentation of graphic depictions of recommended future development of all areas within and adjacent to the airport.
- Evaluation of the impact of future development upon the environment and the surrounding community.
- Establishment of a schedule for development by priorities and a staged improvement program with cost estimates.
- Specific recommendations for implementing the development program including a financial plan.

The Aurora State Airport Master Plan was developed through the combined efforts of many. Participants included representatives from local and state governments, the Federal Aviation Administration and many private citizens representing surrounding communities and users of the airport.

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Much of the Master Plan deals with a program for the future of the airport and with guidelines for use of the surrounding land. Because future trends and goals may not exactly match present forecasts and current community policies, the Master Plan scheme has the built-in flexibility to respond to changes without losing its integrity.

The main goal now after adopting the Master Plan is to follow through with a continuous implementation program, updated as required. This will be the best way to maximize the airport's benefits while minimizing costs and adverse impacts.

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SUMMARY

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SUMMARY

FINDINGS

- No long-range formal Plan exists for the Aurora State Airport.
- The lack of a Master Plan makes long range financial planning difficult or nearly impossible because there can be no budget targets for improvements.
- The Aurora State Airport serves a large service area, including several counties. The airport's sphere of influence is regional and the airport is part of a greater Portland regional system of airports.
- Surface access to the airport is poor from Marion County, but it is reasonably adequate from other counties to the north of the airport.
- The airport needs maintenance of both private and public facilities. Pavement and drainage are key items.
- The airport is built to standards exceeding minimum FAA requirements and often excelling maximum FAA criteria.
- The lack of a parallel taxiway is a serious problem both for safety and for airfield capacity.
- Improvements to airport facilities are not keeping pace with increases in air traffic levels.
- There is no on-site airport management to enforce airport operational safety regulations uniformly.
- Aircraft parking areas are in very poor condition and their use is limited by weather and soil conditions.
- The airport has no central focal point, no main entrance. This is confusing to transient pilots and visitors who are seeking a main terminal area.

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- The airport is owned in two parts. The runway area is owned by the Oregon Division Aeronautics and is basically a paved flight strip. All revenue producing areas of the airport are owned by private interests who are under no requirement to guarantee minimum levels of service to the public.

- Multiple ownership of separate parts of the airport make master planning and policy development impossible to implement through any comprehensive program or Master Plan.

- The Aurora State Airport needs more recognition by public comprehensive plans and by zoning ordinances. Although the airport use is now compatible with adjacent land use the surrounding area has potential for growth. Therefore the airport needs guaranteed protection throughout the long-range future.

- The current zoning of the airport, public amusement (PA) is inappropriate. Zoning adjacent to the airport Residential-Agricultural (RA) is potentially incompatible with the airport.

- The Master Plan forecasts significant increases in general aviation traffic. Master Plan forecasts for 1995 show 248 based aircraft, 209,000 annual operations, 115 operations during the busy hour.

  In 1995 eight percent of the aircraft will be propeller engine multi-engine aircraft and three percent will be turbojet aircraft. The airport will be serving a population of over one million people. The forecasts show a need for an air traffic control tower, a crash/fire/rescue station, a terminal building, and the full time direction of an airport manager. No airline traffic is predicted for the future.

- The airport's current role is General Utility, but this will change to Basic Transport as more corporate types and turbojet aircraft use the airport by the late 1980's. The date when the activity will determine the airport to be Basic Transport may depend upon the airport program of the Port of Portland and upon urban growth from Portland southward toward Aurora.

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- The existing airport site is adequate to accommodate the 20-year forecast needs of the Aurora State Airport.
- A proposed new airport in the southeast Portland area would affect Aurora State Airport slightly by absorbing some of the aviation demand and slowing the growth of the airport, but effects would not be significant.
- Two serious capacity problems limit the airport at this time. There is a runway capacity problem because of the lack of a parallel taxiway, and there is a parking problem, particularly during wet weather, because of the lack of paved public apron space.
- The airport does not presently provide sufficient public service facilities.
- Employment on the airport is increasing, and from 100 to 125 persons are directly employed on the airport. The direct plus indirect salary impact is estimated to approach $1,000,000 annually. The economic impact of the airport is on the increase.
- Eventually the airport will require a longer runway to accommodate more complex aircraft in the future, but a second runway will not be required.
- IFR approach procedures for the airport are unsatisfactory. Minima are poor and the requirement for DME equipment is limiting.
- The airport has no on-site navaids. Additional electronic and visual navaids are required.
- The Master Plan has developed a schedule of projects by priority necessary to develop the airport. They are contained in the Plan.
- For extensive terminal area development soil and drainage conditions may dictate installing central waste treatment facilities.
- The impacts caused by the operation of the airport upon the surrounding environment are light. These are described in the Master Plan.

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- The Master Plan presents a three-stage 20-year capital development program. Total estimated costs including private and Federal investments are about $3.3 million.

- The capital development program can be carried out with a State of Oregon share of $764,000 for the 20-year period.

- Currently the revenue produced by the airport is inadequate to support the forecast aviation demand levels. Under this Airport Master Plan the State's revenue could be developed to support the program recommended by the Master Plan.

- Successful airport operational management under a two part ownership, i.e., State and private, will become more difficult as air traffic levels and FBO levels of competition increase. — language?

- As traffic levels increase and activities become more complex the present airport staff available to the State Aeronautics Division is not adequate to manage the operation and development of the airport.

- Although the Oregon Aviation System Plan has recommended transfer of the airport to a local agency, no such agency appears to be available. State ownership of all airport property and management by the State appears to be the only viable alternative for successful operation and development of the Aurora State Airport.

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RECOMMENDATIONS

- This airport Master Plan should be adopted and implementation commenced immediately.
- Application should be made to the FAA for funds to support the Implementation Plan.
- The Aurora State Airport should be retained at its existing site.
- In order for the State to implement the Master Plan the State needs to control the land. Therefore acquisition of the land for the terminal area should be accomplished without delay.
- The existing airport criteria should be preserved even though they partially excell customary FAA airport standards.
- The parallel taxiway and exit taxiway system must be constructed immediately. This is necessary to protect public safety and to provide adequate runway capacity.
- Obstruction removal should be accomplished as described in the Master Plan.
- Paved aircraft parking aprons should be provided in the near future.
- More and better airfield lighting should be installed in the near future.
- The airport maintenance program should be accelerated, particularly as regards runway pavement rehabilitation and airfield surface drainage improvements.
- The State should continue to work closely with Marion and Clackamas Counties to develop compatible land use planning.
- The State should work closely with Marion and Clackamas Counties to develop zoning changes on and near the airport as recommended by the Master Plan.

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- The State Aeronautics Divison should make recommendations to the State Highway Division for improving access routes and facilities.

- The establishment of bus and/or limousine service to the airport should be encouraged.

- At this time no appropriate alternatives for airport ownership seem to exist. The State should retain ownership of the airport because its closure would have a critical adverse impact on the Oregon Aviation System.

- The State should take a more active part in the management of the entire airport and particularly give more attention to user service and problems.

- The State should develop an airport management program and increase its airport staff as necessary to administer the airport operation and development program.

- The State's financial policy should be to make the airport more self-supporting. This should be accomplished by obtaining more direct control of the sources of airport revenues. Revenues should be increased in accordance with area competition and inflation rates. Lease rates should be reviewed frequently and kept up-to-date.

- Airport traffic surveys should be made periodically and incorporated into the Master Plan and the Oregon Aviation System Plan.

- A program to collect weather data should be initiated and used for facility planning.

- The State should schedule periodic reviews of the Master Plan. It should be revised whenever necessary to keep it current.

- In updating the Master Plan the State should work closely with the airport users, local governments, and citizens. A flexible attitude and approach to the planning process should be maintained.

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AIRPORT REQUIREMENTS

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AIRPORT REQUIREMENTS

INVENTORY

History

The Aurora State Airport is a public airport,owned and operated by the Oregon Division of Aeronautics. The airport was constructed in 1943 by the State Highway Department to provide an emergency alternate field for air carrier aircraft. Thus, the airport has been in operation as an airport for approximately 32 years, although it has not and does not serve air carrier aircraft.

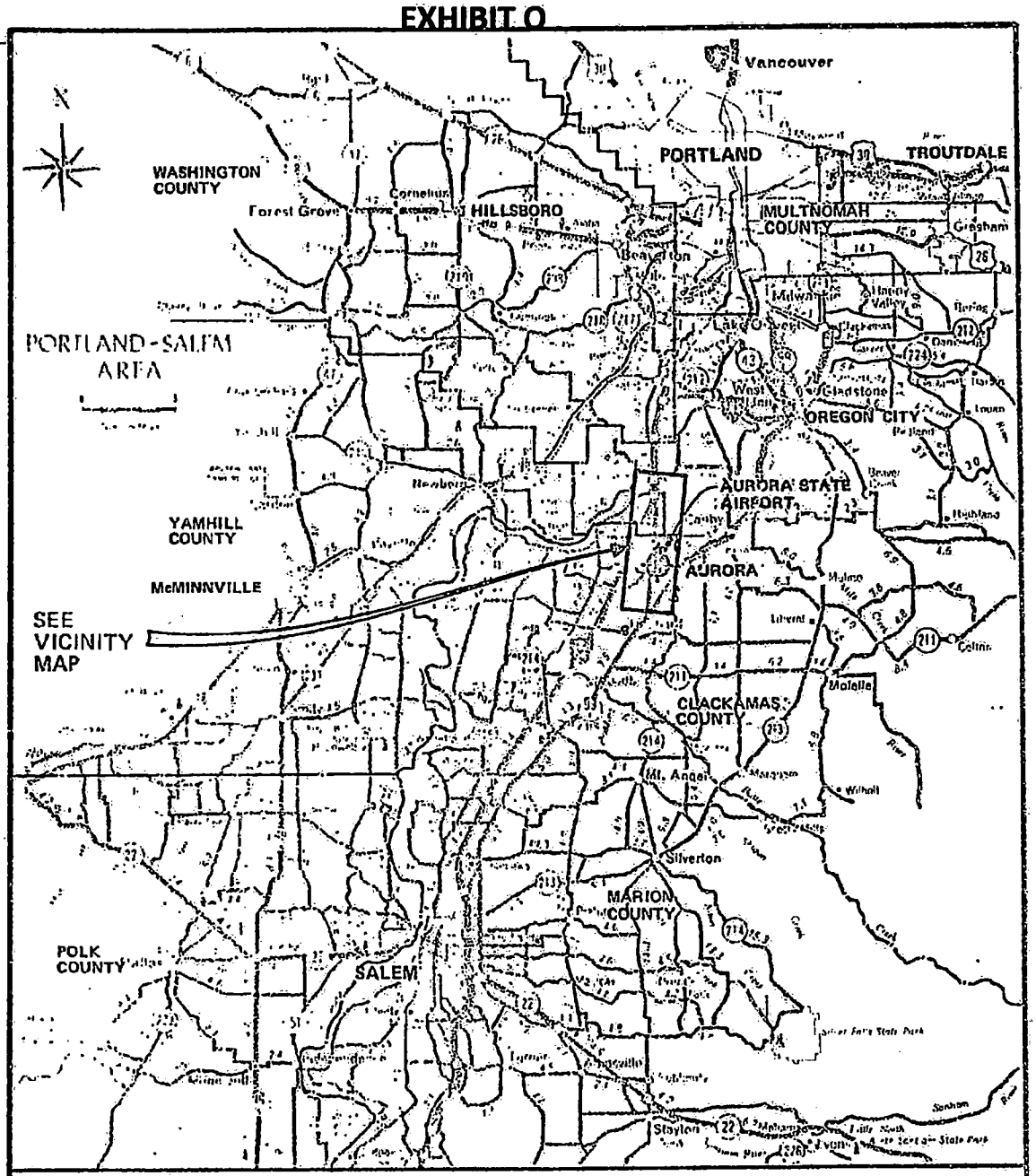
The airport has had a varied history. It has served military aircraft, crop dusters, gliders, as well as the full range of general aviation aircraft. Aurora State Airport began as a Federal Flight Strip Project. In the early years until 1953 the Bureau of Public Roads (BPR) administered the airport. In 1946 the Civil Aeronautics Administration included the Aurora Flight Strip in the National Airport Plan (now National Airport System Plan) where it has remained.

Legislation was passed in 1947 to permit the Board of Aeronautics (now Division of Aeronautics) to own and operate state airports, and in 1953 the Board signed a lease agreement with BPR to maintain and operate the airport. In 1973 the State Highway Commission transferred title to the Board of Aeronautics.

Location

The Aurora State Airport is located in the North Willamette Valley between Portland and Salem as shown on Figure 2, Location Map. The airport lies in Marion County, with the north property line bordering on the Marion-Clackamas County line. The Portland city center is about 20 miles north along Interstate Highway 5, and Salem lies 26 miles to the south.

EXHIBIT O



AURORA STATE AIRPORT
LOCATION MAP
FIGURE 2

CH2M HILL

PROJECT NO. C9198.00
FIGURE NO.

PROJECT NO. AURORA JAN 16 1976
FIGURE AURORA JAN 15 1976

EXHIBIT O

Airport access convenience plays a key role in determining the size of the area which the airport serves. Figure 3 shows travel times by car. The Aurora State Airport is reached by the local highway system. This system provides relatively good access to most of the airport service areas. However several major drawbacks exist as follows:

1) Several roads serving the airport are constructed to low standards and/or are in poor condition.

2) Indirect routes are required for access, particularly in the immediate vicinity of the airport.

3) The indirect routes are further complicated by a deficiency in airport related signing.

4) The surface facilities currently serving the airport are exclusively automobile oriented.

The Freeway (I-5) is about a mile west of the airport. It has and is undergoing improvement for most of its length between Portland and Salem. For this distance the Freeway will soon be an excellent six lane divided highway. It provides convenient access to downtown Portland and southern and western suburbs. The interchange with State Highway 51 just south of Wilsonville affords superior access to the airport.

Travel from the Salem area, although utilizing I-5 for much of its distance, is hampered by the required use of the Fargo Road interchange. This interchange is the only one in the area allowing southern traffic to enter or leave the Freeway between Woodburn and Wilsonville. The result is that traffic is forced to use a narrow, winding road to get from I-5 to Highway 51 in the vicinity of the airport.

Airport users from the southeastern portion of the service area have somewhat more convenient access. Both of the major facilities used, Highways 51 and 99E, have good quality two lane roadways. The access they provide to the impacted airport users is efficient and generally satisfactory.

EXHIBIT O

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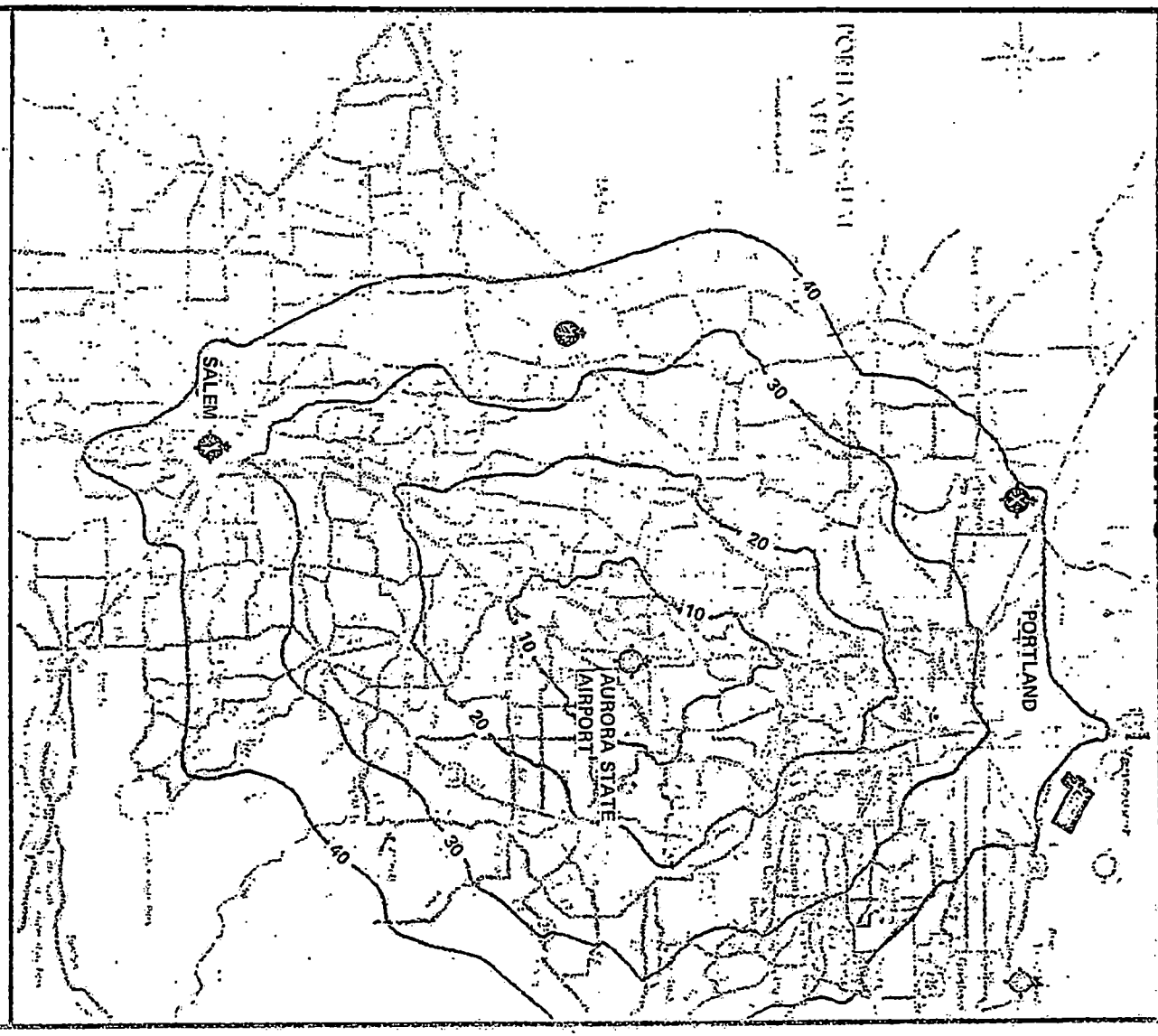
COLOR
SCREEN ☐ NO ☐ YES

AURORA STATE AIRPORT
GROUND TRAVEL TIMES
FIGURE 3



TRAVEL TIME IN MINUTES VIA NORMAL SURFACE ROUTES AT AVERAGE SPEEDS

CH2M HILL

PROJECT NO. C9198.00
FIGURE NO. 4

AURORA JAN 16 1976
AURORA JAN 19 1976

3 PROJECT NO. C9198.00
FIGURE NO.

PERCENT OF COPY 100
COLOR
SCREEN ☐ NO ☐ YES

EXHIBIT O

Highway 99E between Aurora and the Southeastern Portland Communities is a recently improved, undivided four lane facility. It allows adequate mobility but is contrained at times by lower travel times because it passes through several communities on the surface street level as opposed to being grade separated. The sufficiency of 99E will be improved in the future with the completion of I-205. The combination of 99E and I-205 will provide a higher level of service to the central and eastern Portland areas. Portland International Airport and southern Washington will also be more accessible by this route.

<- Language?

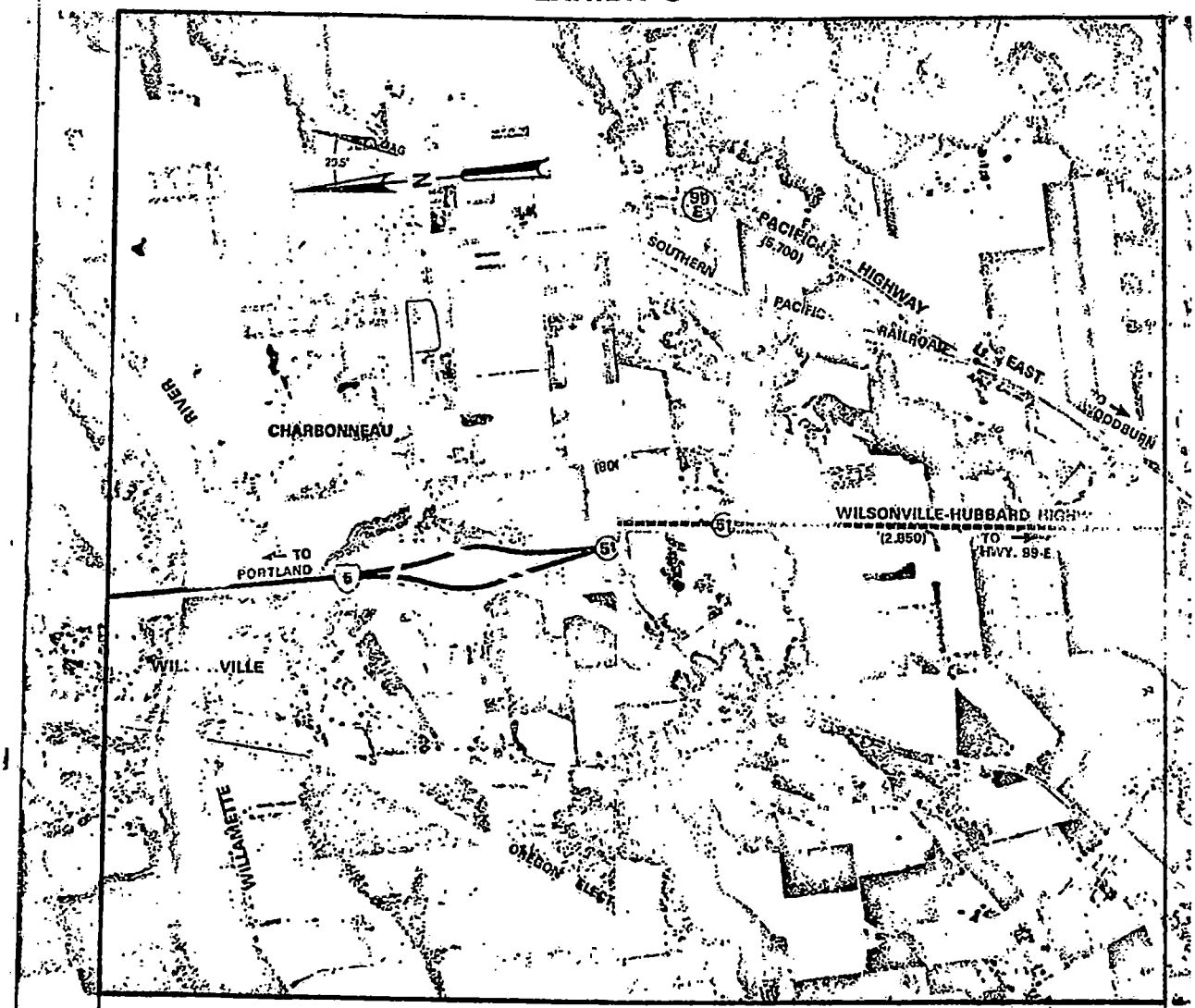
The major drawback of the northern 99E route is that the highway becomes a two lane facility outside of Aurora and enters town essentially as a surface street. The route then travels a circuitous path over city streets and county roads to reach the airport.

Geography

The airport site lies 3 miles south of the Willamette River about 195 feet above sea level. See Figure 4, Vicinity Map. Topography around the airport is generally level. This precludes a need for extensive grading for airport construction work. However, the flat gradients of the site do not permit good surface drainage, particularly during long rainy periods. Less than a mile to the east is a large flood plain created by the Pudding River, but the airport site does not flood.

The soil at the site is classified by the Soil Conservation Service (SCS) as Amity silt loam. The soil and its components tend to fall into the clayey-silt or silty-clay category. While such soil is not an ideal construction material, it can be utilized under proper construction procedures as a foundation for pavements and structures required at the airport. The soil has poor internal drainage characteristics and is often limited by a perched water table. Its suitability for septic disposal drain fields is marginal.

EXHIBIT O



EXISTIN

PRINCIPAL CITIES
PORTLAND (DOWNTOWN)
BEAVERTON
LAKE OSWEGO
TUALATIN
PORTLAND HILLSBORO AIRPORT
AURORA
SALEM
OREGON CITY
MILWAUKIE
PORTLAND INTERNATIONAL AIRP
PORTLAND TROUTDALE AIRPORT
SALEM
EUGENE
WOODBURN
EVERTON
AURORA STATE AIRPORT PERIMET
AIRPORT ACCESS ROADS

NOTE:
NUMBER SHOWN AS (000) REPRESENT ANNUAL DAILY TRAFFIC.

AURORA STATE AIRPORT
VICINITY MAP
FIGURE 4

CH2M HILL

PRELIMINARY

EXHIBIT O

The climate is a modified marine climate influenced by the Coast Range to the west. Total annual precipitation, usually in the form of rain, has averaged 42 inches (107 cm) at the Agricultural Experiment Station just north of the airport. Most of the rainfall occurs from November to March and summers are dry. Winds are rarely of more than moderate force.

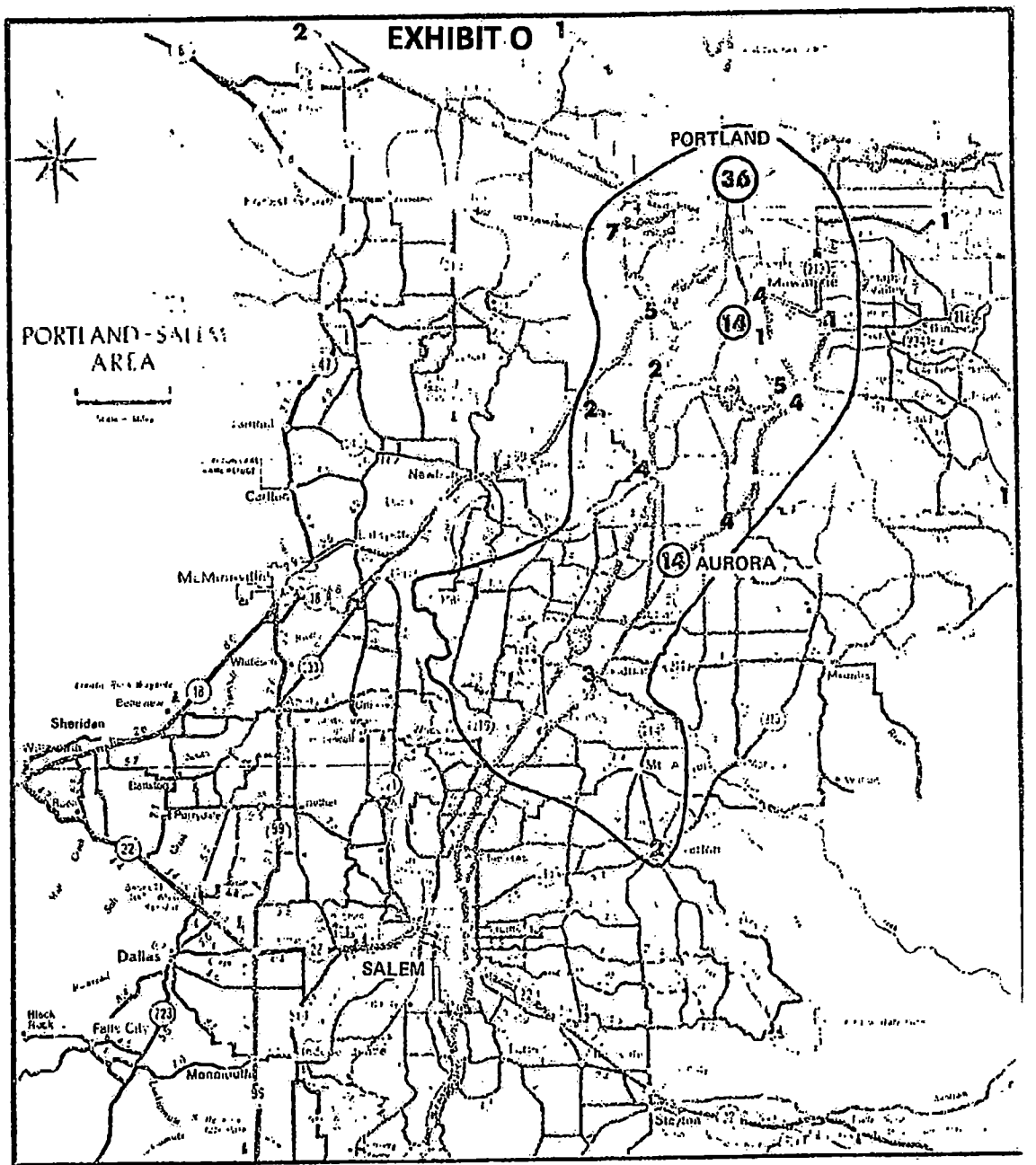
Weather data has been gathered both at the airport and at stations nearby. The normal maximum temperature, 28.7° Celsius (83.6° F) occurs in July. Minimum temperatures below 0° Celsius occur an average of 15 days out of the month during the month of January. Wind analysis is discussed later.

Ceiling and visibility data are not available for any location in the immediate vicinity of the Aurora State Airport. However, local pilots indicate that Aurora weather is better than average regarding visibility conditions when compared with those airports nearer the Columbia River.

The area from which the airport draws most users is shown on Figure 5. This service area shows the location of owners of aircraft which are based at the Aurora State Airport. The principal population concentration within the service area is generally north of the airport. In 1970, the approximate population within that area was 710,100 people.

Outside of the Portland metropolitan area, including suburbs, the remainder of the service area, which contains several outlying communities in Marion and Clackamas Counties, is largely rural in character. Non-agricultural industries are located mostly to the north around Portland and its suburbs.

The greater Portland metropolitan area tends to generate considerable demand for air transportation Airport activity there is well above state and national averages. Figure 6, Existing Airport System, shows other airports serving the region and making up a regional system of airports. This figure illustrates paved airports, airports with improved facilities, and airports open to the public. A few private airports are also indicated. There are also many small unimproved private fields in the region which are not shown on the figure.



LEGEND

BOUNDARY OF AREA IN WHICH ARE LOCATED 90% OF THE OWNERS OF AURORA STATE AIRPORT BASED AIRCRAFT

(14) NUMBER AND LOCATION OF AIRCRAFT OWNERS (1 PER AIRCRAFT) BASED AT AURORA STATE AIRPORT. THE NUMBERS REPRESENT 114 AIRCRAFT. THE ADDRESSES OF 13 OWNERS WERE UNAVAILABLE

AURORA STATE AIRPORT

SERVICE AREA

FIGURE 5

CH2M HILL

PROJECT NO. C9198.00 PERCENT OF COPY 100
FIGURE NO. 7 COLOR
SCREEN ☐ NO ☐ YES

PROJECT NO. C9198.00 PERCENT OF COPY 100
FIGURE NO. AURORA JAN 16 19
SCREEN ☐ NO ☐ YES
AURORA JAN 19 1976

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COLOR
SCREEN ☐ NO ☐ YES
PROJECT NO C9198.00
FIGURE NO

EXHIBIT O
AURORA..JAN 16 1976
AURORA..JAN 19 1976

PERCENT OF COPY
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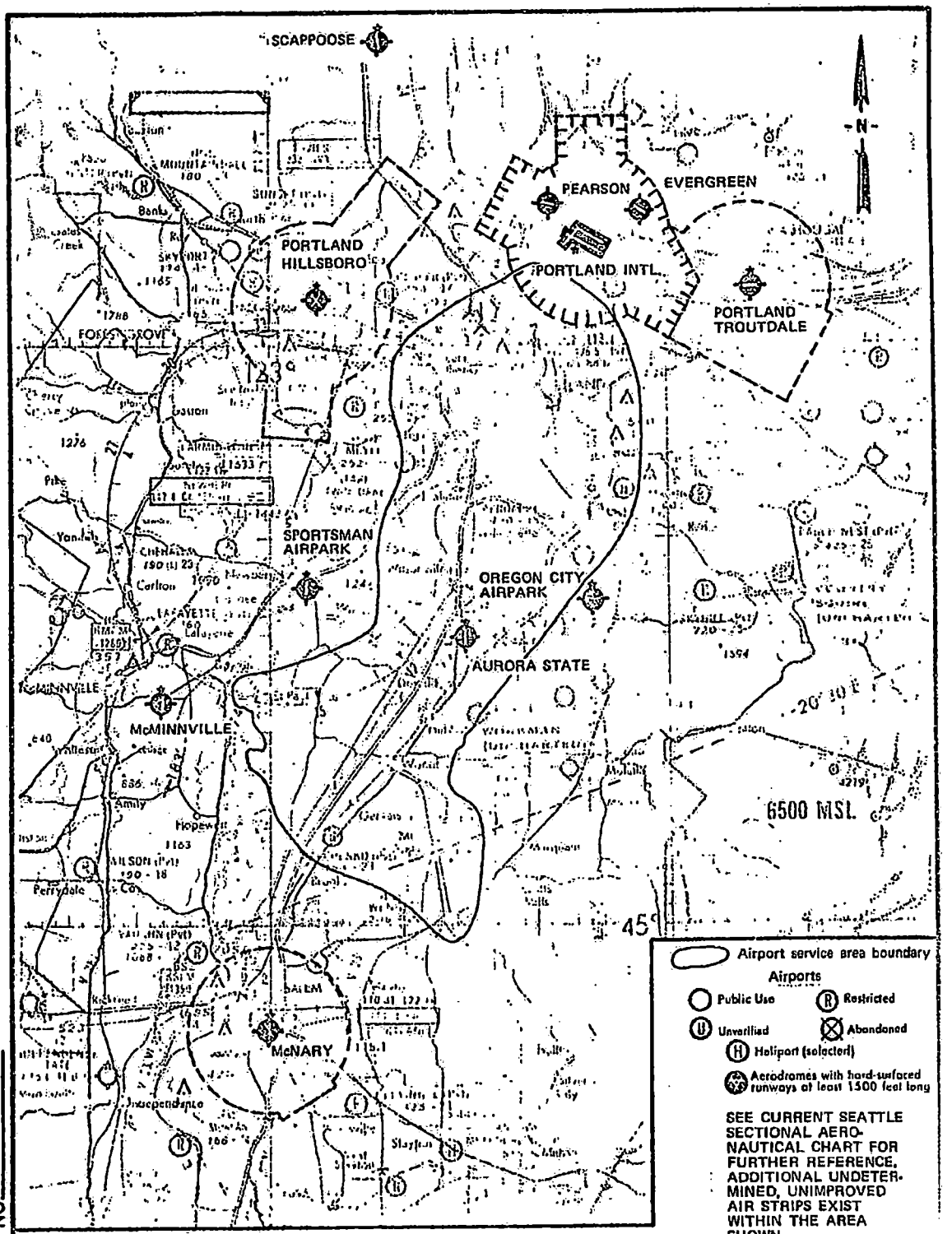
SCREEN ☐ NO ☐ YES
PROJECT NO
FIGURE NO



AURORA STATE AIRPORT
EXISTING AIRPORT SYSTEM
FIGURE 6

CH2M HILL

EXHIBIT O

Area Planning - Land Use

The pattern of existing land use and the prospects for future development in the vicinity of the airport are prime considerations in assuring compatible land use as use as the airport grows.

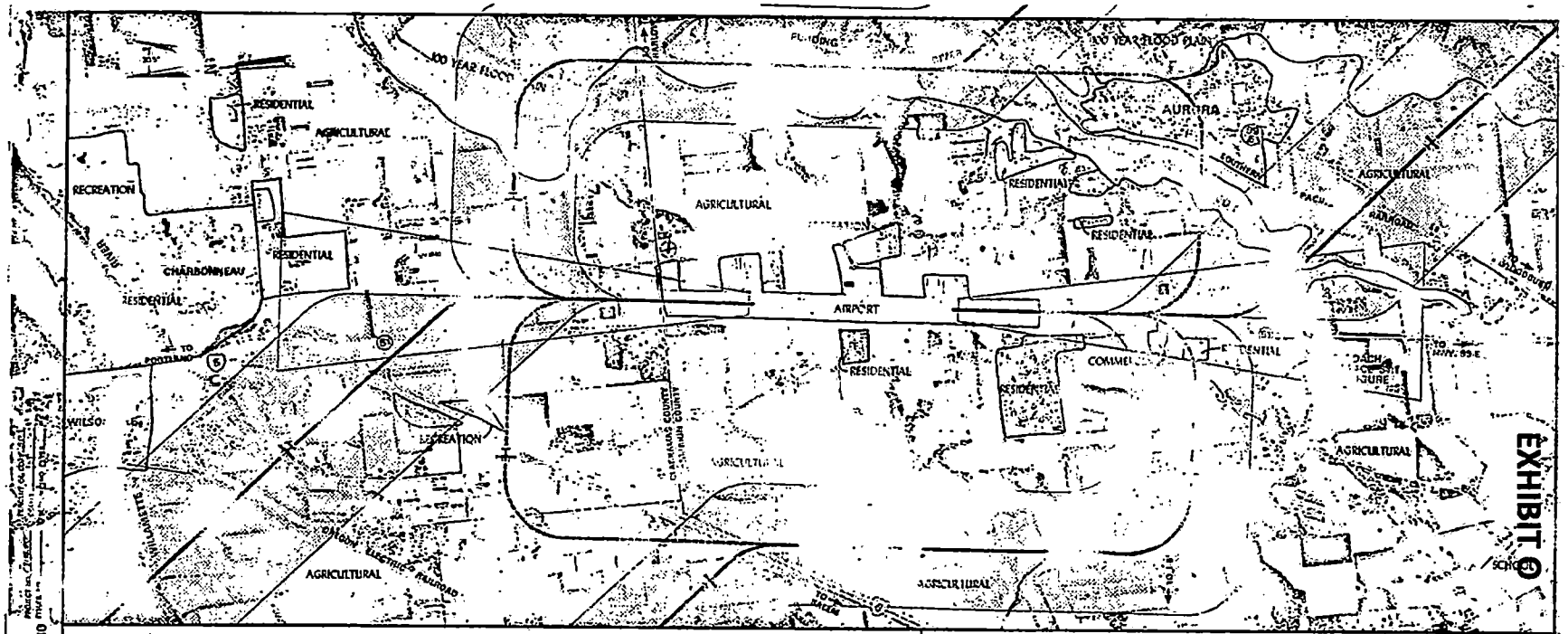
The existing land use pattern, as shown in Figure 7, is predominantly agriculture. The land capability class of the soils is Class II, which is very good farm land. The average 1970 product value for land of this class in Marion County was in the range of $200 to $300 per acre. Typical local products include nursery stock, grass for grazing and for hay, grass seed, orchards, and turkeys.

Three small concentrations of more intensive use exist along the airport perimeter. The largest is a 60-acre residential area west of the Wilsonville-Hubbard Highway, Highway 51. Another is a 35-unit and a mobile home park to the west along the Highway 51. The third is a church retreat center/group camp located to the east between the runway and the road to Aurora. Figure 8, Existing Noise Exposure, shows the extent of aircraft noise on these areas.

The closest urban development, Aurora, population about 550, is about a mile to the southeast. The City is known locally for its historic founding in 1856 by Dr. William Keil as a religious colony based on communal living. A number of historic buildings are being preserved and antique shops are prevelant.

Wilsonville is located about 3 miles to the north of the airport in Clackamas County. The City originally developed as a farm community and later as a freeway service center. More recently, the City has started to grow as a suburb to Portland. One major addition stimulating growth is a new plant built by Tektronix employing 900 to 1100 employees.

The Clackamas County Comprehensive Plan designates the land adjoining the airport on the north as agricultural and to the east as a flood plain. The Plan provides for growth in Wilsonville. It currently includes a growth area south of the Willamette River, but that is being deleted from the Plan. Charbonneau is a 770-acre planned community for 5,000 people located just south of the Willamette River, and is shown on Figure 7.



EXISTING LAND USES

AGRICULTURAL

RESIDENTIAL

RECREATION

COMMERCIAL:

NOSTLY RESTRICTED TO SITES WITH ONLY A FEW SCATTERED POCKETS OF DEVELOPMENT, THE LARGEST OF WHICH IS NEAR THE SOUTH END OF THE AIRPORT

SCHOOL:

GENERALLY LIMITED TO SITES WITH NORTH MARION UNION HIGH SCHOOL AS AN EXCEPTION

FLOOD PLAIN:

DEFINED BY LIMITS OF 100 YEAR FLOOD. AGRICULTURAL, CONSERVATION AND RECREATIONAL USES

AIRPORT:

INCLUDES RUNWAY, TAXIWAY, CLEAR ZONES AND AIRPORT RELATED, FIXED BASE OPERATORS' ACTIVITIES INCLUDED ARE TERMINAL, AIRCRAFT SALES, STORAGE AND REPAIR, AIRCRAFT CHARTER AND RENTAL, AND FLIGHT INSTRUCTION

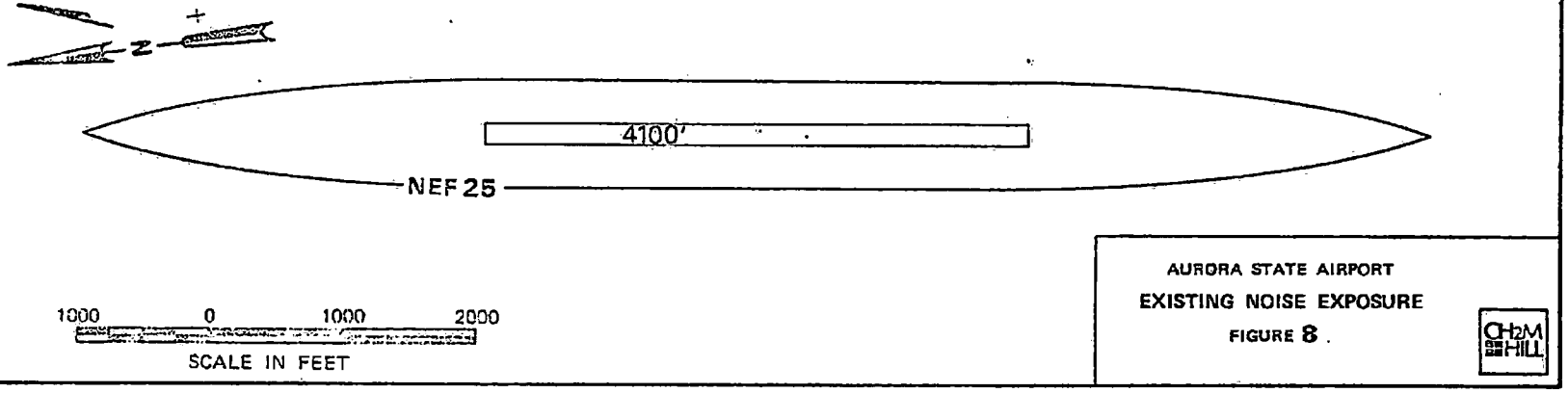
AURORA STATE AIRPORT

EXISTING LAND USE

FIGURE 7

PRELIMINARY

EXHIBIT O



COMMENTS Photograph

12 PROJECT NO. C9198.00
FIGURE NO.

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SCREEN ☒ NO ☐ YES Photo only

EXHIBIT O

Although Marion and Clackamas Counties have adopted Comprehensive Land Use Plans, both are general in nature, and are currently undergoing a revision and updating process. The City of Aurora has recently prepared a comprehensive plan indicating urban expansion outside of current city boundaries but not up to the airport.

With the exception of the three small residential developments west of the airport the existing land use conforms closely to the adopted Comprehensive Plans. All plans adopt the intent to preserve productive farm land, which includes most of the land around the Aurora State Airport.

Zoning

The Marion County Zoning Ordinance designates a specific zoning district for the Aurora State Airport called "Public Amusement and Recreation" (PA). The provisions of this district are primarily confined to other permitted uses which are incompatible with an airport. This is because nearly all of the other uses permitted outright in the district (amusement park, auditorium, exposition, stadium, and zoo) are incompatible with airport operations due to their typical concentrations of people and noise sensitive activities. In addition, the current district, PA, lacks specific provisions for airport related commercial uses and height obstructions in the surrounding airspace.

Nearly all the land in Marion County surrounding the airport is currently zoned "Residential Agricultural," (RA). The provisions of this district enable the development of country estate, or acreage residential, development in addition to farming. The primary permitted uses include single-family dwellings and farming. Minimum lot area requirements for residential development depend on the nature of sewerage service. In areas served by subsurface sewage disposal, minimum lot area is set by the County Health Department, with no minimum area specified.

Marion County is initiating a program to rezone the Woodburn-Hubbard Area with the purpose of which is to assure preservation of prime farm land in conformity with the Marion County Comprehensive Plan and Oregon State Land Conservation and Development Commission (LCDC) Guidelines. The County's intent is to rezone as much land as practical to the "Exclusive Farm Use" (EFU) or "Farm-20" (F-20) classifications. These districts would assure lower density development than currently permitted in the RA zone.

EXHIBIT O

The Marion County Zoning Ordinance does not currently contain provisions to limit building heights as they relate to airspace obstruction surfaces. Buildings in the RA zone are limited in height to 35 feet, except for public and semi-public buildings which may be as high as 70 feet. The EFU and F-20 zones have no height limitations.

The Clackamas County Zoning Ordinance applies to the area north of the airport. This area is currently zoned "Residential Agricultural" (RA-1). Under this classification, residential densities up to two dwelling units per acre are permitted where either public water or sewerage service are provided. For the area in the vicinity of the airport densities lower than two dwellings per acre will be required in the future in order to conform with comprehensive plan policies. Consequently, small acreage residential areas like the one currently under development just south of Charbonneau should not be permitted in the future. Zoning in Clackamas County does not include height limitations.

In the future, Clackamas County intends to rezone the RA-1 area to either "Exclusive Farm Use" (EFU) or "Residential Farm-Forest" (RF-F) in keeping with comprehensive plan and LCDC Guidelines. The EFU and RF-F designations would more adequately assure compatible land use in the airport vicinity; requiring 20 and 10 acre minimum lot areas respectively.

Figure 9 shows existing zoning districts on and around the Aurora State Airport.

Existing Airport - 1975

The present Aurora State Airport is the original Aurora Flight Strip. This consists of a single runway oriented north and south on a 113 acre parcel. Except for three privately constructed taxiway exits there are no other facilities provided to the airport.

The runway is 4100 feet by 150 feet, designated 17/35, and is paved and lighted. It occupies State owned property 600 feet wide and about 8100 feet long beside Highway 51. An instrument approach procedure allows limited IFR operations during instrument weather. The airport is shown on Figure 9.

EXHIBIT O

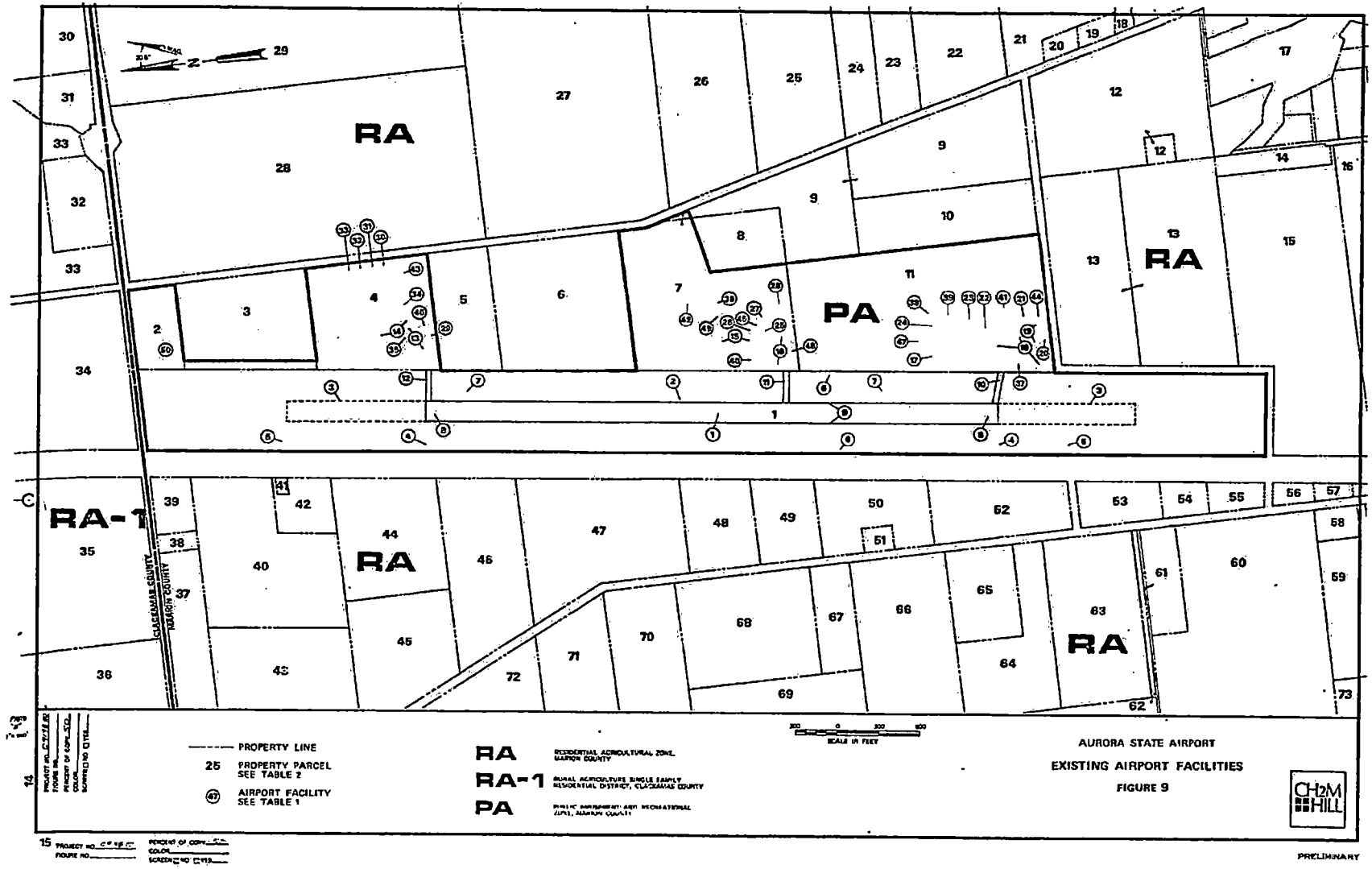

RA
PA
RA-1
RA
RA
RA
CLACKAMAS COUNTY
MARION COUNTY
PROPERTY LINE
PROPERTY PARCEL
SEE TABLE 2
AIRPORT FACILITY
SEE TABLE 1
RA RESIDENTIAL AGRICULTURAL ZONE, MARION COUNTY
RA-1 RURAL AGRICULTURE SINGLE FAMILY RESIDENTIAL DISTRICT, CLACKAMAS COUNTY
PA PUBLIC ENVIRONMENTAL AND RECREATIONAL ZONE, MARION COUNTY
SCALE IN FEET
AURORA STATE AIRPORT
EXISTING AIRPORT FACILITIES
FIGURE 9
CH2M HILL
PRELIMINARY

EXHIBIT O

Various private facilities open to the public and located on private lands east of the airport complement the Aurora State Airport facilities. There are considerable deficiencies. The airport has no main entrance or terminal area. There is no public aircraft parking apron, and there are no FAA facilities on the airport. Table 1 describes the existing facilities, Table 2 provides property information, and Figure 10 shows some of the facilities and conditions existing. General data is provided by Table 3.

The lack of a parallel taxiway system combined with the lack of an FAA traffic controller poses a serious problem as to safety and runway capacity. Taxiing must be conducted along the runway. Since only the runway is State owned and there are three different FBO areas, traffic procedures are difficult to establish that insure safe separations.

Many transient pilots are confused as to which FBO area is their destination and taxi twice. Often taxiing aircraft are forced to give way to landing aircraft and must leave the runway pavement. This spreads loose aggregate on the runway increasing the potential for propeller damage.

Key points concerning airport layout are:

- The runway length accommodates all aircraft using the airport, which are light twin aircraft and smaller. Occasionally turbojets use this runway. There are all weather 1000- x 150-feet gravel overruns on both ends.
- The airport has no parallel taxiway system or turnarounds. However, the runway width, 150 feet, allows adequate space for turning most aircraft.
- The taxiway system is limited to three stub-entrance taxiways not connected to each other. They serve three apron areas, which are mostly turf.

EXHIBIT O

TABLE 1

EXISTING FACILITIES 1975

ITEM	DESCRIPTION	CONDITION	COMMENTS
1 RUNWAY 17-35	150' x 4100' ASPHALT CONCRETE PAVEMENT	FAIR	NUMEROUS CRACKS
2 PARALLEL TAXIWAY	50' x 4100' GRAVEL SURFACE	POOR	TOO CLOSE TO RUNWAY
3 OVERRUN AREAS	150' x 1000' GRAVEL STABILIZED	GOOD	OVERGROWN WITH GRASS
4 WIND CONES	YELLOW FABRIC CONES ON METAL POLE	GOOD	SOUTH WIND CONE IS LIGHTED
5 CLEAR ZONE ACCESS ROADS	UNIMPROVED ROADS	FAIR	MAINTENANCE AND FARM ACCESS ONLY
6 DRAINAGE DITCHES	40' WIDE x 4' DEEP, 275'± FROM RUNWAY CENTERLINE	FAIR	EVIDENCE OF STANDING WATER
7 SERVICE ROAD	UNIMPROVED ROAD	POOR	USED FOR FUEL AND SERVICE TRUCKS
8 RUNWAY MARKINGS	BASIC STANDARD-WHITE	POOR	MARKINGS ARE STANDARD FOR BASIC RUNWAY
9 RUNWAY LIGHTING	STAKE MOUNTED, LOW INTENSITY LIGHTS	GOOD	TAXIWAYS ARE NOT ADEQUATELY LIGHTED. THRESHOLD LIGHTS ARE OFFSET TO THE WEST
10 STUB TAXIWAY	30' WIDE ASPHALT CONCRETE PAVEMENT	GOOD	NON STANDARD MARKINGS
11 STUB TAXIWAY	30' WIDE ASPHALT CONCRETE PAVEMENT	GOOD	DOES NOT EXTEND ACROSS GRAVEL PARALLEL TAXIWAY. NO MARKINGS
12 STUB TAXIWAY	30' WIDE ASPHALT CONCRETE PAVEMENT	GOOD	NO MARKINGS
13 AIRCRAFT PARKING APRON	100' x 200' ASPHALT CONCRETE PAVEMENT	GOOD	PARKING AND MANEUVERING AREA. PRIVATELY OWNED.
14 AIRCRAFT PARKING AND TIE DOWN AREA	150' x 300' ROCK STABILIZED TURF. 20 TIE DOWN SPACES. 10 TO 12 ADDITIONAL PARKING SPACES.	FAIR	USED FOR TRANSIENT AND PRIVATE AIRCRAFT. PRIVATELY OWNED.
15 AIRCRAFT PARKING AND TIE DOWN AREA	100' x 400' ROCK STABILIZED TURF. 14 TIE DOWNS	FAIR	USED FOR TRANSIENT AND NON-FBO AIRCRAFT. PRIVATELY OWNED
16 AIRCRAFT PARKING APRON AND TIE DOWN AREA	100' x 120' AND 20' x 300' ASPHALT CONCRETE PAVEMENT AND 80' x 300' GRAVEL SURFACE. 15 TIE DOWNS, 4 TO 6 PARKING POSITIONS.	FAIR	SERVICING AND PARKING AREA FOR FBO OWNED AIRCRAFT PRIVATELY OWNED.
17 AIRCRAFT PARKING APRON.	100' x 150' ASPHALT CONCRETE PAVEMENT	GOOD	NO MARKED PARKING SPACES, PRIVATELY OWNED.
18 AIRCRAFT PARKING AND TIE DOWN AREA	SEVERAL TURF AREAS. 18 TIE DOWNS, 6 TO 8 ADDITIONAL PARKING POSITIONS	FAIR	USED FOR FBO, PRIVATE AND TRANSIENT AIRCRAFT. PRIVATELY OWNED.
19 AIRCRAFT PARKING APRON	26' x 300' ASPHALT CONCRETE PAVEMENT. NO TIE DOWNS SEVEN PARKING POSITIONS	GOOD	PARKING AND MANEUVERING AREA FOR TIE DOWN AREA AND SHOPS. PRIVATELY OWNED.
20 MAINTENANCE MANAGER AND GROUND SCHOOL OFFICES	70' x 135' x 25' HIGH METAL COVERED WOOD STRUCTURE	GOOD	TRAILER ATTACHED TO WEST SIDE. OSAD BEACON MOUNTED ON ROOF. PRIVATELY OWNED.
21 FBO ADMINISTRATION BUILDING	40' x 40' x 20' HIGH WOOD FRAME STRUCTURE	GOOD	APARTMENT ABOVE OFFICES. PRIVATELY OWNED.
22 T-HANGAR	30' x 290' x 15' HIGH METAL COVERED WOOD STRUCTURE. 10 PLANE CAPACITY	FAIR	NONCOMPARTMENTALIZED, NO ELECTRICITY. PRIVATELY OWNED.
23 T-HANGAR	34' x 190' x 15' HIGH METAL COVERED WOOD STRUCTURE. 6 PLANE CAPACITY	GOOD	NONCOMPARTMENTALIZED, NO ELECTRICITY. PRIVATELY OWNED.
24 MAINTENANCE HANGAR	80' x 180' x 30' HIGH METAL STRUCTURE	EXCELLENT	PRIVATELY OWNED, TEMPORARILY LEASED FOR HELICOPTER MAINTENANCE
25 FBO ADMINISTRATION BUILDING	30' x 40' x 14' HIGH WOOD STRUCTURE	GOOD	PRIVATELY OWNED
26 FBO OFFICE ANNEX	12' x 65' OFFICE TRAILER	GOOD	PILOT AND FLIGHT INSTRUCTOR OFFICES. PRIVATELY OWNED.
27 FBO OFFICE ANNEX	10' x 50' OFFICE TRAILER	FAIR	GROUND SCHOOL OFFICES. PRIVATELY OWNED.
28 MAINTENANCE HANGAR	50' x 60' x 20' HIGH METAL COVERED WOOD STRUCTURE, 20' x 20' LEAN-TO ATTACHED	EXCELLENT	MAINTENANCE SHOP AND PARTS STORAGE. PRIVATELY OWNED.
29 AVIONICS SHOP	40' x 100' x 16' HIGH METAL COVERED WOOD STRUCTURE	EXCELLENT	PRIVATELY OWNED
30 T-HANGAR	40' x 310' x 13' HIGH METAL COVERED, METAL FRAME STRUCTURE, 10 PLANE CAPACITY	EXCELLENT	COMPARTMENTALIZED, ELECTRICITY. PRIVATELY OWNED.
31 T-HANGAR	40' x 310' x 13' HIGH METAL COVERED, METAL FRAME STRUCTURE, 10 PLANE CAPACITY	EXCELLENT	COMPARTMENTALIZED, ELECTRICITY. PRIVATELY OWNED.
32 T-HANGAR	40' x 310' x 13' HIGH METAL COVERED, METAL FRAME STRUCTURE, 10 PLANE CAPACITY	EXCELLENT	COMPARTMENTALIZED, ELECTRICITY. PRIVATELY OWNED.
33 T-HANGAR	40' x 310' x 13' HIGH METAL COVERED, METAL FRAME STRUCTURE, 10 PLANE CAPACITY	EXCELLENT	COMPARTMENTALIZED, ELECTRICITY. PRIVATELY OWNED.
34 OFFICE BUILDING	35' x 50' x 12' HIGH WOOD FRAME STRUCTURE	GOOD	PRIVATELY OWNED. UNOCCUPIED.
35 FUEL TANKS	UNDERGROUND TANKS FOR 80/87 AND 100/130 FUEL. 10,000 GALLON CAPACITY EACH TANK	GOOD	STORAGE FOR FBO AT SOUTH END OF FIELD. PRIVATELY OWNED.
36 FUEL TANKS	ABOVE GROUND TANKS FOR 80/87 AND 100/130 FUEL	GOOD	PORTABLE TANKS. PRIVATELY OWNED.
37 FUEL TANKS	TWO 10,000 GALLON UNDERGROUND TANKS	GOOD	CURRENTLY NOT USED PRIVATELY OWNED.
38 FBO OFFICE	12' x 55' OFFICE TRAILER	GOOD	TEMPORARY OFFICE PRIVATELY OWNED.
39 TRAILERS	THREE SMALL TRAILERS	UNKNOWN	PRIVATELY OWNED. UNOCCUPIED
40 WIND TEE	20' LONG WIND TEE. PAINTED YELLOW AND LIGHTED	GOOD	NO SEGMENTED CIRCLE. PRIVATELY OWNED.
41 ACCESS ROAD	12' WIDE ASPHALT CONCRETE	POOR	PRIVATELY OWNED
42 ACCESS ROAD	16' WIDE ASPHALT CONCRETE	FAIR	PRIVATELY OWNED.
43 ACCESS ROAD	20' WIDE GRAVEL SURFACED	POOR	PRIVATELY OWNED.
44 AUTOMOBILE PARKING	60' x 100' ASPHALT CONCRETE, 20 CAR CAPACITY	FAIR	PRIVATELY OWNED.
45 AUTOMOBILE PARKING	75' x 250' ASPHALT CONCRETE, 50 CAR CAPACITY	FAIR	PRIVATELY OWNED.
46 AUTOMOBILE PARKING	75' x 100' GRAVEL SURFACED, 25 CAR CAPACITY	POOR	PRIVATELY OWNED.
47 STRUCTURAL STEEL	MISCELLANEOUS STRUCTURAL STEEL MEMBERS PILED FOR STORAGE	NA	OWNERSHIP AND USE UNKNOWN
48 MAINTENANCE SHED	40' x 50' x 12' HIGH WOOD FRAME STRUCTURE	POOR	PRIVATELY OWNED.
49 STORAGE SHED	12' x 30' x 10' HIGH WOOD FRAME STRUCTURE	POOR	PRIVATELY OWNED.
50 FBO AREA	HELICOPTER MAINTENANCE FACILITY UNDER CONSTRUCTION	NA	PRIVATELY OWNED.

Exhibit 44, page 38 of 113

EXHIBIT O

TABLE 2

PROPERTY INFORMATION - 1975*

STUDY NO.	OWNER	ACRES	STUDY NO.	OWNER	ACRES
1	OREGON STATE AERONAUTICS DIVISION	112.79	37	D.C. HEWITT	13.59
2	COLUMBIA HELICOPTERS INC.	5.70	38	D.C. HEWITT	0.89
3	W.G. & N.C. LEMATTA	14.35	39	D.C. HEWITT	3.06
4	W.O. REEL	16.77	40	CASCADE XMAS TREE FARM CO.	22.20
5	W. & C. JESKEY	9.28	41	CASCADE XMAS TREE FARM CO.	0.23
6	C.W. SNYDER	21.07	42	CASCADE XMAS TREE FARM CO.	3.77
7	W.M. & V.L. BENNETT	25.10	43	HOEHNKE NURSERY CO.	19.52
8	SAN GABRIEL GOSPEL TEMPLE	5.12	44	FREEMAN, JR. ETAL	15.00
9	SAN GABRIEL GOSPEL TEMPLE	28.18	45	ELMER O. & MARGARET JESKEY	13.92
10	G.W. & K.L. JESKEY	12.62	46	ELMER JESKEY	16.55
11	NORTHWEST AIRMOTIVE	38.56	47	F.R. & E. KAHLE	16.73
12	M.W. & R.L. NAGL	27.74	48	SUNSET HAVEN SUBDIVISION	7.0
13	D.L. DONNELLY	44.32	49	F.R. & E. KAHLE	6.20
14	W. & L. TRAGLIO	2.97	50	R.H. KEIL	9.50
15	R.P. & J.B. JENKS	40.13	51	S.D. & C.J. KENNEY	1.00
16	G. & H. PARDY	57.98	52	W. & H. KEIL	10.02
17	MISCELLANEOUS RESIDENTIAL PARCELS	–	53	W.R. & D. SEELY	4.59
18	D.& M. CATTON	32.14	54	W.R. & D. SEELY	2.00
19	J.P. & M.V. MYERS	1.21	55	H.W. & G.J. McCUNE	2.33
20	R.L. KOCH	1.20	56	W. & H. KEIL	1.05
21	R. & E. REUBEN DALL	70.63	57	A. WATTS	1.00
22	L.H. & M.B. THOMPSON	28.60	58	R.L. & D. BLAND	2.00
23	F.B. SNYDER	13.86	59	R.L. & D. BRAND	13.87
24	C.W. SNYDER	12.77	60	DEER CREEK ESTATES	52.46
25	F.B. SNYDER	34.88	61	J.D. & L.M. PHILLIPS	5.00
26	C.W. SNYDER	37.94	62	L.W. & B.H. PETERS & C.L. PETERS	21.91
27	A.M. & E.M. HESS	80.99	63	W. & N. RUSSELL	20.19
28	M. & E. STAEHLY	76.16	64	W.S. & E.L. MOELLER	13.56
29	H. STAEHELY	79.40	65	L. & V. KLEVE	8.00
30	NOT OBTAINED	68.19	66	R.H. & B. KEIL	42.57
31	ROBERT I. COLVIN	4.50	67	E.B. & D. KNORR	5.14
32	HENRY W.B. & DORTHY L. COLVIN	6.15	68	E.B. & D. KNORR	17.75
33	HENRY W.B. & DORTHY L. COLVIN	70.48	69	F. ANDERSON & D. KNORR	52.02
34	CROWN ZELLERBACH CORP	23.96	70	E.L. DERR	51.76
35	EARL H. & MARILYN R. STOLLER	43.40	71	G.H. & S.L. EROFF	10.00
36	EARL H. & MARILYN R. STOLLER	79.52	72	N.J. McDONALD	60.98
			73	CEDAR FIELD ESTATES	7.00

* COUNTY RECORDS AUGUST 1975

30

111 PROJECT NO. C9198.00

EXHIBIT O

AURORA STATE AIRPORT

PHOTOGRAPHS OF FACILITIES/CONDITIONS

FIGURE 10

EXHIBIT O

TABLE 3 EXISTING AIRPORT DATA	
ELEVATION	195 FEET MSL
LATITUDE	45°14' 43"
LONGITUDE	122°46' 07"
ACREAGE	113 ACRES
MEAN MAXIMUM TEMPERATE (HOTTEST MONTH)	84° F (29° C)
NAVAIDS	NONE
INSTRUMENT APPROACH PROCEDURE	VOR/DME
RUNWAY 17-35	N 07° 08'E TRUE BEARING
LENGTH	4,100 FEET (1250 M)
WIDTH	150 FEET (46 M)
GRADIENT	0.07%
APPROACH SLOPE	34:1
OBSTRUCTION	TREES AT 2,100' FROM RW 17-THRESHOLD
PAVEMENT	ASPHALT CONCRETE
STRENGTH	30,000 LBS, SINGLE GEAR (13,600 KG)
LIGHTING	LOW INTENSITY
MARKING	BASIC

112 PROJECT NO. C 9198.00
FIGURE NO.

EXHIBIT O

- The full width of runway pavement is asphalt-concrete of 3-inch thickness over a gravel base, total thickness 18 inches. Pavement strength has been designed for 30,000 lbs. single wheel loading. The surface condition is poor to fair because of oxidation, extensive cracking, and ravelling. There is considerable loose aggregate on the runway surface most of the time.

- Airport lighting consists of low-intensity runway edge lighting, a rotating beacon of marginal visibility and a lighted wind cone. There are no other visual aids to assist during darkness or low visibility conditions.

- The private facilities which connect to and serve Division of Aeronautics property are not constructed to uniform specifications. Pavement strength and quality varies and geometrical standards are non-uniform. Entrance roads have been constructed to suit individual requirements, and are not interconnected. Utilities consist of electric power, telephone, water from wells and individual septic disposal systems.

- There are three conventional hangars, 56 tee-hangar bays, and various other buildings, some mobile. The fixed base operators provide both 80 and 100 octane gasoline, but no jet fuel is available.

- Space for expansion at this time is mainly dependent upon private lease arrangements by the fixed base operators. Between the highway which lies east of the airport and the east property line of the Division of Aeronautics, there is about 177 acres of land held in private ownership. The 113 acres owned by the Division of Aeronautics provides room for runway lengthening, but not for other types of expansion.

EXHIBIT O

Economic Impact

Employees on the airport average between 100 and 125, with the majority working on maintenance for a helicopters operator. Total salaries directly generated on the airport are estimated to be about $750,000 annually.

Facilities provided the general public include: waiting rooms, restrooms, telephone, car rental and automobile parking. Commercial aviation services to the public include: aircraft rental, flight instruction, charter flying, aircraft maintenance, aviation fuel service, aircraft sales, and aircraft avionics sales and maintenance. However there has been considerable fluctuation in the services offered to the public.

All revenue-producing activities are located on private land, except that a fuel flowage fee of $0.03 per gallon is paid to the State. The Division of Aeronautics is currently revising their rates for flowage and ingress-egress. The operators have ingress-egress permits from the Division of Aeronautics.

One fixed base operation is located at the south end of the airport, and another operator is located in the center of the field. The third operator, a helicopter maintenance facility, is currently in the process of moving from temporary quarters at the south end of the field to permanent facilities at the extreme northeast corner of the airport.

Off the north end of the airport is a parcel of land containing 40 tee-hangars for rent, turf aircraft parking and an aircraft avionics shop.

Wind Analysis

Two years of wind data was collected between May 1968 and April 1970 at the south end of the airport. This was accomplished under the supervision of the Port of Portland. The data summary appears in the appendix and the wind rose appears on the Airport Layout Plan.

EXHIBIT O

Calms (less than 4 mph) occur 66.5 percent of the time. When the wind exceeds 4 mph, it seldom surpasses 13 mph and generally is either northerly or southerly. Winds in excess of 13 mph normally come from the south. This occurs only about 1.5 percent of the time, and it is rare for the wind velocity to exceed 25 mph. It is not possible with available data to correlate wind conditions with ceiling and visibility to develop a reliable IFR wind rose.

Freak storms, such as the Columbus Day Storm in 1962 are a rare phenomenon with only eight other such occurrances recorded in the last 100 years. During these storms sustained winds have exceeded 50 mph with 110+ mph gusts.

The wind data and analysis used for this study was compared with wind measurements made at the OSU Agricultural Experiment Station 2 miles northeast of the airport. Both were found to be in agreement. The Aurora State Airport wind analysis indicates that the present runway orientation, north 7°8' east, is excellent and provides 99.5 percent crosswind coverage for crosswind components 15 mph and under.

Airspace

Figure 11 shows existing airport imaginary surfaces as developed by the Division of Aeronautics in 1972. Any object which penetrates through these geometrical planes needs evaluation as to its effect on air navigation in the vicinity of the airport. The figure also indicates obstructions that should be removed. The State owns air easements, as indicated, which permit the State to remove most of the obstructions shown.

Figure 12 shows the existing airways in the vicinity of the airport. There are no electronic navigational aids located on the airport and there is no certified weather observer on site.

EXHIBIT O

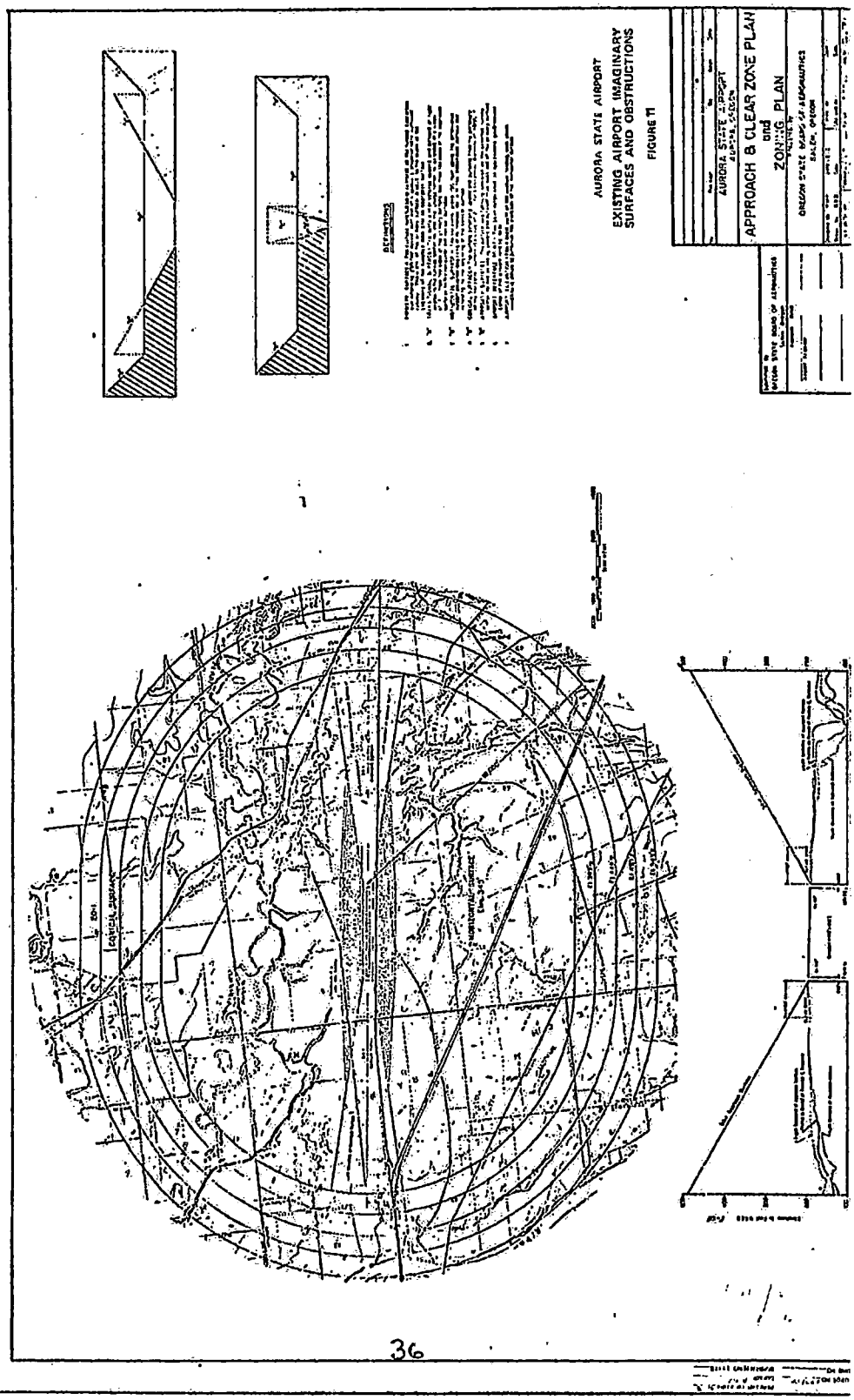
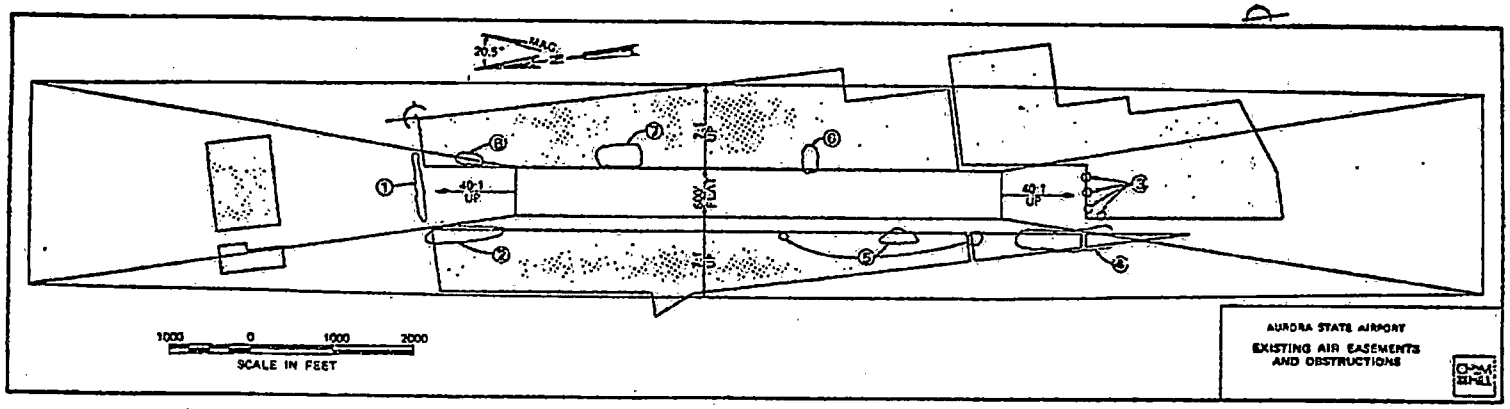

AURORA STATE AIRPORT
EXISTING AIRPORT IMAGINARY SURFACES AND OBSTRUCTIONS
FIGURE 11
AURORA STATE AIRPORT
APPROACH & CLEAR ZONE PLAN
and
ZONING PLAN
OREGON STATE BOARD OF AERONAUTICS
SALEM, OREGON

EXHIBIT O



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OBSTRUCTION REMOVAL PRIORITIES
MEETING FAR PART 77 CRITERIA

① TREES – EXISTING AND ULTIMATE APPROACH SURFACE OBSTRUCTIONS. TO BE REMOVED.

② TREES – EXISTING AND ULTIMATE TRANSITION SURFACE OBSTRUCTIONS. TO BE REMOVED OR TRIMMED.

③ TREES – ULTIMATE APPROACH SURFACE OBSTRUCTIONS. TO BE REMOVED.

④ TREES – EXISTING APPROACH SURFACE AND EXISTING AND ULTIMATE TRANSITION SURFACE OBSTRUCTIONS. TO BE TRIMMED.

⑤ TREES – EXISTING AND ULTIMATE TRANSITION SURFACE OBSTRUCTIONS. TO BE TRIMMED OR REMOVED.

⑥ TREES – EXISTING AND ULTIMATE TRANSITION SURFACE OBSTRUCTIONS. TO BE REMOVED.

⑦ TREES – EXISTING AND ULTIMATE TRANSITION SURFACE OBSTRUCTIONS. TO BE REMOVED.

⑧ TREES – ULTIMATE TRANSITION SURFACE OBSTRUCTIONS. TO BE REMOVED.

37

17 PROJECT NO. C9178.00
FIGURE NO.
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AURORA..JAN 16 19
AURORA..JAN 19 1976

PROJECT NO. C9178.00
FIGURE NO.
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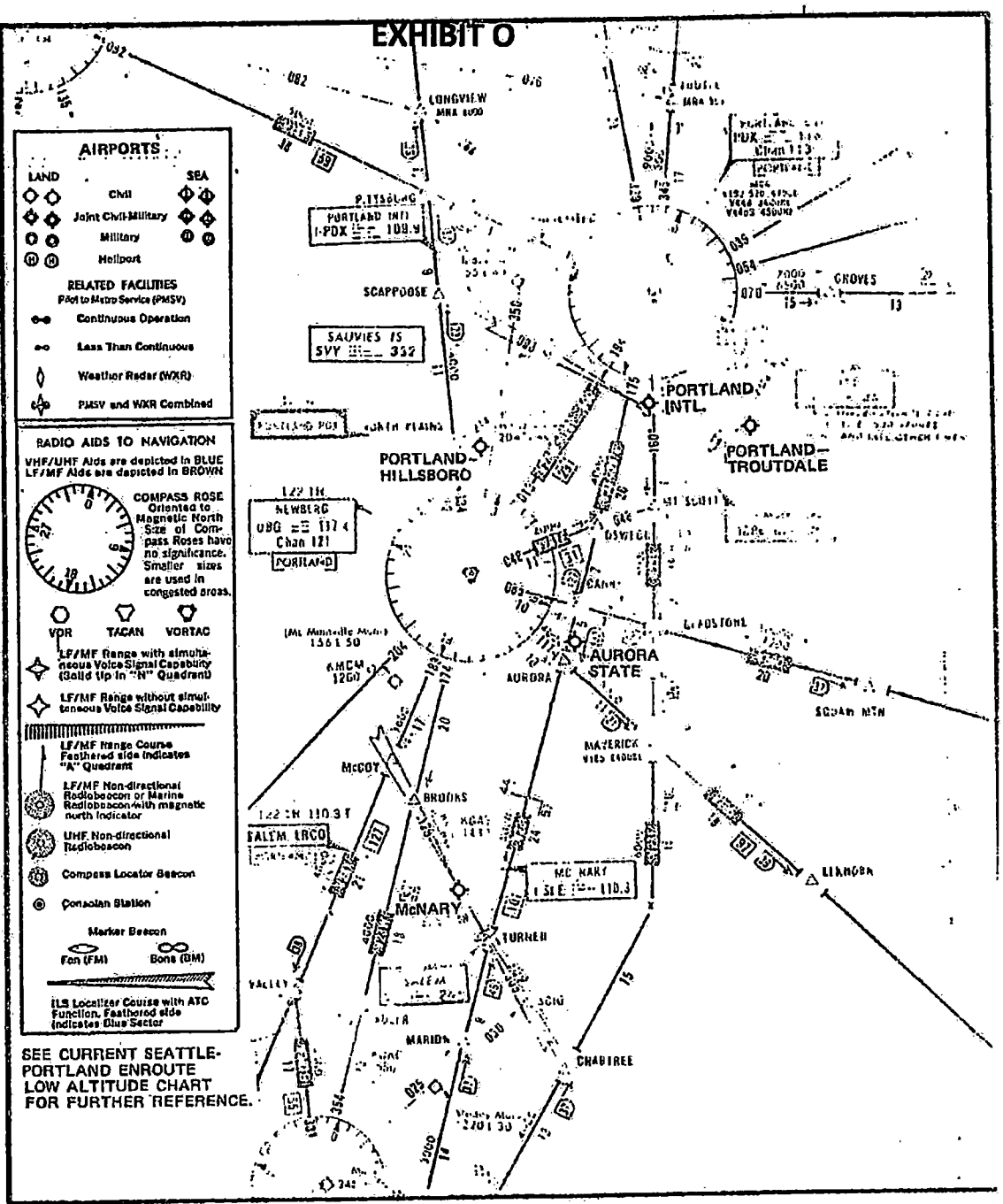

AURORA STATE AIRPORT
EXISTING AIRWAYS
FIGURE 12

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EXHIBIT O

Use of the Aurora State Airport during instrument weather conditions (IFR) is possible with certain restrictions. The airport is served by a non-precision VOR/DME approach using the Newberg VORTAC. The approach is somewhat restricted because this VORTAC is also used for approaches to McMinnville and is a key facility used by the Portland TRACON (Terminal Radar Control Facility). Minimums are 1000 feet ceiling and 1-1/4 miles visibility, which is not very adequate to insure a high rate of useage during IFR weather.

Because Aurora State Airport lies in the Portland Terminal Airspace, some assistance in reaching the airport during conditions of low ceiling with good visibility below the ceiling is possible through the radar coverage of the Portland radar (ASR). However, just over the airport, Portland Approach Control is not able to vector aircraft lower than 3400 feet MSL. North of the airport, minimum vectoring altitude is 2500 feet. In this area, neither terrain nor tall structures pose obstruction problems. Limitations occur only due to incomplete radar coverage.

Air Traffic Activity

For this study, air traffic activity has been compiled from FAA, State, and Port of Portland sources. Insofar as possible, data for this section was obtained from the original source. Also, data collected was correlated with this study's field surveys and was compared with information presented in other recent publications.

Air traffic activity for the Aurora State Airport has been measured in terms of numbers of aircraft based at the airport, and in terms of operations performed by these based aircraft and by itinerant aircraft at the airport. (An operation is either a landing or a takeoff.) Table 4 shows the number and types of aircraft based at the airport.

EXHIBIT O

TABLE 4 DISTRIBUTION OF AIRCRAFT TYPES BASED AT AURORA STATE AIRPORT (1975)	
TOTAL	127
MULTI-ENGINE	8
SINGLE ENGINE, RETRACTABLE	35
SINGLE ENGINE, FIXED GEAR 4 PLACE AND LARGER	45
SINGLE ENGINE, FIXED GEAR UNDER 4 PLACE	35
HELICOPTER	4
TURBOJET	0

113 PROJECT NO. C7198.00
FIGURE NO.

EXHIBIT O

The number of aircraft based at the Aurora Airport fluctuates greatly throughout the year, as it does at other Portland area airports. This is because of fluctuations in the inventory of aircraft for sale and due to the seasonal nature of the flying weather. Although the number of based aircraft may fluctuate to as high as 150, the 1974 count from the Port of Portland field survey indicated 126 based aircraft.

At this time, no turbine powered aircraft or gliders are based at Aurora. In recent months, it is estimated that there have been about ten to twelve transient aircraft parked on the airport at any given time. Turbojet aircraft now use the airport intermittently.

Little information is available concerning the purpose for which the aircraft are flown. Approximately 35 to 40 percent of the aircraft surveyed are owned by businesses. These range from the fixed base operator's charter service to a Portland radio station's traffic watch. It has not been possible to determine the actual hours or percentage of business flying.

In the airport's service area, shown earlier, lives a population of about 710,000. Incomes there are above average, which factor influences air traffic levels to exceed normal national averages. Figure 13 shows the distribution of general aviation aircraft in the greater Portland area and Aurora State Airport's share.

The number of operations flown at the airport determines the level of traffic activity at the airport. Since there is no air traffic control tower on the Aurora State Airport, it was necessary to gather operations information from other sources. Four sources are: The Oregon Aviation System Plan, the FAA Master Record (Form 5010), the Portland-Clackamas Airport Study, and air traffic surveys made by the FAA. Apparently, the first three mentioned sources have utilized some of the same basic data, which conflicts with actual counts.

This study's evaluations determined the actual activity levels to be somewhat lower than some of the above source data indicated. This study's base data was determined by adjusting actual traffic counts to correlate with known counts at other local airports with air traffic control towers. Statistics were developed as shown in Table 5. Figure 14 compares activity at Aurora State Airport with other principal regional Oregon airports.

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FIGURE NO. 19

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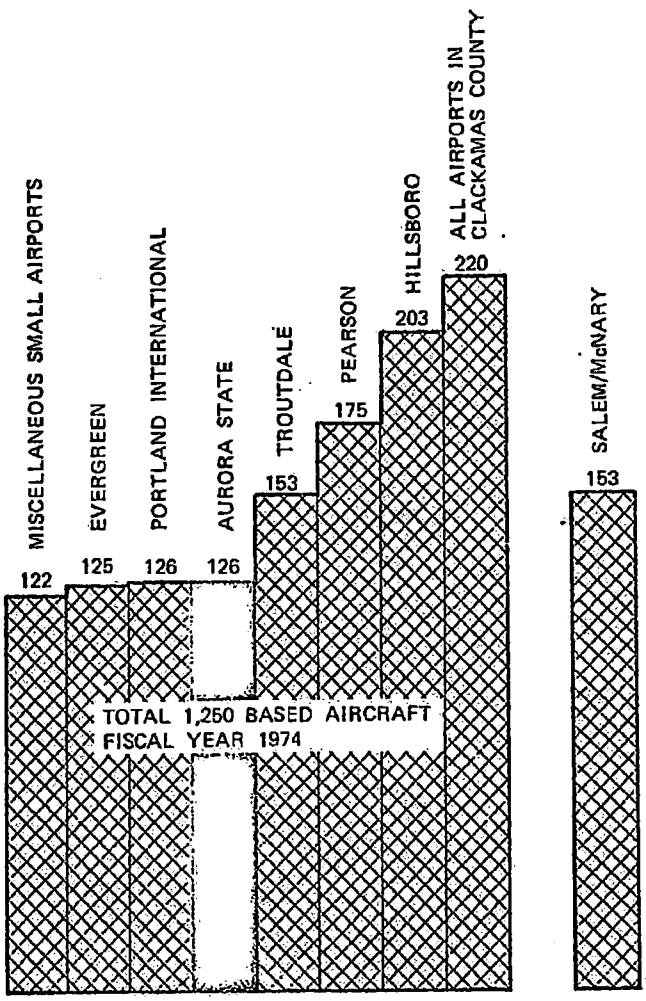


DISTRIBUTION OF GENERAL AVIATION BASED AIRCRAFT IN PORTLAND SMSA

FIGURE 13

SOURCE: PORTLAND – CLACKAMAS AIRPORT STUDY

EXHIBIT O

TABLE 5

1975 AIR TRAFFIC DATA FOR AURORA STATE AIRPORT

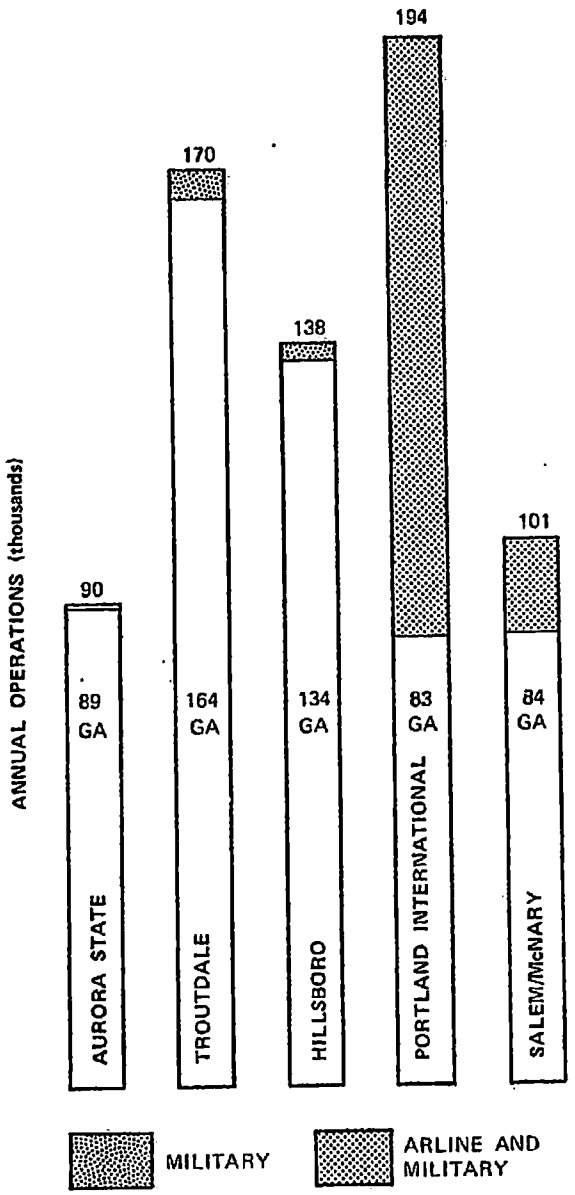
OPERATIONS	
TOTAL ANNUAL	90,000
LOCAL ANNUAL	52,000
ITINERANT ANNUAL	38,000
IFR ANNUAL	500*
PEAK MONTH	11,000
BUSY DAY	400
BASED AIRCRAFT	127
OPERATIONS PER BASED AIRCRAFT	709
MILES FLOWN	2.8 million*
PASSENGER MILES INCLUDING PILOT	6.5 million*

*Approximate

114 PROJECT NO. C9198.00
FIGURE NO.

EXHIBIT O

PROJECT NO. C 9178.00
FIGURE NO. 20



AIR TRAFFIC ACTIVITY AT
AREA MAIN AIRPORTS 1975
FIGURE 14

SOURCE: FAA

EXHIBIT O

AVIATION FORECASTS

Aviation demand forecasts for the years 1980, 1985, and 1995 have been developed to identify the role of the airport in those years. Factors analyzed were population and economic growth, aviation technology and trends, air traffic activity, and the effect upon the airport of other airport development. The effects of new technology seem to have the least impact because of the type and numbers of aircraft now in the system and the relatively long life of present types.

The limits of the service area, Figure 5, page 20 indicates that there is little correlation between the location of aircraft owners and the airports they use. No study, or survey, has yet determined the reasons why aircraft owners in the Portland area often choose to use airports that are not the nearest airport to their home or business.

The Portland-Clackamas Airport Study (PCAS), recently completed by the Port of Portland, recognizes the Aurora State Airport to be part of a regional airport system in the Greater Portland metropolitan area. The Aurora State Airport, along with other airports draws from the entire region to generate traffic activity. Therefore requirements and the timing of requirements for Aurora State Airport will be influenced by developments at the other airports or at new airports in the Portland region. A proposed new public airport in Clackamas County would also be part of the regional system.

The forecasting methodology has been limited by the base data which was available as regards historical aviation statistics and socio-economic data and forecasts. The method used was first, to identify the airport service area and its history, and second, to correlate the airport service area with the area's socio-economic characteristics. Mixed socio-economic projections, mostly population and growth trends, were assembled together with historical air traffic data.

EXHIBIT O

Then, because this airport is inseparable from the "Portland Regional Airport System," it was necessary to examine forecasts on the national, state, and local level. The most up-to-date and thorough of the other forecasts is that of the Portland-Clackamas Airport Study. Other source material included miscellaneous FAA material, but primarily FAA's The Northwest Region Aviation System, Ten-Year Plan 1975-1985, and The Oregon Aviation System Plan (OASP) from the Oregon Department of Transportation.

The possible range of forecasting methods was limited for the Aurora State Airport because the service area lies only partially in the Portland SMSA. Much of the base data available for SMSA's is not available for other parts of the Aurora State Airport's service area. Insofar as possible, the Aurora forecasts have correlated based aircraft to population and socio-economic trends.

The aircraft operations forecasts have been correlated to known general aviation activity trends at Control Tower airports with specific on-airport traffic counts. The results were then adjusted to reflect the trends of other recent forecasts just mentioned. Because historical information did not check closely with actual surveys, the comparison of the Aurora State Airport forecast to other studies necessitated considerable adjustments. Comparisons are shown in the appendix.

Figure 15, Population Trends, indicates the predicted 4-county region growth rate from Marion County Comprehensive Plan and data from the Comprehensive Health Planning Association's projections. The service area, as defined earlier predicts a slower growth rate than the SMSA. On this basis, the growth rate at the Aurora State Airport may be expected to be somewhat slower than the growth rate at some of the other airports in the Portland metropolitan area.

Population forecasts from the above projections for the year 1995, indicate an anticipated population of 1,011,000 in the service area, up from 710,000 in 1970. This represents a 42 percent increase, whereas the four-county increase is project at 82 percent.

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FIGURE NO.

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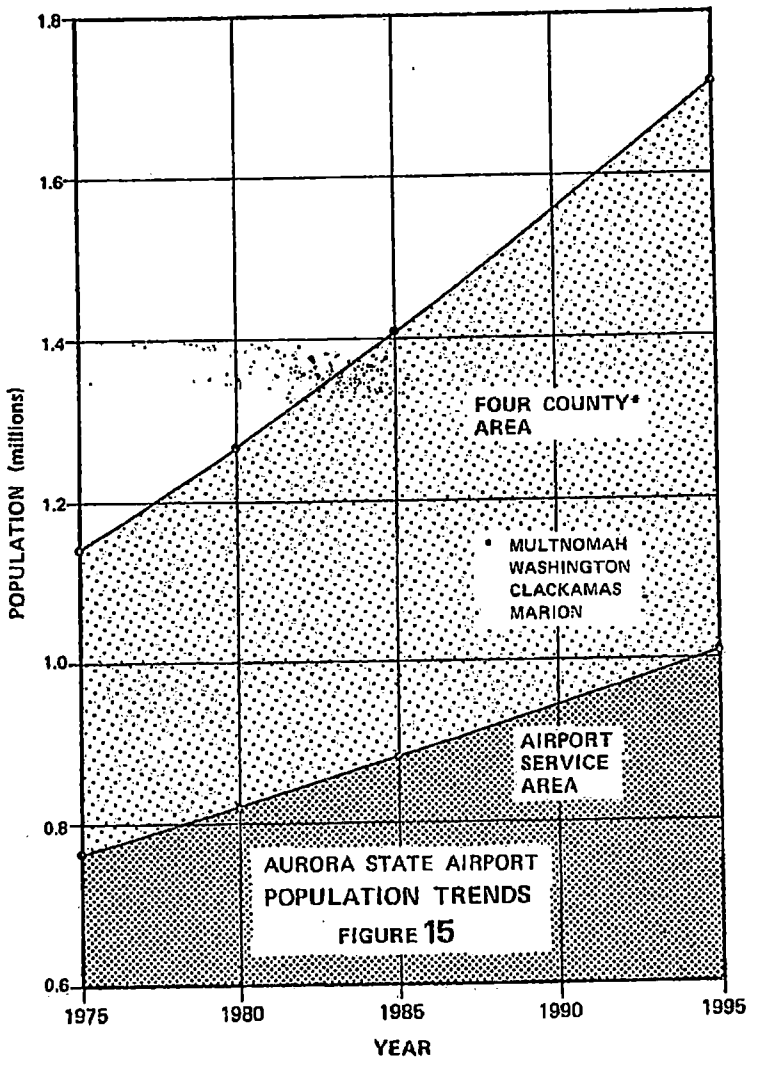

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Figure 16 shows the forecast based aircraft at the Aurora State Airport. Other studys' projections are compared in the appendix. The projections used for this study have assumed no new airport in the southeast Portland area. The appendix contains graphs that indicate either possibility, but the effects were determined not to be critical to this master plan.

The forecast for Aurora State Airport developed in this study shows fewer based aircraft than projections made by other studies. This is because recent surveys seem to indicate inaccuracies in earlier counts of based aircraft. Perhaps the previous counts were taken at periods of peak fluctuations.

The forecast annual aircraft operations for the Aurora State Airport are shown on Figure 17. These have been projected using the best historical data available, that taken from actual surveys and projected in correlation with FAA counts and projections at Portland-Hillsboro and Portland-Troutdale airports. A verification check was made by using the methods of Report No. FAA-RD-74-178, Estimating Operations at Non-Towered Airports Using the Non-Survey Method.

The operations per based aircraft are predicted to increase from 709 in FY 1975 to 843 in 1995. This is a projected increase of 18.9 percent, which is consistent with other state and national trends.

Consistent with the other mentioned studies and national trends, projections were made for the mix of aircraft types. Figure 18 shows forecast aircraft population for the 5, 10, and 20 year periods.

The present and forecast roles of the Aurora State Airport were carefully examined. At the present time, the airport is a General Utility airport (GU), which by definition is an airport whose operational role is to serve all types of piston-powered aircraft of maximum gross weights of 12,500 lbs. or less.

According to the forecasts developed the airport will sustain sufficient numbers of basic transport type general aviation aircraft to change the operational role to Basic Transport (BT). This would occur between 1985 and 1990. A basic transport type is: either any turbojet aircraft, or a propeller aircraft with a maximum gross weight of from 12,500 pounds to 60,000 pounds.

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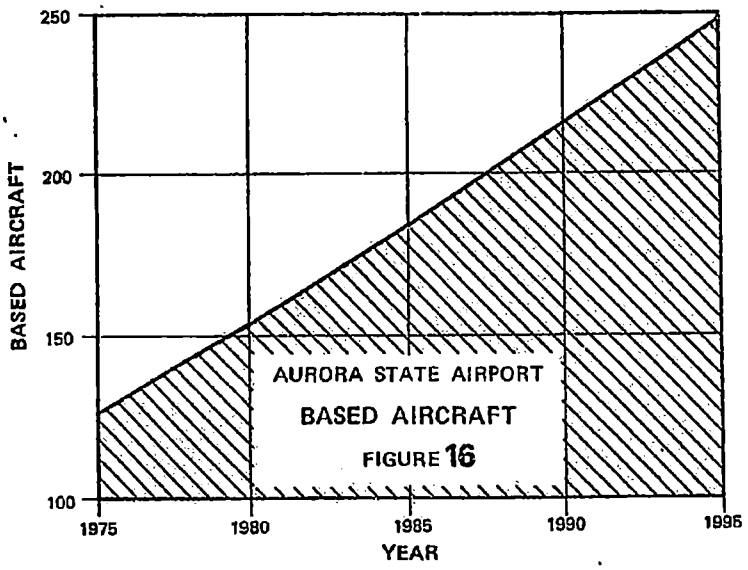

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PROJECT NO. C9/98.00
FIGURE NO.
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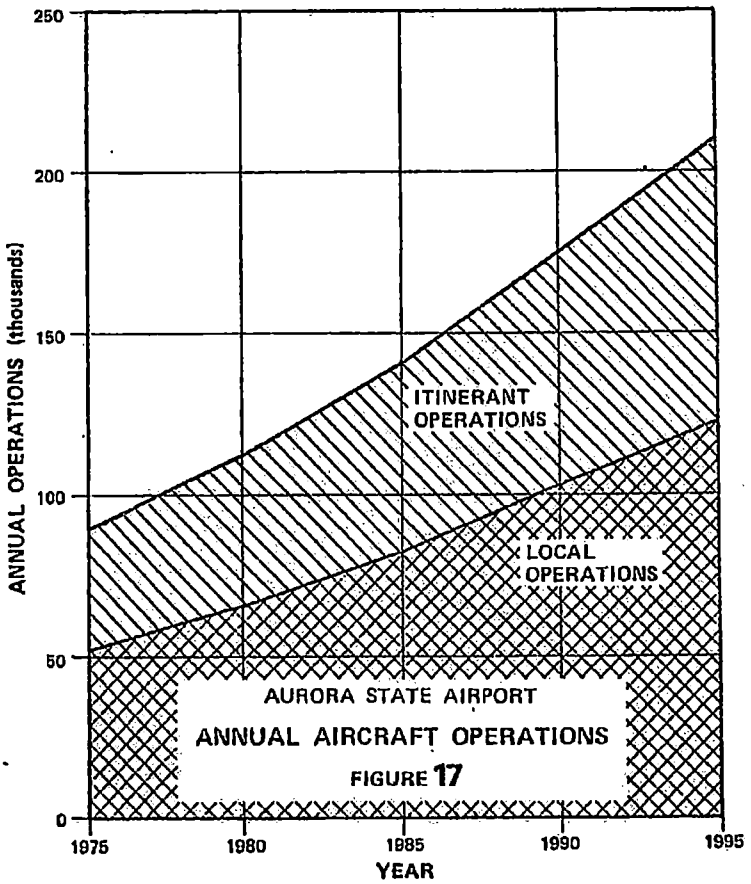
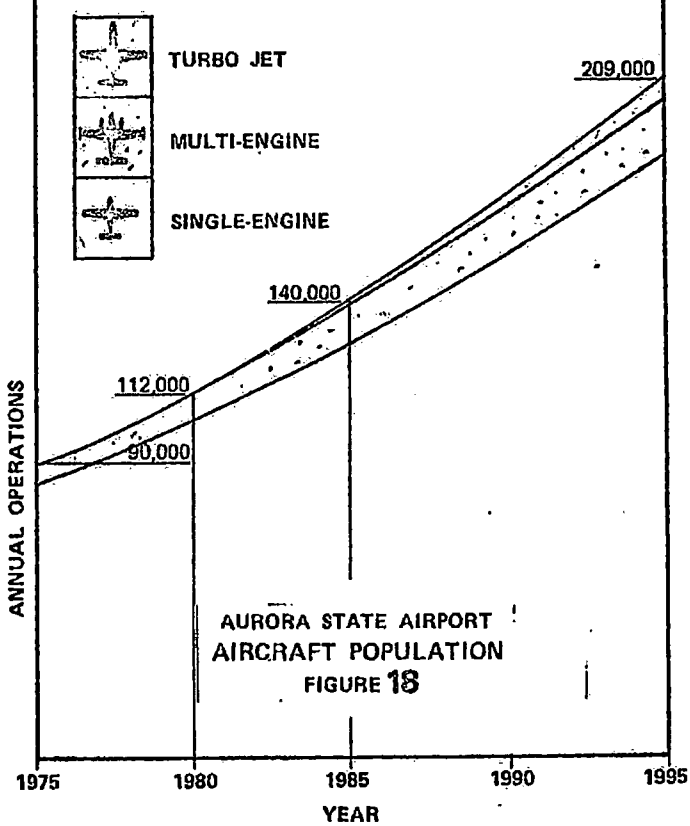


EXHIBIT O

AIRCRAFT MIXES (%)			
1975	1980	1985	1995
0	0	1.0	3.0
6.5	7.5	8.1	8.2
93.5	92.5	90.9	88.8



AURORA STATE AIRPORT
AIRCRAFT POPULATION
FIGURE 18

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24 FIGURE NO.
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PROJECT
10 FIGURE NO.
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EXHIBIT O

The functional role of the airport, defined by service level, is a high density feeder system airport, designated F-1. This is based upon a level of annual operations exceeding 100,000.

The forecast demands for the Aurora State Airport as used in this Master Plan are shown in Table 6. New developments or management policies may change these forecasts. Also since Aurora is part of the Portland regional system, its competitive position in the system strongly influences the distribution of regional aviation demands.

If the facilities at the Aurora State Airport should in the future be considerably upgraded without significant changes at other regional airports, then the competitive position of this airport may significantly increase the aviation demand at Aurora State. For this reason, projections should be periodically checked and revised.

DEMAND VERSUS CAPACITY ANALYSIS

This analysis determines during which years forecast aviation demands upon the airport will exceed facility capacities. Determinations are included for the short, intermediate, and long range periods (1980, 1985, 1995).

Both the airside and the groundside have been analyzed. The airside includes the runway and taxiway system, as well as the airspace. The groundside includes the terminal area, with aprons, hangars, buildings, utilities, development area, and entrance and access roads.

Forecast aviation demands in Table 6 page 52 are the basis for this section. Capacity determinations were made using FAA Advisory Circular 150/5060-3A, Airport Capacity Criteria Used In Long Range Planning. Capacities for the groundside activities were determined from FAA and other airport engineering standards. It was assumed that instrument operations will be conducted with traffic procedures that will not restrict airspace. Also, it was assumed in studying runway capacity, that a taxiway system would be developed to minimize runway congestion.

EXHIBIT O

TABLE 6
MASTER PLAN FORECASTS
FOR AURORA STATE AIRPORT

	1975	1980	1985	1995
BASED AIRCRAFT	127	154	184	248
ANNUAL OPERATIONS	90,000	112,000	140,000	209,000
BUSY HOUR OPERATIONS	50	60	78	115
OPERATIONS PER BASED AIRCARFT	709	727	761	843

115 PROJECT NO. C9198.00
FIGURE NO.

EXHIBIT O

Another factor affecting capacity is the aircraft mix. For this study, it was assumed that the percentage of small general utility type aircraft will exceed 90 percent through the 20-year long range period as indicated on Figure 18, page 50.

Direction of runway operation does not restrict capacity at Aurora where the direction of operation is slightly over 50 percent for the north operation and slightly under 50 percent for the south operation, and where there are no airspace constraints. In the absence of data on IFR conditions at the Aurora Airport, conditions for the Portland-Hillsboro airport were used, where records show 92.8 percent VFR and 7.2 percent IFR. The FAA long range method assumes an annual condition of 9 percent VFR and 10 percent IFR.

In the airside analysis, no restriction on capacity was determined to exist in the airspace around the Aurora State Airport. However, as traffic increases, it must be assumed that increased demands for IFR operations can and will be met by improvements to FAA's traffic control system and airway facilities. No procedural problems are anticipated in the vicinity of the airport, such as for noise abatement.

A parallel taxiway is required before runway capacity will be adequate. See Figure 19. Runway capacity would be then acceptable throughout the long range period, provided an adequate taxiway system is maintained. Runway demands in 1995 are for 209,000 annual operations, without a new southeast Portland airport. In this case, the single runway with adequate taxiways has a practical annual capacity of 215,000 operations.

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FIGURE NO.
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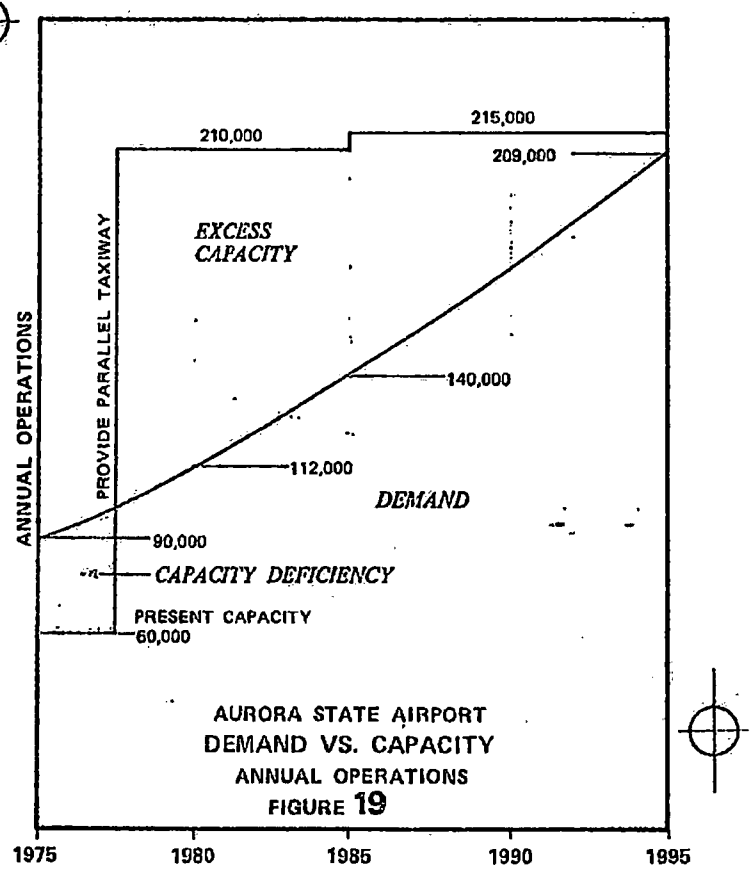

AURORA STATE AIRPORT
DEMAND VS. CAPACITY
ANNUAL OPERATIONS
FIGURE 19

28 PROJECT NO. C7198.00
FIGURE NO.

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E-4

EXHIBIT O

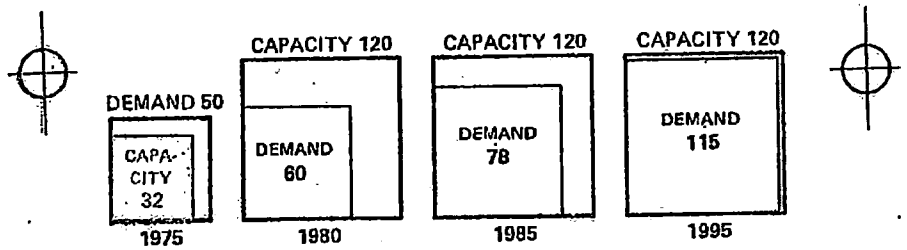
Practical hourly runway capacity based on the FAA method is 53 for IFR and 120 for VFR. No peak hour activity data is available for the Aurora State Airport, but it is estimated that 115 operations may occur during the peak hour during VFR at the end of the 20-year long range period. Figure 20 shows demand versus capacity through the 20-year period. Peak hour activity could be somewhat variable, depending upon the daily peaking factor (the amount of daily activity occurring during the consecutive two busy hours). Capacity would not be exceeded if departure delays during the peak hour of the week do not exceed 2 minutes, which is the delay normally accepted.

The most critical capacity deficiency facing the airport is the complete lack of controlled space outside of the runway area, which already is owned by the airport. All of the groundside analyses assume that the airport owner will be able to develop capacities to meet demands through adequate control of airport development land. Whenever peak hours become saturated, pilots usually reschedule their arrival and departures to less busy hours of the day.

If a single runway at Aurora State Airport is to be satisfactory for the 20-year forecast period, plans must be made to insure that the runway system functions properly. This requires developing a parallel taxiway system including adequate exit taxiways so that runway occupancy time can be reduced to a minimum. This is required for safety as well as for capacity.

Parking apron space is the major groundside deficiency and demands will continue to be significant. The requirements for aircraft parking capacities to meet demands are shown on Figure 21. Although many airports provide all parking on pavement, it has been assumed that it will be adequate to park 90 percent of the based aircraft on paved aprons or in hangars. Hangar capacity is presently 56 aircraft. It is assumed that by the end of the long range period, there will be requirements for 120 tee-hangar bays.

EXHIBIT O



AURORA STATE AIRPORT
DEMAND VS. CAPACITY
PEAK HOUR OPERATIONS
FIGURE 20

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FIGURE NO. [illegible]
[illegible]

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FIGURE NO.
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EXHIBIT O

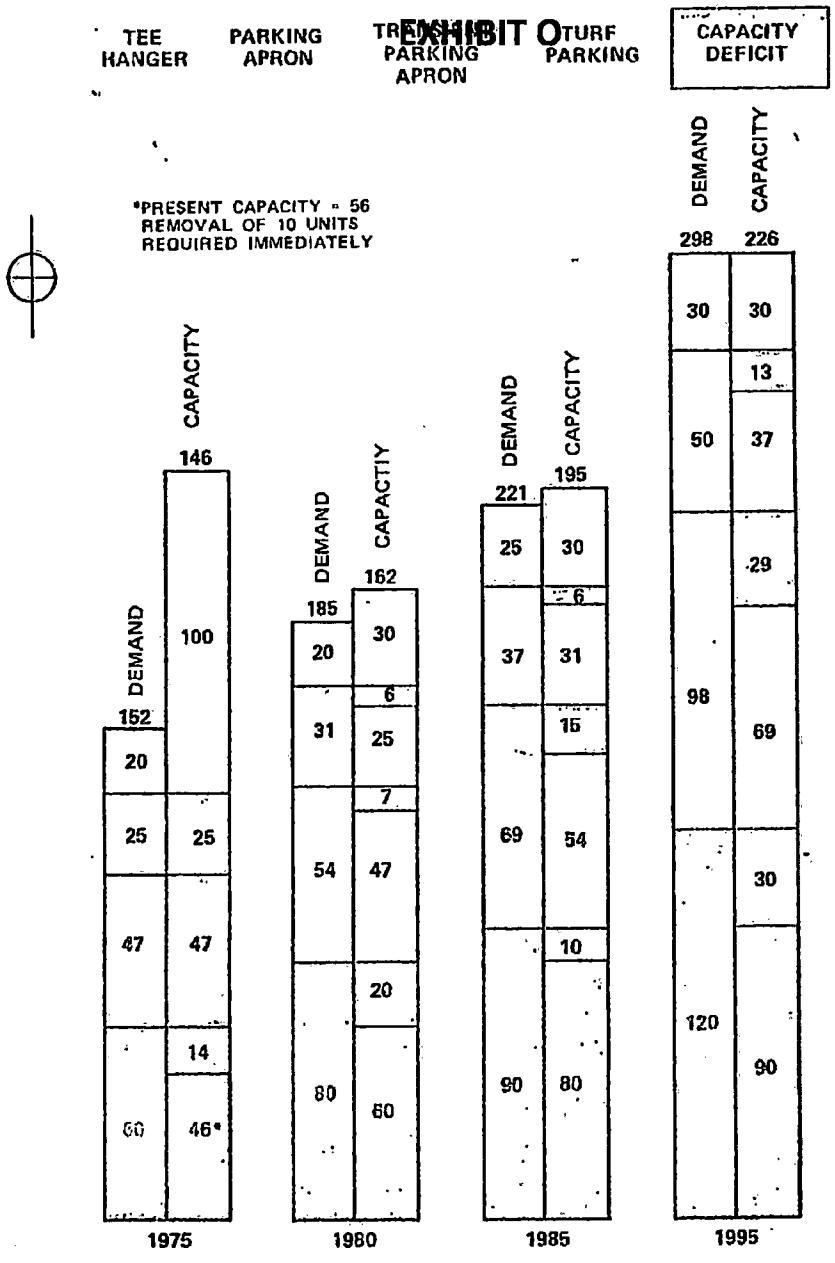

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FIGURE NO 3

DEMAND VS. CAPACITY

AIRCRAFT PARKING
IN NUMBERS OF AIRCRAFT

FIGURE 21

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EXHIBIT O

Also, there is a requirement for one central entrance road connecting the other roads used by the individual operators on the airport. Additional automobile parking will be required, along with more public terminal building space as traffic demands increase. Specific requirements are discussed in the next section.

FACILITIES REQUIREMENTS

The requirements in this section for airport facilities are based upon FAA criteria for Utility and Transport airports. Existing deficiencies and undesirable conditions are identified in the Inventory. The Demand/Capacity analysis shows capacity deficiencies and when expansion is required.

In the long range period soon after 1985 the airport category will change from General Utility to Basic Transport. This will require a runway lengthening of about 1900 feet in two stages. Other than additional costs, this requirement poses no serious space problem because airfield size is presently adequate to accommodate a Basic Transport runway.

However the absolute lack of land to either side of the runway area makes land acquisition a prerequisite to any other airport development. Table 7 shows ultimate facilities requirements and indicates many needed improvements that cannot be placed on present airport property. The table also recommends 1140 acres to be zoned as a buffer zone overlay for land use protection against airport encroachment.

A single runway system is adequate for future needs. Neither capacity constraints, nor constraints posed by crosswind coverage require a second runway, and the effect of constructing or not constructing a new southeast Portland airport will not change this adequacy.

Current runway length, 4100 feet, is slightly more than the General Utility requirement, which is 3600 feet. A Basic Transport length accommodating about 60 percent of the fleet with a 60 percent load would be 4700 feet. One hundred percent of the BT fleet at 60 percent load requires 5300 feet. This Master Plan recommends lengthening to 5000 feet just before 1985 to 30,000 pounds single gear strength in the 1985 to 1995 period. Sixty percent of the BT fleet at 90 percent load requires 6300 feet.

EXHIBIT O

TABLE 7

ULTIMATE FACILITIES REQUIREMENTS

DESCRIPTION	1995 REQUIREMENT	EXISTING (1975) FACILITIES	RECOMMENDED DEVELOPMENT
LAND FOR AIRPORT DEVELOPMENT	226 acres	113 acres	113 acres
LAND FOR AIR EASEMENTS	241 acres	223 acres	18 acres
LAND TO BE ZONED AIRPORT BUFFER	1,140 acres	None	1,140 acres
OBSTRUCTION REMOVAL	1.5 acres	Trees	1.5 acres
RUNWAY, NON-PRECISION INSTRUMENT	6,000' x 150'	4,100' x 150'	1,900' x 150'
STRENGTH	60,000#	30,000#	30,000#
TAXIWAYS: PARALLEL	6,000' x 40'	None	6,000' x 40'
EXITS	6	3(1)	6 (40' wide)
STUBS	4	3(1)	4 (40' wide)
HOLDING APRONS	4	1(1)	4 (50' x 100')
PAVED PARKING APRON:			(50,000 SY)
BASED AIRCRAFT	98 Aircraft	None	98 Aircraft
TRANSIENT AIRCRAFT	50 Aircraft	Negligible	50 Aircraft
TURF PARKING AREA	30 Aircraft	100(2)	20 Aircraft
LIGHTING			
MEDIUM INTENSITY, RUNWAY	6,000 LF	4,100 LF (Low Intensity)	6,000 LF
MEDIUM INTENSITY, TAXIWAY	7,200 LF	None	7,200 LF
TAXIWAY REFLECTORS	6,000 LF	None	6,000 LF
AIRPORT BEACON	1	Substandard	1
LIGHTED WIND INDICATORS	3	1(1)	3
VASI	2 ends	None	2
MALSF	1	None	1
APRON LIGHTING	1,800 LF	None	1,800 LF
SEGMENTED CIRCLE	1	None	1
NAVIGATIONAL APPROACH AIDS	MLS or Equivalent	Newberg VOR TAC	NDB and MLS
FENCING: SECURITY	7,000 LF	None	7,000 LF
PERIMETER	13,500 LF	11,000 LF(1)	13,500 LF
AUTOMOBILE PARKING	280 cars	80 cars	200 cars
AIRPORT ROADS	7,300 LF	Substandard(1)	7,300 LF
TERMINAL/ADMINISTRATION BUILDING	5,000 SF	None	5,000 SF
AIR TRAFFIC CONTROL TOWER	1	None	1(3)
CRASH, FIRE, RESCUE STATION	1	None	1
TEE-HANGARS	120	56(4)	74(5)
CONVENTIONAL HANGARS	6 to 8	3	3(5)
HELIPORT	1	None	1 (120' x 160')

(1) Replace Existing
(2) Abandon 80 Existing
(3) By FAA
(4) Remove 10 Existing
(5) By Private Development

116 PROJECT NO. C9198.0
FIGURE NO.

EXHIBIT O

The present width, 150 feet, should be retained to provide a somewhat better level of safety, particularly during periods of strong winds. When a MLS or equivalent system is installed, a wide runway will be desirable particularly for turbojet aircraft operating at relatively high approach speeds. Retaining the present width of pavement would also minimize construction problems associated with future runway edge lighting.

The taxiway system is very critical to airport safety and capacity. A parallel taxiway, the entire length of the runway, is required immediately with adequate exits from the runway. New stub taxiways from the parallel taxiway to all apron areas are also required. The stub and exit taxiways should be lighted with medium intensity lights and should be marked. Taxiway reflectors are suitable for the parallel taxiway.

Paved aircraft parking aprons are required immediately. Virtually all aircraft are currently parked on turf, which causes instability problems during wet weather. No apron facilities are provided for transient parking. A centrally located public parking apron will cancel this major deficiency.

The frequency of instrument weather conditions and long winter hours of darkness dictate an upgrading of the lighting and navigational systems. Medium intensity runway edge lighting should be installed, including visual approach slope indicators (VASI) on both ends. An on-airport or near-airport nonprecision approach aid should be added to provide better minimums and higher IFR capacity. This should be supplemented by an approach light system such as MALSF.

As the trend for ownership of more expensive airplanes and more multi-engine airplanes increases, the shortage of tee-hangars will become more noticable. As airport services increase additional conventional hangars will be required. Aircraft security needs will increase as more aircraft are based at the airport and as ground traffic increases. Better fencing and more lighting around aircraft parking areas will be required.

EXHIBIT O

Eventually, greater activity on the groundside of the airport will necessitate more terminal and operations building space together with a centrally located administration building. There should be one prominent entrance road to the airport and an internal road system that connects the entrance road to the various services and operators and apron areas. As more people use the airport, it will be necessary to upgrade the sanitary waste systems, and possibly centralize waste treatment facilities.

The needs for development will create a need for capital for investment. Therefore it will be necessary to stimulate revenue producing activities by generally encouraging airport related commercial activities that will lend financial support to the airport.

ENVIRONMENTAL REQUIREMENTS

The principal environmental effects of airport development include: noise, air and water pollution, ecological impacts, social impacts, and effects of construction and operation. The development of many of the improvement projects needed for the airport will affect the environment, sometimes noticeably and sometimes imperceptably.

The primary environmental consideration at the Aurora State Airpot is to have compatible land use in the airport vicinity. The main effect of airport operations on land use compatibility is aircraft noise exposure. Other compatibility considerations include aircraft accident potential, and to a lesser extent air pollution, and vehicular traffic patterns.

Aircraft noise exposure is known to have adverse behavioral and subjective effects on people rather than to effect physical damage. Behavior effects involve interference with on-going activities such as speech, learning, and sleeping. Subjective effects are described by terms like "annoyance" and "nuisance." The magnitude of the problem depends on the volume, frequency, and time of day of aircraft operations; the number of turbojet aircraft operations; and the character of land use exposed. Table 8 describes typical noise impacts on land use.

EXHIBIT O

PROJECT NO. C9198.00
FIGURE NO. 117

TABLE 8
NOISE IMPACTS ON LAND USE

LAND USE	NOISE EXPOSURE FORECAST (NEF)		
	< 30 LOW NOISE IMPACT	30-40 MODERATE NOISE IMPACT	> 40 HIGH NOISE IMPACT
RESIDENTIAL, LOW DENSITY			
RESIDENTIAL MEDIUM DENSITY			
RESIDENTIAL, HIGH DENSITY			
SCHOOLS, HOSPITALS			
OFFICE			
COMMERCIAL			
INDUSTRIAL			
AGRICULTURAL			
RECREATION			

LEGEND



NO CONFLICT | LOW CONFLICT | MODERATE CONFLICT | SERIOUS CONFLICT

EXHIBIT O

The aircraft noise generated at a general aviation airport like Aurora State is ordinarily minimal because there is no appreciable number of turbo-jet or night operations and because the surrounding development has a very low population density. Critical noise contours for existing conditions do not fall outside the airport. See Figure 8, Existing Noise Exposure, page 24.

The FAA, with assistance from EPA, is responsible for regulating aircraft noise. To date no specific regulations or standards for acceptable aircraft noise exposure limits on land use have been established. Instead, general guidelines regarding land use compatibility and noise exposure are used. The application of these guidelines requires a technical forecast of noise exposure levels, which is included in AIRPORT PLANS of this master plan.

Land use compatibility guidelines are based on the relative noise sensitivity of different activities. The most sensitive uses are those involving conversation and sleeping. Typically, auditoriums, arenas, schools, hospitals, and housing are the least compatible and open space uses like farming are the most compatible. Consequently, preservation of the existing agricultural land use pattern around the Aurora State Airport is the key to compatible land use regardless of the noise exposure levels.

The hazard of aircraft accidents is partially related to obstructions in the airspace and their proximity to the runway. Preventing airspace obstructions requires regulating the height of objects under established flight paths and prohibiting light and smoke emissions that adversely effect the pilot's vision. The greatest probability of aircraft accidents is either on or immediately adjacent to the runway. The greatest concern, therefore, is to assure that the airport itself meets adequate design standards. A secondary concern is to prevent development involving large concentrations of people or hazardous materials within the approach and departure paths.

EXHIBIT O

The air quality aspects of airport development are regulated by the Oregon Department of Environmental Quality (DEQ). DEQ is responsible for assuring compliance with State and Federal air quality standards. The Aurora State Airport is subject to the indirect source rules as set out in OAR 340. Under these rules, the potential impacts of airport operations on air quality need to be evaluated only when a modification to the airport is proposed that will increase annual operations by 25,000 or more within 10 years after completion of the improvement. This impact evaluation is called for just prior to the time of making the improvement.

The vehicular circulation aspects of airport development need to be considered in the context of congestion on existing highways. Based operations at the airport currently have individual access points. Consideration must be given to linking all ground operations with a continuous system on the site in order to minimize confusion, congestion and accident hazards on the bordering highways.

At this time, it appears that there are no significant ecological or social impacts upon the airport environs, but future development programs must attempt to minimize the possibility for dislocating persons or businesses.

In general, any major capital improvement at the airport will involve federal funding. Consequently, a full disclosure of environmental effects expected to result will be disclosed in an Environmental Impact Statement under the National Environmental Policy Act of 1969.

SITE SUFFICIENCY

The existing site of the Aurora State Airport was evaluated as to its adequacy to meet forecast requirements and according to possible environment conflicts. Alternative airport sites were identified, examined and compared to the existing airport. The entire study is included in the appendix. The conclusion of that study was that the existing Aurora State Airport site is adequate and the airport should not be relocated.

EXHIBIT O

Figure 22 shows the alternative sites that were evaluated and shows a comparison of key factors affecting the decision. All alternatives had advantages and all had disadvantages. The choice to retain the existing site was made simply because it is the choice where the most benefits seem to be obtained for the least costs. Costs in this case are both financial costs and unfavorable social, environmental and economic impacts as explained in the full study.

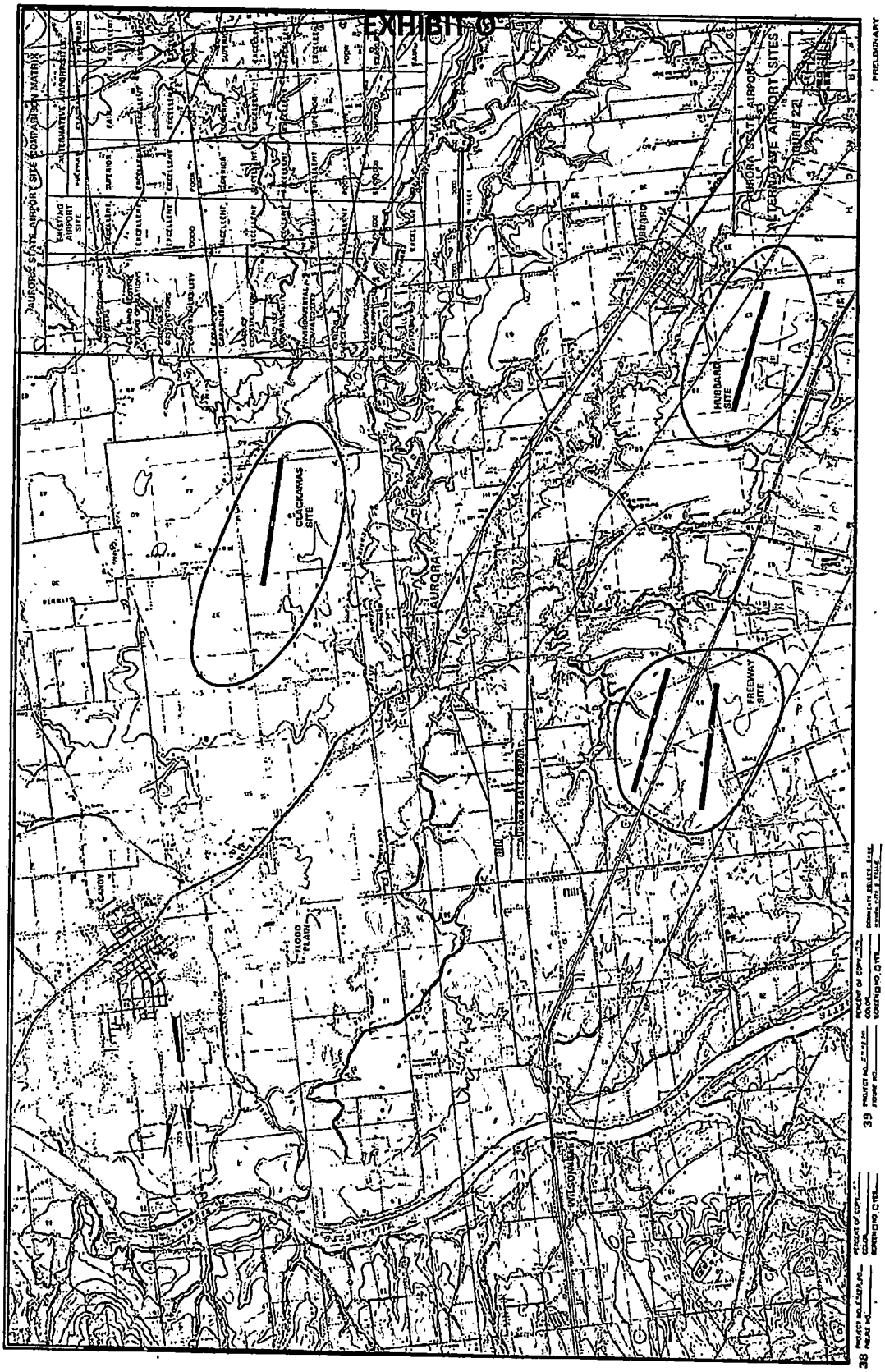


EXHIBIT G
AURORA STATE AIRPORT SITE COMPARISON MATRIX
ALTERNATIVE AIRPORT SITES
CLACKAMAS SITE
HUBBARD SITE
FREEWAY SITE
AURORA
CANBY
WILLAMETTE
WILSONVILLE
PRELIMINARY

EXHIBIT O

AIRPORT PLANS

EXHIBIT O

AIRPORT PLANS

CONCEPT

Conceptual considerations were based on Master Plan Forecasts, Table 6, page 52, and Ultimate Facilities Requirements, Table 7 page 59. Requirements are for a single runway general aviation airport of high standard with a large terminal area and ample off-airport protection from encroachment.

The effective use of space is the critical ingredient to developing or improving the airport system. Space for airport expansion is impacted on three sides by highways, relatively difficult to relocate, and on the fourth side by privately owned and controlled property.

Previous study determined that the best course of action is to develop the present airport. Because the airport is a land use generally compatible with existing uses in the area, the present runway position has been retained. Expansion will be into the space east of present airport property. This is shown on Figure 23, Airport Layout Plan.

AIRPORT LAYOUT PLAN

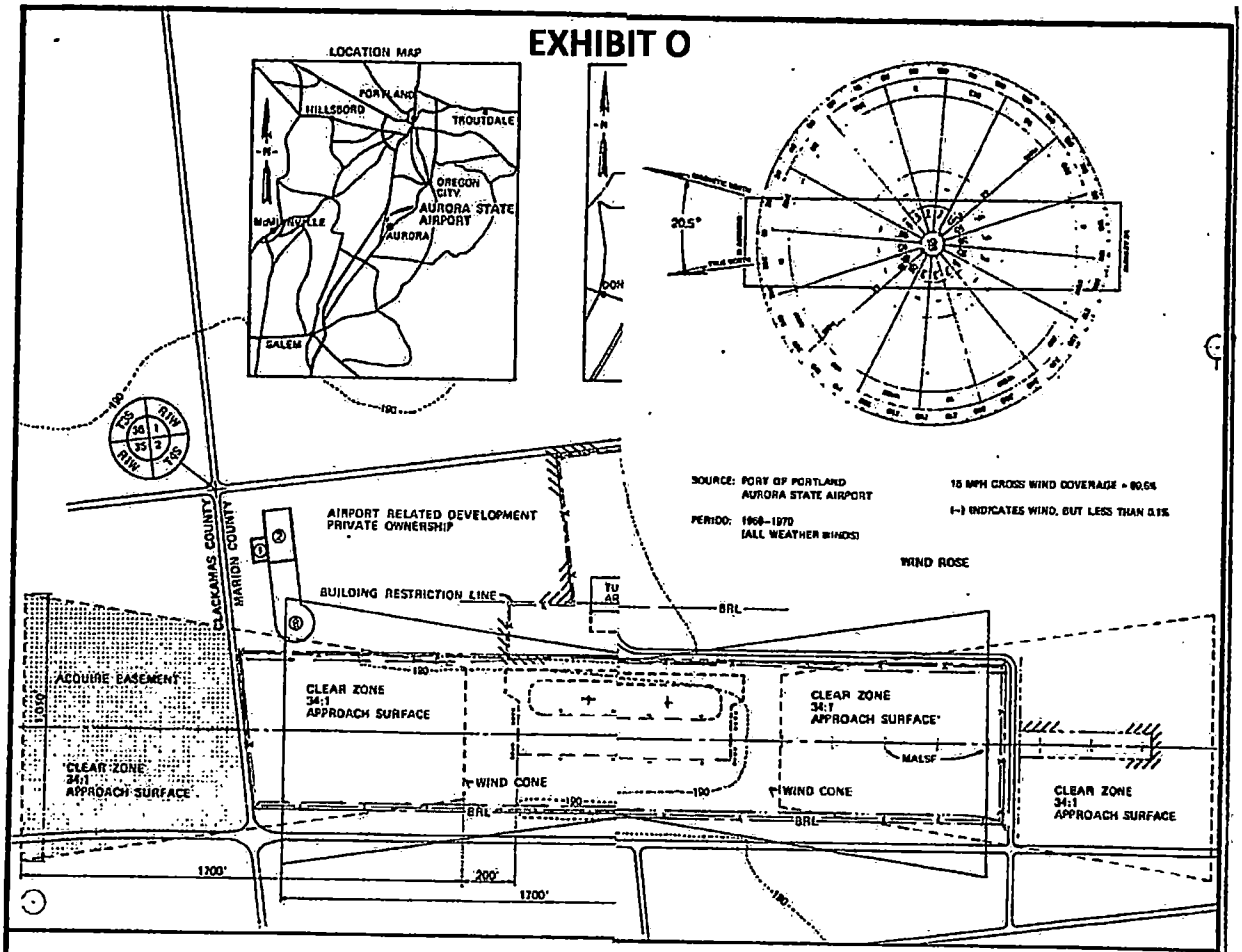
The Airport Layout Plan graphically illustrates the proposed development for the existing airport through the 20-year forecast. The plan provides dimensions of proposed facilities and several tables of data explaining the plan. Details of the development staging are covered later in the Master Plan.

Key points include:

- In order that there can be an implementable Master Plan the Airport Layout Plan prescribes acquiring 113 acres of land in fee on the east side of the airport. Without this space for airport development it will be impossible to implement a complete and productive airport development program.

  Also 18 acres of land is to be acquired in easement for obstruction removal and for airspace protection north of the airport.

EXHIBIT O



NOTES:

1. FOR ADDITIONAL INFORMATION CONCERNING THE TERMINAL AREA SEE TERMINAL AREA PLAN FIGURE 25.
2. FOR ADDITIONAL INFORMATION CONCERNING APPROACH SLOPES, CLEAR ZONES AND OBSTRUCTION SURFACES SEE ULTIMATE AIRPORT IMAGINARY SURFACES, FIGURE 24.

BASIC DATA TABLE				
RUNWAY DATA				
	EXISTING (1975)	STAGE I (1975-1980)	STAGE II (1980-1995)	ST. (1
RUNWAY LENGTH	4,100' 1,250m	4,100' 1,250m	5,000' 1,524m	6, 1,
RUNWAY WIDTH	150' 46m	150' 46m	150' 46m	
EFFECTIVE GRADIENT (%)	0.07	0.07	0.07	0
PERCENT WIND COVERAGE	99.5	99.5	99.5	9
INSTRUMENT RUNWAY	None	None	None	N
PAVEMENT STRENGTH*	30S	30S	30S	3
APPROACH SLOPES AND CLEAR ZONES	34:1	34:1	34:1	3
LIGHTING	L. Intensity	M. Intensity	M. Intensity	M. I
MARKING	Basic	Non-Precision	Non-Precision	Non
NAVIGATIONAL AIDS	None	VASI	MALSF	
*Values given are the gross weight in 1,000 lbs. for single (S) and dual (D) gear aircraft.				

AURORA STATE AIRPORT

AIRPORT LAYOUT PLAN

FIGURE 23

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PRELIMINARY

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- The existing airport is to be retained with a few criteria excelling usual maximums. The existing runway remains at its current length, slightly longer than GU requirements, (4100 versus 3600 feet), and will remain 150 feet wide instead of 100 feet.

  The parallel taxiway will be placed at 225 feet instead of 200 feet because of existing drainage conditions, and the building restriction line will remain at 500 feet as established years ago.

  Pavement strength will remain at 30,000 pounds S.G. except where lighter strength aprons are permanent.

- The runway will be improved from 4100 feet and 30,000 pounds S.G. strength ultimately to 6000 feet and to 60,000 pounds D.G. strength.

- A parallel taxiway will be constructed with several 90 degree exits and stub taxiways to provide direct access to the parking aprons.

- Paved aircraft parking aprons for 98 based aircraft and 50 transient aircraft will be developed, and turf parking for 30 aircraft will be improved.

- Lighting improvements will be an extensive program. Medium intensity runway and taxiway lights will be added together with taxiway reflectors on the parallel taxiway, a new beacon, VASI's for both runway ends, MALSF and apron lighting.

- New navigational aids (NDB and MLS or equivalent) are specified in addition to an air traffic control tower.

- Airport entrance and internal road systems will be considerably modified on the land which is to be acquired and new automobile parking areas will be provided.

- The airport will be divided into areas of different uses which will be separated. The aircraft areas will be separated from public and commercial areas by security fences. Perimeter fences will enclose the entire airport.

EXHIBIT O

- Ultimately a terminal/administration building and a crash/fire/rescue station will be constructed. More hangars are prescribed.

- A heliport is specified for the ultimate airport.

APPROACHES, OBSTRUCTIONS, EASEMENTS

Figure 24 shows the ultimate airport imaginary surfaces and is a part of the Airport Layout Plan. These are according to Federal Aviation Regulations Part 77 and are much like the existing surfaces. After existing obstructions are removed few future problems are anticipated. Existing air easements are to be retained and one new area north of the airport is to be acquired. The figure depicts Part 77 standards for a nonprecision instrument runway.

TERMINAL AREA PLAN

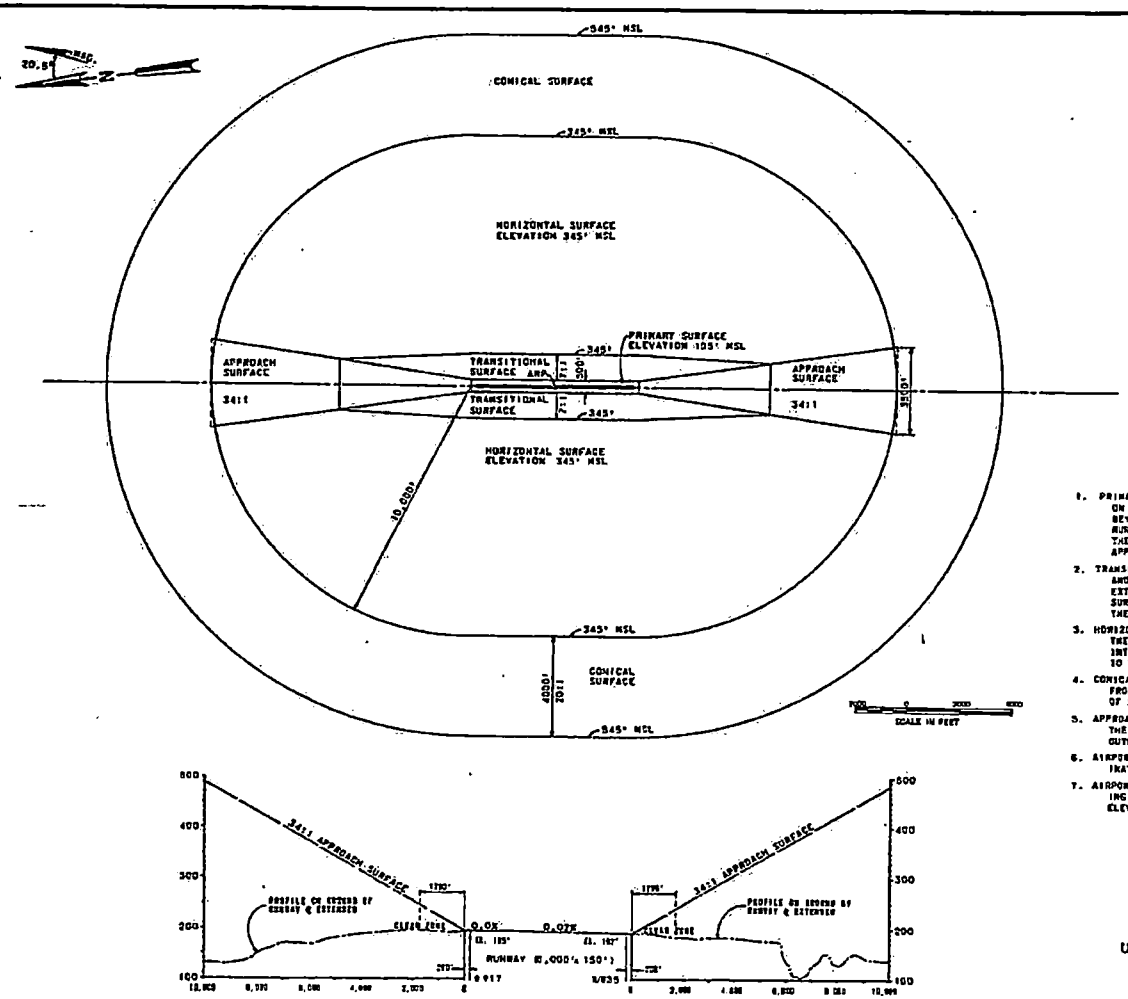
This plan is a part of the Airport Layout Plan, and is the area which contains significant developments. In order to provide assurance that runway and terminal areas can be developed in harmony together, it will be necessary to acquire the land for the terminal area. This will enable the existing flight strip type of airport to become a complete airport, particularly as regards adequate public service areas.

By providing a parallel taxiway with stubs to various apron areas the airport users will have all weather parking and have easy access to tee-hangar parking. Figure 25 shows the Terminal Area Plan.

The terminal area contains three general areas. The first is the south portion of the terminal area where 2 fixed base operations with several tee-hangars will be located. There will be ample room for individuals and businesses to lease space and provide their own hangars and individual service facilities.

In the center of the airport will be space for two kinds of activity. Next to the runway will be a central public apron with terminal building and space for airport maintenance and management personnel. This area will contain in the center of the airport the FAA air traffic control tower, the crash/fire/rescue station and a heliport.

EXHIBIT O



DEFINITIONS

1. PRIMARY SURFACE - THE SURFACE LONGITUDINALLY CENTERED ON THE RUNWAY CENTERLINE AND EXTENDING 200 FEET BEYOND EACH END OF A SPECIALLY PREPARED HARD SURFACED RUNWAY. THE WIDTH OF THE PRIMARY SURFACE IS EQUAL TO THE WIDTH OF THE BEGINNING OF THE RUNWAY'S MOST PRECISE APPROACH SURFACE.
2. TRANSITIONAL SURFACE - THE SURFACE THAT EXTENDS UPWARD AND OUTWARD AT RIGHT ANGLES TO THE RUNWAY CENTERLINE EXTENDED AT A SLOPE OF 7:1 FROM THE SIDES OF THE PRIMARY SURFACE AND FROM THE SIDES OF THE APPROACH SURFACES TO THE HORIZONTAL AND CONICAL SURFACES.
3. HORIZONTAL SURFACE - THE HORIZONTAL PLANE 150 FEET ABOVE THE ESTABLISHED AIRPORT ELEVATION BEGINNING AT ITS INTERSECTION WITH THE TRANSITIONAL SURFACE AND EXTENDING TO THE BEGINNING OF THE CONICAL SURFACE.
4. CONICAL SURFACE - THE SURFACE EXTENDING UPWARD AND OUTWARD FROM THE PERIPHERY OF THE HORIZONTAL SURFACE AT A SLOPE OF 20:1 FOR A HORIZONTAL DISTANCE OF 4000 FEET.
5. APPROACH SURFACES - THE SURFACE LONGITUDINALLY CENTERED ON THE EXTENDED RUNWAY CENTERLINE AND EXTENDING UPWARD AND OUTWARD FROM EACH END OF THE PRIMARY SURFACE.
6. AIRPORT REFERENCE POINT (ARP) - THE POINT ESTABLISHED AS APPROXIMATE GEOGRAPHICAL CENTER OF THE AIRPORT LANDING AREA.
7. AIRPORT ELEVATION - THE HIGHEST POINT ON THE USEABLE LANDING AREA, WHICH ELEVATION IS DATUM TO ESTABLISH THE ELEVATION OF THE HORIZONTAL SURFACE.

AURORA STATE AIRPORT

ULTIMATE AIRPORT IMAGINARY SURFACES

FIGURE 24

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PRELIMINARY

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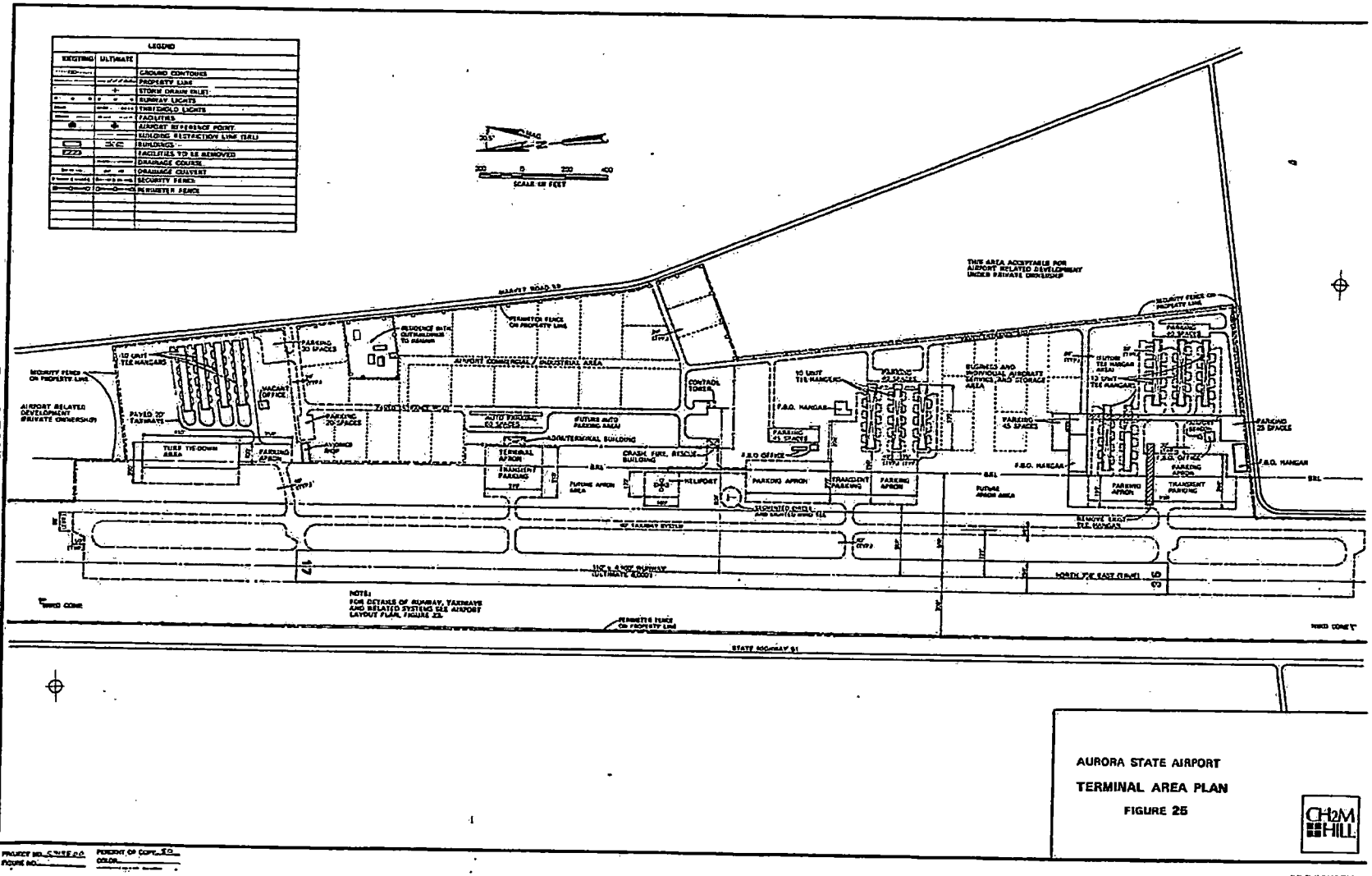

AURORA STATE AIRPORT

TERMINAL AREA PLAN

FIGURE 25

CH2M HILL

PRELIMINARY

52

EXHIBIT O

Just east of the central terminal area is a large area designated to be used for an aviation related commercial/industrial park. This is intended to be a focal point for such services. By being on the airport it can provide more and better services to the airport users as well as providing revenue to broaden the financial base of the airport.

language ?

Another smaller area suitable for further expansion as a third FBO operation lies at the north end of the terminal area property.

The internal road system is designed to provide convenient access to all parts of the airport. It will separate different kinds of airport users. Aircraft areas are to be separated from the general public and from commercial/industrial areas. Apron lighting is prescribed for the aircraft parking area.

SURFACE ACCESS

Although surface access to the airport has been carefully studied, it is beyond the scope of an implementation program to develop improvements to the access system. Therefore recommended solutions have been prepared and are shown on Figure 26, Recommended Airport Access Plan. These recommendations are advisory for other agencies having jurisdiction.

The Recommended Airport Access Plan relys on the strong points of the existing surface transportation systems and reinforces its deficiencies. The basic concept is to provide convenient access from the service area to the main airport entrance.

The Recommended Airport Access Plan makes maximum use of existing facilities with minimum capital expenditures to obtain an efficient airport access system, one that is well suited to the future expansion of the airport. The system may not significantly reduce the travel time of the airport users, but it will substantially improve convenience.

It will retain the present access that Aurora residents have to the airport. However, the major flow of traffic to the airport will be diverted around Aurora allowing the city to remain unaffected by future airport generated traffic, which will aid in attempts to maintain the historical significance of Aurora.

EXHIBIT O

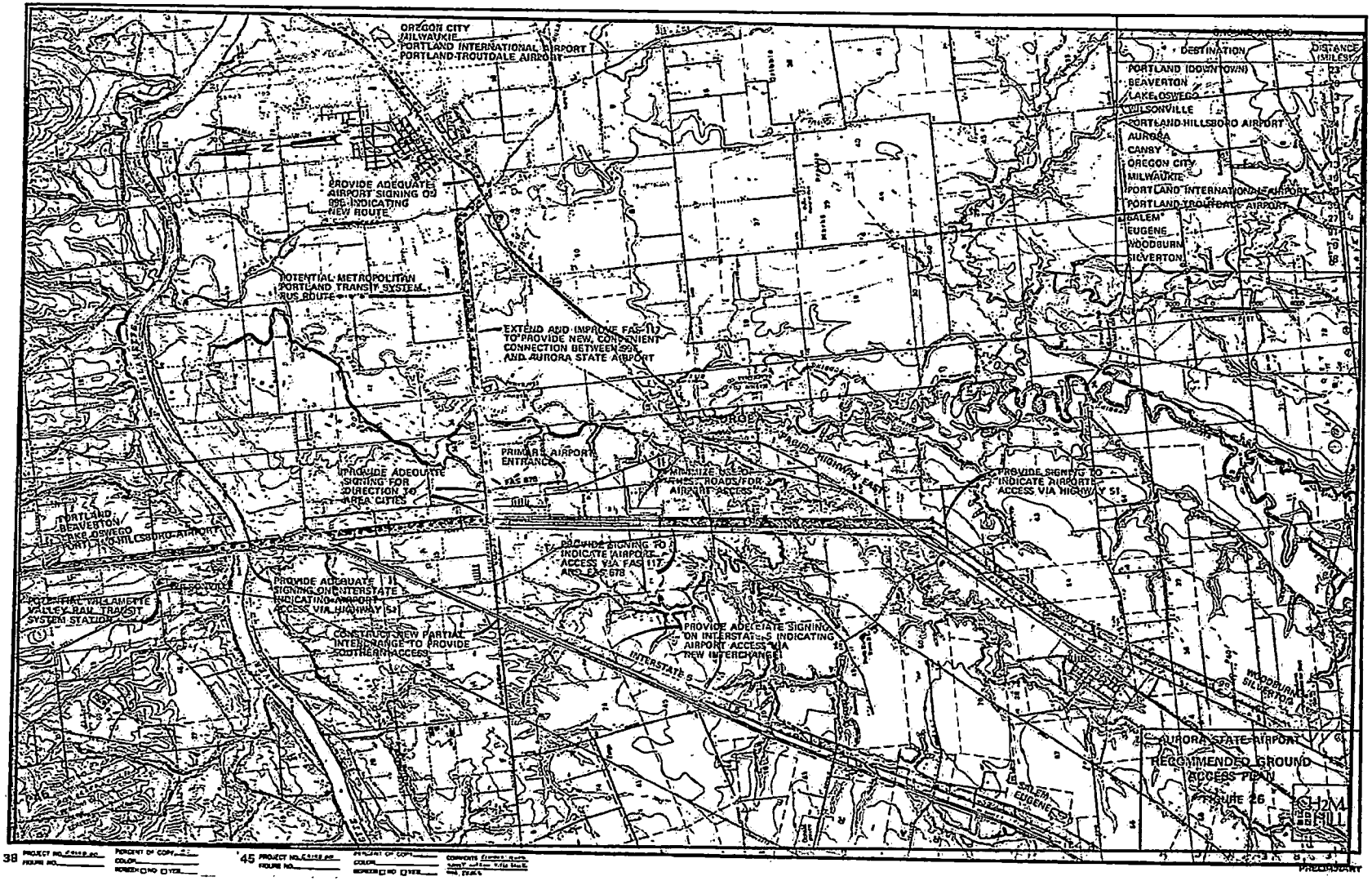
OREGON CITY
MILWAUKIE
PORTLAND INTERNATIONAL AIRPORT
PORTLAND-TROUTDALE AIRPORT
PROVIDE ADEQUATE AIRPORT SIGNING ON 99E INDICATING NEW ROUTE
POTENTIAL METROPOLITAN PORTLAND TRANSIT SYSTEM BUS ROUTE
EXTEND AND IMPROVE FAS 170 TO PROVIDE NEW, CONVENIENT CONNECTION BETWEEN 99E AND AURORA STATE AIRPORT
PRIMARY AIRPORT ENTRANCE
PROVIDE ADEQUATE SIGNING FOR DIRECTION TO AREA CITIES
MINIMIZE NEED FOR NEW ROADS FOR AIRPORT ACCESS
PROVIDE SIGNING TO INDICATE AIRPORT ACCESS VIA HIGHWAY 51
PROVIDE SIGNING TO INDICATE AIRPORT ACCESS VIA FAS 117 AND FAS 878
PROVIDE ADEQUATE SIGNING ON INTERSTATE 5 INDICATING AIRPORT ACCESS VIA HIGHWAY 34
CONSTRUCT NEW PARTIAL INTERCHANGE TO PROVIDE SOUTHERN ACCESS
PROVIDE ADEQUATE SIGNING ON INTERSTATE 5 INDICATING AIRPORT ACCESS VIA NEW INTERCHANGE
POTENTIAL WILLAMETTE VALLEY RAIL TRANSIT SYSTEM STATION
PORTLAND
BEAVERTON
LAKE OSWEGO
HILLSBORO AIRPORT
INTERSTATE 5
PACIFIC HIGHWAY EAST
WOODBURN
SILVERTON
SALEM
EUGENE
DESTINATION
DISTANCE (MILES)
PORTLAND (DOWNTOWN)
BEAVERTON
LAKE OSWEGO
WILSONVILLE
PORTLAND-HILLSBORO AIRPORT
AURORA
CANBY
OREGON CITY
MILWAUKIE
PORTLAND INTERNATIONAL AIRPORT
PORTLAND-TROUTDALE AIRPORT
SALEM
EUGENE
WOODBURN
SILVERTON
AURORA STATE AIRPORT
RECOMMENDED GROUND ACCESS PLAN
FIGURE 26
CH2M HILL
PRELIMINARY

EXHIBIT O

Travel on lower type facilities will be discouraged. By utilizing predominantly higher type roadways actual modification and maintenance in the field will be minimized. It is estimated that airport related activities will generate approximately 200 automobile trips at the peak hour in 1995. This amount is not significant in its impact on the area transportation system or on the major facilities.

The use of major facilities will eliminate most of the problems associated with the circuitous routes now serving the airport. In addition, the costs of operating and maintaining these facilities will be spread over a larger population. This is appropriate due to the regional nature of the Aurora State Airport. Complementing any ultimate routing to the airport will be an extensive signing program. This will alert the public, particularly the airport users, to the most expeditious route to the airport. Without this, much of the benefit of the other steps may be lost.

Finally, the potential exists for the extension of the Portland Metropolitan area transit system (Tri-Met) to include a route that would pass immediately north of the airport on Arndt Road. Routes are now established in Canby and Wilsonville. A tie-in with these would provide a transit link that would allow travel from the airport to virtually anywhere in the metropolitan area.

ENVIRONMENTAL CONSIDERATIONS

Environmental assessments have been made based upon the Airport Layout Plan drawings. None of the developments proposed require an Environmental Impact Assessment Report at this time. However the runway lengthening proposed sometime after the next five year period will require a formal environmental process prior to construction.

Adverse environmental impacts include noise effects, air and water pollution and some traffic congestion due to build-up in the area. Figure 27 shows noise exposures for 1980, 1985 and 1995. The noise contours were developed using the forecast given earlier in Table 6, page 57, and information on aircraft population, Figure 18, page 50. Table 8, page 62 shows noise impacts on land use. Additional noise data is found in the APPENDIX.

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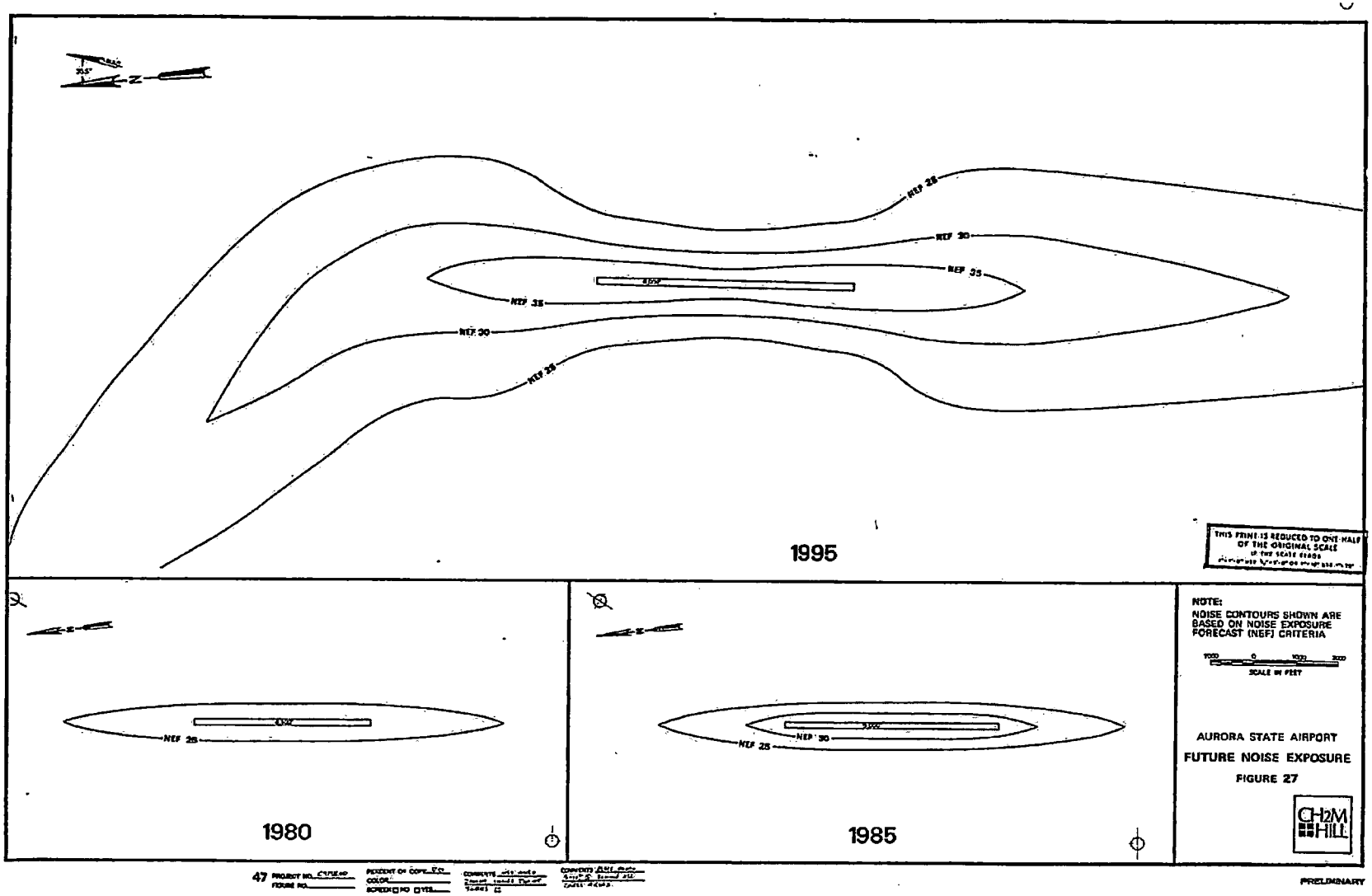
NEF 25
NEF 30
NEF 35
NEF 35
NEF 30
NEF 25
1995
THIS PRINT IS REDUCED TO ONE-HALF OF THE ORIGINAL SCALE
NEF 25
1980
NEF 30
NEF 25
1985
NOTE:
NOISE CONTOURS SHOWN ARE BASED ON NOISE EXPOSURE FORECAST (NEF) CRITERIA
SCALE IN FEET
AURORA STATE AIRPORT
FUTURE NOISE EXPOSURE
FIGURE 27
CH2M HILL
PRELIMINARY

EXHIBIT O

Generally when NEF contours are below 30 the noise impact is slight and requires no special noise insulation for new construction. When the NEF is between 30 to 35 new construction should be undertaken after analysis of noise reduction requirements has been made and needed noise insulation features included in the design of buildings in that area. Because of the agricultural nature of the land around the Aurora Airport the noise exposure, even in 1995, should not effect a large number of people.

Although aircraft emit air pollutants, they are small in numbers compared with the automobile. Table 9 shows air quality impacts produced by the forecast aircraft traffic at the airport. Automobile traffic was not analyzed.

In considering how to diminish the environmental impacts produced by the Aurora State Airport alternatives were examined. The main alternatives are:

- to make no improvements
- to make the improvements according to a Master Plan
- to close the airport

If nothing is done to the airport the tendency for airport encroachment will become stronger and environmental incompatibility could become a serious problem in a few years. The existing runway length accommodates some turbojet aircraft now and it is doubtful that a do-nothing alternative would reduce their environmental impact significantly. If no improvements are made to the airport the airport will probably continue to support growing numbers of traffic with reduced safety standards.

Therefore it has been deemed best for the environment to develop the airport in a positive manner providing for minimizing environmental impacts as development is accomplished.

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PROJECT NO. C7178.00

FIGURE NO.

118

TABLE 9

AIR QUALITY IMPACTS
(peak hour)

	EMISSIONS (micrograms per cubic meter)				
	PARTI-CULATES	SULFUR OXIDES	CARBON MONOXIDE	HYDRO-CARBONS	NITROGEN OXIDES
1975					
SINGLE ENGINE	0.0040	0.0020	0.0020	0.0800	0.0100
TWIN ENGINE	0.0006	0.0003	0.0003	0.0105	0.0014
TURBO JET	0	0	0	0	0
TOTALS	0.0046	0.0023	0.0023	0.0905	0.0114
1995					
SINGLE ENGINE	0.0090	0.0045	0.0045	0.1800	0.0225
TWIN ENGINE	0.0018	0.0009	0.0009	0.0315	0.0041
TURBO JET	0.0120	0.0375	0.0015	0.3465	0.1590
TOTALS	0.0228	0.0429	0.0069	0.5580	0.1856

EXHIBIT O

Serious consideration to closing the airport does not appear warranted because the impacts are not severe. Closure itself would be a serious impact because there would be a need to relocate several persons and businesses. Then secondary social and economic problems would occur.

LAND USE PLAN AND RECOMMENDED ZONING

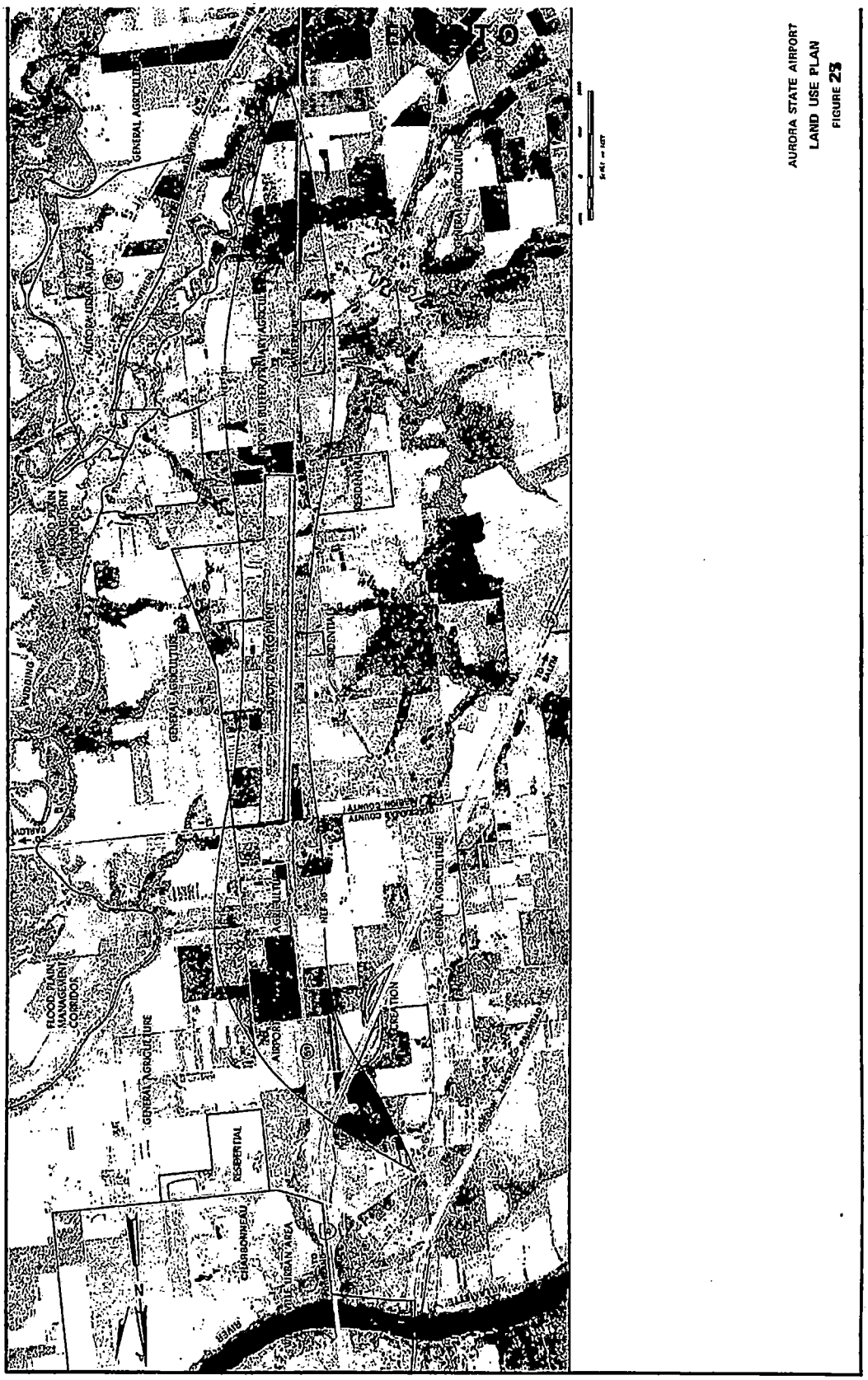
Although the airport has been found to be providing a service to large numbers of users, it can remain in public acceptance only as long as its compatibility with the surrounding land use is preserved. This Master Plan has developed a Land Use Plan, shown in Figure 28, compatible with development proposed by the Airport Layout Plan.

The land use plan shows land uses recommended in the vicinity of the airport which are generally in conformance with the comprehensive plans of Marion County and Clackamas County. Unique to these comprehensive/plans is the indicated airport buffer overlay which this Master Plan is recommending for adoption by both counties. This overlay, following the NEF 30 contour, will protect both the airport and the citizens who might otherwise move into the noise impacted areas.

The airport Master Plan will be submitted to Marion County and Clackamas County for adoption of new zoning suitable for the airport. Figure 29, recommends a zoning plan and three new zones. The first zone is an Airport Development Zone, described on Figure 29.

The second zone is an Airport Buffer Overlay Zone, also shown on Figure 29. Restrictions imposed by this overlay should take precedence over any conflicting permitted uses in the zones under the overlay.

The third zone is an Airport Obstruction Surfaces Overlay Zone. It is an additional overlay superimposed over and surrounding the proposed airport. It is the same as all FAR Part 77 surfaces except the Conical Surface, which is omitted. These surfaces are shown on Figure 24, Ultimate Airport Imaginary Surfaces page 71. All surfaces are dimensioned according to FEDERAL AVIATION REGULATIONS, Part 77, Objects Affecting Navigable Airspace.



AURORA STATE AIRPORT
LAND USE PLAN
FIGURE 23

EXHIBIT O

To- Fig-28

SUGGESTED LAND USE DESIGNATIONS

COMMERCIAL:

INCLUDES LIGHT INDUSTRIAL, DISTRIBUTION AND FARM AND BUSINESS SERVICE

RESIDENTIAL:

ENCOMPASSES MEDIUM TO HIGH DENSITY RESIDENTIAL AREAS, INCLUDING PROPER OPEN SPACE, RECREATION, UTILITY AND TRANSPORTATION FACILITIES.

URBAN AREAS:

INCLUDES THOSE USES NORMALLY ASSOCIATED WITH URBAN AREA DEVELOPMENT, SUCH AS RESIDENTIAL, COMMERCIAL, INDUSTRIAL AND PUBLIC USES. USUALLY LIMITED TO AREAS WHERE ADEQUATE MUNICIPAL FACILITIES ARE AVAILABLE.

RECREATION:

CONSISTS OF AREAS WITHIN THE FLOOD PLAIN MANAGEMENT CORRIDOR THAT PROVIDE SPORT AND LEISURE OPPORTUNITIES. THE REST AREA ALONG INTERSTATE FIVE IS ALSO INCLUDED.

FLOOD PLAN MANAGEMENT CORRIDOR:

INCLUDES AREA WITHIN 100 YEAR FLOOD PLAIN LIMITS. USES ARE PRIMARILY AGRICULTURAL, FORESTRY, PARK, RECREATION, OPEN SPACES, AND EXTRACTION OF SAND AND GRAVEL.

AIRPORT DEVELOPMENT:

INCLUDES THE ACTUAL FACILITIES OF THE AIRPORT SUCH AS, THE RUNWAY, TAXIWAY, PARKING APRONS, HANGARS, ADMINISTRATION AND OPERATION BUILDINGS, CLEAR ZONES, ETC. AVIATION RELATED INDUSTRIAL AND COMMERCIAL BUSINESSES ALSO ALLOWED IN APPROPRIATE AREAS.

AIRPORT BUFFER OVERLAY:

ENCOMPASSES AN AREA AROUND THE AIRPORT, BOUNDED BY THE NEF 30 CONTOUR, WITHIN WHICH LAND USES ARE DESIGNATED THAT WILL BE MINIMALLY AFFECTED BY AIRCRAFT OPERATIONS AT THE AIRPORT. PREFERRED LAND USES WOULD BE PRIMARY AGRICULTURE AND COMMERCIAL LIMITED TO LOW DENSITY CONCENTRATION OF PEOPLE.

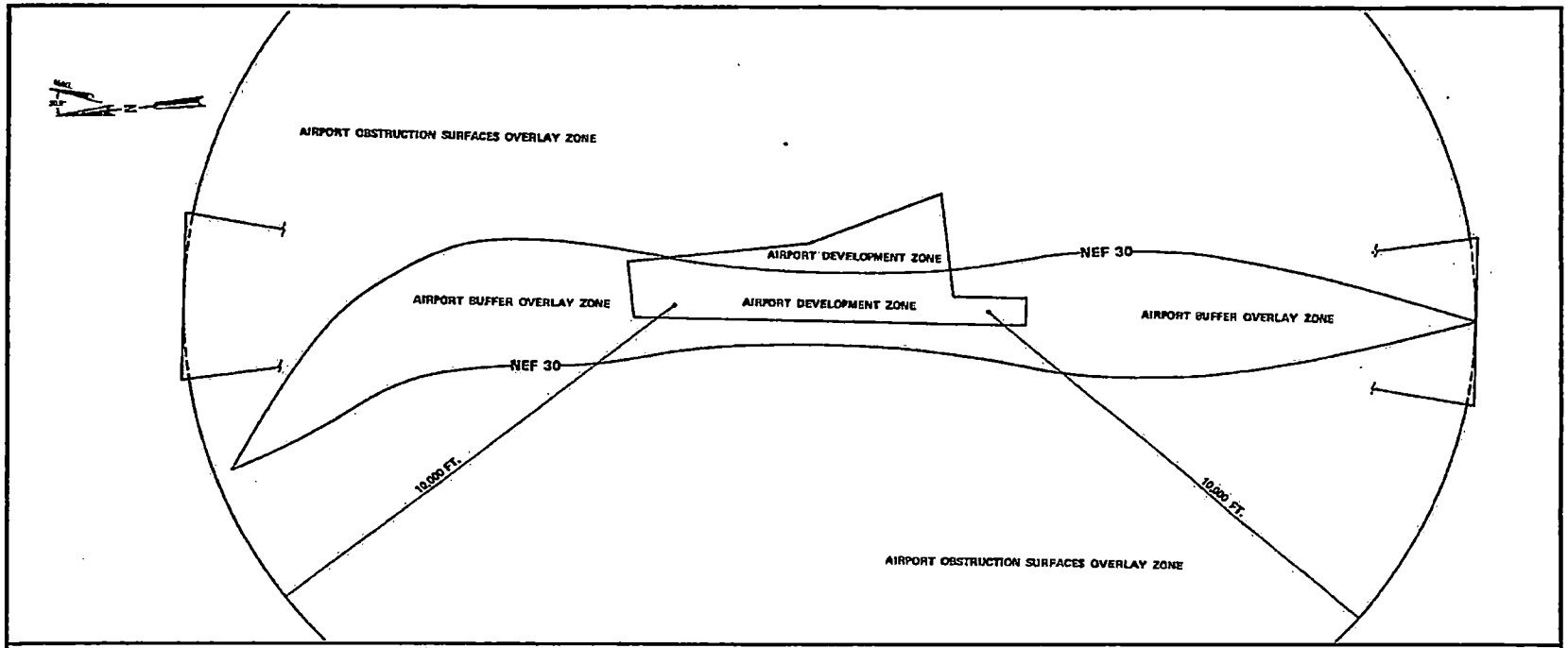
PRIMARY AGRICULTURE:

PRIMARILY FOR AGRICULTURAL USES, INCLUDING FARMSTEADS. ADDITIONAL USES PERMITTED ARE RURAL COMMUNITY FACILITIES SUCH AS SCHOOLS, CHURCHES, PARKS, ETC. THESE SHOULD NOT BE ALLOWED UNDER THE AIRPORT BUFFER OVERLAY. EXISTING NONCONFORMING RESIDENTIAL AND COMMERCIAL USES MAY BE CONTINUED BUT SHOULD NOT BE ALLOWED TO EXPAND BEYOND PRESENT LIMITS SHOWN.

GENERAL AGRICULTURE:

GENERALLY FOR AGRICULTURAL USES INCLUDING LARGE FARMS, LOW DENSITY ACREAGE RESIDENTIAL AREAS AND SMALL HOBBY FARMS. ADDITIONAL USES PERMITTED INCLUDE RESIDENTIAL SUBDIVISIONS, PRIVATE COMMERCIAL RECREATION FACILITIES, FARM PRODUCTS PROCESSING OPERATIONS AND SAND AND GRAVEL EXTRACTION.

EXHIBIT O



RECOMMENDED ZONING DESIGNATIONS

AIRPORT DEVELOPMENT ZONE:

PERMITTED USES TO INCLUDE OPERATION OF AN AIRPORT. CONDITIONAL USES TO BE LIMITED TO AVIATION RELATED COMMERCIAL AND/OR INDUSTRIAL BUSINESSES IN APPROPRIATE AREAS WITH RESPECT TO AERONAUTICAL FACILITIES.

AIRPORT BUFFER OVERLAY ZONE:

AN OVERLAY SURROUNDING AN EXISTING OR POTENTIAL AIRPORT IMPACT AREA. TO BE SUPERIMPOSED OVER AND USED IN CONJUCTION WITH EXISTING ZONING. IT IS DEFINED BY THE EXISTING OR FORECAST NEF 30 NOISE CONTOUR, WHICHEVER ENCOMPASSES THE LARGEST AREA. THE PURPOSE IS TO PROVIDE FOR USES THAT PRECLUDE CONCENTRATIONS OF PEOPLE. FOR THE AURORA STATE AIRPORT BUFFER ZONE EXCLUSIVE FARM USE (EFU), WITH LIMITED COMMERCIAL AREA, IS RECOMMENDED. THE PERMITTED USES IN THE OVERLAY ZONE OVERRIDE CONFLICTING USES IN THE ZONES BENEATH THE OVERLAY.

AIRPORT OBSTRUCTION SURFACES OVERLAY ZONE

AN ADDITIONAL OVERLAY SUPERIMPOSED OVER AND SURROUNDING THE PLANNED AIRPORT DEVELOPMENT AND DIMENSIONED ACCORDING TO FEDERAL AVIATION REGULATION PART 77, OBJECTS AFFECTING NAVIGABLE AIRSPACE. THE OBSTRUCTION SURFACES ARE SHOWN ON FIGURE 24, ULTIMATE AIRPORT IMAGINARY SURFACES. THE CONICAL SURFACE HAS BEEN EXCLUDED FROM THE OVERLAY SO THAT NO AREA FARTHER THAN 10,000 FEET FROM THE PRIMARY AIRPORT SURFACE IS AFFECTED.

SCALE IN FEET

THIS PRINT IS REDUCED TO ONE-HALF OF THE ORIGINAL SCALE

AURORA STATE AIRPORT

RECOMMENDED ZONING PLAN

FIGURE 29

CH2M HILL

PRELIMINARY

EXHIBIT O

As regards the land adjacent to the airport but not directly in either overlay zone the Master Plan encourages both counties to rezone the land in the airport vicinity to preferably EFU (Exclusive Farm Use Zone) or possibly F-20 (Farm-20 acre Zone); or in Clackamas County, EFU or possibly RF-F (Residential Farm-Forest Zone).

in Marion County

EXHIBIT O

IMPLEMENTATION PLAN

EXHIBIT O

IMPLEMENTATION PLAN

DEVELOPMENT SCHEDULE AND STAGING

Table 10, Development Schedule, shows the stage development proposed through the short-range (1975-1980), the mid-range (1980-1985), and the long-range (1985-1995), periods.

This follows the requirements developed in AIRPORT REQUIREMENTS and shown on Table 7, page 59. The developments are according to the Airport Layout Plan and are illustrated on Figure 30. It has been assumed that all new pavements will last the duration of this Master Plan period (20 years).

The quantity of work required to match capacity improvements to demand requirements is shown for each item. The quantities are slightly more than demands require, as the rises. Otherwise the State could construct smaller facilities earlier or more frequently, particularly as regards apron space.

The major development items in Stage I are land acquisition and a parallel taxiway. All land must be acquired initially to insure that the airport remains a complete unit and that the State has control to carry out the Master Plan program.

Other major developments are: parking aprons for more than 100 aircraft, based and transient, runway rehabilitation, major airfield lighting, and site development of the terminal area.

During the Stage II development period the runway and NDB will be extended 900 feet with MALSF lighting. This anticipates a demand for more complex aircraft and longer trip distances with resultant greater takeoff requirements. Most of the other improvements are for developing the terminal area.

The timing for Stage III long-range development needs is less definite. The Master Plan calls for a 6000 feet runway at 60,000 pounds S.G. strength and other pavement strengthening. A MLS or equivalent landing system should be added.

EXHIBIT O

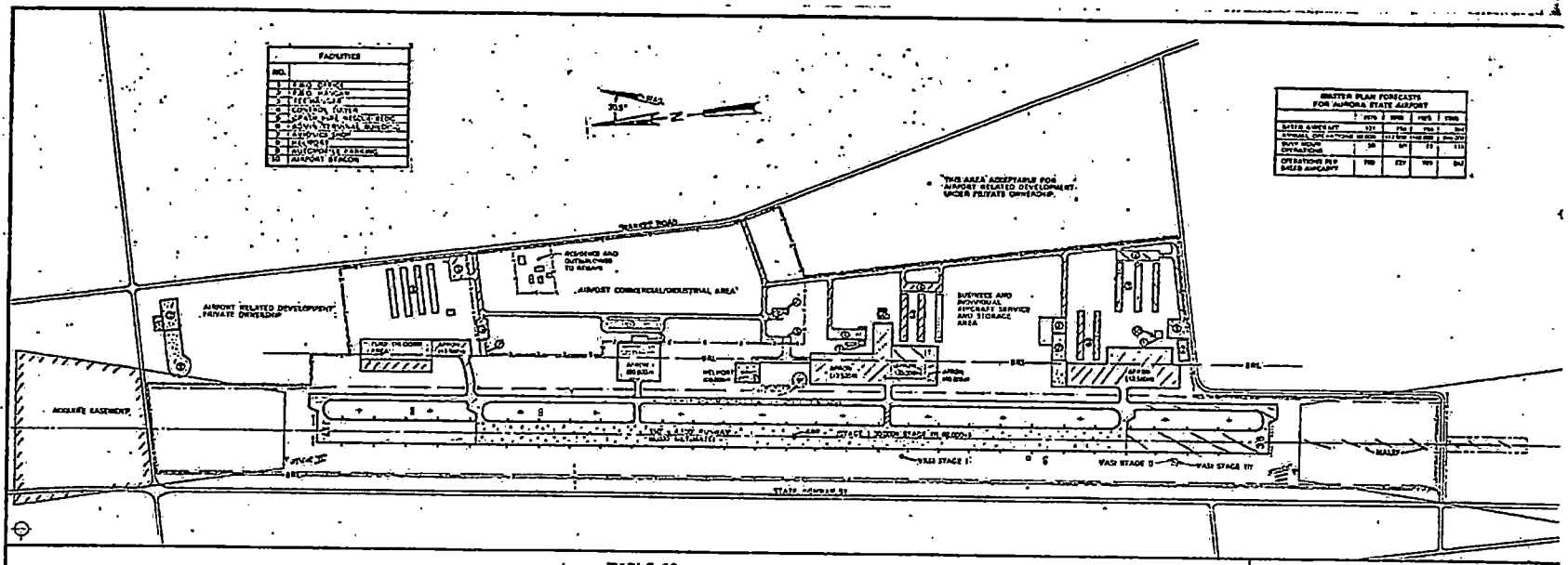
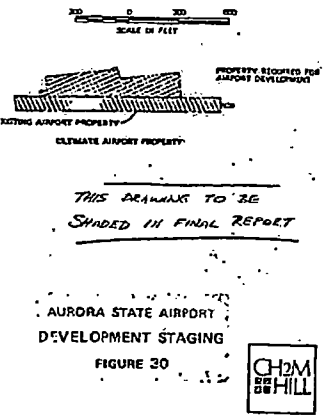


TABLE 10
DEVELOPMENT SCHEDULE

PROJECT DESCRIPTION	QUANTITY
ACQUIRE LAND FOR AIRPORT DEVELOPMENT	132 ACRES
ACQUIRE AIR EASEMENTS	18 ACRES
REMOVE OBSTRUCTIONS	1.5 ACRES
PAVE AND MARK PARALLEL TAXIWAY SYSTEM (30,000+)	5,700 L.F.
PAVE AND MARK HOLDING APRONS (20,000+)	10,000 S.F.
PAVE AND MARK PARKING APRONS (120,000+)	300,000 S.F.
CONSTRUCT TURF PARKING AREA	20 AIRCRAFT
INSTALL ROTATING BEACON AND TOWER	1 EACH
INSTALL LIGHTED WIND TEE AND SEGMENTED CIRCLE	1 EACH
STRENGTHEN RUNWAY (TO 30,000+)	4,000 L.F.
INSTALL NON-FRICTION RUNWAY MARKING	6,100 L.F.
INSTALL MEDIUM INTENSITY RUNWAY LIGHTS	4,100 L.F.
INSTALL VASI SYSTEM	2 ENDS
INSTALL NON-DIRECTIONAL BEACON	1 EACH
INSTALL TAXIWAY REFLECTORS	6,100 L.F.
PAVE AND MARK AIRPORT ROADWAYS	2,800 L.F.
PAVE AND MARK AUTOMOBILE PARKING FACILITIES	80 AUTOS
CONSTRUCT FENCING	6,000 L.F.
CONSTRUCT T-HANGARS (PRIVATE DEVELOPMENT)	34 AIRCRAFT

PROJECT DESCRIPTION	QUANTITY
EXTEND, PAVE AND MARK RUNWAY (30,000+)	800 L.F.
EXTEND MEDIUM INTENSITY RUNWAY LIGHTS	800 L.F.
EXTEND, PAVE AND MARK TAXIWAY SYSTEM (30,000+)	5,800 L.F.
PAVE AND MARK HOLDING APRON (20,000+)	5,000 S.F.
RELOCATE VASI SYSTEM	1 END
INSTALL MEDIUM INTENSITY EXIT TAXIWAY LIGHTS	700 L.F.
INSTALL LIGHTED WIND CONES	2 EACH
PAVE AND MARK PARKING APRON (20,000+)	98,800 S.F.
INSTALL MALSF APPROACH LIGHT SYSTEM	1 END
INSTALL PARKING APRON LIGHTING	800 L.F.
PAVE AND MARK AIRPORT ROADWAYS	2,000 L.F.
PAVE AND MARK AUTOMOBILE PARKING FACILITIES	30 AUTOS
EXTEND FENCING	3,400 L.F.
CONSTRUCT T-HANGARS (PRIVATE DEVELOPMENT)	30 AIRCRAFT

PROJECT DESCRIPTION	QUANTITY
EXTEND, PAVE AND MARK RUNWAY (30,000+)	1,000 L.F.
STRENGTHEN AND MARK RUNWAY (TO 60,000+)	5,000 L.F.
EXTEND MEDIUM INTENSITY RUNWAY LIGHTS	1,000 L.F.
EXTEND, PAVE AND MARK TAXIWAY SYSTEM (60,000+)	1,700 L.F.
STRENGTHEN AND MARK TAXIWAY SYSTEM (TO 60,000+)	5,100 L.F.
PAVE AND MARK HOLDING APRON (50,000+)	5,000 S.F.
INSTALL MEDIUM INTENSITY TAXIWAY LIGHTS	6,900 L.F.
PAVE AND MARK PARKING APRONS (50,000+)	98,000 S.F.
EXPAND VASI SYSTEM	2 ENDS
INSTALL MICROWAVE LANDING SYSTEM (OR TOMVALENT)	1 END
INSTALL PARKING APRON LIGHTING	1,700 L.F.
CONSTRUCT CRASH, FIRE, RESCUE STATION	2,500 S.F.
CONSTRUCT CONTROL TOWER (BY FAA)	1 EACH
PAVE AND MARK HELIPORT	10,000 S.F.
PAVE AND MARK AIRPORT ROADWAYS	900 L.F.
PAVE AND MARK AUTOMOBILE PARKING FACILITIES	80 AUTOS
CONSTRUCT TERMINAL/ADMINISTRATION BUILDING	9,000 S.F.
EXTEND FENCING	2,500 L.F.
CONSTRUCT T-HANGARS (PRIVATE DEVELOPMENT)	80 AIRCRAFT



AURORA STATE AIRPORT
DEVELOPMENT STAGING
FIGURE 20

CH2M HILL

AIR PROJECT NO. 3-08-[illegible]

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Significant additions to the terminal area will include more parking, a control tower, a terminal/ administration building, a heliport and a crash/ fire/rescue station.

ECONOMIC FEASIBILITY

The basis for capital improvements needs has been carefully developed in previous tasks of this study. The safety, capacity, and service benefits to the users have been established. The economic feasibility of including these projects in the Master Plan depends much upon the availability of funds.

Total funds for capital investments over the 20-year forecast period are $3.3 million. A breakdown of these costs is shown in Table 11 in 1975 dollars. Costs are planning capital cost estimates based on industry data. Site characteristics adjustments have been made but without specific engineering design analyses.

Of the total, much of the capital development would be done entirely with federal or with private funds. Most of the remaining work is eligible for FAA cost sharing. The FAA share has been 83.54 percent and may be increased. Oregon State funds required at 83.54 percent funding would be $764,000 or an average of $38,200 for the 20-year period.

The Master Plan accepts this investment level to be reasonable.

FINANCING PLAN

The ability to implement the Master Plan depends on a large measure upon the soundness of the airport's financial plan. Even though the Aurora State Airport has a regional impact, which makes it difficult to determine the distribution of benefits, the Master Plan attempts to make the Airport financially self-supporting.

EXHIBIT O

TABLE 11

CAPITAL DEVELOPMENT PROGRAM

PROJECT DESCRIPTION	ESTIMATED COST* (including contingency) ($000)	ELIGIBLE FAA SHARE ($000)	OSDA SHARE ($000)
STAGE I – 1975-1980			
ACQUIRE LAND FOR AIRPORT DEVELOPMENT	665	472	93
ACQUIRE AIR EASEMENTS	36	30	6
REMOVE OBSTRUCTIONS	3	2	1
PAVE AND MARK PARALLEL TAXIWAY SYSTEM (30,000#)	166	139	27
PAVE AND MARK HOLDING APRONS (30,000=)	7	6	1
PAVE AND MARK PARKING APRONS (12,500=)	206	172	34
CONSTRUCT TURF PARKING AREA	3	2	1
INSTALL ROTATING BEACON AND TOWER	9	7	2
INSTALL LIGHTED WIND TEE AND SEGMENTED CIRCLE	4	3	1
STRENGTHEN RUNWAY (TO 30,000=)	185	156	29
INSTALL NON-PRECISION RUNWAY MARKING	5	4	1
INSTALL MEDIUM INTENSITY RUNWAY LIGHTS	39	33	6
INSTALL VASI SYSTEM	15	13	2
INSTALL NON-DIRECTIONAL BEACON	10	–	10
INSTALL TAXIWAY REFLECTORS	4	3	1
PAVE AND MARK AIRPORT ROAWAYS	61	51	10
PAVE AND MARK AUTOMOBILE PARKING FACILITIES	19	–	16
CONSTRUCT FENCING	29	24	5
CONSTRUCT TEE-HANGARS (PRIVATE DEVELOPMENT)	212	–	–
TOTALS	1,366*	1,117*	249*
STAGE II – 1980-1985			
EXTEND, PAVE AND MARK RUNWAY (30,000=)	98	82	16
EXTEND MEDIUM INTENSITY RUNWAY LIGHTS	9	7	2
EXTEND, PAVE AND MARK TAXIWAY SYSTEM (30,000=)	35	29	6
PAVE AND MARK HOLDING APRON (30,000=)	4	3	1
REPOSITION VASI SYSTEM	3	2	1
INSTALL MEDIUM INTENSITY EXIT TAXIWAY LIGHTS	5	4	1
INSTALL LIGHTED WIND CONES	3	2	1
PAVE AND MARK PARKING APRONS (30,000=)	39	33	6
INSTALL MALSF APPROACH LIGHT SYSTEM	30	25	5
INSTALL PARKING APRON LIGHTING	9	7	2
PAVE AND MARK AIRPORT ROADWAYS	53	44	9
PAVE AND MARK AUTOMOBILE PARKING FACILITIES	8	–	8
EXTEND FENCING	21	17	4
CONSTRUCT TEE-HANGARS (PRIVATE DEVELOPMENT)	63	–	–
TOTALS	317*	256*	62*
STAGE III – 1985-1995			
EXTEND, PAVE AND MARK RUNWAY (60,000=)	113	94	19
STRENGTHEN AND MARK RUNWAY (TO 60,000=)	343	287	56
EXTEND MEDIUM INTENSITY RUNWAY LIGHTS	10	8	2
EXTEND, PAVE AND MARK TAXIWAY SYSTEM (60,000=)	43	36	7
STRENGTHEN AND MARK TAXIWAY SYSTEM (TO 60,000#)	93	78	15
PAVE AND MARK HOLDING APRON (60,000=)	10	8	2
INSTALL MEDIUM INTENSITY TAXIWAY LIGHTS	49	41	8
PAVE AND MARK PARKING APRONS (60,000=)	73	61	12
EXPAND VASI SYSTEM	10	8	2
INSTALL MICROWAVE LANDING SYSTEM (OR EQUIVALENT)	94	94	–
INSTALL PARKING APRON LIGHTING	18	15	3
CONSTRUCT CRASH, FIRE, RESCUE STATION	106	–	106
CONSTRUCT CONTROL TOWER (BY FAA)	400	400	–
PAVE AND MARK HELIPORT	14	12	2
PAVE AND MARK AIRPORT ROADWAYS	9	7	2
PAVE AND MARK AUTOMOBILE PARKING FACILITIES	21	–	21
CONSTRUCT TERMINAL/ADMINISTRATION BUILDING	188	–	188
EXTEND FENCING	50	42	8
CONSTRUCT TEE-HANGARS (PRIVATE DEVELOPMENT)	188	–	–
TOTALS	1,644*	1,191*	453*
GRAND TOTALS	3,327*	2,563*	764*

*Costs are shown in 1975 dollars. Appropriate escalation factors must be applied for extrapolation to future years.

119 PROJECT NO. C9198.00
FIGURE NO.

EXHIBIT O

Table 12 shows the level of revenues required to meet projected expenses in terms of 1975 dollars. In developing a management program for the airport revenue goals should be established and a program carried out to develop income from the airport users.

MANAGING A CONTINUING PROGRAM

These actions are required by the Division of Aeronautics:

- This airport Master Plan should be adopted and implementation commenced immediately.
- Application should be made to the FAA for funds to support the Implementation Plan.
- In order for the State to implement the Master Plan the State needs to control the land. Therefore acquisition of the land for the terminal area should be accomplished without delay.
- The parallel taxiway and exit taxiway system must be constructed immediately. This is necessary to protect public safety and to provide adequate runway capacity.
- Other needed developments should be started as indicated by the Master Plan.
- The airport maintenance program should be accelerated, particularly as regards runway pavement rehabilitation and airfield surface drainage improvements.
- The State should continue to work closely with Marion and Clackamas Counties to develop compatible land use planning.
- The State should work closely with Marion and Clackamas Counties to develop zoning changes on and near the airport as recommended by the Master Plan.
- At this time no appropriate alternatives for airport ownership seem to exist. The State should retain ownership of the airport because its closure would have a critical adverse impact on the Oregon Aviation System.

EXHIBIT O

TABLE 12

AIRPORT REVENUE GOALS

($000-1975 Dollars)

	SHORT RANGE 1975-1980		MID-RANGE 1980-1985		LONG RANGE 1985-1995		20 YEAR PERIOD 1975-1995	
	ANNUAL AVERAGE	TOTAL	ANNUAL AVERAGE	TOTAL	ANNUAL AVERAGE	TOTAL	ANNUAL AVERAGE	TOTAL
EXPENDITURES TO MEET MASTER PLAN GOALS								
OPERATION AND MAINTENANCE								
MAINTENANCE AND REPAIR	8	40	9	45	11	110	9.8	195
MATERIALS AND EQUIPMENT	3	15	3	15	4	40	3.5	70
SALARIES	0	0	6	30	20	200	11.5	230
ADMINISTRATION	2	10	2	10	3	30	2.5	50
TOTAL	13	65*	20	100*	38	380*	27.3	545*
CAPITAL IMPROVEMENTS								
STATE'S SHARE	49.8	249*	12.4	62*	45.3	453*	38.2	764*
TOTAL REVENUES REQUIRED TO MAKE AURORA STATE AIRPORT FINANCIALLY INDEPENDENT	62.8	314*	32.4	162*	83.3	833*	65.5	1309*

*Cost are shown in 1975 dollars. Appropriate escalation factors must be applied for extrapolation to future years.

PROJECT NO. C9178.00

120 FIGURE NO.

EXHIBIT O

- The State should take a more active part in the management of the entire airport and particularly give more attention to user service and problems.
- The State should develop an airport management program and increase its airport staff as necessary to administer the airport operation and development program.
- The State's financial policy should be to make the airport more self-supporting. This should be accomplished by obtaining more direct control of the sources of airport revenues. Revenues should be increased in accordance with area competition and inflation rates. Lease rates should be reviewed frequently and kept up-to-date.
- Airport traffic surveys should be made periodically and incorporated into the Master Plan and the Oregon Aviation System Plan.
- A program to collect weather data should be initiated and used for facility planning.
- The State should schedule periodic reviews of the Master Plan. It should be revised whenever necessary to keep it current.
- In updating the Master Plan the State should work closely with the airport users, local governments, and citizens. A flexible attitude and approach to the planning process should be maintained.

EXHIBIT O

APPENDIX

CH2M HILL

SUBJECT _____ BY _____ DATE _____

EXHIBIT O

SHEET NO. _____ OF _____

PROJECT NO. _____

APPENDIX

BIBLIOGRAPHY

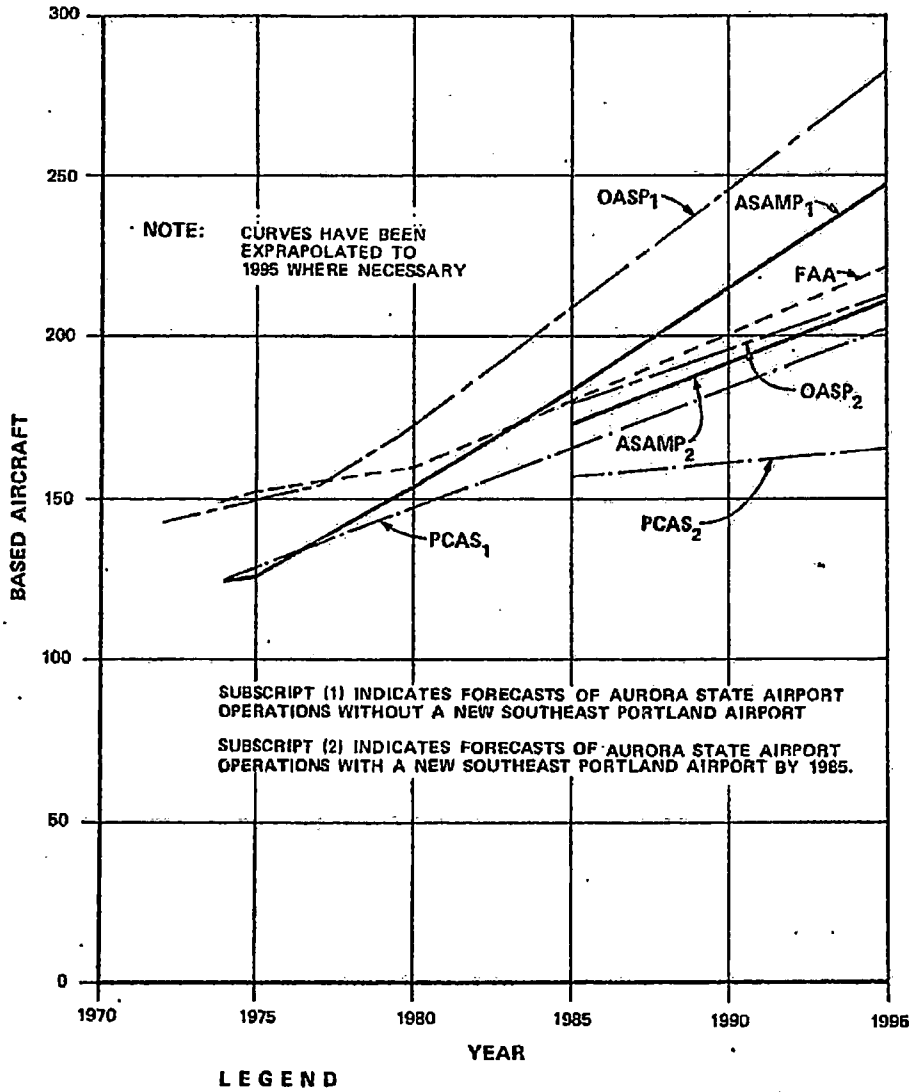
CORRESPONDENCE

SUMMARY OF MEETINGS

TECHNICAL DATA

not complete in final Draft

EXHIBIT O



LEGEND

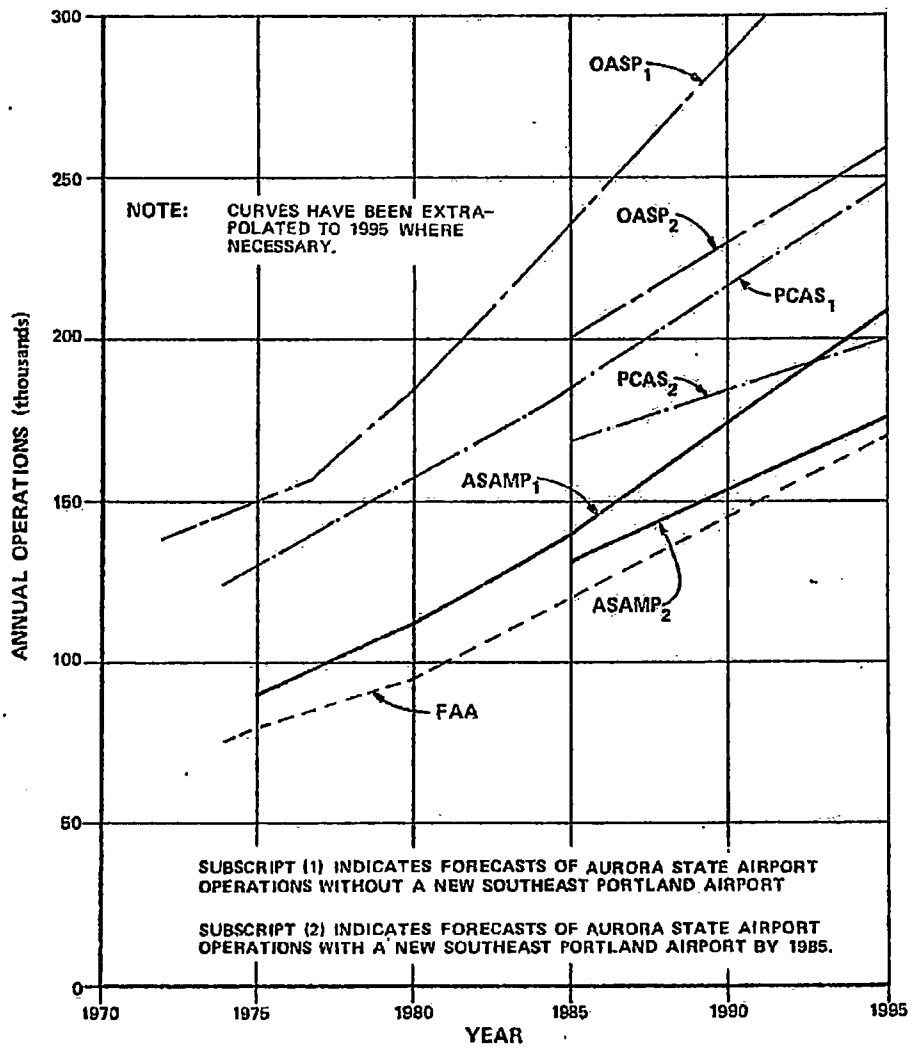
ASAMP – AURORA STATE AIRPORT MASTER PLAN
OASP – OREGON AVIATION SYSTEM PLAN
PCAS – PORTLAND CLACKAMAS AIRPORT STUDY
FAA – FEDERAL AVIATION ADMINISTRATION

AURORA STATE AIRPORT
BASED AIRCRAFT FORECASTS
FIGURE

CH2M HILL

AURORA..JAN 16 1976

EXHIBIT O



LEGEND

ASAMP – AURORA STATE AIRPORT MASTER PLAN
OASP – OREGON AVIATION SYSTEM PLAN
PCAS – PORTLAND CLACKAMAS AIRPORT STUDY
FAA – FEDERAL AVIATION ADMINISTRATION

AURORA STATE AIRPORT

ANNUAL OPERATIONS FORECASTS

FIGURE

CH2M HILL

AURORA..JAN 16 197L

AURORA STATE AIRPORT

MAY '68 THRU APR '70

C9198.00.00

	CALM (MPH) OBS	%	(5.5) 4-7 OBS	%	(10) 8-12 OBS	%	(15.5) 13-18 OBS	%	(21.5) 19-24 OBS	%	(28) 25-31 OBS	%	(35) 32-38 OBS	%	39+ OBS	%	TOTAL OBS	%	AVE. VEL. (MPH)	
N			568	4.32	117	0.89	4	0.03	0	0							689	5.23		N
NNE			402	3.05	72	0.55	0	0	1	0.01	0	0					475	3.61		NNE
NE			58	0.44	0	0											58	0.44		NE
ENE			61	0.46	2	0.02	4	0.03	0	0							67	0.51		ENE
E			30	0.23	0	0											30	0.23		E
ESE			85	0.65	10	0.08	1	0.01	0	0							96	0.73		ESE
SE			188	1.43	56	0.43	16	0.12	6	0.05	0	0					266	2.02		SE
SSE			186	1.41	75	0.57	37	0.28	17	0.13	0	0					315	2.39		SSE
S			484	3.68	258	1.96	104	0.79	17	0.13	1	0.01	0	0			864	6.56		S
SSW			313	2.38	66	0.50	23	0.17	1	0.01	0	0					403	3.06		SSW
SW			66	0.50	11	0.08	4	0.03	1	0.01	0	0					82	0.62		SW
WSW			78	0.59	18	0.14	6	0.05	0	0							102	0.77		WSW
W			26	0.20	10	0.08	3	0.02	0	0							39	0.30		W
WNW			30	0.23	3	0.02	1	0.01	0	0							34	0.26		WNW
NW			256	1.94	12	0.09	1	0.01	0	0							269	2.04		NW
NNW			549	4.17	62	0.47	4	0.03	0	0							615	4.67		NNW
CALM	8758	66.54															8758	66.54		CALM
TOTAL	8758	66.54	3380	25.68	772	5.87	208	1.58	43	0.33	1	0.01	0	0	0	0	13162	99.98 100.0		TOTAL

100.1

EXHIBIT O

EXHIBIT O

AURORA STATE AIRPORT MASTER PLAN

REPORT OF SITE SUFFICIENCY STUDY

November 1975
By CH2M HILL

INTRODUCTION

The Airport Master Plan work program includes Task G, Site Sufficiency Study. It is a logical conclusion to Phase I work, Airport Requirements, and is required to be submitted to FAA prior to proceeding to Phase III work, Airport Plans.

REDOMMENDATION

The conclusions of this study are that the existing Aurora State Airport site is adequate and that the airport should not be relocated.

PURPOSE

The purpose of this study was first to review the adequacy of the present airport site in light of the needs and impacts developed in previous tasks of the Master Plan.

Second, it includes locating alternative airport sites and comparing them to the present site. The object of this study is either to recommend to continue using the present airport or to advise investigating alternative sites for a replacement airport.

METHOD

This analysis has been conducted primarily in the office using base data gathered for other tasks and using analyses developed in previous tasks. Limited aerial and ground inspection was made of alternative sites.

The first step of the study was to establish the factors or items upon which to evaluate the airport's adequacy. The procedure for site investigation followed FAA Order NW 5030.1, Airport Site Investigation and Approval; FAA advisory Circular 150/5060-2, Airport Site Selection, and FAA advisory circulars specifying airport planning and design criteria.

EXHIBIT O

Next the existing airport and existing airport site were rated. For this purpose the data from and the findings of Phase I, Airport Requirements, were used.

The final step of the analysis was to identify and compare alternative sites to the present airport. Basic to the identification of alternative sites is identifying the size and boundaries of the area within which alternative airport sites could be considered.

ALTERNATIVE SITE ANALYSIS

Three main factors influenced this determination. First, an alternative airport site must be able to conveniently serve the same service area that Aurora State Airport serves. Second, within that service area, physical factors must suit airport development and operation. And third, the location of an alternative airport site should be generally convenient to the same access routes as the Aurora State Airport, and should not be considerably closer to another airport. Impacts were examined after sites were chosen.

Consideration was given to operational factors, airspace, navigational aids, physical and engineering factors, area for development, land values, economic factors, and environmental and land use planning aspects. In establishing and identifying alternative airport sites, the Basic Transport airport category was used. Although prior tasks indicate that one runway will suffice for the 20-year period, it was thought that the site should provide adequate space for a short parallel runway, if practical. All sites including the existing airport site would permit this.

FINDINGS

Basically, analysis of the adequacy of the Aurora Site and the evaluation of the alternative sites resulted in a determination that the present Aurora State Airport should continue to fulfill the present airport function. First, the Aurora State Airport has no serious or insurmountable problems. It is well engineered and meets operational criteria. Expansion to meet forecast needs appears feasible.

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Airport use is in accordance with compatible land use and the existing airport has minimum environmental impacts. Also, the site has been an airport continuously for 32 years. It has been accepted by the City of Aurora in their Draft Land Use Plan as well as by the Marion County Comprehensive Plan. In a public meeting 18 November 1975, a discussion of this matter indicated unanimous concurrence of those attending to retain the present airport rather than to relocate.

Adequate services are presently being provided by fixed base operators and a considerable hardship on operators and on users could be expected if the airport were to be closed or relocated. As regards land available for development area, there is adequate area just east of the existing runway. Acquisition problems appear to be less for a new airport than elsewhere because of the lack of zoning conflicts at the existing airport as opposed to the need to rezone for a new airport.

As regards economic factors, the cost in developing a new airport could be expected to be significantly higher than that of improving an existing airport. an exact dollar amount, however, cannot be determined because of lack of detailed engineering data and because of uncertainties regarding the cost of land. However, it can be assumed that land values would be approximately the same for all areas. In the case of Aurora State Airport, considerably less acreage (approximately 52 acres) is required, so that even if cost per acre were to be higher, total land cost would be less. A sample comparison is shown below using about $5,000 per acre for land acquisition.

EXHIBIT O

COMPARISON OF APPROXIMATE COSTS*
ESTIMATED FOR 1995 AIRPORT NEEDS

Item	Existing Airport	New Site
Land Acquisition	$ 260,000	$ 830,000
Site Preparation	160,000	250,000
Pavement	540,000	800,000
Lighting	90,000	90,000
Miscellaneous	90,000	120,000
Non-ADAP Items	310,000	600,000
Total Cost Estimate	$1,450,000	$2,690,000

*Using cost estimating methods similar to Oregon Aviation System Plan -- to be refined in Phase III.

Three alternative airport sites were evaluated.

The first alternative site considered is located close to the existing Aurora Airport in northern Marion County. This site is designated as the Freeway Site, as it is located beside the freeway. Possibilities for development here include: to the east of the freeway, a single runway, or to the west of the freeway, two runways.

The second alternative site is located in Clackamas County and is designated as the Clackamas Site. It is that site slightly southeast of the City of Aurora, and lies about 2 miles north of the Lenhardt Airprt. This site includes an area large enough to permit considerable shifting of the runway location and would easily permit development of a parallel runway.

The third alternative site is that shown to the south of the first site. It is located near the City of Hubbard and is designated as the Hubbard Site. It also occupies a sufficient space to permit development of a parallel runway.

EXHIBIT O

All three alternative sites near the Aurora State Airport are generally in the same kind of geographical region. Rural population densities are generally similar and the primary business is agriculture. The same general surface transportation networks serve all three airports. However, the Clackamas Site is somewhat less convenient to major highways. All sites are located in areas designated as Agricultural Use in County Comprehensive Plans.

Topographic features of all sites are generally similar. The area lacks terrain obstructions, is generally level with slow surface runoff, has generally similar good agricultural soil types, and experiences the same general metereological and climatological conditions as for the Aurora State Airport. Engineering problems appear to be about equal for all airport sites and utilities appear to be more or less equally convenient as regards electricity and water. However, approval for waste treatment facilities at new sites will give some problems because of the difficulty of soils meeting the requirements of the DEQ for septic disposal.

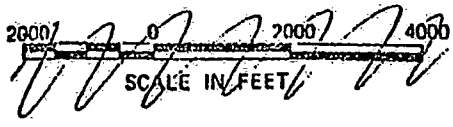
In all cases, runway orientation is generally north-south, with a slight shift to the southwest to allow for southwest winds during wintertime cold front passage. Experience at the Aurora State Airport indicates that this orientation would be favorable.

A part of the evaluation of alternative sites included evaluating the effort necessary to develop the alternative site to the condition that exists at the present airport. This would be mainly acquisition of land, grading and paving a General Utility category runway. A second part of the evaluation considered development needed through 1995.

EXHIBIT O

AURORA STATE AIRPORT SITE COMPARISON MATRIX

	EXISTING AIRPORT SITE	ALTERNATIVE AIRPORT SITES		
		FREEWAY	CLACKAMAS	HUBBARD
ACCESS/CONVENIENCE TO USERS	EXCELLENT	SUPERIOR	FAIR	EXCELLENT
SAFE AND ROUTINE FLIGHT OPERATIONS	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
LACK OF OBSTRUCTIONS	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
LAND AVAILABILITY	GOOD	POOR	POOR	POOR
EXPANSION CAPABILITY	EXCELLENT	SUPERIOR	SUPERIOR	SUPERIOR
EASE OF CONSTRUCTION	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
LAND USE COMPATIBILITY	EXCELLENT	EXCELLENT	EXCELLENT	EXCELLENT
ENVIRONMENTAL COMPATIBILITY	EXCELLENT	EXCELLENT	SUPERIOR	EXCELLENT
CITIZEN ACCEPTANCE	EXCELLENT	POOR	POOR	POOR
DEVELOPMENT COST–APPROXIMATE	$1,450,000	$2,690,000	$2,690,000	$2,690,000
OVERALL SUITABILITY	EXCELLENT	FAIR	POOR	FAIR



from Figure 22

EXHIBIT O

By far the most significant problem at alternative sites would be that of obtaining permission to use the land as an airport. This would necessitate changes in either County Comprehensive Plan. Comprehensive Plans require considerable justification before they can be changed, and public sentiment demonstrated at recent meetings does not indicate support for a new airport (examples are several meetings held in 1975 by the Port of Portland regarding the Portland-Clackamas Airport Study and a meeting held 18 November 1975 to present and discuss the work accomplished by Phase I of the Aurora State Airport Master Plan). Another problem is in actually acquiring the land. This would probably necessitate condemnation and costs could run very high (in the range of $500,000 to $1 million). As shown earlier, development costs would be about double for a new airport.

All of the alternative sites have certain advantages, but they also have disadvantages. One principal disadvantage is the time required to acquire and develop an airport. Another is the high costs anticipated. Another problem is that in moving away from the Aurora State Airport it would probably be necessary to sell the present property and discontinue its use as an airport. This would undoubtedly cause a hardship on the operators presently based at the airport and might create the need to provide relief to them. As regards the Clackamas Site, the people in Clackamas County have already rejected a proposed new airport in that county. Furthermore, the Clackamas site development might necessitate closing the Lenhardt Airport.

On the other hand, the advantage common to all alternative sites is that a fresh new airport could be developed starting with present-day knowledge of needs and present-day criteria. This would permit more flexibility in the development program for the future.

The following Site Comparison Matrix summarizes why it was concluded advisable to retain the airport at the present site. Mainly the benefits do not appear to warrant the costs.

EDGE ANALYTICAL

Burlington, WA *Corporate Laboratory (a)*
1620 S Walnut St - Burlington, WA 98233 - 800.755.9295 - 360.757.1400

Bellingham, WA *Microbiology (b)*
805 Orchard Dr Ste 4 - Bellingham, WA 98225 - 360.715.1212

Portland, OR *Microbiology/Chemistry (c)*
9150 SW Pioneer Ct Ste W - Wilsonville, OR 97070 - 503.682.7802

Corvallis, OR *Microbiology/Chemistry (d)*
540 SW Third Street - Corvallis, OR 97333 - 541.753.4946

Bend, OR *Microbiology (e)*
20332 Empire Blvd Ste 4 - Bend, OR 97701 - 541.639.8425

Reference Number: **18-20961**

System ID Number:
System Name:
Sampler Phone:
FAX/Email: **shilohwater@shilohwater.com**

Authorized by:

Lawrence J Henderson, PhD
Director of Laboratories, Vice President

Client Name: **Shiloh Water Systems, Inc.**
PO Box 257
190 West Church St
Mt. Angel, OR 97362

ORELAP #: **OR100063**
Lab Sample #: **18_42885**

Project: **Ted Millar**

Date Collected: **6/13/18 10:30**
Sampled By: **Neil**
Sampler Phone Number:
Sample Location: **22515 Airport Rd NE Aurora 97002**
Field ID: **Outside Faucet**

Sample Type:
Free Chlorine:
Original Sample Date:
Sample Purpose: **Investigative or Other**
Treatment:
Repeat Sample Number:

Date Received: **6/13/18 12:44**
Analysis Start: **6/13/18 15:50**
Prep Analyst: **TBP**
Method: **SM9223 B / Colilert-18**
Date Analyzed: **6/14/18 12:34**
Analyst: jal
Approved By: tbp

Test Results

PARAMETER	RESULT
TOTAL COLIFORM	**Satisfactory, Coliforms Absent**
E. Coli	**Absent**

Sample Invalidation:

☐ Other: _____

Test results relate only to the parameters tested and to the samples as received by the laboratory. Test results meet all requirements of NELAP unless otherwise noted. This report shall not be reproduced, except in full, and with written consent of this laboratory.

If the sample is unsatisfactory you can get information at the health department website.

NOTES:

If the result is Unsatisfactory a repeat sample is required for Public Water Systems. Private individuals should investigate the cause of the unsatisfactory result and resample.
If E. Coli or Fecal Coliform are present in sample do not drink the water until it is properly treated.

FORM: cBact_OR



WATER QUALITY & FLOW TEST REPORT

190 W Church St. | PO Box 257 | Mt. Angel, OR 97362
p 503.845.5225 | tf 866.873.1110 | f 503.845.5229
contact@shilohwater.com

Client/Realtor Billing Address		Property Address	
TLM Hlodings/Ted Millar		22515 Airport Rd NE	
14379 Keil Rd NE		Aurora, OR 97002	
Aurora, OR 97002			
Phone:	Fax:	Phone:	Cell:

Test Date	Length of Test	Tested By	Sample Site
6/13/2018	2-HR	Neil	Outside H/B
Well Depth	**Pump Size**	**Model #**	**Tank Size**
Unknown	2 HP	Unknown	220 Gallon Galvanized

Tests Ordered			
Laboratory Tests		Water Quality Tests	
(Check tests ordered)		Iron	
Bacteria	x	pH	
Nitrates	x	Hardness	
Arsenic	x	TDS	
Sodium		Chlorine	
Lead		Manganese	
		Sulphur	
(Lab tests results are on a separate lab report)			

Additional Information:

Flow Test		
Start Time 9:20 AM	Gallons Per Minute	Static Water Level
beginning at	40	No Access
15 min	40	
30 min	40	
45 min	40	
1 hr	40	
1 hr 15 min	40	
1 hr 30 min	40	
1 hr 45 min	40	
2 hrs	40	
2 hrs 15 min		
2 hrs 30 min		
2 hrs 45 min		
3 hrs		
3 hrs 15 min		
3 hrs 30 min		
3 hrs 45 min		
4 hrs		

EPA United States Environmental Protection Agency

Arsenic Virtual Trade Show

Arsenic in Drinking Water

Arsenic Rule

Compliance Help

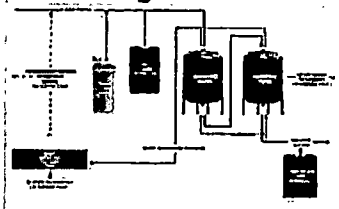
Learn

Adsorption Media

Arsenic can be removed by passing untreated water though adsorptive granular media contained in a pressure vessel. As the water passes through the media, the negatively charged arsenic V ions are adsorbed onto the surfaces of the positively charged media particles. There are currently several adsorption media available: activated alumina (AA), titanium based media, zirconium based media, and iron based sorbents. The most common media include modified activated alumina and iron-based materials.

Interactive Schematic of an Adsorption Media System

Click image to view schematic in a popup window.



In addition to strong arsenic removal efficiency, several factors make adsorptive media treatment attractive to systems installing treatment for the first time.

Learn

- Non Treatment
- Treatment
  - Adsorption
  - Ion Exchange
  - Coagulation
  - Oxidation
  - Point-of-Use
  - Point-of-Entry

1. System is low-cost and simple to operate.
2. System requires minimal operator attention (part time) during treatment runs.
3. System can employ manual operation and is adaptable to automatic operation.

The recommended empty bed contact time (EBCT) for adsorptive media systems is 3 to 10 minutes, with a median around 5. The bed depth is generally 3 to 6 feet, depending on the size of the vessel, with space left for bed expansion of 15 to 50% during backwash. Most adsorptive media systems require backwash to remove particulates and redistribute the bed material. However, it is important to follow the vendor's recommendations for optimal use.

For all adsorption media, liquid residuals from the filter backwashing step contain low concentrations of arsenic. Spent media will also need to be disposed of as either a solid or hazardous waste. See water.epa.gov/lawsregs/rulesregs/sdwa/arsenic/index.cfm for more information on waste disposal options.

Iron Based Sorbents

Adsorption of arsenic onto iron based adsorptive granular media is applied in fixed bed pressure vessels like those for AA. Due to limited performance research at the time the Arsenic Rule was promulgated, it was not listed in the Rule as a best available technology (BAT) or small system compliance technology (SSCT). For additional information on BATs and SSCTs see www.federalregister.gov/articles/2001/01/22/01-1668/national-primary-drinking-water-regulations-arsenic-and-clarifications-to-compliance-and-new-source.

Recent studies, including the EPA Arsenic Treatment Technology Demonstration Program, have shown iron based media to be effective for arsenic removal. For

information on the Demonstration Program visit http://epa.gov/nrmrl/wswrd/dw/arsenic/.

The affinity of iron media for arsenic is strong under natural pH conditions, relative to AA. This feature allows iron based sorbents to treat more bed volumes without the need for pH adjustment. However, similar to AA, optimal performance is obtained at lower pH values. It is important to weigh the advantages and disadvantages of pH adjustment, if deemed optimal. Chemical addition for pH adjustment often increases the required operator skill level and introduces additional concerns such as the handling of hazardous chemicals and possible effects on a system's ability to comply with the lead and copper rule.

As with the selection of any treatment strategy, it is important to consider raw water characteristics for potential interference. Phosphate and silica have been shown to compete aggressively with As(V) for adsorption sites. Each 0.5 mg/L increase in phosphate above 0.2 mg/L will reduce adsorption capacity by roughly 30%.

Iron-based sorbents are typically used in the throw-away mode. Thus, solid wastes will be produced as well as backwash water. The backwash water can easily be recycled through the treatment plant. Exhausted iron based sorbents media have not exceeded Resource Conservation and Recovery Act (RCRA) toxicity characteristics, enabling it to be disposed of in a municipal solid waste landfill.

Additional Resources:

- Design Manual: Removal of Arsenic from Drinking Water by Adsorptive Media (EPA 600/R-03/019)
- Treatment Technology Research Demonstrations: Round 1
- Treatment Technology Research Demonstrations: Round 2

- Treatment Technology Research Demonstrations: Round 2a
- Arsenic Removal from Drinking Water by Ion Exchange and Activated Alumina Plants (EPA 600/R-00/088)
- Arsenic Removal from Drinking Water by Iron Removal Plants (EPA 600-R-00-086)

Activated Alumina

Activated alumina (AA) is a sorption process that uses porous, granular aluminum-based material. In drinking water treatment, packed-bed AA adsorption is used for removal of natural organic matter and fluoride. The removal of As(V) by adsorption can be accomplished by continuously passing water under pressure through one or more beds. The efficiency and economics of the system are contingent upon factors such as: water quality characteristics, pre-oxidation of As(III) to As(V), and presence of suspended solids. Although AA has a long history as adsorptive media for arsenic removal, it is rarely used because the emerging media, including modified AA, treat much higher bed volumes of water without the need to adjust pH.

Several constituents of water can interfere with the arsenic removal process by competing for adsorption sites or clogging the media with particulates. Table 1 below shows some of the most widely recognized water quality characteristics that interfere with arsenic removal.

Table 1: Water Quality Interferences with Activated Alumina Adsorption

Parameter	Problem Level
Chloride	250 mg/L
Fluoride	2 mg/L
Silica	30 mg/L

Iron	0.5 mg/l
Manganese	0.005 mg/L
Sulfate	720 mg/L
Dissolved organic carbon	4 mg/L
Total dissolved solids	1000 mg/L

There are several varieties of these proprietary activated alumina media, which are commonly referred to as "modified AA." Modified AA systems typically contain iron and can have greater overall adsorptive capacities, enhanced selectivity towards arsenic, and/or greater overall operational flexibility than conventional AA, thus making them more cost effective. Many of these media can achieve high arsenic removal in the presence of interfering substances and in higher pH conditions.

The capacity for arsenic removal by AA is pH dependent. If the pH range deviates from the range pH 5.0 - 6.0, the adsorption capacity for arsenic decreases at an increasing rate.

If operating in a regeneration mode, liquid waste is produced from the backwash, caustic regeneration, neutralization, and rinse steps. Also, the media loses adsorptive capacity with each regeneration, and will eventually have to be disposed of. If using throw away media, solid waste will be produced and will need to be tested to determine if it can be disposed of in a municipal landfill.

QUOTATION

NELSEN
CORPORATION

Main Office
3250 Barber Rd.
Norton, OH 44203
800-362-9686

10115 W. Van Buren St. #6
Tolleson, AZ 85353
866-445-4299

1012 Assembly Circle #100
Schertz, TX 78154
855-674-0357

4410 E. Adamo Dr. #102
Tampa, FL 33605
866-712-6796

Order Number	
2103100	
Order Date	Page
10/30/2018 16:42:29	1 of 1

Quote Expires On 11/29/2018

Charlie Jenkins

SHILOH WATER SYSTEMS
P.O. BOX 257
MOUNT ANGEL, OR 97362
USA

503-873-3237

SHILOH WATER SYSTEMS
190 W. CHURCH ST.
PO BOX 257
MOUNT ANGEL, OR 97362
USA

Requested By: Mr. MIKE LOWRIE

Customer ID:	PO Number	Carrier	Taker
13792	50GPM Arsenic - Quote	UPS Grnd	CJENKINS

Quantities					Item ID / Item Description	Unit Price	Extended Price
Ordered	Allocated	Remaining	UOM Unit Size	Disp.			
					Customer Note: **EMAIL INVOICES****		
5.00	0.00	5.00	1.0 EA		**CAFB-12** =Nelsen 12x48 Filter Unit	335.0000	1,675.00
10.00	0.00	10.00	1.0 DRUM		**AD-33S** Adedge Arsenic Reduction Media, 2 CF	950.0000	9,500.00

Total Lines: 2

SUB-TOTAL:	11,175.00
TAX:	0.00
SHIPPING AND HANDLING:	0.00
AMOUNT DUE:	**11,175.00**

Disposition Key - B-Backorder - C-Cancel - D-Direct Ship - P-Production Order - S-Special Order

sorting facility. The Preferred Alternative places the cargo apron north of Aurora Aviation because of good accessibility to the Airport's current access road.

North Run-up Area

There is no run-up area to Runway 17, which poses a safety hazard. Current restrictions do not allow construction of a run-up area near the Runway 17 end. As a compromise, a run-up area is proposed approximately 500 feet south of the north end of the parallel taxiway. In order for the run-up area to be constructed, the Aurora Aviation fuel tanks must be relocated.

Relocation of Fuel Tanks

As stated in prior chapters, the Aurora Aviation fuel tanks are located in an undesirable area due to their close proximity to Airport taxiways. Additionally, the north run-up area is proposed where the fuel tanks are located. ODA will negotiate relocating these fuel tanks northeast of the Aurora Aviation FBO building.

Aurora Rural Fire Protection District

While an Airport Rescue and Fire Fighting (ARFF) facility is not required for the Airport, the Aurora Rural Fire Protection District has indicated interest in locating a facility on the Airport where they could house their firefighting apparatus. The most desirable location, based on the District's input, is adjacent to the existing fire suppression system centrally located on the Airport near Airport Road.

Helicopter Parking

The helicopter parking area on state-owned property is proposed in an area currently used for fixed-wing tiedowns, approximately 500 feet south of the proposed run-up area. This area separates helicopter and fixed-wing aircraft parking to minimize possible damage to small fixed-wing aircraft by rotor wash.

Internal Service Road

An internal service road is included to help separate vehicular traffic from taxiing aircraft, which will enhance safety. It is intended to be used exclusively by approved operators (ODA and others who must use it for specific purposes, like fuel trucks, etc.).

Precision Approach Path Indicators (PAPIs)

PAPIs should be installed to replace the less precise visual glide slope indicators at the Airport.

Demand-Based Improvements

The Preferred Alternative shows additional hangar and tiedown areas on state-owned property. It is expected that not all of the demand-based needs will be met by development on state-owned land, and development/reconfiguration of private property will likely occur. Accordingly, the adjacent 16-acre church camp property is identified as suitable for airport-related development. Within the 20-year planning period, the projected need for additional land that is not currently zoned Public is only 5 acres. However, demand may exceed the forecast or development density may be lower than projected. The

church camp property east of the Airport is a logical area for excess demand to be met because it is adjacent to the Airport and on the Airport side of Airport Road.

Although previous discussions identified the adjacent church camp property as a potential location to meet this forecasted need, through the public involvement process, it was determined that it would not be identified on the Airport Layout Plan as future airport-related development.

Working Session: Ensuring Aurora State Airport for the next decade of ORS 836.642 operations.

In 2006, the Oregon legislature directed the Department of Aviation through ORS 836.642 to establish through the fence operations at Aurora State Airport in order to promote economic development. This program has flourished ever since with over 1,000 jobs now tied to the airport. With a new master plan set to set to conclude in 2023 which will set the stage for airport infrastructure for the following decade, it's time for the Oregon Aviation Board to review associated funding and airport management going into the next decade to ensure Aurora State Airport remains the economic engine first envisioned over 15 years ago.

FUNDING

In terms of airport management, Aurora State Airport does generate funds back to the Oregon Department of Aviation of roughly $90 to $100K annually. However, expected expenditures for the next decade significantly exceeds this. As such, additional funding sources need to be identified.

Aurora Profit and Loss Statement By Biennium Not Including FAA & Connect OR Projects

Biennium	Time Frame	Revenues	Expenditures	Profit
2009-2011	July 09-June 11	350,054.00	207,946.00	142,108.00
2011-2013	July 11-June 13	358,373.00	101,576.00	256,797.00
2013-2015	July 13-June 15	400,467.00	121,078.00	279,389.00
2015-2017	July 15-June 17	431,154.00	206,620.00	224,534.00
2017-2019	July 17-June 19	461,857.00	243,618.00	218,239.00
2019-2021	July 19-June 21	457,856.91	277,428.00	180,428.91
Total	**July 09-June 21**	**$ 2,459,761.91**	**$ 1,158,266.00**	**$ 1,301,495.91**

Note: Expenditures include operations and maintenance staff time, utilities and tower expenses. ODA does not fully allocate all related costs (such as accounting or management including the state airport manager)

Anticipated Project List (expected ODA 10% match) - Costs are rough estimates for discussion only

FY 2022:	Easement acquisition supporting obstacle removal	$825,000
FY 2023:	Tree removal	$509,000

FY 2024:	Environmental Assessment for runway extension	$580,000
FY 2024:	Phase 1 Runway Rehab (design)	$373,000
FY 2025:	Phase 2 Runway Rehab (construction)	$2,360,000
FY 2026:	Runway extension Property Purchase	$4,000,000
FY 2026:	Runway extension Design Engineering	$2,275,000
FY 2027:	Runway extension Construction	$26M - $30M
Total:		$37M - $41M
TOTAL ODA Costs		$3.7M - $4.1M

Funding Sources being explored:

- FAA AIP grants – The federal Aviation Administration's Airport Improvement Program provides funding for AIP-eligible projects identified on the airports master plan. The federal share is generally 90%, with a local 10% match.
- Federal Earmark – in addition to AIP grants, Congress members have the opportunity to request directed spending (or earmarks) for specific projects. Although this practice was banned about ten years ago, Congress has recently agreed to begin sponsoring these requests again.
- State Bonding / State Funds
- Federal Transportation Funds from expected Federal infrastructure package
- Connect OR – The OR Department of Transportation has a grant program for marine, rail and aviation. This competitive grant process is generally offered once every two years and requires a 30% local match.
- SOAR – The OR Department of Aviation has a small grant program for repair and capital improvements at the 28 state-owned airports. It is currently paused due to declining revenues related to the pandemic.

STAFFING

Besides being designated for through the fence operations, Aurora is ODA's only Urban General Aviation Airport with a daily total operations of 94,935 versus the next busiest ODA airport at Independence with 33,600 total operations. Aurora is also unique in the amount of revenue produced as well as economic impact with 1,500 on airport jobs versus Independence at 21. Finally, the fast-growing community in which the airport resides is especially sensitive of the issues brought about by grow and requires a level of public engagement unlike any other ODA owned airport. This fact was specifically called out in an earlier Oregon Solutions report, recommending that "ODA, as the owner of the asset, owns the burden of proper communication related to the airport. While it has worked to provided public engagement for planning purposes, the question of how meaningful that engagement was still exists" and in terms of stakeholder communication, "ODA should take a leadership role" in providing forums for communication.

Looking at the data, it's clear Aurora is considerably different than any other airport in ODA's portfolio. So, in addition to reviewing governing structures for Aurora, the question needs to be asked if Aurora has grown beyond what the staffing levels within ODA can give it and if it's time for a level of fulltime staffing.

In contrast to the growing vitality of Aurora State Airport, ODA has seen continuous cuts both in overall staffing and in operations manpower.

2003-05 budget, ODA had 16 FTE, with 5 in Ops.
2007-09, ODA had 17 FTE, with 7 in Ops
2011-13, ODA had 16 FTE, with 7 in Ops
2013-15, ODA had 12.5 FTE, with 5 in Ops.
2015-17, ODA had 12 .25FTE, with 5 in Ops
2017-19 , ODA had 14.25 FTE, with 5 in Ops
2019-21, ODA had 15.5 FTE, with 6.5 in Ops
2021-23, ODA will have 12.5 FTE, with 4.5 in Ops

This is a disturbing trend but doesn't necessarily point towards more dedicated manpower for Aurora State. Rather the Board needs to review expectations for airport management at Aurora and balance them against what ODA can provide. Generally, airport management includes such administrative roles as managing FAA grants, scheduling and documenting meetings, assembling traffic counts, basic accounting, contract management for snow removal, grass cutting, wildlife hazard management, lights and signs maintenance, pavement maintenance and any potential items that may arise. It also includes operational duties including community involvement, i.e., maintain public relations, ensuring the facility is operated in an efficient and safe manner, Contract Tower management/coordination, lease negotiations, manage the through-the-fence operations, airport security, issue NOTAMs, construction management, obstruction removal, conduct regular inspections, etc.

Optimally, two individuals would fulfill these roles: an Airport Manager and an assistant. Should the board want to investigate manning specific to Aurora, initial estimates would be an airport manager salary of $75,000 - $95,000 depending upon experience with an assistant ranging from $60,000 to $75,000.

Unfortunately, there's no specific formula directing when an airport needs full time management as it's heavily influenced by the airport sponsors' desire and the funds available. As a reference, below is a review of other Urban General Aviation Airports similarly classed to Aurora State. These airports support all general aviation aircraft and accommodate corporate aviation activity, including piston and turbine engine aircraft, business jets, helicopters, gliders, and other general aviation activity. The most demanding user requirements are business-related. These airports service a

large/multi-state geographic region or experience high levels of general aviation activity. The minimum runway length objective for Category II airports is 5,000 feet (Oregon Aviation Plan).

Included Airports:

Aurora State Airport
- Airport: 144 acres; Total operations: 66,000
- No dedicated airport manager, State of Oregon acts as airport manager

Portland – Hillsboro Airport
- Airport: 928 acres; Total operations: 199,155
- No dedicated airport manager; Port of Portland acts as airport manager

Bend Municipal Airport
- Airport: 420 acres; Total operations: 141,175.
- Full time airport manager, salary: $81,785.60 - $106,225.60

Portland -Troutdale Airport
- 284 acres; Total operations: 121,977
- No dedicated airport manager; Port of Portland acts as airport manager

McMinnville Municipal Airport
- Airport: 650 acres; Total operations: 63,500
- No dedicated airport manager; FBO serves as airport manager

Scappoose Industrial Airpark
- Airport: 196 acres; Total operations: 60,000
- Full time airport manager

Corvallis Municipal Airport
- Airport: 1,520 acres; Total operations: 52,300
- No dedicated airport manager; Public Works serves as airport manager

Warrenton-Astoria Regional Airport
- Airport: 870 acres; Total operations: 38,721 operations.
- No dedicated airport manager; Port of Astoria serves as airport manager

Salem McNary Field
- Airport: 751 acres; Total operations: 35,657
- Full time airport manager, salary $84,000 - $113,000

Newport Municipal Airport

- Airport: 700 acres; Total operations: 16,000
- Full time airport manager, salary $73,500 - $96,340

LaGrande/Union County Airport

- Airport: 640 acres; Total operations: 16,000
- No dedicated airport manager; Public Works serves as airport manger

GOVERNING STRUCTURES

The Oregon Aviation Board is committed to ensuring airports across the state provide an aviation system that effectively serves our communities, airport users, and the region as a whole. A large part of this responsibility entails direct oversight of the Oregon Department of Aviation and the 28 airports it owns. Of these 28, Aurora State Airport is the largest and most dynamic, supporting 1,500 jobs and contributing over $1.8M to county's general fund in taxes. Ensuring the governing structures remain in sync with the growing airport is a key part of the board's oversight responsibilities for this site.

The major driver of growth at the Aurora State Airport is its unique position within Oregon as the state's largest "through the fence" pilot program. As a state recognized program governed by ORS 836, ODA is tasked to utilize public-private relationships to ensure *"Shared responsibility for: (A) Establishing and meeting the fiscal needs of the pilot site* (ie. test site)*; (B) Maintaining safety of operations; and C) Maintaining positive community relations and compatibility with existing uses. Examples of past public-private ventures at the airport are included as an attached appendix for reference.*

While public-private partnerships have been effective in the past, no guidance exists on when it should be used or what their limits are. As such, there's confusion on expected roles within the decision-making process. Explicitly this revolves around what level of engagement ODA should exercise with the business entities and to what extent those entities should able to influence ODA's actions in its role as the airport sponsor. Because of this, the board should look at whether there are any required changes in policy to eliminate confusion in the future.

In addition to tweaking existing relationships within the existing construct with ODA as the airport sponsor, the board may want to review other ownership possibilities in the name of thoroughness. The reason for this is while the costs of airport operations and maintenance often makes local ownership unfeasible, Aurora State Airport has grown into a healthy, thriving enterprise and is at a point where alternate ownership may be viable. In particular, ORS 836.642 stipulates

(6)To the extent practicable, the airport sponsors shall utilize innovative airport infrastructure and operations funding to support the pilot sites including, but not limited to:

(a)Airport districts as provided in ORS chapter 838;
(b)Economic development programs administered by the Oregon Business Development Department;
(c)Tax increment financing to provide funding for airport-related infrastructure;
(d)United States Department of Agriculture Rural Development grants or low-interest loans; and
(e)Programs, including funding for short line railroads under ORS 367.067 (Short Line Credit Premium Account), designed to facilitate development of intermodal transportation projects. [2005 c.820 §3; 2009 c.398 §2]

So what is an "Airport District"? It is a type of "Special District" authorized via ORS 838 to manage airports and enhance local economies. In general, Special Districts ... "are a form of local government created by a local community to meet a specific need. Inadequate revenue bases and competing demands for existing taxes make it difficult for cities and counties to provide all of the services that their constituents want. When residents or landowners want new services or higher levels of existing services, they can form a district to pay for them. Each special district focuses on a specific set of services, like fire protection, water, healthcare, parks and recreation." (Special Districts Association of Oregon). They are funded through property tax revenues or fees charged to customers for services, and also has the authority to issue bonds.

Coos County Airport District is Oregon's only current airport district and oversees the Southwest Regional Airport in North Bend. It was formed, as a Special District, by general election on
December 4, 2002. The District is responsible for the operation of the Southwest Oregon Regional Airport and strives to provide a stable economic base for aviation services for all of Coos County. The District is governed by a Board of five Commissioners elected county wide. The primary duty of the Board is to establish policies for the governance of the District and provide oversight of its daily activities. The Executive Director and staff, operate under the oversight of the District, and are responsible for the operation and maintenance of the airport. The Board established three primary goals for the District in 2003

- Make the District financially independent so that no tax dollars will be required for operations
- Maintain and enhance general and commercial aviation
- Operate and maintain the airport Business Park in support of general and commercial aviation.

Process for Special District Formation. There are three procedures that may be used to form a special district:

- The filing of a petition for formation
- The consent of all property owners within the area of the proposed district
- Initiation and order of the county board (for districts located entirely within its borders).

Once the petition has been approved by the required county agencies, the county must hold a hearing within 30 to 50 days. Upon conclusion of the hearing, the county board will further evaluate the petition according to ORS 199.462. Upon county approval, a final hearing will be held, after which the county enacts formation resolution and an election date is scheduled.

Appendix 1: KUAO Public Private Partnership (Aurora Airport Improvement Association)

KUAO Public Private Partnership:

A list of Historic, On-going, and Planned Examples

Aurora Airport Improvement Association14497 Keil Road
Aurora, Oregon 97002

September 3, 2021

Summary Report

Aurora Airport is an FAA approved "through the fence" type of public airport that is a mix of public and private lands. Most public airports are not this, and have all of their lands owned by the government agency. When all of the land is publicly owned, all of the users are "tenants." Tenants on public land have time-limited leases during which to create their development, and when the lease is over, the development reverts to public ownership. Airport tenants at these airports often point out that at the mid-point of their lease periods, they lose motivation to maintain and improve their development, because they often are forced to move out at the end of the lease.

At Aurora Airport the private properties create additional "owner" relationships with the airport that are different from being a "tenant." Ownership promotes the making of permanent long term investments that retain their value, and that often result in more durableaviation businesses from a community investment and employment standpoint. The uses of the buildings can be more quickly changed to meet market changes, and industry innovations, because ownership also allows rapid redevelopment and re-investment using conventional financing methods of the banking industry.

The essence of a public-private partnerships (often referred to as PPP's) are that they can join the best of the public sector knowledge and abilities, with the best of the private sector knowledge and abilities, to create a better result. As joint owners, they share responsibility for the success of the airport. The private sector owners become partners with the public airport. This makes for a strong combination. The private owners have "skin in the game." For their business to be successful, they need the airport to be successful. There is a built in "win-win" relationship with the airport. For the public side, this means that the private owners put in time, resources, and funds that specifically benefit the public airport as a whole.

Examples of the public-private improvement projects accomplished through the years at Aurora Airport, that provided large public benefits, are listed in the bullets below. For those who want to know more about each bullet item, the following pages provide more details of their history and current status:

1. **2021 – The private side of Aurora Airport annually puts $1.9 million dollars into the local schools, police, fire, and other Marion County services. The businesses at the airport employ 1,500 workers with family wage pay. So the public-private partnership at Aurora Airport uniquely better supports local citizens than a traditional publicly owned airport.**

2. In 2015, the private sector properties at Aurora Airport joined with ORAVI and OPA to strongly lobby support for HB 2075 to raise the fuel tax rate in Oregon and have those additional funds support airport infrastructure, airport economic development, and the Oregon Department of Aviation. ODA staff were prohibited from advocating for the bill, so private sector support was essential.
3. In 2012, the FAA approved the Control Tower project in the 2012 Airport Master Plan, but there were no funds available for it. ODA made clear that they could not advocate for those funds and had to remain neutral. The private sector worked extensively with the Oregon Congressional Delegation during 2013 and 2014 to explain the importance of the Control Tower for airport safety, which resulted in funds becoming available and construction completed in 2015.
4. In 2007, to improve the instrument approach capabilities of the airport, the parallel taxiway needed to be relocated to meet FAA's design standard for a greater runway-taxiway centerline separation. Most of the property needed for this relocation was on private properties. There was a friendly and quick agreement created. In 2009, the taxiway relocation was completed.
5. In 2005, with Aurora Airport showing the power of using a public-private model for an airport, the legislature approved Senate Bill 680 which instructed all state agencies to use the Aurora Airport as a model airport for how an airport can maximize its Economic Development impact to Oregon and its surrounding communities.
6. In 2003, there was agreement that the runway should be reconstructed to add 1000 feet of length and to resurface and groove it for safety. However, there were no FAA funds available for the work at the time. ODA made clear that they could not advocate for those funds and had to remain neutral. The private sector worked extensively with our Congressional Delegation, the FAA, and ODA to get the funding committed for the work. The runway extension was completed in 2004.
7. 2003 - Creation of the Aurora Airport Water Control District, to solve major fire and life safety needs for all at the airport, led by the needs of private sector, assisted by Marion County, and providing a fire protection water system for the entire ODA airport.
8. 1999 Agreement to install comprehensive Fencing and Security gates around the entire perimeter of the Airport, paid by Private funds on Private Land, and paid by FAA Public funds on Public Land.
9. 1999 The Airport Gate colors & Airport Signs were installed on Canby-Hubbard Highway, Keil Road, Arndt Road, and Airport Road, thus creating the Red, Yellow, Purple, Blue, Orange, Green, and Yellow, Gates and Signs around the airport. All of the design, construction, and installation was paid by the private sector. The State agreed to maintain them and pay for the electricity in them.
10. 1999 – Joint use parking lot developed for state owned public tie-down area with private funds and public on-going maintenance.
11. 1999 – Joint use septic system developed on leased land from the state, is now shared to provide the needs for the Control Tower toilet facilities.

12. **1997 - Stenbock Road, the major entry to the public airport lands that have FBO, tie-downs, hangars, and the Control Tower, was created by a public-private partnership.**
13. **1996 Creation of Positive Aurora Airport Management (PAAM) by the private sector, at the request of the public sector, to be the Liaison between the airport users, pilots, the surrounding communities, and anyone interested in be involved in the airport, with the ODA.**
14. **1986 – The private sector willingly sold private land to the state, for the creation of what became the public tie-down, hangar development, and Control Tower Area.**
15. **1968+ - Private sector airport management donated much of the time needed for providing weather reporting, Unicom service and monitoring of the airport runway.**
16. **1943 - As a military airport, the runway was constructed with public funds, and the aircraft aprons were all on private property. This shows that even at the beginning of the airport's existence it was a public-private partnership.**
17. **Miscellaneous examples of the public-private partnership efforts through private efforts that provided: radar coverage to the Aurora Airport area, getting the airport sign on I-5, presentation of WWII aircraft to honor veterans, bringing local retirement home residents for visit, weather reporting that is useful for the public, and many open houses at the airport for the public.**

Consistent with this long history of public-private partnerships at Aurora Airport there are two projects that are just now under way:

- **Private property owners are now negotiating with ODA for a partnership to install an internal circulation road that has been in the FAA and state approved Airport Layout Plan (ALP) since 2012.**

- **Private Property owners are requesting a partnership with ODA to help get the tree removal accomplished as the trees are now potentially going to raise the landing IFR flight altitude minimums needed for safety during periods of low visibility at the airport.**

Detailed Report

There has been a long history of public-private projects accomplished at the Aurora Airport, because a large amount of the developed lands around the airport are on private properties. These properties have been allowed access to the use of the runway and taxiways via a permit system with the state that requires payment of a fee and annual renewal of the access permit. In addition, all fuel sold at the airport pays a tax to the state, which supports the Oregon Department of Aviation and their airport improvement programs.

More important than paying their share of the costs of the airport, through access fees to the runway, is the synergy created by public-partner partnerships. These have allowed for very efficient, low cost, innovative major improvements at Aurora Airport at much reduced cost to the airport, due to the donations of funds, time, and effort by the private sector.

Examples of these public-private improvement projects accomplished through the years, that provided large public benefits, are listed in the bullets below:

1. **2021 – The private side of Aurora Airport annually puts $1.9 million dollars into the local schools, police, fire, and other Marion County services. The businesses at the airport employ 1,500 workers with family wage pay. So the public-private partnership at Aurora Airport uniquely better supports local citizens than a traditional publicly owned airport.**

Most publicly owned development does not pay taxes. However, the private sector pays full taxes on their property development. Thus, at Aurora Airport the private development provides enormous support for governmental services, that most public airports do not provideto their local community. Most recently Marion County records show approximately $250 million value of development at the airport, and this creates $1.9 million in annual taxes paid toMarion County. The taxes next year are expected to be well over $2 million. This supports schools, police, fire, parks, roads, and governmental services for the local area and the county at large. In addition, the approximately 1,500 employees of companies at the airport, pay income taxes as do the employers also pay additional taxes for each employee, which provides great support at the state level for social services, roads, bridges, and administrative services.

2. **In 2015, the private sector properties at Aurora Airport joined with ORAVI and OPA to strongly lobby support for HB 2075 to raise the fuel tax rate in Oregon and have those additional funds support airport infrastructure, airport economic development, and the Oregon Department of Aviation. ODA staff were prohibited from advocating for the bill, so private sector support was essential.**

In 2015 Oregon Aviation Industries Inc. (ORAVI) wrote HB 2075 and called for an increase in the aviation and jet fuel tax rate. The bill was specifically written to support airport infrastructure, economic development, and the ODA administration. The Aurora Airport private sector properties joined with ORAVI and the Oregon Pilots Association (OPA) to strongly support this bill by testifying in the Legislature and contacting their State Representatives and Senators. Thebill was opposed by the Port of Portland and the Airlines because much of the tax revenues

would come from the airlines. The ODA director and staff were told by the Governor that they could not advocate for the tax or have involvement with the bill. The private sector properties recognized the importance of the increase in fuel taxes to maintaining the health of all of Oregon airports. The private sector support ruled the day, and HB 2075 passed and was signed by the Governor.

3. **In 2012, the FAA approved the Control Tower project in the 2012 Airport Master Plan, but there were no funds available for it. The private sector worked extensively with the Oregon Congressional Delegation during 2013 and 2014 to explain the importance of the Control Tower for airport safety, which resulted in funds becoming available and construction completed in 2015.**

The 2012 Airport Master Plan Update confirmed the need for construction of a control tower, as had previous Master Plans. The FAA approved the Control Tower, but there were no funds available for it. ODA made clear that they could not advocate for those funds and had to remain neutral. The private airport sector worked extensively with the Oregon Congressional Delegation during 2013 and 2014 to explain the importance of the Control Tower for safety at the airport. The Congressional delegation working with the FAA was able to find some FAA projects in other Districts that could not meet their deadlines, and the funds could be transferred to Aurora. So in 2015 a control tower was constructed and became operational, in large part because of the private sector efforts.

4. **In 2007, to improve the instrument approach capabilities of the airport, the parallel taxiway needed to be relocated to meet FAA's design standard for a greater runway-taxiway centerline separation. Most of the property needed for this relocation was on private properties. There was a friendly and quick agreement created. In 2009, the taxiway relocation was completed.**

To improve the instrument approach capabilities of the airport, the parallel taxiway needed to be relocated to meet FAA's design standard for a greater runway-taxiway centerline separation. Most of the property needed for this relocation was on private properties. Since it was a win-win for both parties, there was a friendly and quick agreement created so that the state could acquire the needed property. The relocation of the taxiway allowed the minimum descent altitude for the instrument approaches to be lowered, so that the airport was useful when the cloud ceilings were lower. In 2009, the taxiway relocation was completed.

5. **In 2005, with Aurora Airport showing the power of using a public-private model for an airport, the legislature approved Senate Bill 680 which instructed all state agencies to use the Aurora Airport as a model airport for how an airport can maximize its Economic Development impact to Oregon and its surrounding communities.**

Senate Bill 680 called for the Oregon Department of Aviation to use Aurora Airport as the model for how a public-private partnership at an airport could work to create jobs and improved economy for the community. It referenced "through the fence" operations, which is

the aviation lingo for an airport public-private partnership. Its goals to show how rural airportscan encourage development of through the fence operations designed to promote economic development by creating family wage jobs, by increasing local tax bases and by increasing financial support for rural airports.

To the extent practicable, the airport sponsor of a pilot site shall use public-private partnerships that incorporate: (a) Innovative and creative technologies for increasing airport usability and safety; (b) Innovative and creative performance of aviation services to make the services more competitive and useful for the public; (c) Development of the pilot site as a setting for customary and usual aviation-related activities to develop and thrive, in concert with the goals of the Economic and Community Development Department; and (d) Shared responsibility for: (A) Establishing and meeting the fiscal needs of the pilot site; (B) Maintaining safety of operations; and (C) Maintaining positive community relations and compatibility with existing uses. It used Aurora Airport as the model for other airports to follow.

6. **In 2003, there was agreement that the runway should be reconstructed to add 1000 feet of length and to resurface and groove it for safety. However, there were no FAA funds available for the work at the time. ODA made clear that they could not advocate for those funds and had to remain neutral. The private sector worked extensively with our Congressional Delegation, the FAA, and ODA to get the funding committed for the work. The runway extension was completed in 2004.**

In 2003, there was agreement that the time had come when the runway should be reconstructed to add 1000 feet of length and to resurface and groove it for safety. This was part of a runway extension that had been planned since 1976 as part of the airport's master plans. However, there were no FAA funds available for the work at the time. ODA made clear that they could not advocate for those funds and had to remain neutral. The private sector worked extensively with our Congressional Delegation, the FAA, and ODA to get the funding committed for the work. The runway extension was completed in 2004.

7. **2003 - Creation of the Aurora Airport Water Control District, to solve major fire and life safety needs for all at the airport, led by the needs of private sector, assisted by Marion County, and providing a fire protection water system for the entire ODA airport.**

In 1999 Dick VanGrunsven bought a portion of the land in the south end of the airport, with the goal of re-locating his company Van's Aircraft to Aurora Airport. An initial Van's building was designed and submitted to Marion County for building permits. Prior to this time there had been construction of hangars at some of the private lands at the airport. However, this was a moment in time when the building code was changing. In 2000 the International Building Codecame into being to replace the Uniform Building Code. Oregon would be formally adopting thenew IBC in 2004, but the State Fire Marshal wanted to promote safety so advised that, whereasprior large buildings at the airport hadn't needed to have water fire sprinkling, soon that wouldbe a requirement. So Van's first building was allowed to be constructed without fire sprinklering, however the State Fire Marshal said: "no more until you have a fire protection water system at the airport." In reality, each property could have created its own water

system, but that would have meant that there would be the cost of building 10 or more different large reservoirs or tanks for water, with pipes, fire hydrants, and a large pump, each costing upwards of $750,000 each ($1.25m in 2021 dollars). Instead, the land owners all got together and looked at options for creating a common system that would serve all of their properties.

Marion County played a big role in this, helping the joint group of airport private properties and public properties create a "Water District." In 2002 the Aurora Airport Water Control District was created by the Marion County Commissioners, following filing of a petition and testimony of how it was a new requirement for many airport buildings. The AAWCD, now formed, could then go to the USDA Rural Development branch of the federal government and request, and in 2003 received a loan of $703,000 to build a 247,800 gallon underground tank system, a pump house, underground water pipes, fire hydrants, and "T" connections for private sprinkler systems. The State ODA offered up their land for the underground tanks, a well-water for water replenishment of the tanks. In 2004 the system was up and running just as the new IBC code came into effect.

Initial planning and management of the project was done by the private sector as donated time. Where costs were incurred for initial engineering the private sector donated those costs up front. Marion County assisted in the creation of the water district. On opening, the Aurora Fire District performed a water truck caravan training session using multiple fire districts in the area to do the initial filling of the tanks from water in the Willamette River. The Aurora Fire District has continued to use the system for their training exercises, year by year. They have also used the water on occasion for off airport firefighting activities in the community.

The management of the water system is largely done by volunteer effort of the Board of Directors, four of whom are from private properties, and one from State ODA. Thankfully, in the following 17 years there has so far, not been a need for the water system – there have beenno building fires. None-the-less, most of the current buildings have fire sprinklers. Fire marshals often explain the importance of fire sprinklers: if a fire occurs in a building that has a fire sprinkler system, on average one and a half heads go off. This means, the one or two headsthat went off, put the fire out, and that was the end of the problem. Aurora Airport now has this status, thanks to the very strong public-private partnership that accomplished the creation of the Aurora Airport Water Control District.

The AAWCD infrastructure has allowed other important uses at the airport. In 2014 a Control Tower was installed at the airport. This could not have occurred without the availability of Oregon building code required fire protection water. In 2020 the water system was made available to the Oregon Department of Forestry to fight the wild fires burning east and south of Estacada. And today, the presence of Van's Aircraft, Life Flight Network Regional Headquarters, and many other nationally known businesses the 1,500 workers at the airport, was only possible because of that public-private effort.

8. **1999 Agreement to install comprehensive Fencing and Security gates around the entire perimeter of the Airport, paid by Private funds on Private Land, and paid by FAA Public funds on Public Land.**

As the airport grew, in 1999, the need for a major new security fence at the airport was needed. There were major problems with deer and coyotes on the runway, as well as visitors to the airport driving right out onto active operations areas. To best allow for the safe operation of the airport as a whole airport community, private owners and the state came together to design, jointly fund (emphasis added) and construct a comprehensive and completeperimeter fence system. This included the state establishing a common standard for all of the automatically operated sliding security gates. This system improved safety and security by reducing wildlife contacts with aircraft as well as helped reduce the illegal operations of motor vehicles on state airport owned facilities.

9. **1999 The Airport Gate colors & Airport Signs were installed on Canby-Hubbard Highway, Keil Road, Arndt Road, and Airport Road, thus creating the Red, Yellow, Purple, Blue, Orange, Green, and Yellow, Gates and Signs around the airport. All of the design, construction, and installation was paid by the private sector. The State agreed to maintain them and pay for the electricity in them.**

To modernize and improve the image of the airport, in 1999, a public private partnership was formed to create defined Gate colors & Airport Signs. They were installed on Canby-Hubbard Highway, Keil Road, Arndt Road, and Airport Road, thus creating the Red, Yellow, Purple, Blue, Orange, Green, and Yellow, Gates and Signs around the airport. All of the design, construction, and installation was paid by the private sector. The State agreed to maintain them and pay for the electricity in them. designed and emplaced modern signage around the airport. The signage improved surface traffic flow around the airport as well as served to bring the airport an organized image in line with the growing investment in aviation related industry and jobs brought to the airport. This public private partnership project added greatly to making the airport a recognized economic engine of North Marion County.

10. **1999 – Joint use parking lot developed for state owned public tie-down area with private funds and public on-going maintenance.**

The state had developed the public aircraft tie-down area it had acquired, and the Columbia Aviation Association had built a new meeting facility on land it owned. A joint use parking lot was developed in adjacent state owned land, to be used by both groups. The parking lot grading, paving, striping, and light poles were paid for and put in by the CAA, while the ODA agreed maintain the parking lot and pay for the electrical cost for the parking lot lights.

11. **1999 – Joint use septic system developed on leased land from the state, is now shared to provide the needs for the Control Tower toilet facilities.**

The Columbia Aviation Association had built a new meeting facility on land it owned, but needed a septic system. The state leased land for CAA to put in a septic system. And then when the Control Tower was put up, it needed a septic system to connect to for the toilet in theControl Tower, so it was joined to the CAA's septic system, for joint use, since it was on the same state owned land.

12. 1997 - Stenbock Road, the major entry to the public airport lands that have FBO, tie-downs, hangars, and the Control Tower, was created by a public-private partnership.

The entry to the state's public 10 acres of land used to be an odd curving gravel road which still shows up as lines on the county tax map. There was a need for a direct road into the 10 acres that the state had bought. So a public-private deal was created whereby: a) the land area was donated by the private sector as an easement, b) a logger paid by the property owner agreed to cut down the trees, c) a third private sector person (pilot and contractor Brian Cloptan) took out all the stumps, and with that done, d) the state agreed to construct a new asphalt road and maintain it.

13. 1996 Creation of Positive Aurora Airport Management (PAAM) by the private sector, at the request of the public sector, to be the Liaison between the airport users, pilots, the surrounding communities, and anyone interested in be involved in the airport, with the ODA.

In 1996, Aurora State Airport was looked at as a rural, uncontrolled airport, far on the outskirts of the Portland Metropolitan area. Thinking there was nothing important happening at the airport, there arose a significant effort by a minority in the surrounding area to actually close down the airport. In fact the Mayor of the City of Aurora at that time organized a group named "Stop" that had the goal of closing Aurora Airport. Their plan was to create in its place "Williamsburg of the West."

State officials, local owners of airport neighboring properties and private enterprise came together at the request of the Director of ODA (Betsy Johnson at that time) to form the Positive Aurora Airport Management (PAAM). There was a signed agreement that this volunteer group's purpose was to be ODA's laison to the community. PAAM created a forum for all of thevoices of interested parties within and around the airport to talk together and learn from each other. By having all the parties at the table together, hearing each other in real time, it createda place for neighbors to be able to find out what was going on at the airport, and for people at the airport to know what at the airport was affecting neighborhoods around the airport. The PAAM group began in 1996 and has continuously operated ever since.

PAAM focuses on safety, respectful flight operations, noise abatement, surface traffic, discussion of planning efforts for needed improvements, interaction with schools, aviation related training of first responders, coordination of flights during periods of construction, making the airport available for community events, assisting coordination for firefighting, and more. It is a forum for complaints to be heard, solutions proposed, and an effort made to have good relations between the airport and the community. Common involved people attending are:

a. Airport Private Property Owners
b. Airport business heads and managers
c. ODA Director & Staff
d. ODA board members
e. Aircraft users, pilots & mechanics

f. Control tower operators
g. Aurora Fire Department Chief & Staff
h. Marion County Sherriff's Department
i. Clackamas County Sherriff's department
j. Charbonneau Representatives
k. City of Aurora Representatives
l. Contractors doing work on the airport
m. Many others, including interested citizens

Meetings are held weekly on Thursday mornings, with typical attendance by 20 to 40 people. Membership is voluntary and there are no paid staff. So it is funded by the airport private businesses who volunteer their staff to do the work needed of running the meetings, issuing agendas, issuing meeting minutes, and sending out coordination emails. It has been so successful that it has been copied by airports around the nation as a model way to be involved with the interests of the surrounding community.

14. 1986 – The private sector willingly sold private land to the state, for the creation of what became the public tie-down, hangar development, and Control Tower Area.

The 1976 Airport Master Plan pointed out that the State should own more than just the airfield property. A most important aspect of this was that ODA and the FAA wanted there to be a State controlled location for an FBO facility that could guarantee that airport services would always be available to users of the public airport. At one point the ODA reported to the privateowners that the FAA would not continue funding airfield developments at the airport unless some public land was acquired that could guarantee public access. So Bruce's family willingly agreed to sell ten acres to the state in 1986, to solve that problem. This is the land that becamethe ODA's developed public tie-down, FBO, hangar development, and Control Tower Area.

15. 1968+ - Private sector airport management donated much of the time needed for providing weather reporting, Unicom service, and monitoring of the airport runway.

Bruce's company, Aurora Aviation in the days beginning in 1968 assisted in much of the management of the airport. This included having the staff take classes and become certified in weather reporting, including the release of weather balloons. This information was gathered so that when an airplane called in on the radio unicom, his staff would respond on the radio with an airport advisory including weather conditions. This weather information also went hourly into regional weather data used by NOAA. The FBO staff were also the ones who would go out and take care of getting the runway cleared up if a plane was stuck on the runway, such as from landing with wheel gear up. This volunteer effort of the private sector continues to this day, evidenced by Lynx FBO recently clearing a disabled Aircraft off the runway in July of this year.

16. 1943 - As a military airport, the runway was constructed with public funds, and the aircraft aprons were all on private property. This shows that even at the beginning of the airport's existence it was a public-private partnership.

Aurora Airport was constructed in 1943, during World War II by the United States Army Air Forces. At that point in the war the outcome was still in serious question. Just a year prior, a Japanese submarine along the south Oregon coast had launched a floatplane that had dropped incendiary bombs inland, trying to start major forest fires. Another Japanese submarine had fired shells at Fort Stevens near Astoria. It was recognized by the Federal government that there was an essential need to be able to patrol and defend the West Coast with military aircraft from numerous locations in western Oregon. Aurora Airport was constructed and during its initial period was used for patrolling the coast, looking for enemy ships and aircraft, and for pilot training.

Aurora Airport from its beginning, represents a major investment of public tax dollars, to create essential public infrastructure. As a military airport, Aurora Airport was designed, and construction specified, using the standard military criteria of that era. It was established as a 150 foot wide by 4,104 foot long runway. The asphalt pavement was built upon a very thick, heavy gravel base, designed to accommodate the loads of military aircraft. This included the ability to handle medium and heavy bombers such as B-25, B-26, B-17, B-24 and cargo aircraft such as C-45, C46, and C-54. It is particularly interesting that all of the ramp areas used for tiedowns, fueling, and repair of aircraft was on the adjacent private lands. Thus, many of seen the early picture of the PBY's at Aurora Airport. Those are in the area where South End Corporate Airpark is now. In fact, from its beginning in 1943 until the early 1980's ALL development (other than airfield) at the Airport was on private property.

17. **Miscellaneous examples of the public-private partnership efforts through private efforts that provided: radar coverage to the Aurora Airport area, getting the airport sign on I-5, presentation of WWII aircraft to honor veterans, bringing local retirement home residents for visit, weather reporting that is useful for the public, and many open houses at the airport for the public.**

Miscellaneous examples of the public-private partnerships are: 1980's letters from Governor Tom McCall and Aurora Aviation working with the FAA and State government to bring radar coverage to the Aurora Area; Aurora Aviation working with Representative Denny Smith to install an Airport sign on I-5; 12 years that Aurora Aviation sponsored the Collings foundation's "living history" tour of their WWII Aircraft, inviting neighbors to the airport to honor Veterans; 2021 summer visit by "dream flights" bringing hundreds of local retirement home residents to the Airport; the current "AWOS" airport weather system (like the former volunteer manual weather reporting) feeds into the national weather system which in turn provides data for television weather reports for the public; Many open-houses and large airport events since the 1970s through the present inviting the public to view Aurora Airport operations.

The Future

Consistent with this long history of public-private partnerships at Aurora Airport there are two projects that are just now under way:

- **Private property owners are now negotiating with ODA for a partnership to install an internal circulation road that has been in the ALP since 2012.**

- **Private Property owners are requesting a partnership with ODA to help get the tree removal accomplished as the trees are now potentially going to raise the landing IFR flight altitude minimums needed for safety during periods of low visibility at the airport.**

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Memorandum

To:	Aron Faegre	From:	George Saunders, P.E., G.E.
Company:	Aron Faegre & Associates	Date:	March 25, 2019
Address:	520 SW Yamhill Street, Roofgarden 1 Portland, OR 97204		
cc:	n/a		
GDI Project:	AronFA-1-01		
RE:	Preliminary Geotechnical Engineering Results Aurora Airport Business Center Aurora, Oregon		

INTRODUCTION

GeoDesign, Inc. is pleased to submit this memorandum as part of our geotechnical engineering services associated with the proposed land acquisition and future Aurora Airport Business Center (AABC) located east of the Aurora Airport in Aurora, Oregon. Figure 1 shows the site relative to existing topographic and physical features. Existing conditions, the site boundary, and the approximate location of our exploration are shown on Figure 2.

We understand the proposed development will likely consist of new hangars, shops, offices, and associated pavement and taxi lanes. In addition, we understand the future development may include an essential facility.

Based on correspondence with Aron Faegre of Aron Faegre & Associates, we understand the first step for the proposed development is a land zone change to switch the approximately 16 acres of agricultural land to airport use. We understand geologic hazard maps indicate that the area is susceptible to liquefaction and soil amplification during an earthquake. Specifically, the Relative Earthquake Hazard Maps (Madin, Ian P. and Wang, Zhenming, 1999) assigns a Zone B (intermediate to high hazard) earthquake risk to the southern portion of the airport.

BACKGROUND

GeoDesign has conducted numerous projects in the area, including explorations and a geotechnical report for the proposed Lima North Hangar site. In addition, we are currently completing a geotechnical report for a fuel farm on the south portion of the airport. As shown on Figure 1, the Lima North Hangar site is located approximately 800 feet west of the AABC site and the fuel farm is located approximately 2,000 feet southwest of the AABC site.

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Memorandum

APPROACH

We have completed one boring and one cone penetration (CPT) probe to supplement our existing subsurface information in the project vicinity to preliminarily evaluate the potential seismic hazards associated with the proposed development. The draft boring and CPT logs from the supplemental explorations completed at the AABC site are presented in Attachment A. The logs from the Lima North Hangar and fuel farm projects are presented in Attachment B.

CONCLUSIONS

INTRODUCTION

Although future explorations will be needed for other areas of the AABC site to prepare a final geotechnical report for the project, based on the results of our subsurface explorations and engineering analyses from this and the nearby sites, our preliminary opinion is that the site can be developed as proposed. Our final report will include a site-specific seismic hazard evaluation of the future business center project; however, for preliminary purposes, a site-specific seismic hazard evaluation was completed for the fuel farm site, which is presented in Attachment C. We anticipate the site-specific seismic hazard evaluation for the AABC site will be similar.

SITE CONDITIONS

A detailed discussion of the site conditions will be presented in our final report. Relative to this preliminary memorandum, the site geology and subsurface conditions from the AABC site, Lima North Hangar site, and the fuel farm site are relatively similar, consisting of silt and silty sand with variable amounts of clay. The silt and silty sand include interbedded layers of sand and silt, respectively. In general, the sand content increases with depth. Based on SPT blow counts, the silt is generally medium stiff to very stiff and the silty sand is generally medium dense to very dense (although an interbedded layer of loose material was encountered at the fuel farm site). The CPT indicates interbedded seams and layers of sand, silty sand, clay, and silt.

SESIMIC CONSIDERATIONS

Although the Relative Earthquake Hazard Maps (Madin, Ian P. and Wang, Zhenming, 1999) assigns a Zone B (intermediate to high hazard) earthquake risk to the southern portion of the airport, the work completed for this evaluation indicates a relatively low seismic risk. More detailed discussions on the following seismic considerations are presented in Attachment C.

Liquefaction

We performed liquefaction analysis using the CPT results from the AABC site, the Lima North Hangar site, and the fuel farm site using the procedures indicated in Attachment C. Based on our analysis, we estimate total post-liquefaction settlement at the AABC site, Lima North Hangar site, and the fuel farm site will be less than approximately 1 inch during a design-level earthquake. We anticipate differential settlement across the site will be less than approximately one-half of the total liquefaction settlement.

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Lateral Spreading
Because minimal liquefaction is predicted and there are no open faces near the project, lateral spreading is not a design consideration.

Ground Motion Amplification
Soil capable of significantly amplifying ground motions beyond the levels determined by our site-specific seismic hazard study were not encountered during our subsurface explorations.

Landslide
The site and surrounding area are relatively flat, and seismically induced landslides are not considered a site hazard.

Settlement
We do not anticipate that seismic-induced settlement in addition to liquefaction-induced settlement will occur during design levels of ground shaking.

Subsidence/Uplift
We do not anticipate that subsidence or uplift is a significant design concern.

Lurching
The anticipated ground accelerations shown in Attachment C are below the threshold required to induce lurching of the site soil.

Seiche and Tsunami
Seiches and tsunamis are not considered a hazard in the site vicinity.

LIMITATIONS

We have prepared this memorandum for use by Aron Faegre & Associates to provide a preliminarily evaluation of the potential seismic hazards associated with the proposed development. As discussed above, additional explorations will be needed for other areas of the AABC site to prepare a final geotechnical report for the project. This evaluation also included results from nearby parcels at the Aurora Airport.

Exploration observations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during subsequent explorations, re-evaluation will be necessary.

The site development plans and design details were preliminary at the time this memorandum was prepared. When the design has been finalized and if there are changes in the site grades or location, configuration, design loads, or type of construction, the conclusions and recommendations

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Memorandum

presented may not be applicable. If design changes are made, we request that we be retained to review our conclusions and recommendations and to provide a written modification or verification.

The scope does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our memorandum for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in this area at the time this memorandum was prepared. No warranty, express or implied, should be understood.

GPS:kt
Attachments
One copy submitted (via email only)
Document ID: AronFA-1-01-032519-geom.docx
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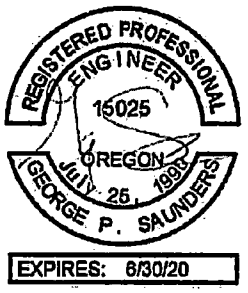

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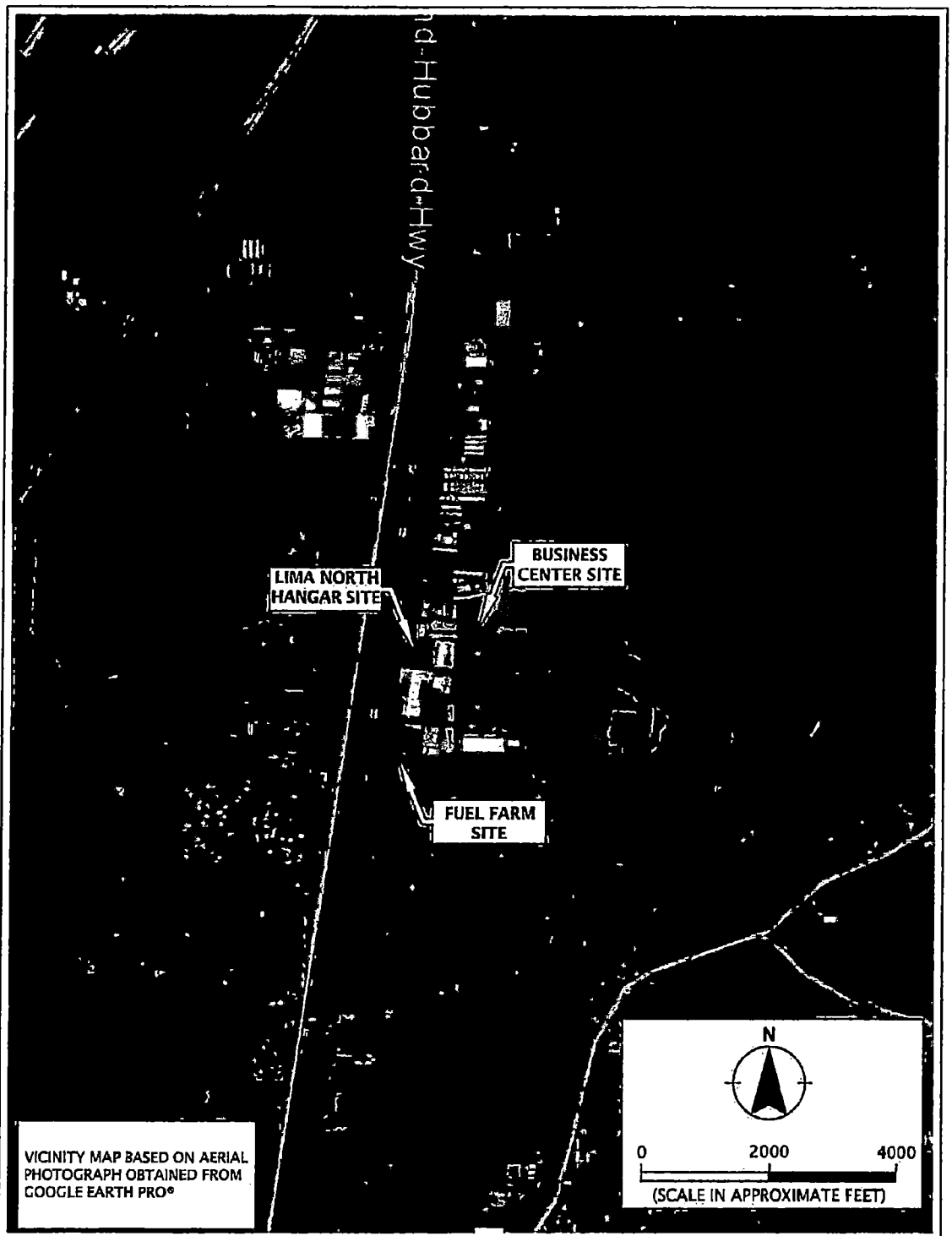
Memorandum

REFERENCES

Madin, Ian P. and Wang, Zhenming, 1999, Interpretive Map Series IMS-8: Relative Earthquake Hazard Maps for Selected Urban Areas in Western Oregon, Canby-Barlow-Aurora, Lebanon, Silverton-Mount Angel, Stayton-Sublimity-Aumsville, Sweet Home, Woodburn-Hubbard: Oregon Department of Geology and Mineral Industries report, p. 9

FIGURES



GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	ARONFA-1-01	VICINITY MAP	
	MARCH 2019	AURORA AIRPORT BUSINESS CENTER AURORA, OR	FIGURE 1

Printed By: mmiller | Print Date: 3/25/2019 8:21:12 AM
File Name: J:\A-D\AronFA\AronFA-1\AronFA-1-01\Figures\CAD\AronFA-1-01-VM01.dwg | Layout: FIGURE 1

GEODESIGN INC
ARONFA-1-01
MARCH 2019
SITE PLAN
AURORA AIRPORT BUSINESS CENTER
AURORA, OR
FIGURE 2
AIRPORT ROAD NE
STENBOCK WAY NE
LEGEND:
SITE BOUNDARY
B-1
BORING
CPT-1
CONE PENETRATION TEST
N
0
100
200
(SCALE IN FEET)
SITE PLAN BASED ON IMAGE OF PAGE L1.1 MASTER PLAN DATED
JANUARY 24, 2019 PREPARED BY ARON FAEGRE ARCHITECT

ATTACHMENT A

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Memorandum

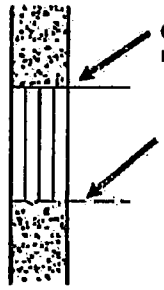
ATTACHMENT A

FIELD EXPLORATIONS (ON SITE)

The boring logs and CPT probes completed on the business center site are presented in this attachment. More detail regarding the attached logs will be provided in our final report.

SYMBOL	SAMPLING DESCRIPTION
	Location of sample obtained in general accordance with ASTM D 1586 Standard Penetration Test with recovery
	Location of sample obtained using thin-wall Shelby tube or Geoprobe® sampler in general accordance with ASTM D 1587 with recovery
	Location of sample obtained using Dames & Moore sampler and 300-pound hammer or pushed with recovery
	Location of sample obtained using Dames & Moore sampler and 140-pound hammer or pushed with recovery
	Location of sample obtained using 3-inch-O.D. California split-spoon sampler and 140-pound hammer
	Location of grab sample
	Rock coring interval
	Water level during drilling
	Water level taken on date shown

Graphic Log of Soil and Rock Types



GEOTECHNICAL TESTING EXPLANATIONS

ATT	Atterberg Limits	P	Pushed Sample
CBR	California Bearing Ratio	PP	Pocket Penetrometer
CON	Consolidation	P200	Percent Passing U.S. Standard No. 200 Sieve
DD	Dry Density		
DS	Direct Shear	RES	Resilient Modulus
HYD	Hydrometer Gradation	SIEV	Sieve Gradation
MC	Moisture Content	TOR	Torvane
MD	Moisture-Density Relationship	UC	Unconfined Compressive Strength
NP	Nonplastic	VS	Vane Shear
OC	Organic Content	kPa	Kilopascal

ENVIRONMENTAL TESTING EXPLANATIONS

CA	Sample Submitted for Chemical Analysis	ND	Not Detected
P	Pushed Sample	NS	No Visible Sheen
PID	Photoionization Detector Headspace Analysis	SS	Slight Sheen
		MS	Moderate Sheen
ppm	Parts per Million	HS	Heavy Sheen

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EXPLORATION KEY

TABLE A-1

RELATIVE DENSITY - COARSE-GRAINED SOIL

Relative Density	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)
Very Loose	0 - 4	0 - 11	0 - 4
Loose	4 - 10	11 - 26	4 - 10
Medium Dense	10 - 30	26 - 74	10 - 30
Dense	30 - 50	74 - 120	30 - 47
Very Dense	More than 50	More than 120	More than 47

CONSISTENCY - FINE-GRAINED SOIL

Consistency	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)	Unconfined Compressive Strength (tsf)
Very Soft	Less than 2	Less than 3	Less than 2	Less than 0.25
Soft	2 - 4	3 - 6	2 - 5	0.25 - 0.50
Medium Stiff	4 - 8	6 - 12	5 - 9	0.50 - 1.0
Stiff	8 - 15	12 - 25	9 - 19	1.0 - 2.0
Very Stiff	15 - 30	25 - 65	19 - 31	2.0 - 4.0
Hard	More than 30	More than 65	More than 31	More than 4.0

PRIMARY SOIL DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOIL (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (< 5% fines)	GW or GP	GRAVEL
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	GRAVEL with silt
			GW-GC or GP-GC	GRAVEL with clay
		GRAVEL WITH FINES (> 12% fines)	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SAND (<5% fines)	SW or SP	SAND
		SAND WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	SAND with silt
			SW-SC or SP-SC	SAND with clay
		SAND WITH FINES (> 12% fines)	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOIL (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50	ML	SILT
			CL	CLAY
			CL-ML	silty CLAY
			OL	ORGANIC SILT or ORGANIC CLAY
		Liquid limit 50 or greater	MH	SILT
			CH	CLAY
			OH	ORGANIC SILT or ORGANIC CLAY
HIGHLY ORGANIC SOIL			PT	PEAT

MOISTURE CLASSIFICATION		ADDITIONAL CONSTITUENTS					
		Secondary granular components or other materials such as organics, man-made debris, etc.					
			Silt and Clay In:			Sand and Gravel In:	
Term	Field Test	Percent	Fine-Grained Soil	Coarse-Grained Soil	Percent	Fine-Grained Soil	Coarse-Grained Soil
dry	very low moisture, dry to touch						
moist	damp, without visible moisture	< 5	trace	trace	< 5	trace	trace
		5 - 12	minor	with	5 - 15	minor	minor
wet	visible free water, usually saturated	> 12	some	silty/clayey	15 - 30	with	with
					> 30	sandy/gravelly	Indicate %

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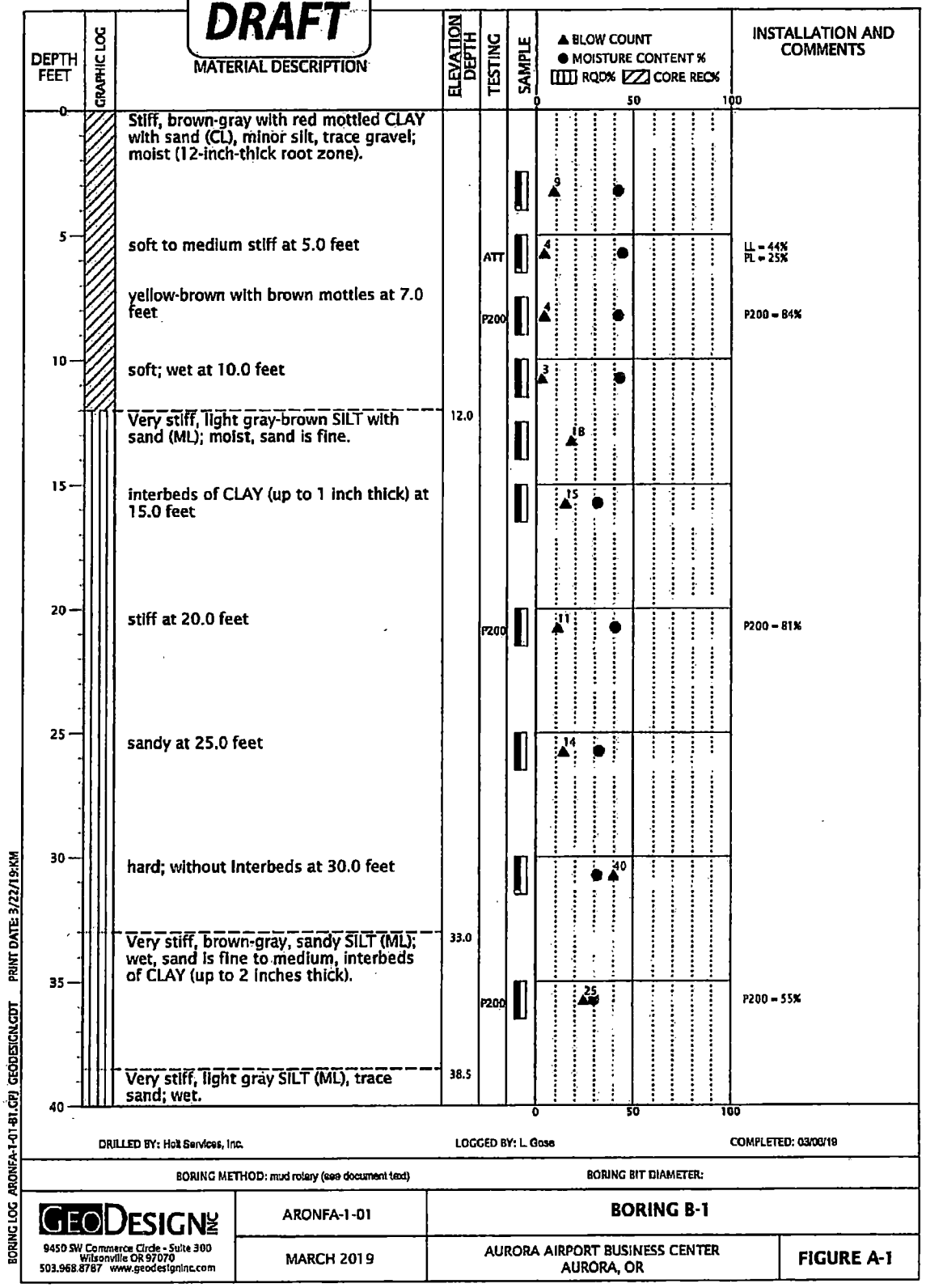
SOIL CLASSIFICATION SYSTEM

TABLE A-2

DRAFT


DEPTH FEET
GRAPHIC LOG
MATERIAL DESCRIPTION
ELEVATION DEPTH
TESTING
SAMPLE
▲ BLOW COUNT
● MOISTURE CONTENT %
RQD% CORE REC%
0 50 100
INSTALLATION AND COMMENTS
Stiff, brown-gray with red mottled CLAY with sand (CL), minor silt, trace gravel; moist (12-inch-thick root zone).
soft to medium stiff at 5.0 feet
ATT
LL = 44%
PL = 25%
yellow-brown with brown mottles at 7.0 feet
P200
P200 = 84%
soft; wet at 10.0 feet
Very stiff, light gray-brown SILT with sand (ML); moist, sand is fine.
12.0
interbeds of CLAY (up to 1 inch thick) at 15.0 feet
stiff at 20.0 feet
P200
P200 = 81%
sandy at 25.0 feet
hard; without interbeds at 30.0 feet
Very stiff, brown-gray, sandy SILT (ML); wet, sand is fine to medium, interbeds of CLAY (up to 2 inches thick).
33.0
P200
P200 = 55%
Very stiff, light gray SILT (ML), trace sand; wet.
38.5
0 50 100
DRILLED BY: Holt Services, Inc.
LOGGED BY: L. Goss
COMPLETED: 03/06/19
BORING METHOD: mud rotary (see document text)
BORING BIT DIAMETER:
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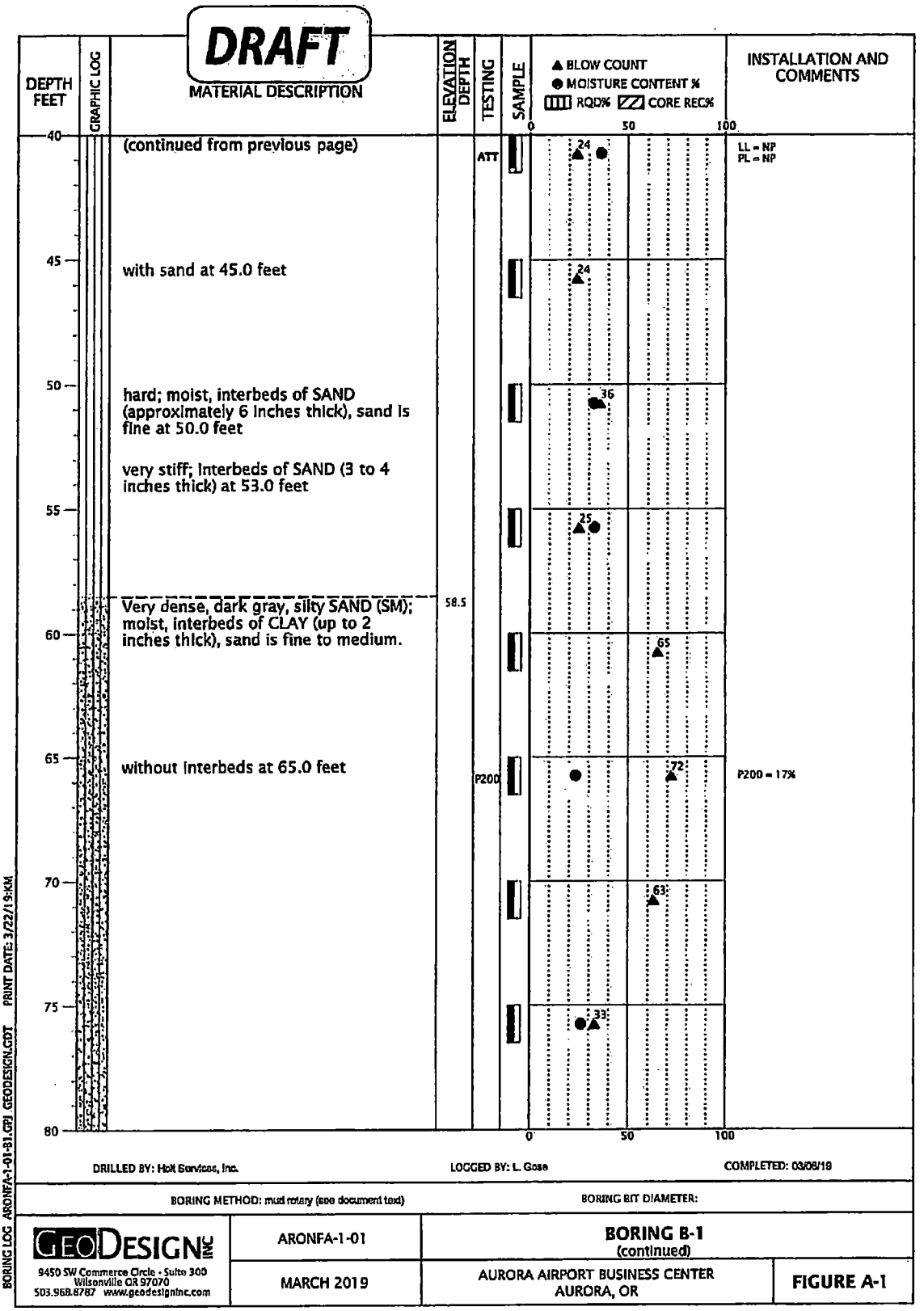
ARONFA-1-01
MARCH 2019
BORING B-1
AURORA AIRPORT BUSINESS CENTER
AURORA, OR
FIGURE A-1
BORING LOG ARONFA-1-01-B1.GPJ GEODESIGN.GDT PRINT DATE: 3/22/19:KM


DRAFT
DEPTH FEET
GRAPHIC LOG
MATERIAL DESCRIPTION
ELEVATION DEPTH
TESTING
SAMPLE
▲ BLOW COUNT
● MOISTURE CONTENT %
RQD% CORE REC%
INSTALLATION AND COMMENTS
(continued from previous page)
with sand at 45.0 feet
hard; moist, interbeds of SAND (approximately 6 inches thick), sand is fine at 50.0 feet
very stiff; interbeds of SAND (3 to 4 inches thick) at 53.0 feet
Very dense, dark gray, silty SAND (SM); moist, interbeds of CLAY (up to 2 inches thick), sand is fine to medium.
58.5
without interbeds at 65.0 feet
ATT
P200
LL = NP
PL = NP
P200 = 17%
DRILLED BY: Holt Services, Inc.
LOGGED BY: L. Goss
COMPLETED: 03/08/19
BORING METHOD: mud rotary (see document text)
BORING BIT DIAMETER:
GEODESIGN INC
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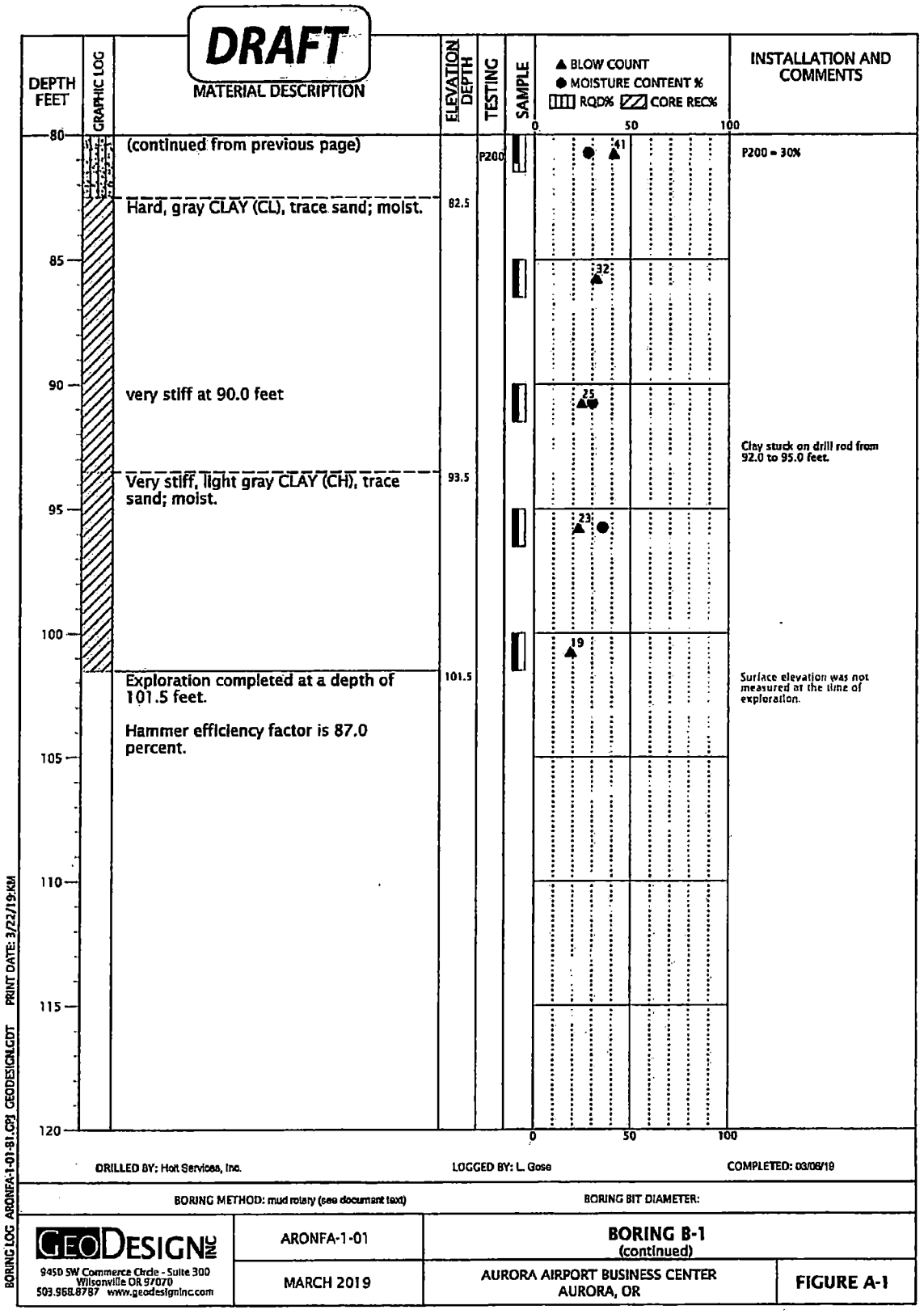
503.968.8787 www.geodesigninc.com
ARONFA-1-01
BORING B-1
(continued)
MARCH 2019
AURORA AIRPORT BUSINESS CENTER
AURORA, OR
FIGURE A-1
BORING LOG ARONFA-1-01-B1.GPJ GEODESIGN.GDT PRINT DATE: 3/22/19:KM

39


DRAFT
DEPTH FEET
GRAPHIC LOG
MATERIAL DESCRIPTION
ELEVATION DEPTH
TESTING
SAMPLE
▲ BLOW COUNT
● MOISTURE CONTENT %
RQD% CORE REC%
0 50 100
INSTALLATION AND COMMENTS
80
85
90
95
100
105
110
115
120
(continued from previous page)
P200
P200 = 30%
Hard, gray CLAY (CL), trace sand; moist.
82.5
41
32
very stiff at 90.0 feet
25
Clay stuck on drill rod from 92.0 to 95.0 feet.
Very stiff, light gray CLAY (CH), trace sand; moist.
93.5
23
19
Exploration completed at a depth of 101.5 feet.
101.5
Surface elevation was not measured at the time of exploration.
Hammer efficiency factor is 87.0 percent.
0 50 100
DRILLED BY: Holt Services, Inc.
LOGGED BY: L. Gose
COMPLETED: 03/06/19
BORING METHOD: mud rotary (see document text)
BORING BIT DIAMETER:
GEODESIGN INC
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ARONFA-1-01
BORING B-1
(continued)
MARCH 2019
AURORA AIRPORT BUSINESS CENTER
AURORA, OR
FIGURE A-1
BORING LOG ARONFA-1-01.GPJ GEODESIGN.GDT PRINT DATE: 3/22/19:KM

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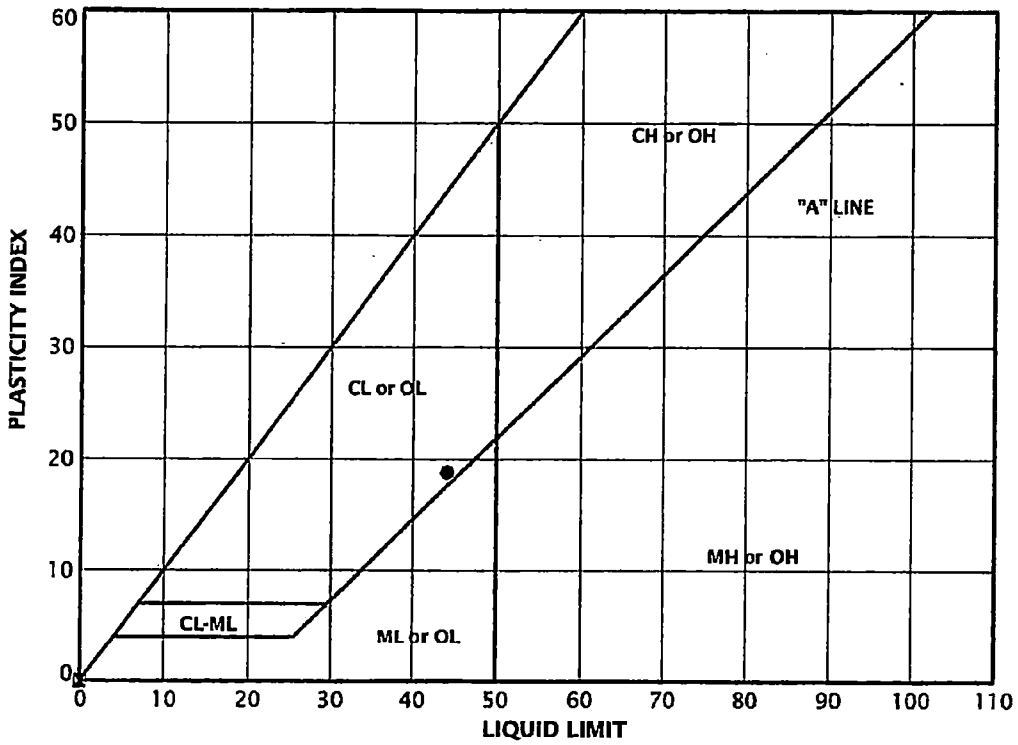

KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
●	B-1	5.0	45	44	25	19
▣	B-1	40.0	36	NP	NP	NP

ATTERBERG_LIMITS 7 ARONFA-1-01-B1.GPJ GEODESIGN.GDT PRINT DATE: 3/22/19:KM

GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	ARONFA-1-01	ATTERBERG LIMITS TEST RESULTS	
	MARCH 2019	AURORA AIRPORT BUSINESS CENTER AURORA, OR	FIGURE A-2

DRAFT

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-1	2.5		42							
B-1	5.0		45					44	25	19
B-1	7.5		42				84			
B-1	10.0		43							
B-1	15.0		32							
B-1	20.0		41				81			
B-1	25.0		33							
B-1	30.0		32							
B-1	35.0		30				55			
B-1	40.0		36					NP	NP	NP
B-1	50.0		33							
B-1	55.0		33							
B-1	65.0		24				17			
B-1	75.0		27							
B-1	80.0		28				30			
B-1	90.0		30							
B-1	95.0		36							

LAB SUMMARY ARONFA-1-01-81.GPJ GEODESIGN.GDT PRINT DATE: 3/22/19:KM

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Wilsonville OR 97070
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ARONFA-1-01

SUMMARY OF LABORATORY DATA

MARCH 2019

AURORA AIRPORT BUSINESS CENTER
AURORA, OR

FIGURE A-3

42.

Robert Miner Dynamic Testing, Inc.

Dynamic Measurements and Analyses for Deep Foundations

October 22, 2015

Mr. Dale Abernathy
Holt Services, Inc.
13000 Lakeholme Road Sw
Lakewood, WA 98498

Re: Penetration Test Energy Measurements
Bore Hole: 15-RD-01, October 19, 2015
Truck Mounted Rig 215, Mobile B60, 140lb ram, NW-J Rod
Seattle, Washington

RMDT Job No. 15F48

Dear Mr. Abernathy,

This letter presents energy transfer measurements made during Standard Penetration Tests for the drill hole and drill rig referenced above. Robert Miner Dynamic Testing, Inc. (RMDT) made dynamic measurements with a Pile Driving Analyzer® as a hammer advanced the NW rod during sampling with a split spoon sampler.

The purpose of RMDT's testing was the measurement of energy transferred to the drill rods. Measurements were made on a section of NW gauge rod at the top of the drill rod. Strain gages and accelerometers on the rod were connected to a Pile Driving Analyzer® (PDA) which generally processed acceleration and strain measurements from each hammer blow and stored both the measurements and computed results. Measurements and data processing generally followed the ASTM D 4633-10 standard. Energy transfer past the gage location, EFV, was computed by the PDA using force and velocity records as follows:

$$EFV = \int_a^b F(t)\ v(t)\ dt$$

The value "a" corresponds to the start of the record which is when the energy transfer begins and *"b"* is the time at which energy transferred to the rod reaches a maximum value. Appendix A contains more information on our measurement equipment and methods of analysis. The EFV energy calculation is identical to the EMX energy result discussed in Appendix A. The EFV and EMX values apply to the sensor location near the top of the rod.

TEST DETAILS

Testing occurred on October 19, 2015. Boring 15-RD-01 was advanced on the north shore of the Ballard Locks near of the locker room building of the Army Corps of Engineers Facility In Seattle, WA. During all measurements, a NW size rod was used to advance a standard split spoon sampler. The automatic hammer in use during our testing was manufactured by Mobile

Mailing Address: P.O. Box 340, Manchester, WA, 98353, USA **Phone:** 360-871-5480
Location: 2288 Colchester Dr. E., Ste A, Manchester, WA, 98353 **Fax:** 360-871-5483

Drill International and was reported to use a 140 lb ram. The drill rig was a truck-mounted Mobile B60 and referred to as Rig 215 by the operator (Licence No. WAB71109W) .

RESULTS

A summary of testing and monitoring results is given in Table 1. The tabulated results include the starting sample depth, the penetration resistance, the number of hammers blows in our data set, measured energy transfer, EFV, the computed transfer efficiency, ETR, and the hammer blow rate, BPM. Appendix B contains detailed numeric results for each individual test.

Energy measurements must be divided by the theoretical free fall energy of the hammer to obtain an efficiency. A 140 lb ram raised 30 inches above an impact surface has 350 lb-ft of potential energy. Thus, the transfer energy results for sampling with the 140 lb ram may be divided by 350 lb-ft to yield the ratio of the delivered energy to the nominal potential energy. This efficiency ratio, ETR, is given for each sample interval as a percent efficiency.

Table 1. Summary of Test Details and Results for the 140-lb ram and Split Spoon Sampler

Sample Name and Depth	Penetration Resistance (Blow/Set)	Number of Blows in Data Set	Average Transfer Energy EFV (lb-ft)	Average Transfer Efficiency ETR (percent)	Average Hammer Blow Rate BPM (blow/min)
27.5 ft Sample	5/1ft	5	299	85	39
35 ft Sample	4/1ft	4	297	85	45
45 ft Sample	35/1ft	35	303	87	45
55 ft Sample	32/1ft	32	305	87	49
60 ft Sample	32/1ft	31	310	89	44
Average for Split Spoon Samples:			**303**	**87**	**44**

5 sample returns were monitored while the 140 lb ram and standard split spoon sampler were in use. The overall average ETR and hammer blow rate was 87 percent and 44 blows per minute, respectively.

It was a pleasure to assist you and to participate on this project with the staff of Holt Services, Inc. Please do not hesitate to contact us if you or your client have any questions about this report.

Sincerely,

Robert Miner Dynamic Testing, Inc.



October 22, 2015

Andrew Banas, P.E.
Staff Engineer

ATTACHMENT B

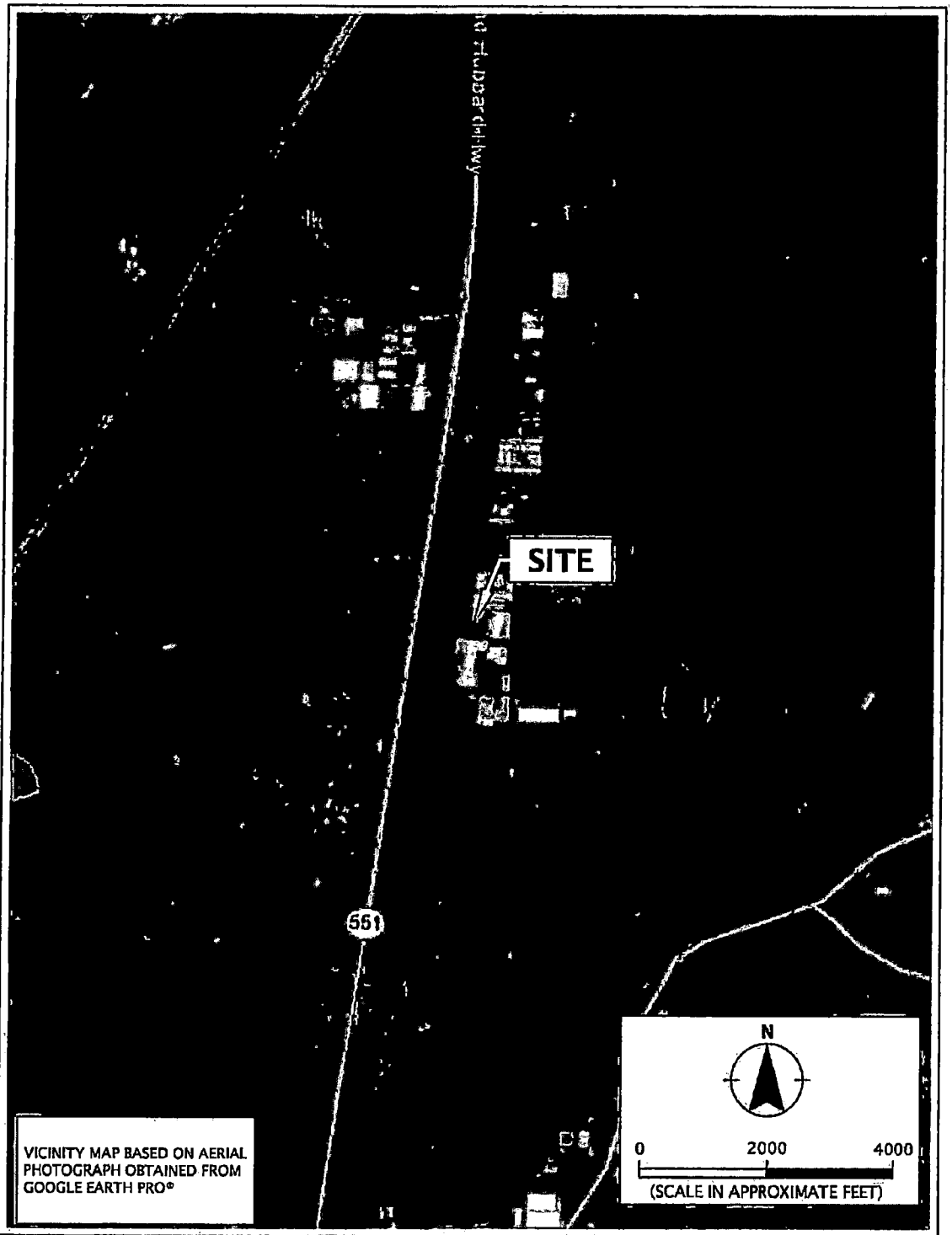
GEODESIGN INC

Memorandum

ATTACHMENT B

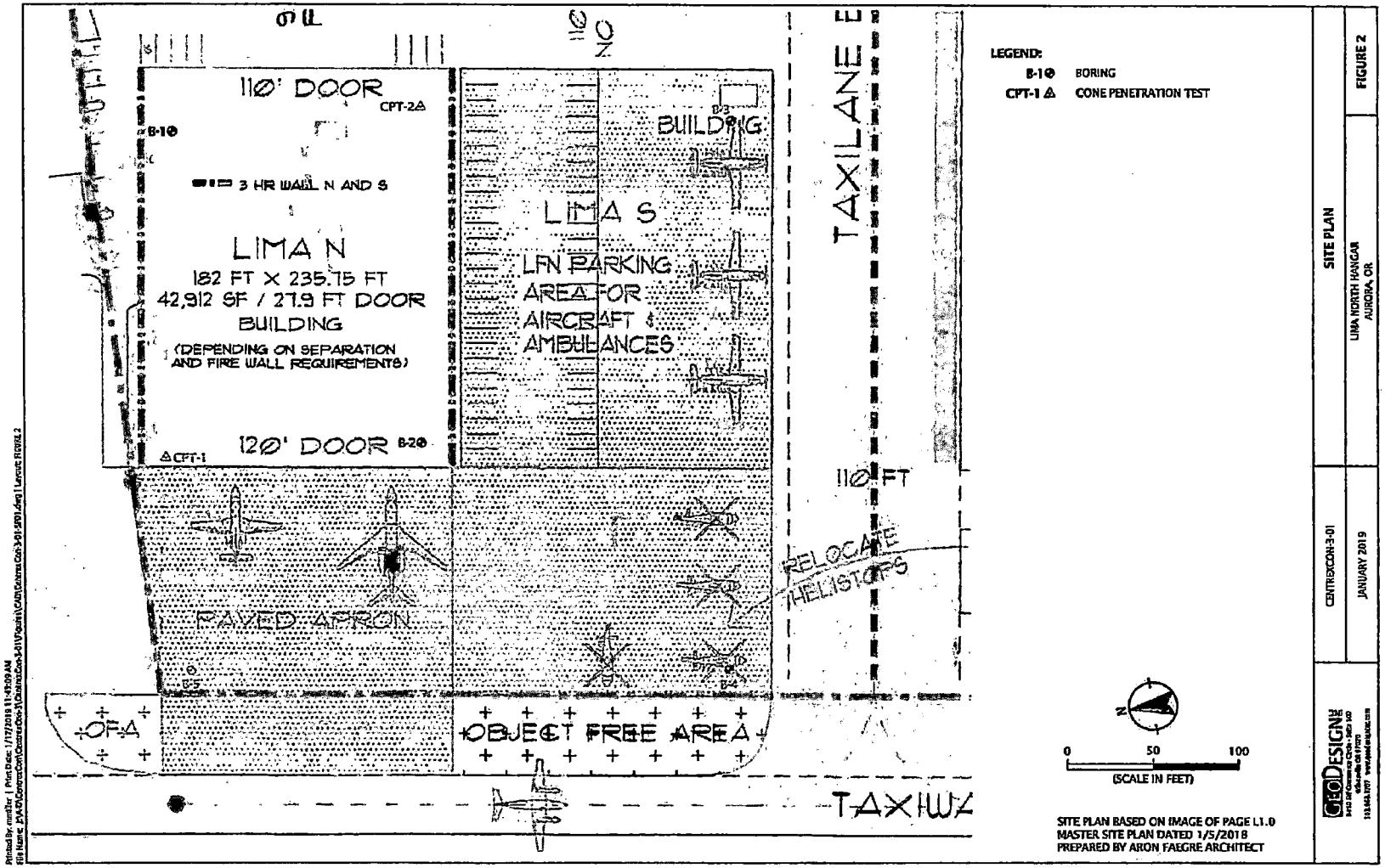
FIELD EXPLORATIONS (OFF SITE)

The boring logs and CPT probes completed on the nearby Lima North Hangar and fuel farm sites are presented in attachment. The locations of the sites relative to the AABC site are provided on Figure 1.



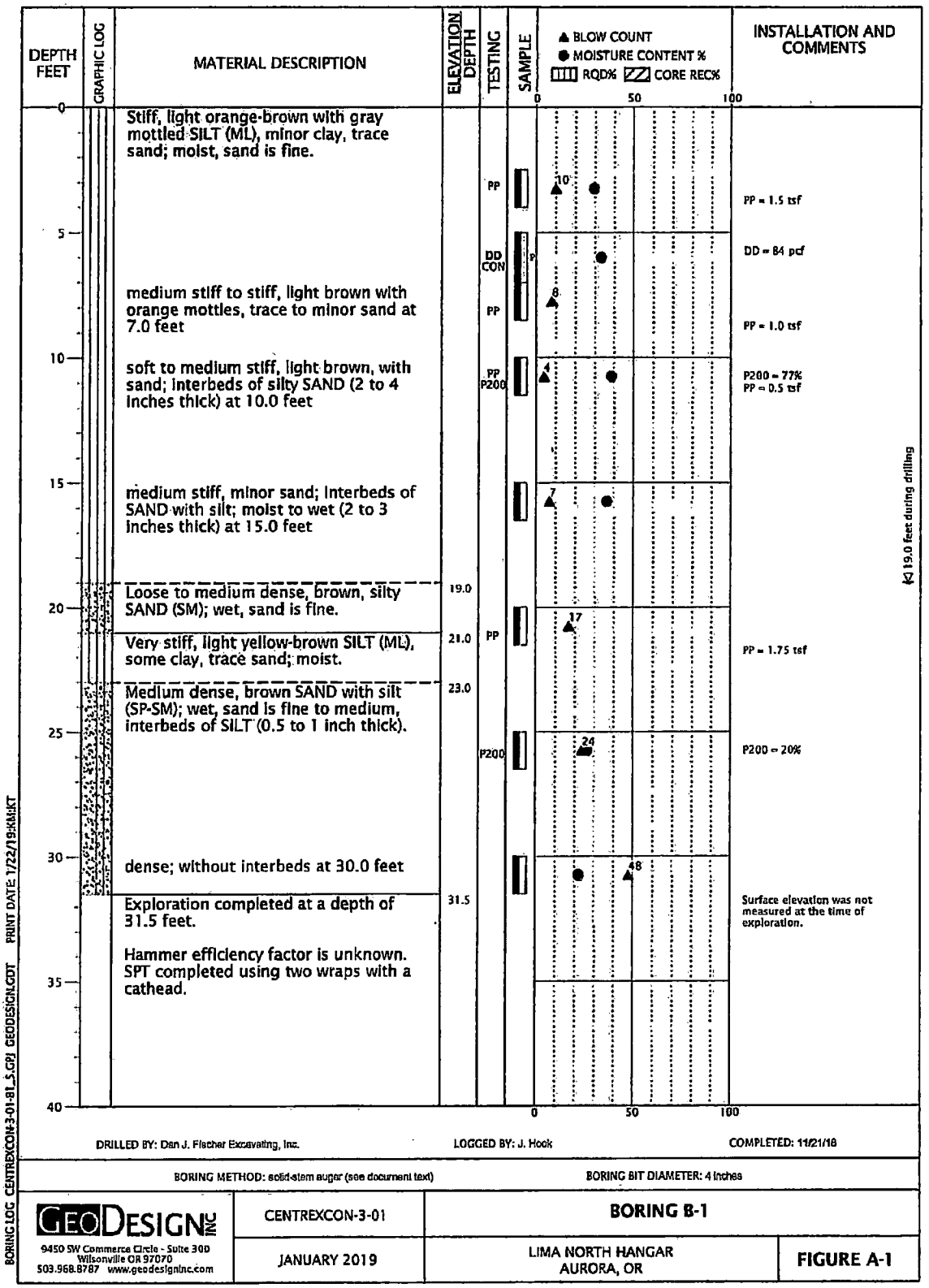
GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CENTREXCON-3-01	VICINITY MAP	
	JANUARY 2019	LIMA NORTH HANGAR AURORA, OR	FIGURE 1

Printed By: mmiller | Print Date: 1/17/2019 11:43:02 AM
File Name: J:\A-D\CentrexCon\CentrexCon-3\CentrexCon-3-01\Figures\CAD\CentrexCon-3-01-VM01.dwg | Layout: FIGURE 1


110' DOOR
CPT-2
B-1
3 HR WALL N AND S
LIMA N
182 FT X 235.75 FT
42,912 SF / 27.9 FT DOOR
BUILDING
(DEPENDING ON SEPARATION AND FIRE WALL REQUIREMENTS)
120' DOOR B-2
CPT-1
BUILDING
LIMA S
LFN PARKING AREA FOR AIRCRAFT & AMBULANCES
TAXILANE
110 FT
RELOCATE HELISTOPS
PAVED APRON
OFA
OBJECT FREE AREA
TAXIWAY
LEGEND:
B-1 BORING
CPT-1 CONE PENETRATION TEST
0 50 100
(SCALE IN FEET)
SITE PLAN BASED ON IMAGE OF PAGE L1.0
MASTER SITE PLAN DATED 1/5/2018
PREPARED BY ARON FAEGRE ARCHITECT
SITE PLAN
LIMA NORTH HANGAR
AURORA, OR
FIGURE 2
CENTRXCON-3-01
JANUARY 2019
GEODESIGN

6293

49


DEPTH FEET
GRAPHIC LOG
MATERIAL DESCRIPTION
ELEVATION DEPTH
TESTING
SAMPLE
▲ BLOW COUNT
● MOISTURE CONTENT %
RQD% CORE REC%
INSTALLATION AND COMMENTS
Stiff, light orange-brown with gray mottled SILT (ML), minor clay, trace sand; moist, sand is fine.
PP
PP = 1.5 tsf
DD CON
DD = 84 pcf
medium stiff to stiff, light brown with orange mottles, trace to minor sand at 7.0 feet
PP
PP = 1.0 tsf
soft to medium stiff, light brown, with sand; interbeds of silty SAND (2 to 4 inches thick) at 10.0 feet
PP P200
P200 = 77%
PP = 0.5 tsf
medium stiff, minor sand; interbeds of SAND with silt; moist to wet (2 to 3 inches thick) at 15.0 feet
19.0 feet during drilling
Loose to medium dense, brown, silty SAND (SM); wet, sand is fine.
19.0
Very stiff, light yellow-brown SILT (ML), some clay, trace sand; moist.
21.0
PP
PP = 1.75 tsf
Medium dense, brown SAND with silt (SP-SM); wet, sand is fine to medium, interbeds of SILT (0.5 to 1 inch thick).
23.0
P200
P200 = 20%
dense; without interbeds at 30.0 feet
Exploration completed at a depth of 31.5 feet.
31.5
Surface elevation was not measured at the time of exploration.
Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.
DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: J. Hook
COMPLETED: 11/21/18
BORING METHOD: solid-stem auger (see document text)
BORING BIT DIAMETER: 4 inches
BORING LOG CENTREXCON-3-01-B1_S.GPJ GEODESIGN.GDT PRINT DATE: 1/22/19:KM:KT
GEODESIGN INC
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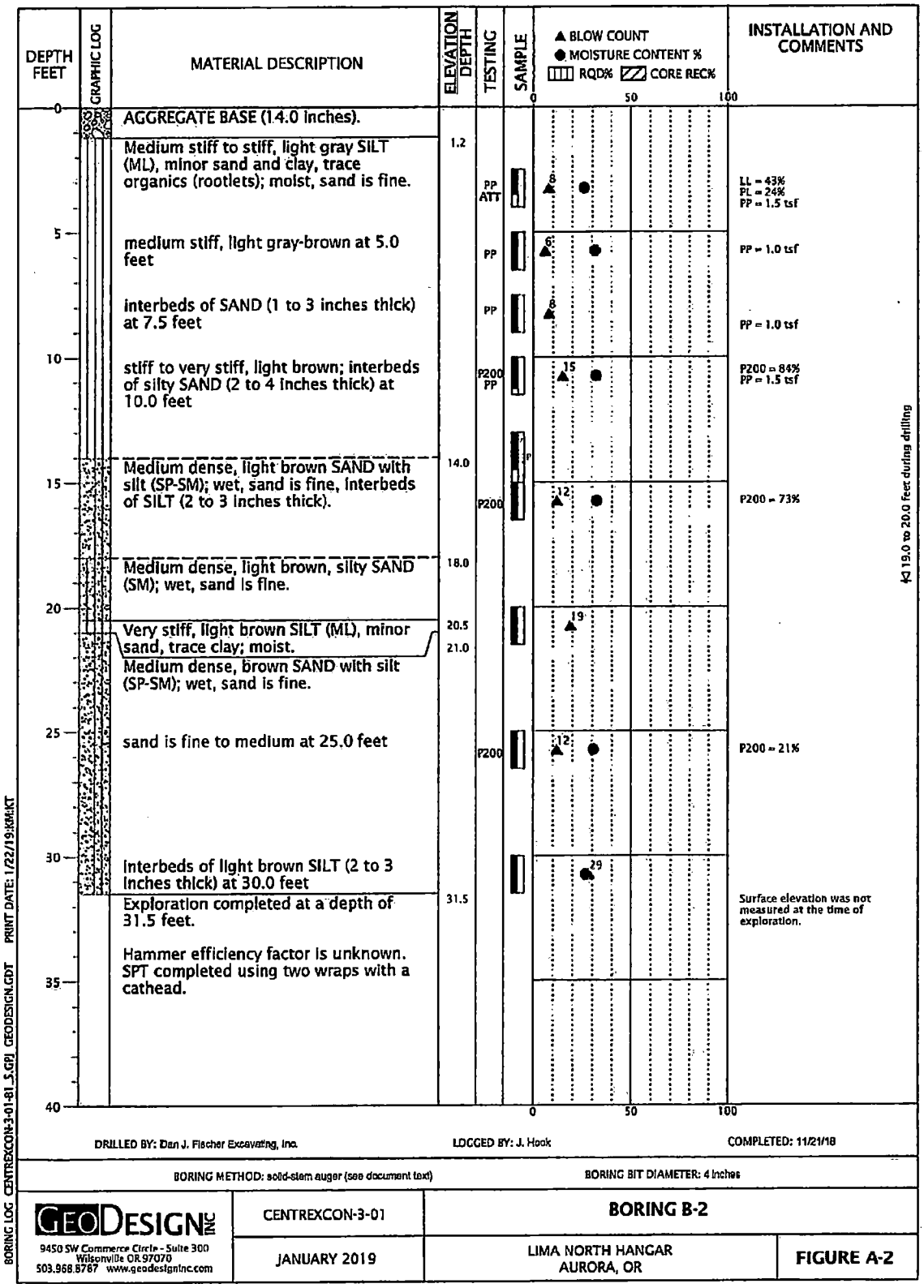
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com
CENTREXCON-3-01
BORING B-1
JANUARY 2019
LIMA NORTH HANGAR
AURORA, OR
FIGURE A-1


DEPTH FEET
GRAPHIC LOG
MATERIAL DESCRIPTION
ELEVATION DEPTH
TESTING
SAMPLE
▲ BLOW COUNT
● MOISTURE CONTENT %
RQD% CORE REC%
0
50
100
INSTALLATION AND COMMENTS
AGGREGATE BASE (14.0 inches).
1.2
Medium stiff to stiff, light gray SILT (ML), minor sand and clay, trace organics (rootlets); moist, sand is fine.
PP ATT
LL = 43%
PL = 24%
PP = 1.5 tsf
medium stiff, light gray-brown at 5.0 feet
PP
PP = 1.0 tsf
interbeds of SAND (1 to 3 inches thick) at 7.5 feet
PP
PP = 1.0 tsf
stiff to very stiff, light brown; interbeds of silty SAND (2 to 4 inches thick) at 10.0 feet
P200 PP
P200 = 84%
PP = 1.5 tsf
Medium dense, light brown SAND with silt (SP-SM); wet, sand is fine, interbeds of SILT (2 to 3 inches thick).
14.0
P200
P200 = 73%
Medium dense, light brown, silty SAND (SM); wet, sand is fine.
18.0
Very stiff, light brown SILT (ML), minor sand, trace clay; moist.
20.5
21.0
Medium dense, brown SAND with silt (SP-SM); wet, sand is fine.
sand is fine to medium at 25.0 feet
P200
P200 = 21%
Interbeds of light brown SILT (2 to 3 inches thick) at 30.0 feet
Exploration completed at a depth of 31.5 feet.
31.5
Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.
Surface elevation was not measured at the time of exploration.
19.0 to 20.0 feet during drilling
DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: J. Hook
COMPLETED: 11/21/18
BORING METHOD: solid-stem auger (see document text)
BORING BIT DIAMETER: 4 inches
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Wilsonville OR 97070
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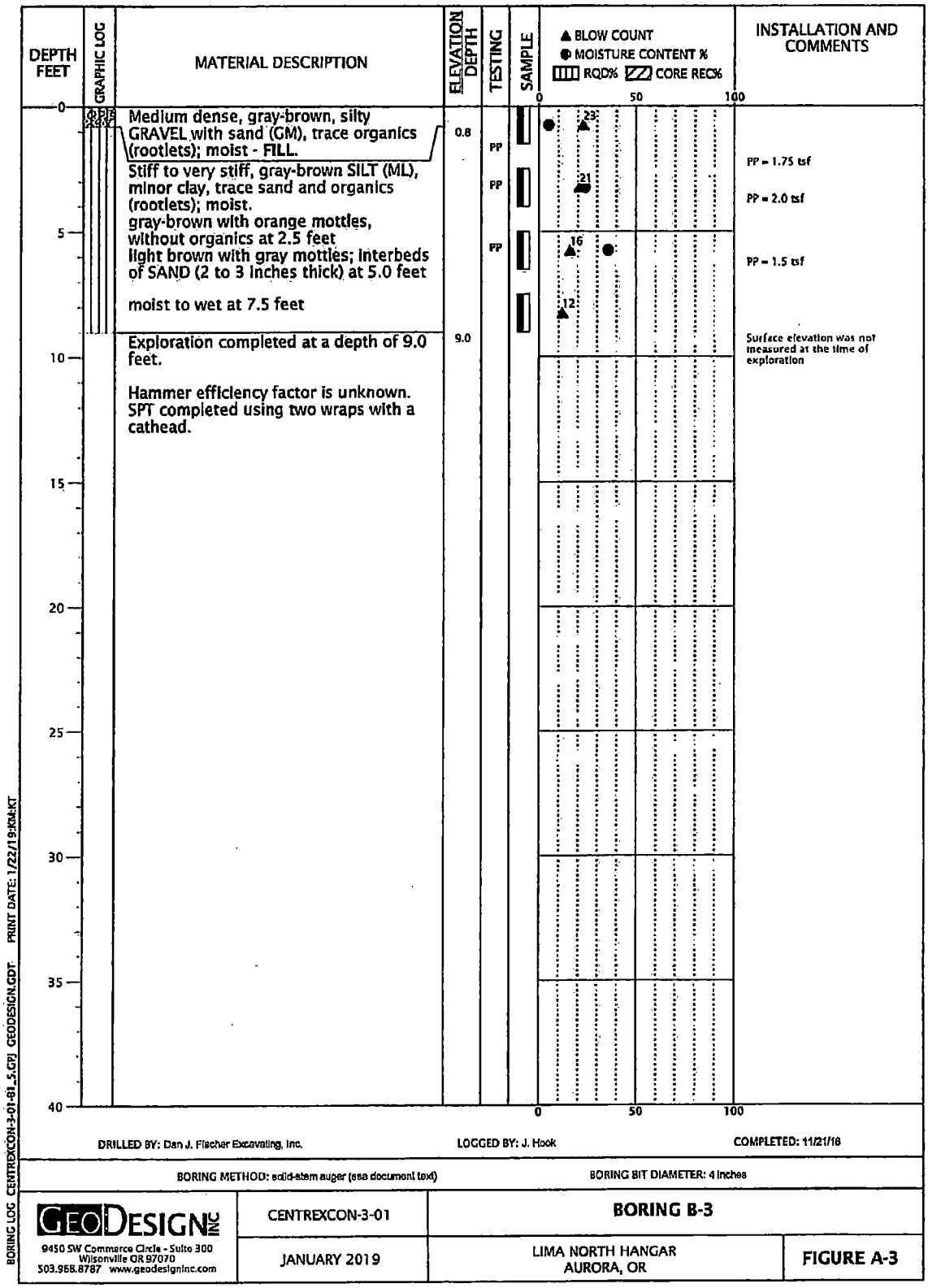
CENTREXCON-3-01
JANUARY 2019
BORING B-2
LIMA NORTH HANGAR
AURORA, OR
FIGURE A-2
BORING LOG CENTREXCON-3-01-B1_S.GPJ GEODESIGN.GDT PRINT DATE: 1/22/19:KMKT


DEPTH FEET
GRAPHIC LOG
MATERIAL DESCRIPTION
ELEVATION DEPTH
TESTING
SAMPLE
▲ BLOW COUNT
● MOISTURE CONTENT %
RQD% CORE REC%
0
50
100
INSTALLATION AND COMMENTS
Medium dense, gray-brown, silty GRAVEL with sand (GM), trace organics (rootlets); moist - FILL.
0.8
Stiff to very stiff, gray-brown SILT (ML), minor clay, trace sand and organics (rootlets); moist.
gray-brown with orange mottles, without organics at 2.5 feet
light brown with gray mottles; interbeds of SAND (2 to 3 inches thick) at 5.0 feet
moist to wet at 7.5 feet
Exploration completed at a depth of 9.0 feet.
9.0
Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.
PP
PP
PP
23
21
16
12
PP = 1.75 tsf
PP = 2.0 tsf
PP = 1.5 tsf
Surface elevation was not measured at the time of exploration
0
5
10
15
20
25
30
35
40
DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: J. Hook
COMPLETED: 11/21/18
BORING METHOD: solid-stem auger (see document text)
BORING BIT DIAMETER: 4 inches
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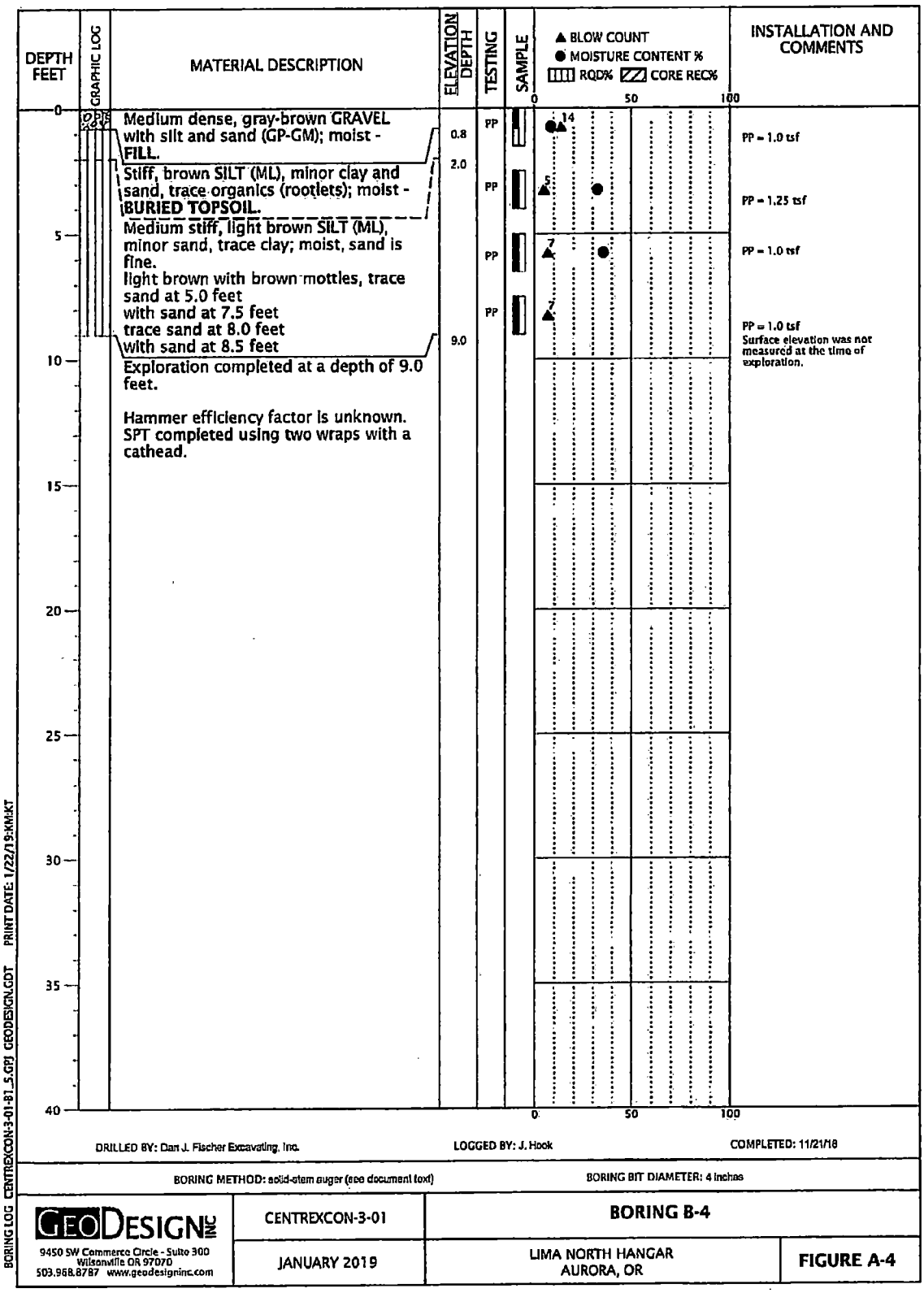
CENTREXCON-3-01
JANUARY 2019
BORING B-3
LIMA NORTH HANGAR
AURORA, OR
FIGURE A-3
BORING LOG CENTREXCON-3-01-B1_S.GPJ GEODESIGN.GDT PRINT DATE: 1/22/19:KM:KT


DEPTH FEET
GRAPHIC LOG
MATERIAL DESCRIPTION
ELEVATION DEPTH
TESTING
SAMPLE
▲ BLOW COUNT
● MOISTURE CONTENT %
RQD% CORE REC%
INSTALLATION AND COMMENTS
Medium dense, gray-brown GRAVEL with silt and sand (GP-GM); moist - FILL.
0.8
Stiff, brown SILT (ML), minor clay and sand, trace organics (rootlets); moist - BURIED TOPSOIL.
2.0
Medium stiff, light brown SILT (ML), minor sand, trace clay; moist, sand is fine.
light brown with brown mottles, trace sand at 5.0 feet
with sand at 7.5 feet
trace sand at 8.0 feet
with sand at 8.5 feet
9.0
Exploration completed at a depth of 9.0 feet.
Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.
PP = 1.0 tsf
PP = 1.25 tsf
PP = 1.0 tsf
PP = 1.0 tsf
Surface elevation was not measured at the time of exploration.
DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: J. Hook
COMPLETED: 11/21/18
BORING METHOD: solid-stem auger (see document text)
BORING BIT DIAMETER: 4 inches
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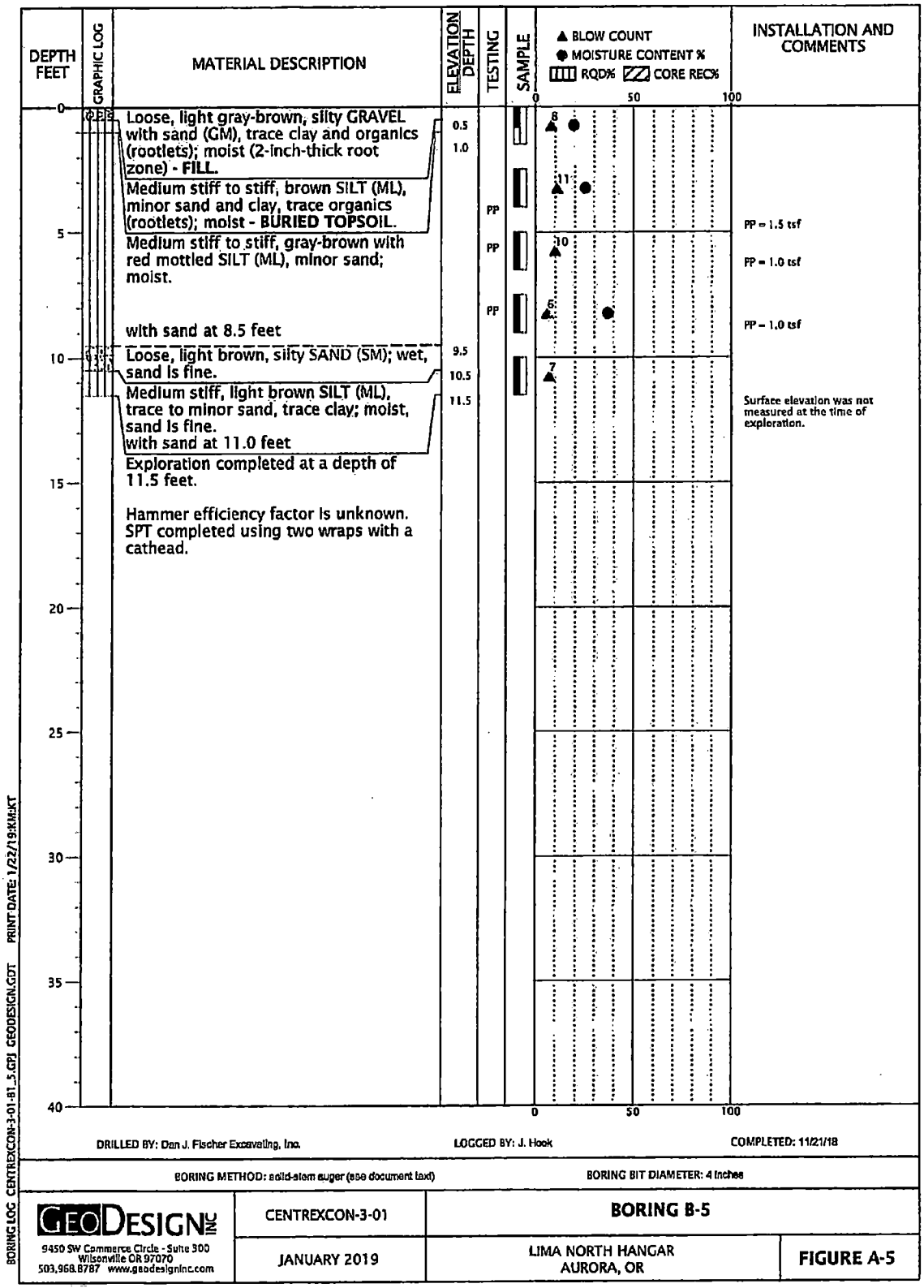
CENTREXCON-3-01
JANUARY 2019
BORING B-4
LIMA NORTH HANGAR AURORA, OR
FIGURE A-4
BORING LOG CENTREXCON-3-01-81_5.GPJ GEODESIGN.GDT PRINT DATE: 1/22/19:KM:KT


DEPTH FEET
GRAPHIC LOG
MATERIAL DESCRIPTION
ELEVATION DEPTH
TESTING
SAMPLE
▲ BLOW COUNT
● MOISTURE CONTENT %
RQD% CORE REC%
INSTALLATION AND COMMENTS
Loose, light gray-brown, silty GRAVEL with sand (GM), trace clay and organics (rootlets); moist (2-inch-thick root zone) - FILL.
0.5
1.0
Medium stiff to stiff, brown SILT (ML), minor sand and clay, trace organics (rootlets); moist - BURIED TOPSOIL.
Medium stiff to stiff, gray-brown with red mottled SILT (ML), minor sand; moist.
with sand at 8.5 feet
PP = 1.5 tsf
PP = 1.0 tsf
PP = 1.0 tsf
Loose, light brown, silty SAND (SM); wet, sand is fine.
9.5
10.5
Medium stiff, light brown SILT (ML), trace to minor sand, trace clay; moist, sand is fine.
with sand at 11.0 feet
11.5
Exploration completed at a depth of 11.5 feet.
Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.
Surface elevation was not measured at the time of exploration.
DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: J. Hook
COMPLETED: 11/21/18
BORING METHOD: solid-stem auger (see document text)
BORING BIT DIAMETER: 4 inches
GEODESIGN INC
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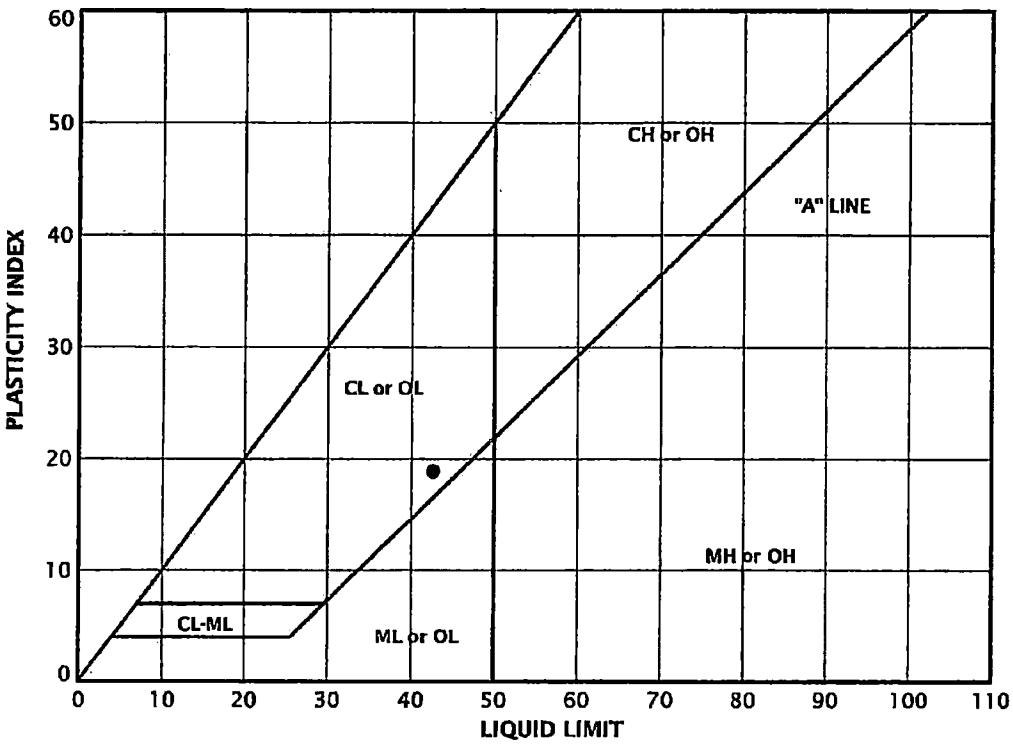
CENTREXCON-3-01
BORING B-5
JANUARY 2019
LIMA NORTH HANGAR
AURORA, OR
FIGURE A-5
BORING LOG CENTREXCON-3-01-B1_5.GPJ GEODESIGN.GDT PRINT DATE: 1/22/19:KMcKT



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
●	B-2	2.5	26	43	24	19

ATTERBERG_LIMITS 7 CENTREXCON-3-01-01_5.GPJ GEODESIGN.GDT PRINT DATE: 1/17/19:KM

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CENTREXCON-3-01

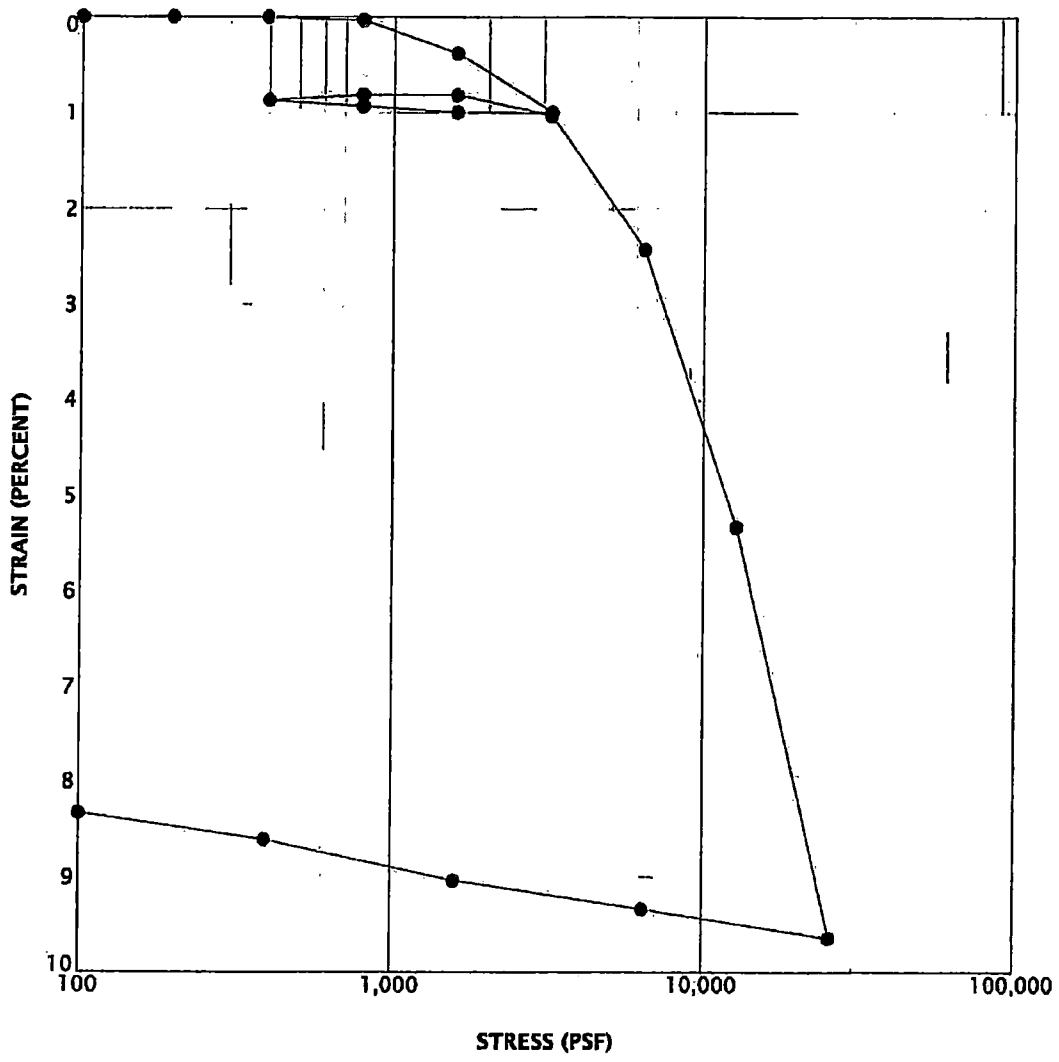
ATTERBERG LIMITS TEST RESULTS

JANUARY 2019

LIMA NORTH HANGAR
AURORA, OR

FIGURE A-6

55



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)
●	B-1	5.0	34	84

CONSOL_STRAIN_100K CENTREXCON-3-01-81_5.GPJ GEODESIGN.GDT PRINT DATE: 1/17/19:KM

GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CENTREXCON-3-01	CONSOLIDATION TEST RESULTS	
	JANUARY 2019	LIMA NORTH HANGAR AURORA, OR	FIGURE A-7

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-1	2.5		30							
B-1	5.0		34	84						
B-1	10.0		39				77			
B-1	15.0		37							
B-1	25.0		26				20			
B-1	30.0		22							
B-2	2.5		26					43	24	19
B-2	5.0		32							
B-2	10.0		32				84			
B-2	15.0		33				73			
B-2	25.0		31				21			
B-2	30.0		27							
B-3	0.0		5							
B-3	2.5		24							
B-3	5.0		36							
B-4	0.0		9							
B-4	2.5		33							
B-4	5.0		36							
B-5	0.0		20							
B-5	2.5		26							
B-5	7.5		37							

LAB SUMMARY CENTREXCON-3-01-81_5.GPJ GEODESIGN.GDT PRINT DATE: 1/17/19:KM

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CENTREXCON-3-01

SUMMARY OF LABORATORY DATA

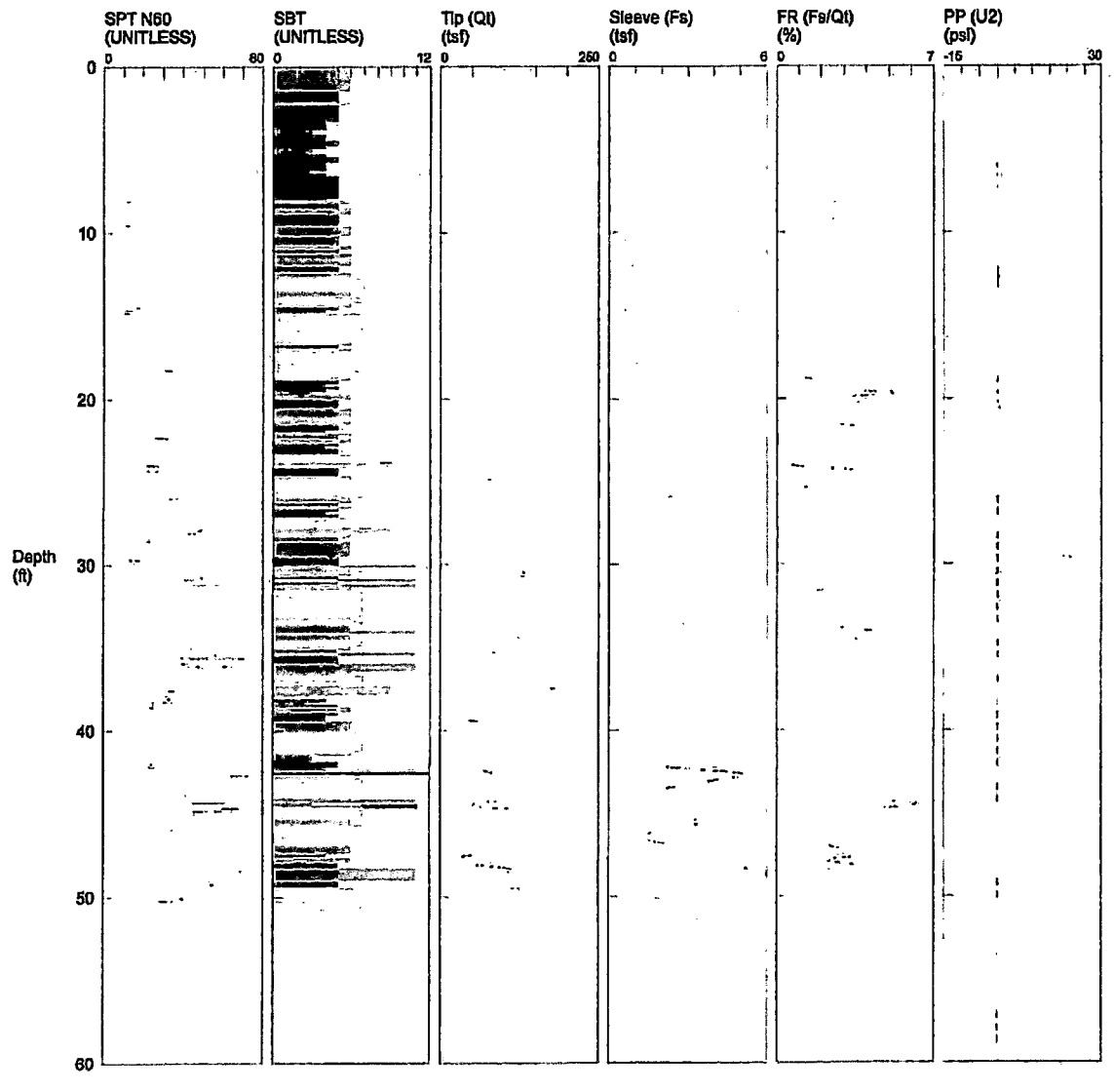
JANUARY 2019

LIMA NORTH HANGAR
AURORA, OR

FIGURE A-8

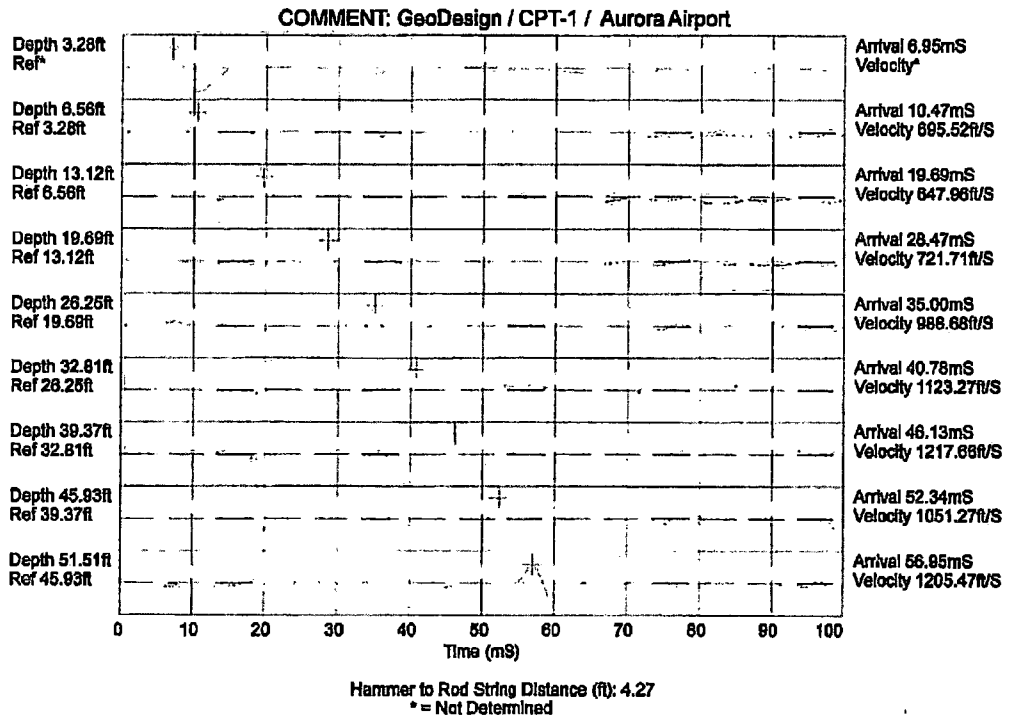
GeoDesign / CPT-1 / Aurora Airport

OPERATOR: OGE BAK
CONE ID: DPG1386
HOLE NUMBER: CPT-1
TEST DATE: 11/21/2018 8:52:39 AM
TOTAL DEPTH: 51.509 ft

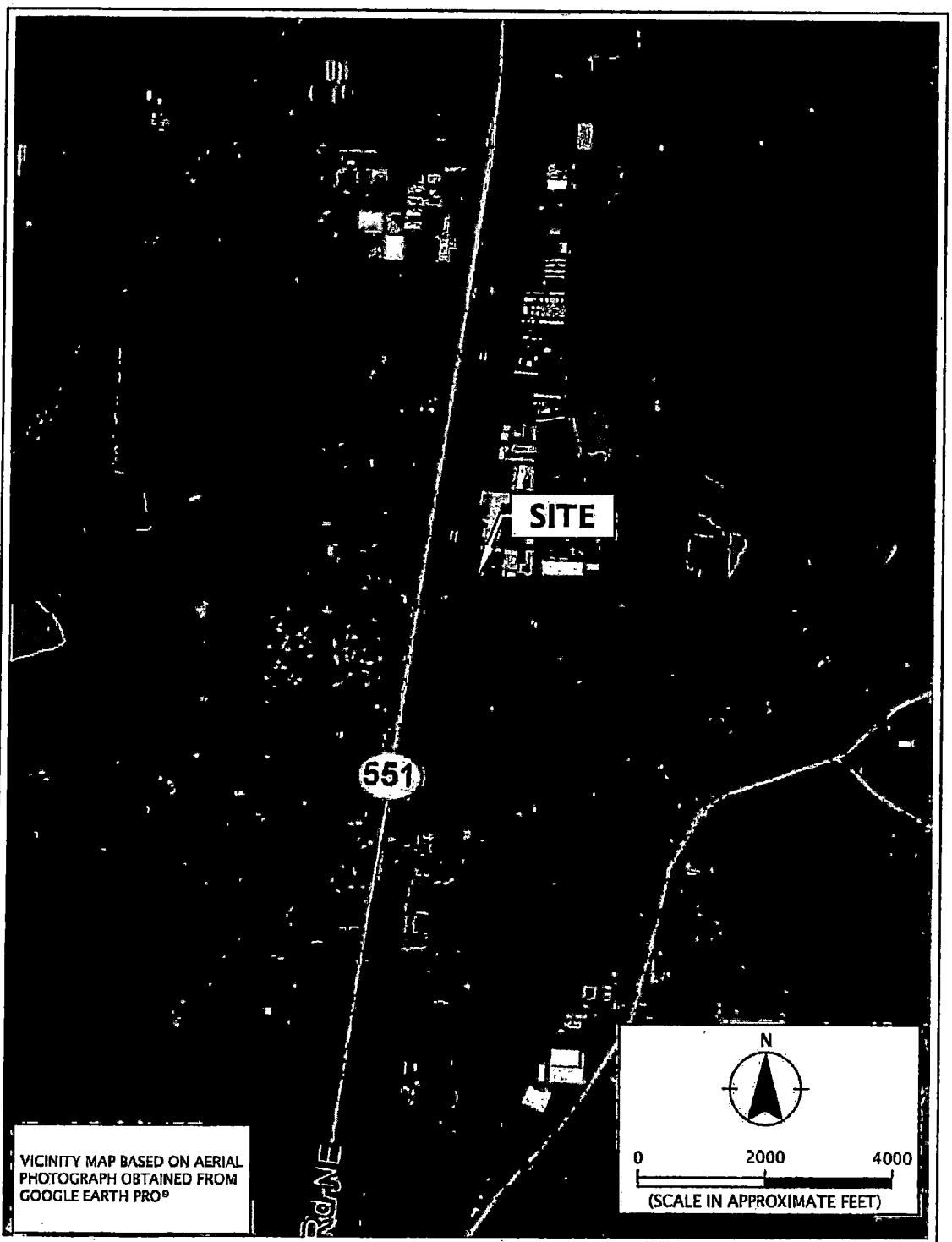


*SBT/SPT CORRELATION: UBC-1983

58

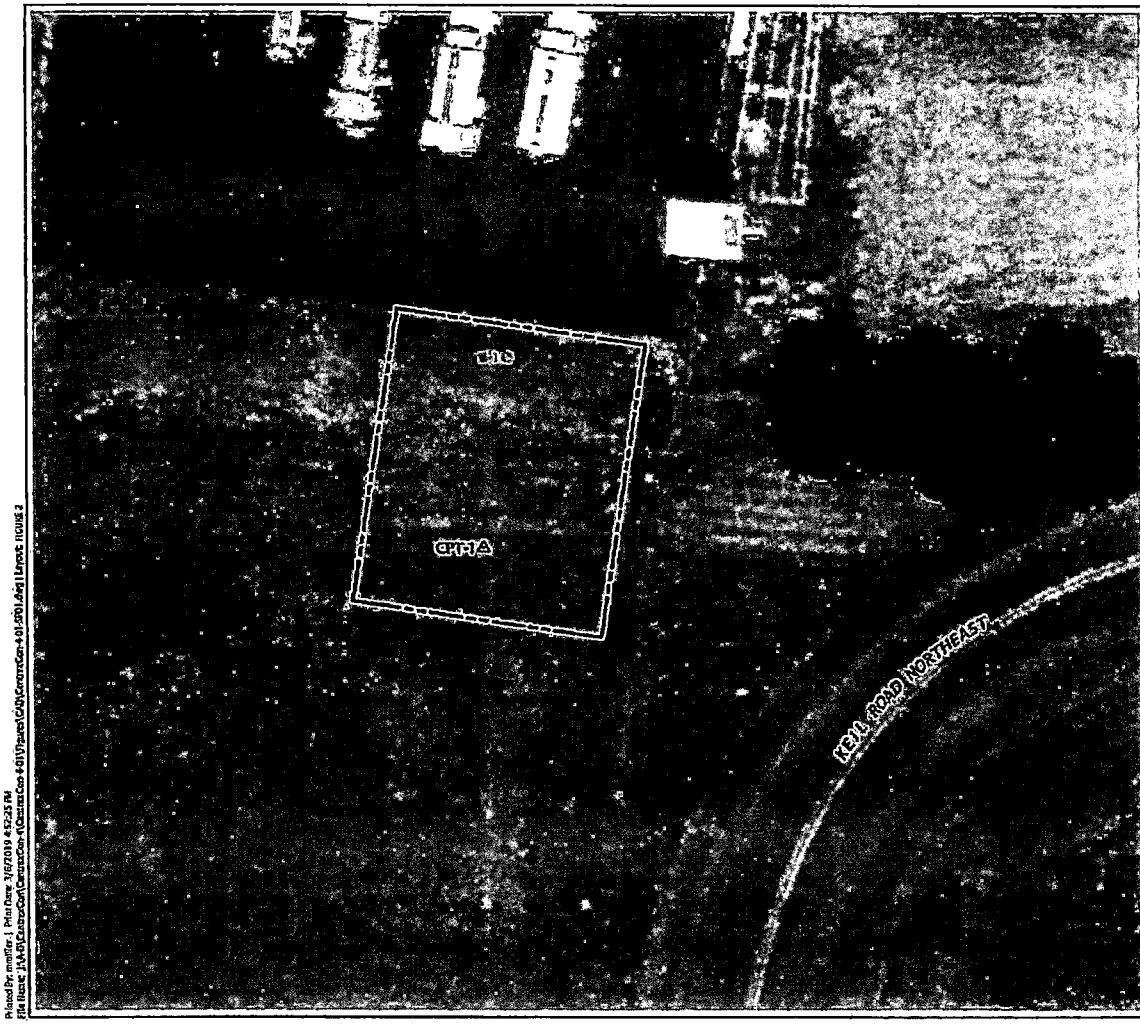

COMMENT: GeoDesign / CPT-1 / Aurora Airport
Depth 3.28ft
Ref*
Arrival 6.95mS
Velocity*
Depth 6.56ft
Ref 3.28ft
Arrival 10.47mS
Velocity 695.52ft/S
Depth 13.12ft
Ref 6.56ft
Arrival 19.69mS
Velocity 647.96ft/S
Depth 19.69ft
Ref 13.12ft
Arrival 28.47mS
Velocity 721.71ft/S
Depth 26.25ft
Ref 19.69ft
Arrival 35.00mS
Velocity 988.68ft/S
Depth 32.81ft
Ref 26.25ft
Arrival 40.78mS
Velocity 1123.27ft/S
Depth 39.37ft
Ref 32.81ft
Arrival 46.13mS
Velocity 1217.66ft/S
Depth 45.93ft
Ref 39.37ft
Arrival 52.34mS
Velocity 1051.27ft/S
Depth 51.51ft
Ref 45.93ft
Arrival 56.95mS
Velocity 1205.47ft/S
0
10
20
30
40
50
60
70
80
90
100
Time (mS)
Hammer to Rod String Distance (ft): 4.27
* = Not Determined

59



GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CENTEREXCON-4-01	VICINITY MAP
	MARCH 2019	AURORA AIRPORT FUEL FARM AURORA, OR — FIGURE 1

Printed By: mmiller | Print Date: 3/6/2019 4:52:23 PM
File Name: J:\A-D\CentrexCon\CentrexCon-4\CentrexCon-4-01\Figures\CAD\CentrexCon-4-01-VM01.dwg | Layout: FIGURE 1



LEGEND:

— — —	SITE BOUNDARY
B-1	BORING
CPT-1	CONE PENETRATION TEST

N

0 20 40

(SCALE IN FEET)

SITE PLAN BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®, MARCH 6, 2019

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CENTEREXCON-4-01

MARCH 2019

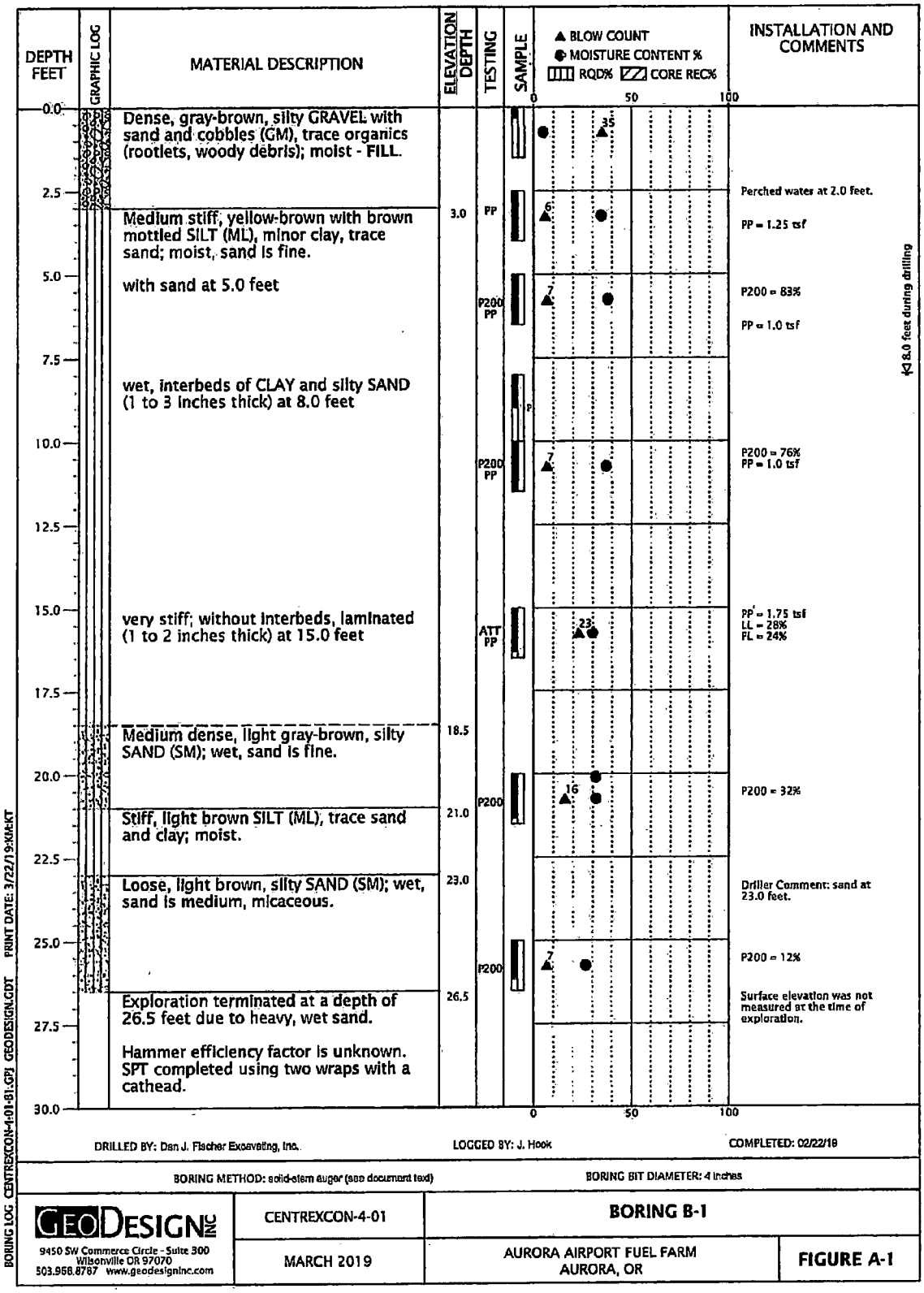
SITE PLAN

AURORA AIRPORT FUEL FARM
AURORA, OR

FIGURE 2

Printed By: mmiller-1 Print Date: 3/6/2019 4:52:25 PM
File Name: J:\A-D\CentrexCon\CentrexCon-4\CentrexCon-4-01\Figures\CAD\CentrexCon-4-01-SP01.dwg | Layout: FIGURE 2

6305


DEPTH FEET
GRAPHIC LOG
MATERIAL DESCRIPTION
ELEVATION DEPTH
TESTING
SAMPLE
▲ BLOW COUNT
● MOISTURE CONTENT %
RQD% CORE REC%
INSTALLATION AND COMMENTS
Dense, gray-brown, silty GRAVEL with sand and cobbles (GM), trace organics (rootlets, woody debris); moist - FILL.
Perched water at 2.0 feet.
Medium stiff, yellow-brown with brown mottled SILT (ML), minor clay, trace sand; moist, sand is fine.
3.0
PP
PP = 1.25 tsf
with sand at 5.0 feet
P200 PP
P200 = 83%
PP = 1.0 tsf
8.0 feet during drilling
wet, interbeds of CLAY and silty SAND (1 to 3 inches thick) at 8.0 feet
P200 PP
P200 = 76%
PP = 1.0 tsf
very stiff; without interbeds, laminated (1 to 2 inches thick) at 15.0 feet
ATT PP
PP = 1.75 tsf
LL = 28%
PL = 24%
Medium dense, light gray-brown, silty SAND (SM); wet, sand is fine.
18.5
P200
P200 = 32%
Stiff, light brown SILT (ML), trace sand and clay; moist.
21.0
Loose, light brown, silty SAND (SM); wet, sand is medium, micaceous.
23.0
Driller Comment: sand at 23.0 feet.
P200
P200 = 12%
Exploration terminated at a depth of 26.5 feet due to heavy, wet sand.
26.5
Surface elevation was not measured at the time of exploration.
Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.
DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: J. Hook
COMPLETED: 02/22/19
BORING METHOD: solid-stem auger (see document text)
BORING BIT DIAMETER: 4 inches
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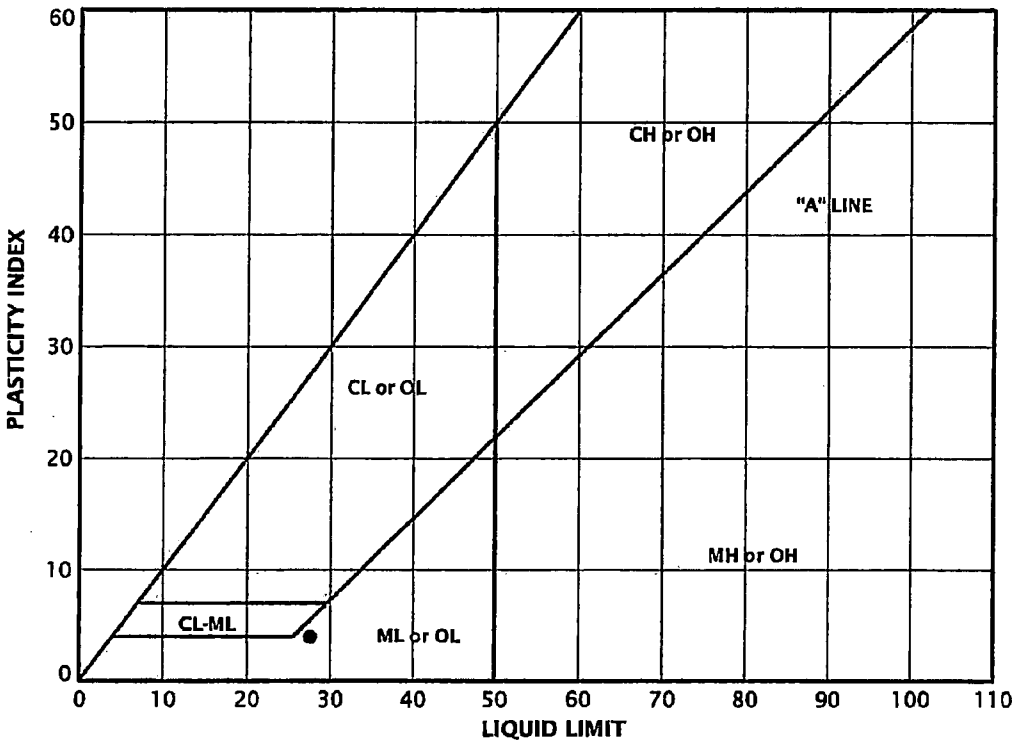
CENTREXCON-4-01
BORING B-1
MARCH 2019
AURORA AIRPORT FUEL FARM
AURORA, OR
FIGURE A-1
BORING LOG CENTREXCON-4-01-B1.GPJ GEODESIGN.GDT PRINT DATE: 3/22/19 KM-KT



KEY	EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	MOISTURE CONTENT (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
●	B-1	15.0	30	28	24	4

ATTERBERG_LIMITS 7 CENTREXCON-4-01-81.GPJ GEODESIGN.GDT PRINT DATE: 3/13/19:KM

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CENTREXCON-4-01	ATTERBERG LIMITS TEST RESULTS	
MARCH 2019	AURORA AIRPORT FUEL FARM AURORA, OR	FIGURE A-2

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-1	0.0		5							
B-1	2.5		35							
B-1	5.0		38				83			
B-1	10.0		37				76			
B-1	15.0		30					28	24	4
B-1	20.0		32				32			
B-1	20.1		32							
B-1	25.0		27				12			

LAB SUMMARY CENTREXCON-4-01-B1.GBJ GEODESIGN.GDT PRINT DATE: 3/13/19:KM

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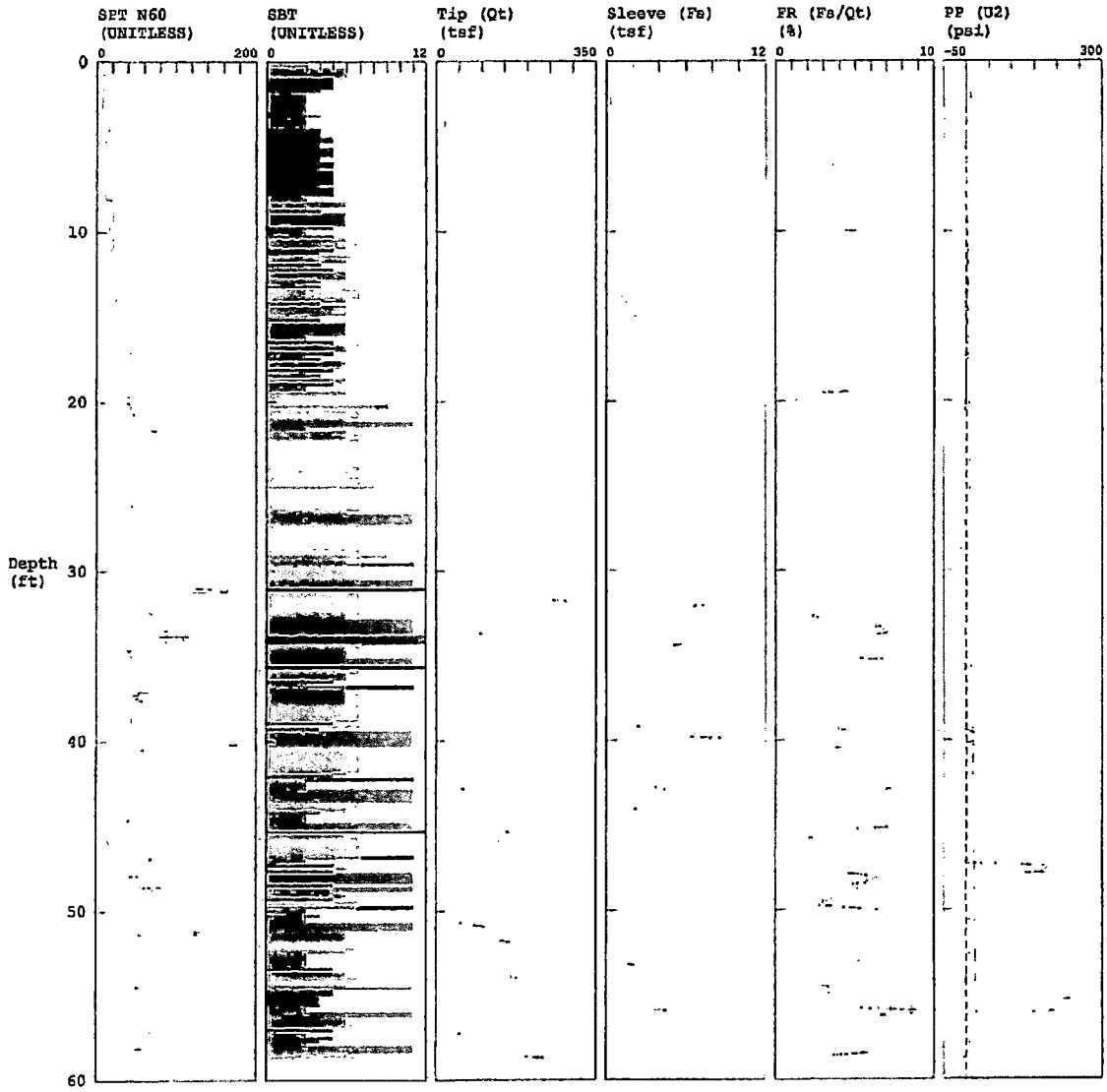
CENTREXCON-4-01	SUMMARY OF LABORATORY DATA	
MARCH 2019	AURORA AIRPORT FUEL FARM AURORA, OR	FIGURE A-3

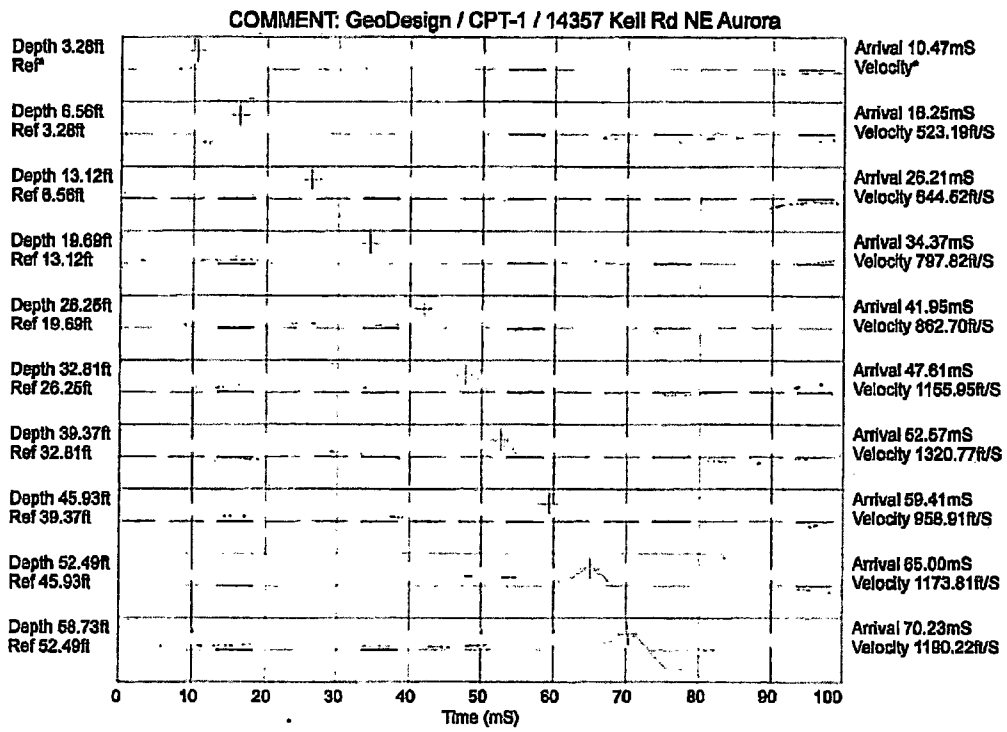
GeoDesign / CPT-1 / 14357 Keil Rd NE Aurora

OPERATOR: OGE DMM
CONE ID: DPG1323
HOLE NUMBER: CPT-1
TEST DATE: 2/18/2019 8:34:35 AM
TOTAL DEPTH: 58.727 ft



1 sensitive fine grained
2 organic material
3 clay
4 silty clay to clay
5 clayey silt to silty cl
6 sandy silt to clayey s
7 silty sand to sandy si
8 sand to silty sand
9 sand
10 gravelly sand to sand
11 very stiff fine grained (*)
12 sand to clayey sand (*)

*SBT/SPT CORRELATION: UBC-1983



Hammer to Rod String Distance (ft): 1.97
* = Not Determined

ATTACHMENT C

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ATTACHMENT C

SITE-SPECIFIC SEISMIC HAZARD EVALUATION

INTRODUCTION

The information in this attachment summarizes the results of a site-specific seismic hazard evaluation for the proposed fuel farm at the Aurora Airport in Aurora, Oregon. This seismic hazard evaluation was performed in accordance with the requirements ASCE 7-16. We understand the project will consist of new fuel tanks within an approximately 3,000-square-foot area on the southern portion of the airport.

SITE CONDITIONS

REGIONAL GEOLOGY AND SUBSURFACE CONDITIONS

The regional geology in the area and site subsurface conditions are discussed in the fuel farm report.

SEISMIC SETTING

Earthquake Source Zones

Three scenario earthquakes were considered for this study consistent with the local seismic setting. Two of the possible earthquake sources are associated with the Cascadia subduction zone (CSZ), and the third event is a shallow, local crustal earthquake that could occur in the North American Plate. The three earthquake scenarios are discussed below.

Regional Events

The CSZ is the region where the Juan de Fuca Plate is being subducted beneath the North American Plate. This subduction is occurring in the coastal region between Vancouver Island and northern California. Evidence has accumulated suggesting that this subduction zone has generated eight great earthquakes in the last 4,000 years, with the most recent event occurring approximately 300 years ago (Weaver and Shedlock, 1991). The fault trace is mapped approximately 50 to 120 kilometers (km) off the Washington Coast.

Two types of subduction zone earthquakes are possible and considered in this study:

1. An interface event earthquake on the seismogenic part of the interface between the Juan de Fuca Plate and the North American Plate on the CSZ. This source is capable of generating earthquakes with a moment magnitude M_w 9.0 or greater.
2. A deep intraplate earthquake on the seismogenic part of the subducting Juan de Fuca Plate. These events typically occur at depths of between 30 and 60 km. This source is capable of generating an event with a moment magnitude of up to 8.0.

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Local Events

An earthquake could occur on a local fault near the site within the design life of the facility. Figure C-1 shows the locations of faults with potential Quaternary movement within a 20-mile radius of the site. Figure C-2 shows the interpreted locations of seismic events that occurred between 1833 and 2014 (USGS, 2014). The closest local faults in the site vicinity are the Canby-Molalla and Newberg faults. Table C-1 presents the closest mapped distance and mapped length of these faults.

Table C-1. Significant Crustal Faults

Source	Closest Mapped Distance[1] (miles)	Mapped Length[1] (km)
Canby-Molalla	5.5	50
Newberg	9.5	5

1. Reported by the U.S. Geological Survey (USGS, 2019)

CODE-BASED SEISMIC DESIGN PARAMETERS

Due to the potential for minor liquefaction, the site is considered a Site Class F. ASCE 7-16 Section 20.3.1 requires a site-specific ground motion analysis be completed for structures with a fundamental period (T) greater than 0.5 second that are located within a Site Class F. If structures have a fundamental period of less than 0.5 second, seismic design parameters can be determined using the pre-liquefaction class. Structural elements for the project are expected to have fundamental period of less than 0.5 second; however, the project will house explosive substances and the airport will likely be a used as a critical facility after a seismic event. A site-specific seismic evaluation has been requested irrespective of the fundamental period of the structures.

If code-based parameters were used, a site classification of D would be appropriate based on shear wave velocity testing in CPT-1. Code-based seismic design criteria in accordance with ASCE 7-16 are summarized in Table C-2.

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Table C-2. Seismic Design Parameters

Seismic Design Parameter	Short Period (T_s = 0.2 second)	1 Second Period (T_1 = 1.0 second)
MCE Spectral Acceleration	S_s = 0.808 g	S_1 = 0.380 g
Site Class	D	
Site Coefficient	F_a = 1.177	F_v = 1.92
Adjusted Spectral Acceleration	S_{MS} = 0.951 g	S_{M1} = 0.730 g
Design Spectral Response Acceleration Parameters	S_{DS} = 0.634 g	S_{D1} = 0.487 g

Parameters correspond to Site Class D per ASCE 7-16. A site-specific analysis is required for the project.
g: gravitational acceleration (32.2 feet/second^2)
MCE: maximum considered earthquake

SITE RESPONSE ANALYSIS

RISK TARGETED BEDROCK SPECTRUM

A probabilistic bedrock spectrum for the site was determined using the computer program EZ-FRISK 8.0 and the 2014 USGS fault source parameters. The ground motion models and weighting in the analysis are consistent with the 2014 USGS fault source parameters. Near-source effects were included in the analysis per Bayless and Somerville (2013). We determined the spectral accelerations for the outcropping bedrock response spectrum for periods ranging from 0 to 10 seconds. The response spectrum is consistent with a shear wave velocity equal to 760 meters per second. Table C-3 presents a summary of values used to compute the MCE target bedrock response spectrum.

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Table C-3. Target Bedrock Spectrum

Period (seconds)	MCE Target Bedrock Spectral Acceleration (g)
0.01	0.369
0.02	0.391
0.03	0.422
0.05	0.495
0.075	0.644
0.1	0.764
0.15	0.842
0.2	0.808
0.25	0.749
0.3	0.704
0.4	0.615
0.5	0.534
0.75	0.409
1	0.334
1.5	0.235
2	0.181
3	0.116
4	0.0873
5	0.0667
7.5	0.0397
10	0.0294

BASE GROUND MOTIONS

Six recorded base ground motions were selected to represent the local seismic setting. Based on deaggregation at the peak ground acceleration, ground motions are generally equally controlled by CSZ (approximately 55 percent) and crustal events (approximately 40 percent of hazard, predominately gridded sources). The remainder is deep background seismicity. Based on the deaggregation results, we selected three time histories for the CSZ and three time histories for the crustal event. Table C-4 provides the ground motions selected for this study. The base motions were spectrally matched to the MCE target spectrum using EZ-FRISK 8.0.

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Table C-4. Selected Ground Motions

Ground Motion/Recording Station	Magnitude	Distance (km)	Component
CSZ Zone Records			
Tohoku - Tsukuba City Hall	9.0	106.9	004
Maule - Curico Hospital	8.8	76.3	EW
Tokachi-oki - Estacion de Medicisn	8.29	65.8	EW
Crustal Zone Records			
Chi-Chi, Taiwan - CHY065	7.62	9	E
Kobe, Japan - Abeno	6.9	1.0	000
Darfield, New Zealand - DFHS	7.0	11.86	S73W

SITE CONDITION MODELING

A non-linear seismic site response analysis was conducted on the six spectrally matched acceleration time histories to determine the site response. The site response analysis was performed using DEEPSOIL version 7.0 software and the soil parameters described in Table C-5. As part of our analysis both effect stress analysis (ESA) and total stress analysis (TSA) were completed.

The input soil models used in analysis are based on the findings of our subsurface exploration program, shear wave velocity testing from the CPT, a review of well logs, and our experience in the site vicinity.

Three cases were analyzed for each profile to capture the epistemic uncertainty at the site. Profile 1 used the shear wave velocities in Table C-5. Profile 2 reduced the shear wave velocities in Table C-5 at the site by 20 percent (i.e., divide by 1.25). Profile 3 increased the shear wave velocities in Table C-5 by 25 percent (i.e., multiply by 1.25). A weighted average of the results of the site response (Profile 1 = 0.6, Profile 2 = 0.2, and Profile 3 = 0.2) were taken as the site response spectra for the site.

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Table C-5. Input Soil Profile

Depth Interval (feet)	Subsurface Unit	Shear Wave Velocity (fps)	Modulus Reduction Curve	Damping Curve	Pore Water Pressure Model
0 to 10	Silt and Clay	550 to 600	Vucetic and Dobry, 1991	Vucetic and Dobry, 1991	Pacific NW Silt (Dickenson, unpublished)
10 to 20	Silty Sand to Sandy Silt	600 to 800	Vucetic and Dobry, 1991	Vucetic and Dobry, 1991	Pacific NW Silt (Dickenson, unpublished)
20 to 32	Sand	850 to 1,200	Seed and Idriss, 1970	Seed and Idriss, 1970	Herber Road Sand PB (Vucetic and Dobry 1988)
32 to 44	Sandy Silt	1,000 to 1,200	Vucetic and Dobry, 1991	Vucetic and Dobry, 1991	Pacific NW Silt (Dickenson, unpublished)
44 to 60	Sandy Clay	1,200	Vucetic and Dobry, 1991	Vucetic and Dobry, 1991	Pacific NW Silt (Dickenson, unpublished)
60 to 100	Sand	1,200 to 1,300	Seed and Idriss, 1970	Seed and Idriss, 1970	Santa Monica Beach Sand (Matasovic 1993)
100 to 400[1]	Clay	1,300	Vucetic and Dobry, 1991	Vucetic and Dobry, 1991	Warrenton, Oregon, Silt (Dickenson, 2008)

1. Input ground motion is at a depth of 400 feet.
2. Groundwater assumed at a depth of 8 feet below ground surface.

fps: feet per second

Because the ground motion models used in the hazard calculation compute the average horizontal component of ground motions, scale factors were applied to adjust the site response results to the maximum rotated component as described in ASCE 7-16 (C21.2). According to ASCE 7-16 Supplement 1, a scale factor of 1.1 should be used for periods of 0.2 second and shorter, a scale factor of 1.3 should be used for periods of 1.0 second, and a scale factor of 1.5 was used for periods greater than 5.0 seconds (with averaging in between 0.2 and 1.0 second and between 1.0 second and 1.5 seconds).

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The results of the site response were also modified with risk coefficients using Method 2 outlined in ASCE 7-16 Section 21.2.1.2. The intent of this is to achieve a uniform 1 percent probability of collapse in a 50-year period. A risk coefficient of $C_{RS} = 0.884$ was applied to the spectrum at periods of 0.2 second or less and a risk coefficient of $C_{R1} = 0.875$ was applied to the spectrum at periods greater than 1.0 second. Linear interpolation was used to compute risk coefficients between periods of 0.2 and 1.0 second.

The acceleration response spectra for the ESA and TSA with maximum rotated component and risk coefficients are presented on Figure C-3. Because only minor liquefaction occurs the TSA and ESA spectra are very similar. The upper envelope of the TSA and ESA was used as the project site response spectrum as shown in Figure C-3.

PROBABILISTIC MCE_R RESPONSE SPECTRUM

Per ASCE 7-16 Section 21.1.3, the recommended probabilistic seismic hazard analysis site-specific MCE_R shall not be lower than the MCE_R response spectrum of the base motion multiplied by the average spectral amplitude ratio (SAR) obtained from the site response analysis. The SAR for the site is shown on Figure C-4. The upper envelope of the TSA and ESA events were multiplied by the SAR to determine the MCE_R. Figure C-5 provides the probabilistic site-specific MCE_R spectrum for the site (upper envelope of SAR multiplied by the target bedrock spectrum in Table C-3).

DETERMINISTIC MCE_R RESPONSE SPECTRUM

The deterministic approach considers the maximum ground acceleration that may occur at the site as a result of a characteristic earthquake on all known active faults in the region. ASCE 7-16 Section 21.2.2 requires that the spectral response at each period be calculated as an 84th percentile 5 percent damped spectral response acceleration in the direction of maximum horizontal response. However, the lower limit is computed in accordance with ASCE 7-16 Figure 21.2-1 where:

1. For Site Classes A, B, and C: F_a and F_v are determined using Tables 11.4-1 and 11.4-2, with the value of S_s taken as 1.5 and the value S_1 taken and 0.6
2. For Site Class D: F_a is 1.0 and F_v is 2.5
3. For Site Class E and F: F_a is 1.0 and F_v is 4.0

Figure C-5 shows the deterministic lower limit as prescribed by ASCE 7-16 Section 21.2.2. Since the code-prescribed deterministic lower limit is greater than the probabilistic results, a deterministic analysis of individual faults is not necessary.

SITE-SPECIFIC MCE_R RESPONSE SPECTRUM

As outlined in ASCE 7-16 Section 21.2.3, the site-specific MCE_R shall be taken as the lesser of the probabilistic MCE_R and the deterministic MCE_R. Figure C-5 shows the site-specific design response spectrum.

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DESIGN RESPONSE SPECTRUM

In accordance with ASCE 7-16 Section 21.3, the design response spectrum is two-thirds of the MCE_R at all periods; however, the design response spectrum at any period shall not be taken less than 80 percent of S_a determined in accordance with ASCE 7-16 Section 11.4.6, where F_a and F_v are determined as follows:

1. For Site Classes A, B, and C: F_a and F_v are determined using Tables 11.4-1 and 11.4-2, respectively
2. For Site Class D: F_a is determined using Table 11.4-1 and F_v is taken as 2.4 for $S_1 < 0.2$ or 2.5 for $S_1 \geq 0.2$
3. For Site Class E: F_a is determined using Table 11.4-1 for $S_S < 1.0$ or taken as 1.0 for $S_S \geq 1.0$ and F_v is taken as 4.2 for $S_1 \leq 0.1$ or 4.0 for $S_1 > 0.1$

DESIGN ACCELERATION PARAMETERS

The parameter S_{DS} is taken as 90 percent of the maximum spectral acceleration from the site-specific design response spectrum at any period within the range of 0.2 second to 5.0 seconds. The parameter S_{D1} shall be taken as the maximum value of the product, TS_a, for periods from 1.0 second to 2.0 seconds for sites with $Vs_{30} > 1{,}200$ fps and for periods from 1.0 second to 5.0 seconds for sites with $Vs_{30} \leq 1{,}200$ fps. Figure C-6 shows the design response spectrum for ASCE 7-16.

The values of S_{MS} and S_{M1} shall be taken as 1.5 times S_{DS} and S_{D1} but shall not be less than 80 percent of the values determined in accordance with ASCE 7-16 Section 11.4.3 for S_{MS} and S_{M1} and ASCE 7-16 Section 11.4.5 for S_{DS} and S_{D1}. Therefore, the site-specific design parameters are as follows:

- $S_{DS} = 0.671$ g
- $S_{D1} = 1.007$ g
- $S_{MS} = 0.430$ g
- $S_{M1} = 0.645$ g

FAULT SURFACE RUPTURE

The closest mapped fault is more than 5 miles northeast of the site as described in Table C-1. Consequently, it is our opinion that the probability of surface fault rupture beneath the site is low.

LIQUEFACTION

Liquefaction is caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. In general, loose, saturated sand soil with low silt and clay content is most susceptible to liquefaction. Silty soil with low plasticity is also susceptible to liquefaction or strain softening under relatively higher levels of ground shaking.

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We performed liquefaction analysis using the CPT results in accordance with Boulanger and Idriss (2014) employing the depth weighting methods from Cetin (2009). The CPT probe provides continuous soil strength data for the full depth of penetration. The two strength parameters obtained are tip resistance and frictional resistance along the probe.

Based on our analysis, we estimate total post-liquefaction settlement at the existing ground surface will be less than approximately 1 inch during a design-level earthquake. We anticipate differential settlement across the site will be less than approximately one-half of the total liquefaction settlement.

LATERAL SPREADING

Lateral spreading is a liquefaction-related seismic hazard and occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Liquefied soil adjacent to an open face can flow toward the open face, resulting in lateral ground displacement. The primary difference between a conventional slope stability failure and lateral spreading is that no distinct failure plane is formed during a lateral spreading event.

Because minimal liquefaction is predicted and there are no open faces near the project lateral spreading is not a design consideration.

GROUND MOTION AMPLIFICATION

Soil capable of significantly amplifying ground motions beyond the levels determined by our site-specific seismic study were not encountered during our subsurface explorations. The main report for the fuel farm report provides a detailed description of the subsurface conditions encountered.

LANDSLIDE

Earthquake-induced landsliding generally occurs in steeper slopes comprised of relatively weak soil deposits. The site and surrounding area are relatively flat, and seismically induced landslides are not considered a site hazard.

SETTLEMENT

Settlement due to earthquakes is most prevalent in relatively deep deposits of dry, clean sand. We do not anticipate that seismic-induced settlement in addition to liquefaction-induced settlement will occur during design levels of ground shaking.

SUBSIDENCE/UPLIFT

CSZ earthquakes can cause vertical tectonic movements. The movements reflect coseismic strain release accumulation associated with interplate coupling in the CSZ. Based on our review of the literature, the locked zone of the CSZ is located in excess of 50 miles from the site. Consequently, we do not anticipate that subsidence or uplift is a significant design concern.

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LURCHING

Lurching is a phenomenon generally associated with very high levels of ground shaking, which cause localized failures and distortion of the soil. The anticipated ground accelerations shown on the figures in this appendix are below the threshold required to induce lurching of the site soil.

SEICHE AND TSUNAMI

The site is inland and elevated away from tsunami inundation zones and away from large bodies of water that may develop seiches. Seiches and tsunamis are not considered a hazard in the site vicinity.

REFERENCES

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Cetin, K.O., Bilge, H.T., Wu, J., Kammerer, A.M., and Seed R.B. (2009). Probabilistic Model for the Assessment of Cyclically Induced Reconsolidation (Volumetric) Settlements. *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE. 135(3), 387-398.

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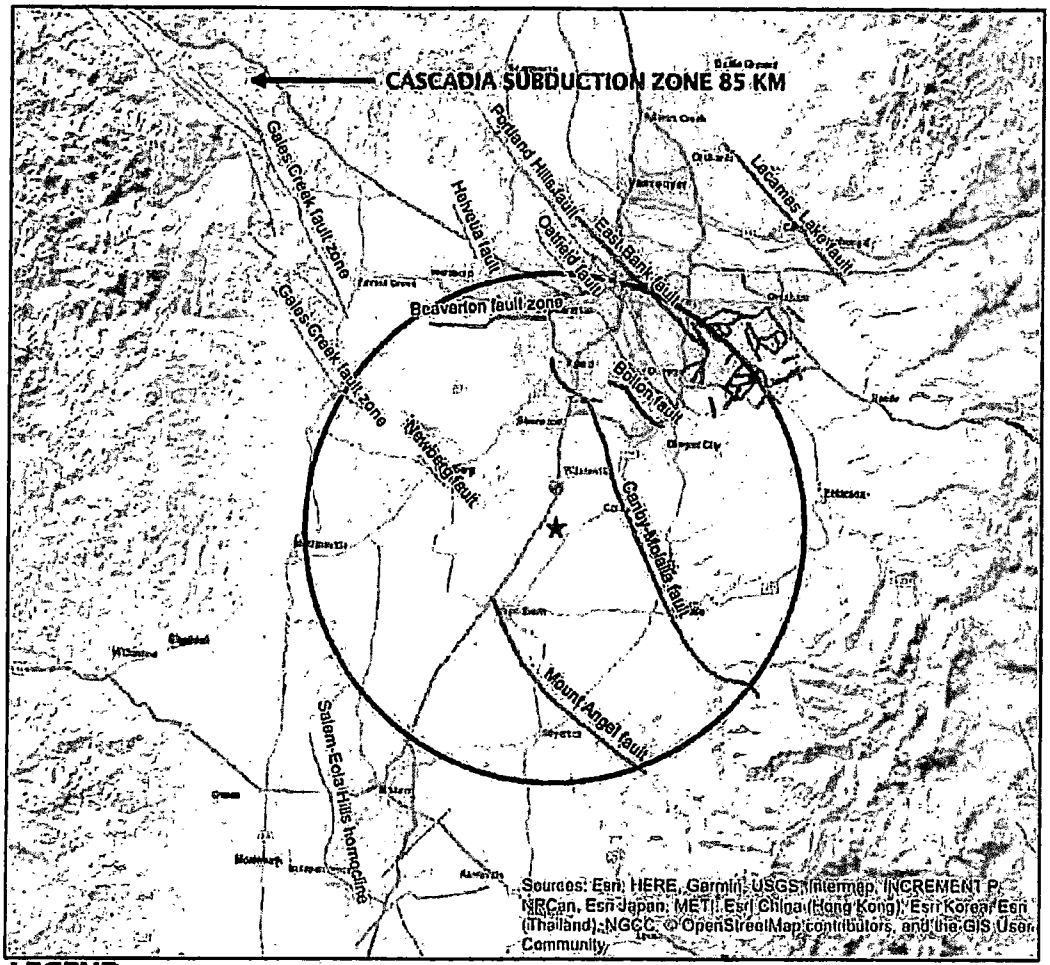


LEGEND

★ SITE LOCATION

20 MILE RADIUS

USGS QUATERNARY FAULTS

AGE

- <150
- <15,000
- <130,000
- <750,000
- <1,600,000
- Class B

N

0 5 10

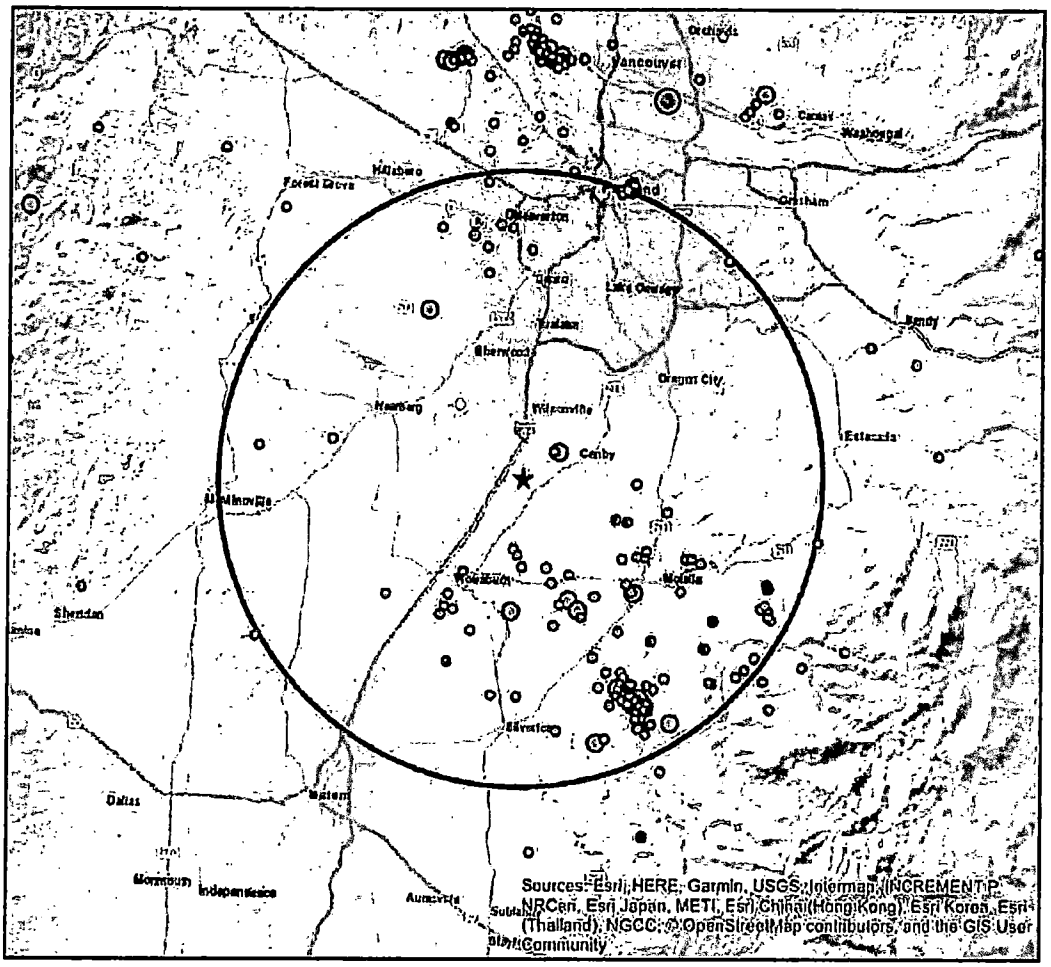
Miles

QUATERNARY FAULT DATA FROM USGS (2018); https://services.arcgis.com/v01gqwM5QqNysAAI/arcgis/rest/services/Qfaults_2018/FeatureServer

CentrexCon-4-01-FC1_C2.docx Print Date: 3/23/19

GeoDesign Inc 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CENTREXCON-4-01	QUATERNARY FAULT MAP	
	MARCH 2019	AURORA AIRPORT FUEL FARM AURORA, OR	FIGURE C-1

78



LEGEND

- ★ SITE LOCATION
- 20 MILE RADIUS

EARTHQUAKE MAGNITUDE

- 2.0 - 3.0
- 3.0 - 4.0
- 4.0 - 5.0
- > 6.0

N

0 5 10

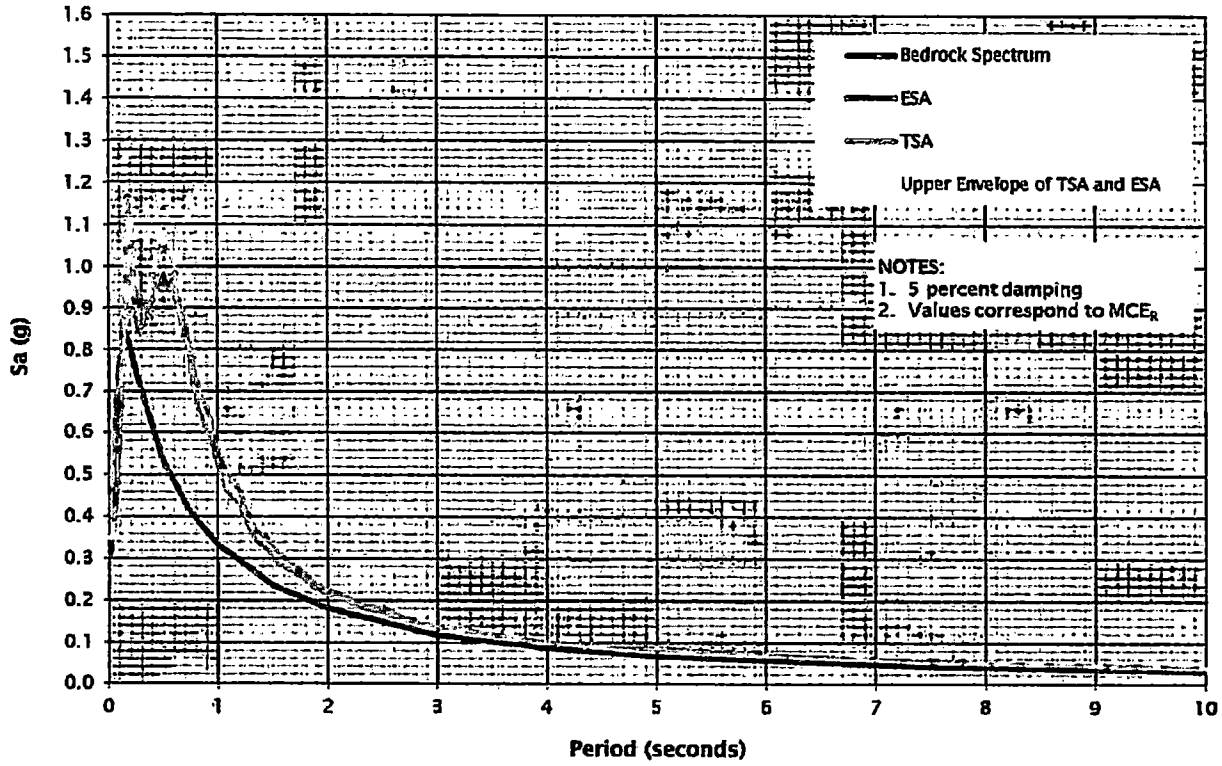
Miles

USGS, 2018, Earthquake Hazards Program, US Earthquake Information by State, U. S. Geological Survey, Available: http://earthquake.usgs.gov/earthquakes/search.

GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CENTREXCON-4-01	HISTORICAL SEISMICITY MAP	
	MARCH 2019	AURORA AIRPORT FUEL FARM AURORA, OR	FIGURE C-2

CentrexCon-4-01-FC1_C2.docx Print Date: 3/23/19

CentrexCon-4-01-FC3_C6.docx Print Date: 3/23/19



GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CENTREXCON-4-01	SITE RESPONSE SPECTRA	
	MARCH 2019	AURORA AIRPORT FUEL FARM AURORA, OR	FIGURE C-3

6324

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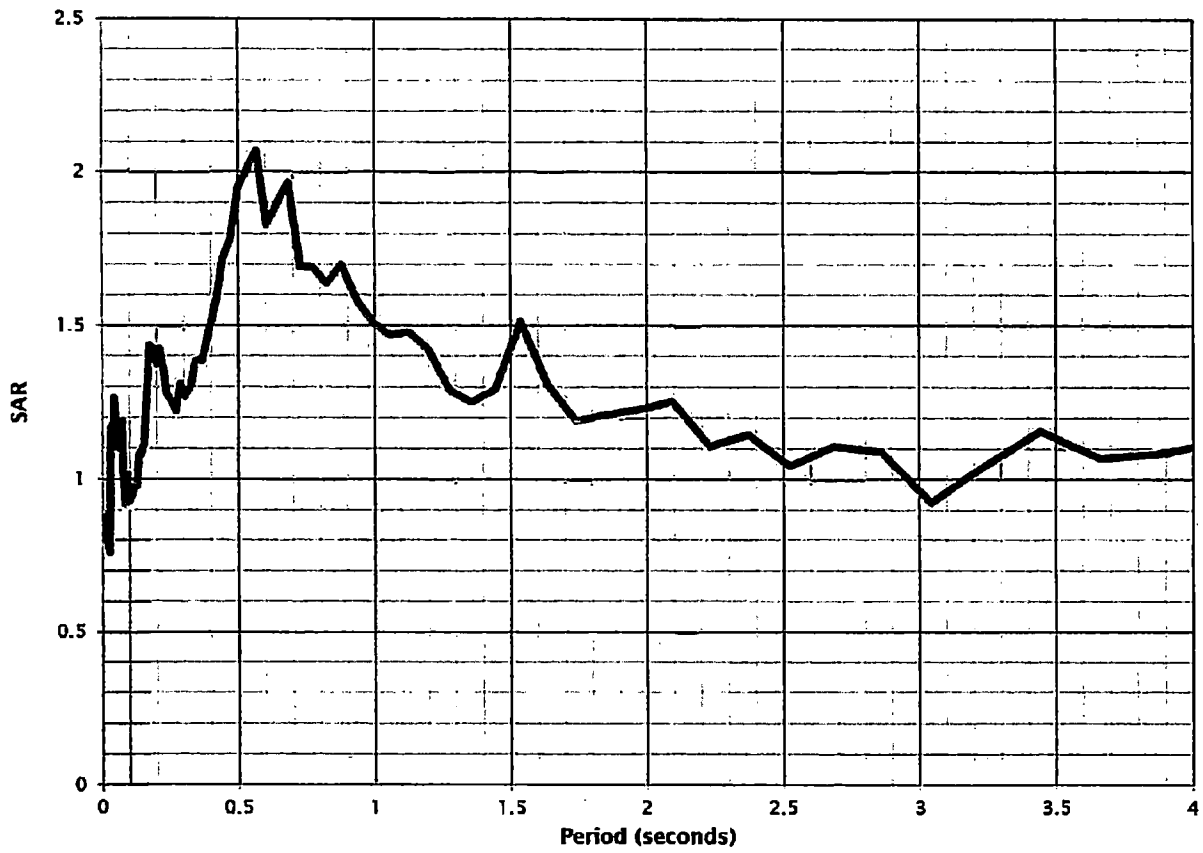
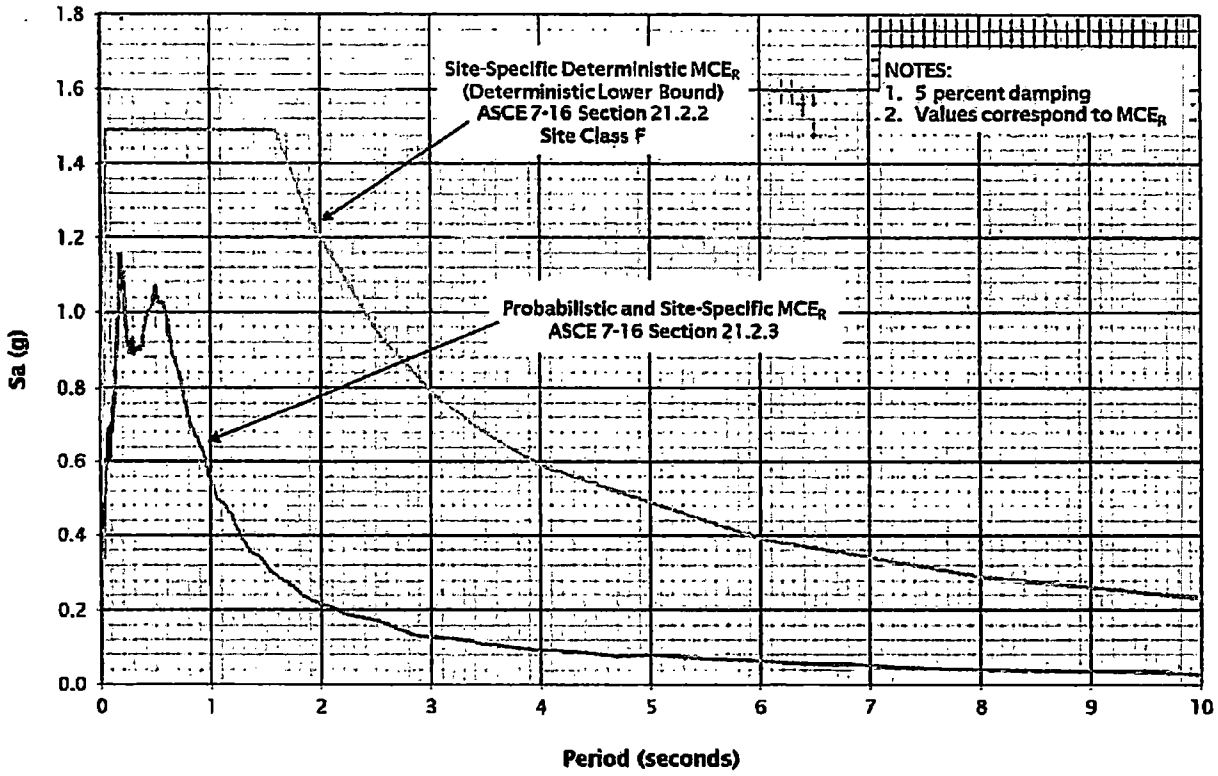


GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CENTREXCON-4-01	SAR PLOT	
	MARCH 2019	AURORA AIRPORT FUEL FARM AURORA, OR	FIGURE C-4

6325

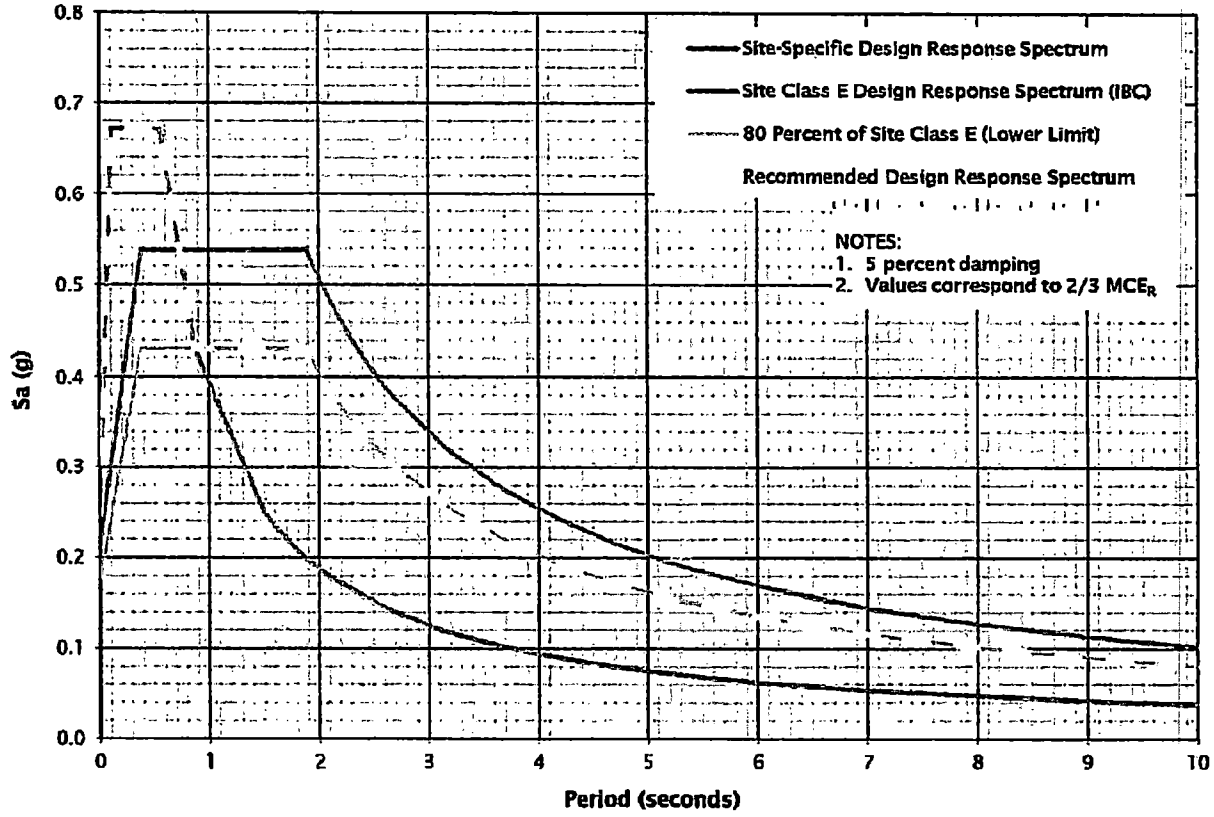
CentrexCon-4-01-FC3_C6.docx Print Date: 3/23/19



GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CENTREXCON-4-01	SITE-SPECIFIC RESPONSE SPECTRA	
	MARCH 2019	AURORA AIRPORT FUEL FARM AURORA, OR	FIGURE C-5

6326

CentrexCon-4-01-FC3_C6.docx Print Date: 3/23/19



GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CENTREXCON-4-01	DESIGN RESPONSE SPECTRUM	
	MARCH 2019	AURORA AIRPORT FUEL FARM AURORA, OR	FIGURE C-6

6327

BEFORE THE BOARD OF COMMISSIONERS
FOR MARION COUNTY, OREGON

In the Matter of the	)	Case No. CP 03-4
	)	
Application of:	)	Clerk's File No. 4968
	)	
RICHARD VAN GRUNSVEN	)	COMPREHENSIVE
OF HD AVIATION, TED MILLAR	)	PLAN AMENDMENT
OF SOUTH END AVIATION,	)	
AND JACK HOGAN	)	AN ADMINISTRATIVE ORDINANCE

ORDINANCE NO. 1205

THE MARION COUNTY BOARD OF COMMISSIONERS HEREBY ORDAINS AS FOLLOWS:

SECTION I. **Purpose**

This Ordinance is enacted pursuant to the authority granted to general law counties in the State of Oregon by ORS Chapters 197, 203, and 215 to implement the Marion County Comprehensive Land Use Plan. This ordinance amends the Marion County Comprehensive Plan by taking exceptions to Statewide Land Use Planning Goals 11—Public Facilities and Services and 14—Urbanization for certain properties to share a septic system at the Aurora State Airport. (T4S; R1W; Section 11A; Tax lots 200, 201, 203, and 400) and (T4S; R1W; Section 02D; Tax lots 1100 and 1600).

SECTION II. **Procedural History**

The Marion County Board of Commissioners held a public hearing on September 22, 2004, for which proper public notice and advertisement was given. The purpose of the hearing was to consider proposed amendments to the Marion County Comprehensive Plan to take exceptions to Statewide Land Use Planning Goals 11—Public Facilities and Services and 14—Urbanization for certain properties to share a septic system at the Aurora State Airport. All persons present during the public hearing were given the opportunity to speak or present written statements.

SECTION III. **Adoption of Findings and Conclusion**

The Board has reviewed the evidence and testimony in the record. The amendments to the Marion County Comprehensive Plan made hereunder are based on consideration and analysis of existing Marion County Comprehensive plan goals and policies and zoning regulations and the provision of ORS Chapters 197 and 215, Oregon Administrative Rules 660 Divisions 4, 11, 14, 8, and 33, and the State Land Use Planning Goals.

After careful consideration of all facts and evidence in the record, the Board adopts as its own the Facts and Findings contained in Exhibit A, attached hereto, and by this reference incorporated herein. The properties which are granted goal exceptions are shown on the map attached as Exhibit B, attached hereto, and by this reference incorporated herein.

SECTION IV. **Action**

The exceptions to Goals 11 and 14 to permit six parcels at the Aurora Airport to share an existing septic disposal system are **GRANTED**.

SECTION VI. **Severability**

Should any section, subsection, paragraph, sentence, clause, or phrase of this Ordinance or any policy, provision, findings, statement, conclusion, or designation to a particular land use or area of land, or any other portion, segment or element of this Ordinance or of any amendments thereto and adopted hereunder, be declared invalid for any reason, such declaration shall not affect the validity and continued application of any other portion or element of this Ordinance or amendments to the Comprehensive Plan; and if this Ordinance or any portion thereof should be held to be invalid on one ground, but valid on another, it shall be construed that the valid ground is the one upon which this Ordinance of any portion thereof was enacted.

SECTION VII. **Effective Date**

Pursuant to Ordinance 669, this is an administrative Ordinance and shall take effect 21 days after the adoption and signatures of the Marion County Board of Commissioners.

SIGNED and FINALIZED this 13 day of October, 2004 at Salem, Oregon.

MARION COUNTY BOARD OF COMMISSIONERS

Janet Carlson
Chair

Jan McEachern
Recording Secretary

JUDICIAL NOTICE

Oregon Revised Statutes (ORS) Chapter 197.830 provides that land use decisions may be reviewed by the Land Use Board of Appeals (LUBA) by filing a notice of intent to appeal within 21 days from the date this ordinance becomes final.

Exhibit A

Facts and Findings:
Exceptions to Goals 11 and 14

BACKGROUND:

In 1999, the applicants received approval from the Oregon Department of Environmental Quality (DEQ) to construct a recirculating gravel filter septic disposal system which was intended to serve six parcels at the southern end of the Aurora. After constructing the system, the applicants were informed by DEQ that Goal 11 forbids the extension of septic lines across property lines and an exception to Goal 11 would have to be taken in order to connect and operate the system.

In June 2003, the applicants applied for a comprehensive plan change to take an exception to Goal 11 to permit shared septic facilities. Staff from the Department of Land Conservation and Development commented that the Goal 11 exception would have to be accompanied with either an exception to Goal 14, because the Public zone at that time did not comply with Goal 14 requirements, or amendments to the Public zone that would bring it into compliance with Goal 14 requirements for rural uses outside of rural communities.

The county was involved in a periodic review task to amend the rural zoning ordinance to comply with Goal 14 and the applicants agreed to place their application on hold until the Goal 14 issues were resolved regarding the Public zone. On July 28, 2004, the Marion County Board of Commissioners adopted amendments to the Marion County Rural Zoning Ordinance which brought the code into compliance with Goal 14 requirements. Subsequently, this application was taken off hold and the applicants requested that the Board call-up the request and hold the first evidentiary hearing. Notice of public hearing was mailed on September 1, 2004 to property owners within 500 feet of the subject parcels. Notice was also published in the Statesman-Journal.

On September 22, 2004, the Board held a public hearing to consider amendments to the Marion County Comprehensive Plan taking exceptions to Goals 11 and 14 for an existing shared septic system for six parcels at the southern end of the Aurora Airport. The Board closed the hearing and directed staff to prepare an ordinance taking those exceptions.

FACTS:

1. The subject properties are designated Public in the Marion County Comprehensive Plan and are correspondingly zoned P (PUBLIC) under the Marion County Rural Zoning Ordinance (MCRZO). The purpose of the Public designation and zone is to provide regulations governing the development of land appropriate for specific public and semi-public uses.

2. The properties are located on the north side of Keil Road NE, approximately 1,700 feet west of the intersection of Airport Road NE and Keil Road. The parcels contain aircraft related facilities and are proposed for additional development in the future.

3. Adjacent properties to the southwest, west, east, and north are zoned P and contain the Aurora Airport and airport related uses and businesses. Properties to the south are zoned EFU (EXCLUSIVE FARM USE) and are devoted to farm use.

4. The airport facility was constructed at this site in 1943 to provide an emergency alternate field for carrier aircraft. It has been in operation as an airport, and zoned public, since that time. Since before 1968, additional land east of the runway and north of Keil Road has also been zoned public and closely associated with the airport. Between 1968 and 1981, properties to the south of Arndt Road and east of the runway were rezoned to public and developed with airport uses. In 1981, the airport facility, and surrounding airport related uses in the public zone, were acknowledged as exceptions in the Marion County Comprehensive Plan.

5. The 1976 Airport Master Plan was adopted by Marion County as part of its comprehensive plan. The adoption included a committed exception area to Statewide Planning Goal 3 of approximately 250 acres at the Aurora State Airport. In 1994, an exception for an additional 1.86 acres was taken and acknowledged to add land to the southwest of the airport. The County's Airport Overlay Zone, Marion County Rural Zoning Ordinance (MCRZO) Chapter 177 has been applied to both the 1981 exception area and the area added in 1994.

6. In Legislative Amendment 03-3, which amended the Marion County Rural Zoning Ordinance to comply with Goal 14 requirements for rural exception areas, an exception to Goal 14 for size of use was approved for airport related uses at the Aurora State Airport due to its being developed with a use that is urban in nature and requiring urban styled development to support the existing uses.

COMMENTS:

7. Marion County Building Inspection commented that based on the information submitted in the attached site plan, Building Inspection cannot make a determination on the permit requirements.

8. The FAA commented, "on-airport development requires submittal to FAA of FAA Form 7460-1, off-airport development requires submittal of separate form 7860-1, concurrence of Oregon Dept. of Aviation required for on-airport development, recommended for off-airport development."

9. All other contacted agencies stated that they had no objections or had not commented at the time the staff report was prepared. All comprehensive plan changes are subject to review by the State Department of Land Conservation and Development (DLCD).

DLCD's comments are contained in the file and explained in the background section of this report.

ANALYSIS:

10. Goal 11—Public Facilities and Services states: "Local Governments shall not allow the establishment or extension of sewer systems outside urban growth boundaries or unincorporated community boundaries...." The Goal defines "extension of a sewer or water system" as "the extension of a pipe, conduit, pipeline, main, or other physical component from or to an existing sewer or water system in order to provide service to a use that was not served by the system on the applicable date of this rule...."

    Goal 14—Urbanization prohibits the establishment of urban services on rural lands and the shared septic facility constitutes a urban level of service as defined by Goal 11. Because of this, an exception to Goal 14 will have to be taken along with an exception to Goal 11.

11. The exception requirements for land physically developed to uses other than those allowed by the applicable goal is set forth in OAR 660-004-0025:

    (1) A local government may adopt an exception to a goal when the land subject to the exception is physically developed to the extent that it is no longer available for uses allowed by the applicable goal.

    (2) Whether land has been physically developed with uses not allowed by an applicable Goal will depend on the situation at the site of the exception. The exact nature and extent of the areas found to be physically developed shall be clearly set forth in the justification for the exception. The specific area(s) must be shown on a map or otherwise described and keyed to the appropriate findings of fact. The findings of fact shall identify the extent and location of the existing physical development on the land and can include information on structures, roads, sewer and water facilities, and utility facilities. Uses allowed by the applicable goal(s) to which an exception is being taken shall not be used to justify a physically developed exception.

12. It was determined previously in Legislative Amendment Case No. 03-3 that the existing airport-related development at the airport exceeds the size limitations for commercial and industrial uses allowed by Goal 14 and the Unincorporated Communities Rule and an exception was talen to permit continued development to occur at a level consistent with existing development at the airport. The Land Use Board of Appeals (LUBA) recognized that the level of development at the airport would likely require exceptions to Goals 11 and 14, referring to the Aurora State Airport as an "urban public facility" and commenting that the text of an exception "probably could be very similar to that required for the proposed exception to Goal 3," an exception which was subsequently acknowledged by LCDC. Murray et al. v. Marion County, 23 Or LUBA 268 (1992).

13. OAR 660-014-0040 sets forth the criteria for taking an exception to Goal 11—Public Facilities and Goal 14—Urbanization:

(1) As used in this rule, "undeveloped rural land" includes all land outside of acknowledged urban growth boundaries except for rural areas committed to urban development. This definition includes all resource and nonresource lands outside of urban growth boundaries. It also includes those lands subject to built and committed exceptions to Goals 3 or 4, but *not* developed at urban density or committed to urban level development.

(2) A county can justify an exception to Goal 14 to allow incorporation of a new city or establishment of new urban development on undeveloped rural land. Reasons which can justify why the policies in Goals 3, 4, 11, and 14 should not apply can include but are not limited to findings that an urban population and urban levels of facilities and services are necessary to support an economic activity which is dependent upon an adjacent or nearby natural resource.

(3) To approve an exception under this rule, a county must also show:

(a) That Goal 2, Part II(c)(1) and (c)(2) are met by showing the proposed urban development cannot be reasonably accommodated in or through expansion of existing urban growth boundaries or by intensification of development at existing rural centers;

(b) That Goal 2, Part II(c)(3) is met by showing the long-term environmental, economic, social and energy consequences resulting from urban development at the proposed site with measures designed to reduce adverse impacts are not significantly more adverse than would typically result from the same proposal being located on other undeveloped rural lands, considering:

(A) Whether the amount of land included within the boundaries of the proposed urban development is appropriate, and

(B) Whether urban development is limited by the air, water, energy and land resources at or available to the proposed site, and whether urban development at the proposed site will adversely affect the air, water, energy and land resources of the surrounding area.

(c) That Goal 2, Part II(c)(4) is met by showing the proposed urban uses are compatible with adjacent uses or will be so rendered through measures designed to reduce adverse impacts considering:

(A) Whether urban development at the proposed site detracts from the ability of existing cities and service districts to provide services; and

(B) Whether the potential for continued resource management of land at present levels surrounding and nearby the site proposed for urban development is assured.

(d) That an appropriate level of public facilities and services are likely to be provided in a timely and efficient manner;

(e) That incorporation of a new city or establishment or new urban development of undeveloped rural land is coordinated with comprehensive plans of affected jurisdictions and consistent with plans that control the area proposed for incorporation.

14. The Aurora Airport has been in place since 1943 and airport related uses have been associated with the airport since before 1968. The airport consists of properties in multiple ownerships providing a wide range of aviation-related and support services such as aircraft instruction, rental, maintenance, charter, sales, avionics sale and repair, aircraft construction, storage, fueling, helicopter maintenance and fueling, aerial photography, and others. This airport provides necessary air transportation services to businesses and individuals in Marion, Clackamas, Washington and Multnomah counties, enhancing the economy of the region and the state. The airport facility depends on its location, and the commercial, industrial and population centers and growth in the area, for its viability and necessity. This state airport facility is uniquely able to provide services to the surrounding rural area and nearby communities, as well as a connection to other urban airports because of it's proximity to the Interstate 5 corridor and Highway 99E, the county roadway system, Clackamas County and the south Metro area. In addition, the need for airport transportation facilities is recognized in the Marion County Comprehensive Plan (MCCP).

The Aurora State Airport is needed to serve the economic and air transportation needs of the surrounding community which is dependent upon the existing location of the airport. The criteria in 13(1) and 13(2) are met.

15. The nearest UGB is that of the City of Aurora, approximately 1500 feet to the southeast of the airport. The land between the existing UGB and the airport boundary is resource land. The City of Aurora originally proposed that the airport be included in the UGB when it was going through acknowledgement; however, this was not approved by LCDC and the UGB was reduced to the present area. It continues to be unreasonable to extend the UGB this distance due to the amount of intervening resource land at this time. There are also no rural centers which could encompass the proposed exception area. The closest rural center, Fargo Interchange, is over 9,000 feet west of the airport. The criterion in 13(3)(a) is met.

16. The criteria in 13(3)(b) require that the long-term environmental, economic, social and energy consequences resulting from urban development at the proposed site not be significantly more adverse than would result from the same proposal being located on

other undeveloped rural lands. Because the Aurora Airport is already developed with airport and airport-related uses, and because of its demonstrated need to be located where it currently is, as explained in #14, there are no alternative locations being considered requiring the use of undeveloped land.

Additionally, information provided by the applicant demonstrates that developing the properties with septic or holding tanks would be much more expensive than using a shared septic system.

Also there are environmental concerns developing with septic systems on the subject properties. The soils on the subject properties are not optimum soils for septic systems and can be difficult to locate a system on an individual property. A shared septic also provides the opportunity to process the effluent in a more complete manner that can be certified to meet Leadership in Energy and Environmental Design (LEED) standards.

Considering the lack of alternatives locations for the airport, as well as the benefits economically and environmentally and the potential for positive affects on the air, water, energy and land resources of properties and surrounding area, the criteria in 13(3)(a) and (b) are met.

17. Public facilities are not provided by any of the surrounding cities or service districts. The airport has existed surrounded by resource land and uses since 1943. During that time there has been no evidence that the airport has reduced the potential for continued resource management of land surrounding the airport. Aside from a runway extension, no expansion of airport facilities has occurred historically and no expansion of facilities is proposed in the airport master plan. There is no evidence that a shared septic system for the subject properties will adversely impact surrounding property uses. The criterion in 13(3)(c) is met.

18. The airport has established an Aurora Airport Water Control District to provide a fire suppression water system. Development on the subject properties would still be limited to the capacity of systems in place, including holding tanks, which would serve the uses. Although the City of Aurora sewer system became operational in 2001, there are no plans to extend the system to the airport, at this time, nor has any determination been made of the capacity of the city system to serve the airport. The criterion in 13(3)(d) is met.

19. No incorporation of a new city or establishment is proposed. Any new urban development of undeveloped rural land will be coordinated with the comprehensive plans of affected jurisdictions and applicable zoning. The criterion in 13(3)(e) is met.

20. OAR 660-004-0018 states that for "physically developed" and "irrevocably committed" exceptions to goals, plan, and zone designations shall authorize a single numeric minimum lot size and shall limit uses, density, and public facilities and services to those:

    (a) Which are the same as the existing land uses on the exception site; or

(b) Which meet the following requirements:

(A) The rural uses, density, and public facilities and services will maintain the land as "Rural Land" as defined by the goals and are consistent with all other applicable Goal requirements; and

(B) The rural uses, density, and public facilities and services will not commit adjacent or nearby resource land to nonresource use as defined in OAR 660-004-0028; and

(c) The rural uses, density, and public facilities and services are compatible with adjacent or nearby resource uses.

21. The proposal does not change the allowable commercial or industrial uses at the airport. The purpose of the exception is to allow a shared septic system to serve six parcels at the airport, consistent with the existing urban level of development already existing at the airport. There is no evidence that an exception to permit a shared septic will not commit adjacent or nearby resource land to nonresource use as defined in OAR 660-004-0028. The proposal satisfies the criterion in 20(a) and (b).

22. The airport has a history of being compatible with adjacent and nearby resources uses since its inception over sixty years ago. There is no evidence that allowing the subject properties to share a septic system will be incompatible with surrounding resource uses. The shared septic will be located on the properties where the septic is shared and will not commit surrounding land to nonresource uses. The surrounding resource uses have also been compatible with airport uses. The master planning process, which the Oregon Department of Aviation recently completed for the airport in 2000, requires consideration of National Environmental Protection Act (NEPA) requirements as well as compatibility with surrounding uses. The proposal satisfies the criterion in 20(c).

23. In addition to providing procedures, the MCCP provides guidelines and policies to ensure compatibility with the adopted comprehensive plan and consistency in the planning process. The first guideline is that the proposal should comply with the Statewide Planning Goals that apply in a particular situation. This proposal must be consistent with all applicable Statewide Planning Goals except Goals 3, 11 and 14 for which exceptions have been taken.

24. The proposal is consistent with Statewide Planning Goal 1—Citizen Involvement, which provides for citizen involvement in the planning process. Notice was sent of the request for goal exceptions. A public hearing will were be held before the Board of Commissioners where concerned citizens will have the opportunity to provide comment and make suggestions.

The application is consistent with Goal 2—Land Use Planning since the proposal is consistent with the County's acknowledged comprehensive plan. Moreover, appropriate analysis of the exception provisions have been provided with regard to Goals 11 and 14.

Goals 3—Agricultural Lands, 4—Forest Lands and 5—Open Spaces, Scenic and Historic Areas, and Natural Resources are not applicable to this proposal.

Because the airport and related uses already exist, and the proposal seeks to maintain development at the existing level of uses and sizes, there is no evidence that the proposal will impact air, water or land resource quality over any impacts of the existing airport. Development within the public zone is subject to standards that address and seek to minimize adverse impacts to surrounding uses and resources. The proposal is consistent with Goal 6—Air, Water and Land Resources Quality.

The airport is not in an area subject to natural disasters; the proposal is consistent with Goal 7—Areas Subject to Natural Disasters and Hazards.

Goal 8—Recreational Needs is not applicable to this proposal.

The proposal is consistent with Goal 9—Economic Development. The subject properties are needed to serve commercial, industrial, and public uses in the surrounding community. Allowing development to continue at sizes commensurate with existing development will sustain the economic viability of the airport. The airport and associated uses provide employment to the area and in the state. Employment at the airport should also increase as use of the airport continues to increase as described in the Aurora State Airport Master Plan.

Goal 10—Housing is not applicable to this proposal.

The proposal is consistent with Goal 12—Transportation because the airport is necessary to serve the aviation needs of users at the airport and the surrounding communities. The location of this airport has also been demonstrated to be necessary because neighboring cities and communities do not provide public airport facilities. In addition, the airport is either bordered by or in close proximity to major road facilities, the Interstate 5 corridor, Hubbard Cutoff Road, Highway 99E, Arndt Road, Keil Road, and Airport Road, which provide the traveling public access to and from the airport for both persons and freight.

Goals 13—Energy Conservation, 15—Willamette River Greenway, 16—Estuarine Resources, 17—Coastal Shorelands, 18—Beaches and Dunes and 19—Ocean Resources do not apply to this proposal.

Overall, the proposal is in compliance with the Statewide Planning Goals or an appropriate exception has been taken.

25. The proposal must also conform to the relevant policies in the comprehensive plan. In discussing this requirement, only relevant comprehensive plan policies will be mentioned.

Rural Services Policy #1: The impact on existing services and the potential for additional facilities should be evaluated when rural development is proposed.

Rural Services Policy #2: It is the intent of Marion County to maintain the rural character of areas outside of urban growth boundaries by allowing those uses that do not increase the potential for urban services.

Rural Services Policy #3: Only facilities and services that are necessary to accommodate planned rural land uses should be provided unless it can be shown that the proposed service will not encourage development inconsistent with maintaining the rural density and character of the area.

Rural Services Policy #4: The sizing of public or private service facilities shall be based on maintaining the rural character of the area. Systems that cannot be cost effective without exceeding the rural densities specified in this Plan shall not be approved. The County shall coordinate with private utilities to ensure that rural development can be serviced efficiently.

Any new development on the subject properties will be airport-related and similar to, and no more intensive than, existing development. There is no evidence that the existence of the airport since 1943 has increased the need for urban services or that the development at the airport has impacted the density or character of the rural area. The shared septic facility reflects the urban nature of uses at the airport while not committing the parcels to a fully urban level of development. The parcels would still be able to be developed with urban facilities once those became available. The proposal complies with the rural development policies.

Transportation Policy #8: Airports and airstrips shall be located in areas that are safe for air operations and compatible with surrounding uses.

The existing location of the airport has demonstrated it is in a safe location for air operations. There have been concerns from neighboring residential areas regarding noise at the airport. Efforts have been made over the years to reduce the level of noise associated with airport operations. This proposal will not have an impact on airport operations and, so, will not affect the level of noise produced at the airport. The fact that many of the surrounding lands are in resource zones helps to mitigate the impact of noise from the airport on those lands and surrounding urbanized uses. The proposal complies with applicable transportation policies.

CONCLUSION:

The Board finds that the proposed exceptions meet the applicable criteria in the Oregon Administrative Rules, Oregon Revised Statutes, Statewide Planning Goals, and the Marion County Comprehensive Plan that physically developed and reasons exceptions to Goals 11 and 14 are justified for the subject properties to be able to share a septic system at the Aurora State Airport.

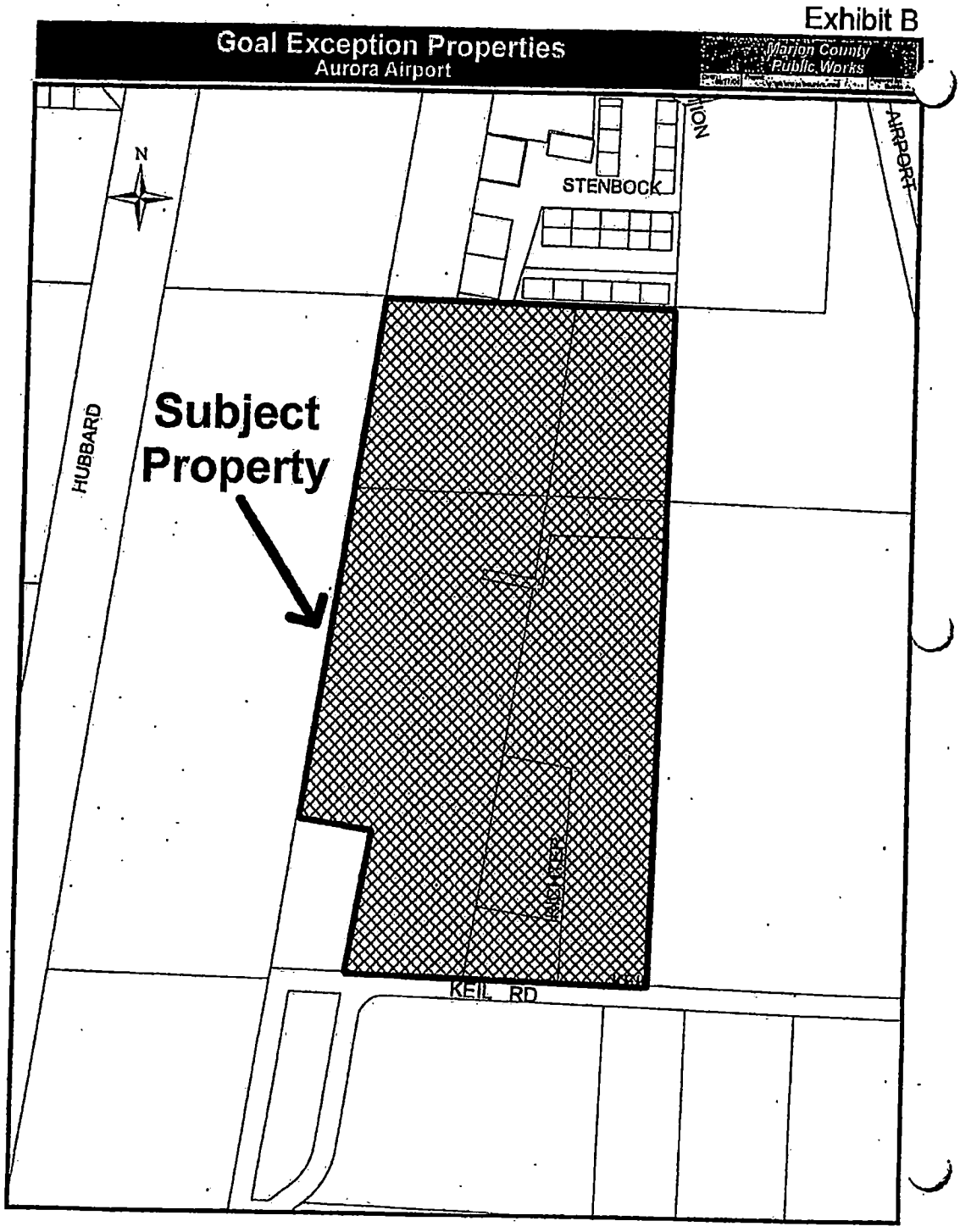
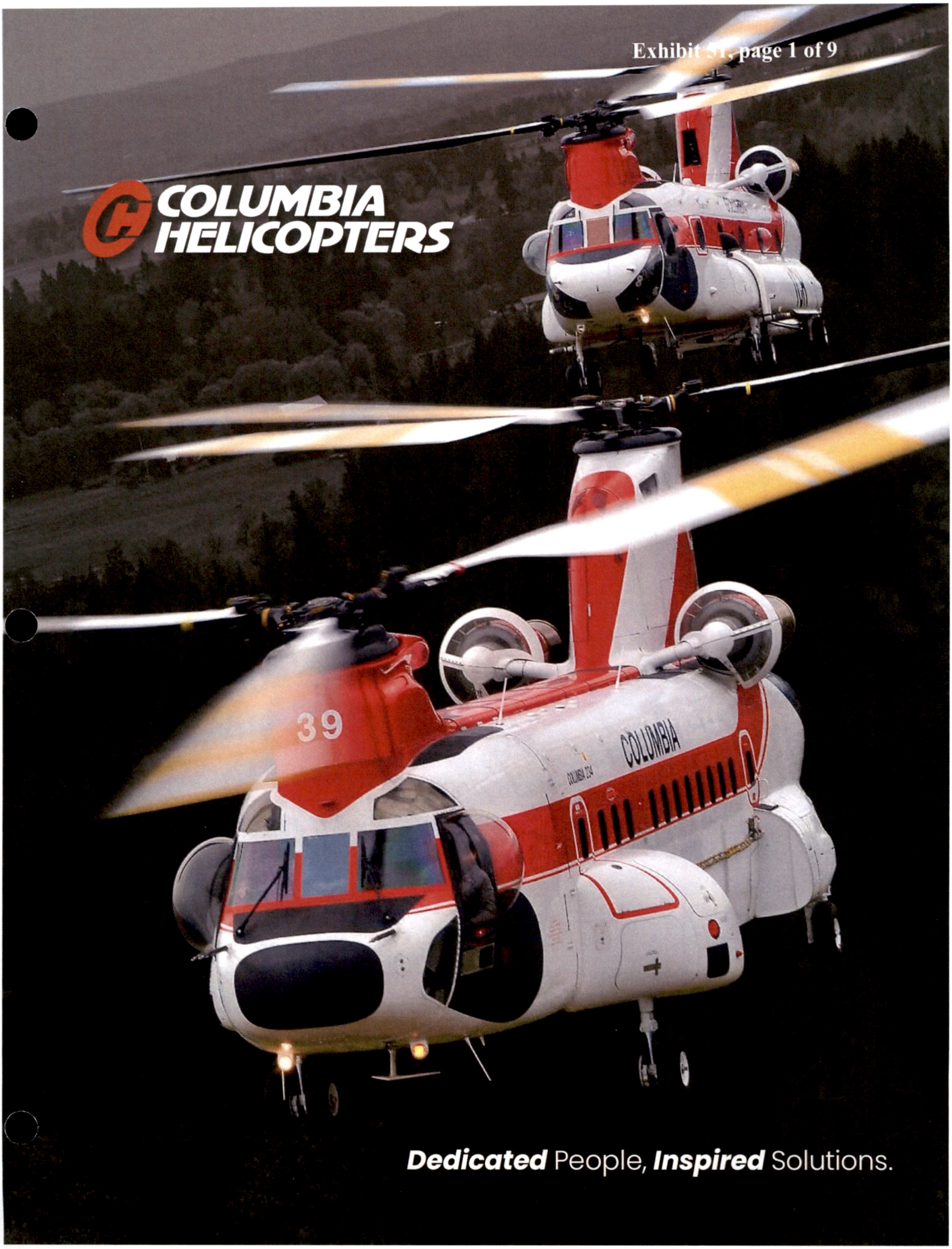


Exhibit B
Goal Exception Properties
Aurora Airport
Marion County
Public Works
N
STENBOCK
AIRPORT
HUBBARD
Subject
Property
KEIL RD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The company holds the FAA Type Certificate and two separate Production Certificates for both aircraft and engine OEM components for the Columbia Model 234 and Model 107-II helicopters.

In addition Columbia holds a FAA Type Certificate for the CH-47D Chinook. These certifications allow the company to manufacture, modify, and provide unmatched lifecycle support for these aircraft and their components to meet customers' needs. With a range of mission-focused proprietary modifications, Columbia delivers the ultimate in helicopter solutions for your heavy-lift operations.

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UNMATCHED

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OEM SERVICES

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- Aircrew Services
- Aircraft Fleet Management
- Program Management
- Flight Operations
- Airfield Management
- Finishing and Paint
- Test Cells for the Honeywell T55 Engine and GE T58 and CT58 Engines
- Major Airframe Modifications (Structural, Avionics, and Mission Equipment)
- Components Repair and Overhaul
- MRO on Avionics, Hydraulics, Rotor Blades, and Parts
- Engineering Support Services
- Aftermarket Maintenance and Material Management

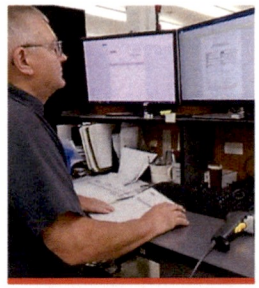
Operations, Flight, and Maintenance Training Services



At Columbia, we recognize well trained forces lead to efficient, effective mission operations. Our highly skilled and experienced educational professionals travel to wherever they are needed to deliver quality comprehensive training that ensures the technical proficiency, safety, and security of each person and operation. Training services include:

- Curriculum Development
- Computer-Based Training
- Classroom Training
- Flight Training
- Courseware Development
- Training & Certification
- Records Maintenance & Systems
- On-The-Job & Field Training

Engineering and Technical Support Services



Columbia stands unrivaled in the decades of experience and expertise across every facet of the Model 234 and Model 107-II. This level of experience allows us to optimize aircraft uptime while ensuring the aircraft perform at their full mission potential in harsh environments. The Columbia engineering team is constantly seeking opportunities to modernize, increase efficiency, and further develop operational capabilities for our customers with modifications and updates to our aircraft. In addition, Columbia maintains highly skilled FAA Designated Engineering Representatives (DERs) on staff ensuring all engineering efforts follow appropriate airworthiness standards and offers complete engineering and technical support services.

Supply Chain Management and Logistics Services



Close, long-term relationships with suppliers, vendors, and partners allows Columbia's supply chain management and logistics services to reduce costs, optimize product delivery lead times, and accurately forecast resources and planning needs, driving greater efficiency and profitability. Columbia's comprehensive approach enables us to provide complete supply chain management that keeps projects on budget and on schedule while providing the flexibility and agility to adapt to changing requirements. With our proven expertise and dedication to excellence, Columbia delivers unparalleled supply chain management solutions that enhance your operations and bottom line.

COLUMBIA AIRCRAFT



Model 234



Model 107-II



Model CH-47D



COLUMBIA

Model 234



Unmatched in range, endurance, and multi-mission capability, the standard category Model 234 Helicopter provides year-round heavy-lift support.

This unrestricted Model 234 can be quickly reconfigured to meet multiple mission profiles, expanding the aircraft's economic efficiencies and return on investment. A variety of available proprietary Columbia modifications make the 234's exceptional flexibility possible. Columbia is the OEM of the Model 234 Helicopter.

It can be configured for multiple commercial uses, including firefighting, passenger transport, cargo, and MEDEVAC.

SPECIFICATIONS	*Imperial*	*Metric*
Maximum Gross Weight	50,000 lbs	22,680 kgs
Maximum Hook Weight	25,000 lbs	11,339 kgs
Range *(Max Fuel)*	550 nm	1018 km
Range *(Max Fuel & Aux Tanks)*	850 nm	1574 km
Fuel Capacity	1,028 gal	3,891 liters
Fuel Capacity *(w/ Aux Tanks)*	1,528 gal	5,784 liters
Fuel Consumption	329 gal/hr	1,245 liters/hr
Maximum Speed	150 knots	278 km/hr
Cruise Speed	120 knots	222 km/hr



COLUMBIA

Model 107-II



COLUMBIA

Model CH-47D



The Columbia Model 107-II helicopter is a highly capable aircraft that excels in its weight class and category. Compared to its competitors, it offers exceptional payload capacity, flight range, and fuel efficiency.

Highly maneuverable, the Columbia Model 107-II is agile and responsive, making it well-suited for a range of mission profiles. The Model 107-II can be configured for multiple uses, including commercial passenger transportation, internal and external cargo transportation, aerial firefighting, helicopter logging, oil and gas exploration, and infrastructure support. Columbia is the OEM for the Model 107-II Helicopter.

SPECIFICATIONS	*Imperial*	*Metric*
Maximum Gross Weight	22,000 lbs	9,979 kgs
Maximum Hook Weight	11,500 lbs	5,216 kgs
Range *(Max Fuel)*	250 nm	463 km
Range *(Max Fuel & Aux Tanks)*	400 nm	741 km
Fuel Capacity	350 gal	1,325 liters
Fuel Consumption	170 gal/hr	643 liters/hr
Maximum Speed	148 knots	274 km/hr
Cruise Speed	120 knots	222 km/hr

The CH-47D Chinook is a powerful, economical, and versatile aircraft with capabilities that make it ideal for firefighting and heavy-lifting operations.

As a restricted category aircraft, it can be configured for external cargo transportation and aerial firefighting with an external water bucket or internal tank. Columbia owns the FAA Type Certificate for the CH-47D.

SPECIFICATIONS	*Imperial*	*Metric*
Maximum Gross Weight	50,000 lbs	22,680 kgs
Maximum Hook Weight	26,000 lbs	11,793 kgs
Range *(Max Fuel)*	360 nm	722 km
Range *(Max Fuel & Aux Tanks)*	556 nm	1,030 km
Fuel Capacity	1,028 gal	3,891 liters
Fuel Consumption	329 gal/hr	1,245 liters/hr
Maximum Speed	170 knots	315 km/hr
Cruise Speed	130 knots	241 km/hr

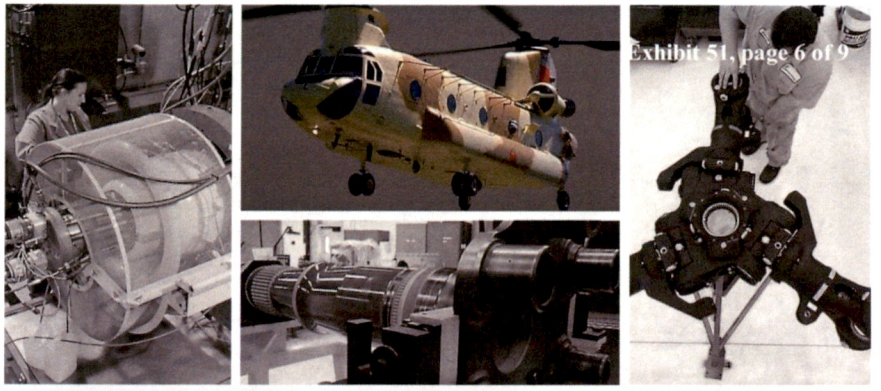


WORLDWIDE

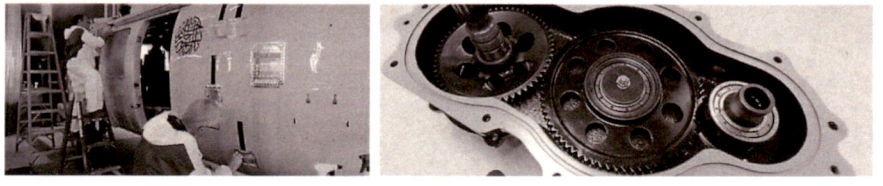
MRO Service and Support

Above: The appearance of U.S. Department of Defense (DoD) visual information does not imply or constitute DoD endorsement.

Exhibit 51, page 6 of 9







As the world's leading heavy-lift helicopter OEM, MRO, and operator, Columbia Helicopters is renowned for its exceptional MRO capabilities.

With decades of experience, a highly skilled team of technicians and engineers, and state-of-the-art facilities, Columbia Helicopters MRO delivers world-class maintenance and repair services to ensure that your aircraft is operating efficiently, minimizing downtime and maximizing lifespan.

Lifecycle Management Services

Columbia Helicopters' lifecycle management services cover a range of areas, including logistics and supply chain management, maintenance and repair, modifications and upgrades, training and support, and end-of-life disposal. With its comprehensive suite of services, Columbia Helicopters can provide customers with a one-stop-shop for all their lifecycle management needs, streamlining the process and reducing costs. Services include:

- Aircraft Maintenance
- Airframe and Powerplant Modifications
- Aircrew Services
- Aircraft Fleet Management
- Program Management
- Complete Aftermarket Maintenance and Materials Management
- Contractor Logistics Support & Life Cycle Contractor Support (CLS/LCCS)
- Operations and Maintenance Training
- Kit Design, Manufacture, Assembly, & Installation
- Non-Destructive Testing/Inspection (NDT/NDI)

MRO Support

Columbia Helicopters puts more than 50 years of experience in maintenance and overhaul to work at our FAA-Approved Part 145 Repair Station and in the field. Our extensive parts inventory, paired with ownership of type and production certificates, enables us to provide fast turnaround times and outstanding service on virtually every part of the Columbia Model 234, Model 107-II and CH-47D – airframe, components, and engines. Our capabilities include:

- Test Cells for the Honeywell T55 Engine and GE T58 and CT58 Engines
- Major Airframe Modifications (Structural, Avionics, and Mission Equipment)
- Components Repair and Overhaul
- MRO on Avionics, Hydraulics, Rotor Blades, and Parts
- Finishing and Paint

COLUMBIA

Aviation Services

Full-Service Operational Support

Columbia's aircraft operation services range from full-service support to customer-specific programs. In addition to being a Commercial Airlift Review Board (CARB) certified airlift provider to the U.S. Department of Defense (DOD), Columbia Helicopters also holds an FAA 14 CFR Part 135 Operating Certificate.

FULL-SERVICE AIRCRAFT OPERATIONS

- Trained Pilot, Crew, and Maintenance Personnel
- Aircraft Maintenance
- Fuel and Special Equipment Support
- Specialized Mission Execution Expertise

Aerial Firefighting



Columbia's helicopters bring targeted capabilities to wildland firefighting around the globe, including some of the highest volume bucket loads possible. With each aircraft, Columbia delivers turnkey support, equipment, and crews. From dropping water and retardant to carrying cargo, ground clearing equipment, and firefighters, Columbia's aerial firefighting capabilities are as broad as our experience is deep.

- Internal Tank Water and Foam Drops
- External Bambi Bucket Drops
- Night NVG Operations
- Crew Repositioning
- Internal and External Cargo and Equipment Transport

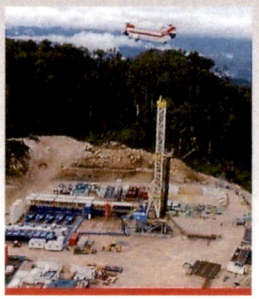
Infrastructure



Columbia Helicopters' heavy-lift helicopters can carry up to 25,000 lbs., performing work and lifting loads no other aircraft can touch. More versatile and efficient than single main rotor designs, the tandem-rotor and twin-engine design of our helicopters allows all available power to support higher internal and external payloads. The design also provides increased stability in crosswinds, allowing pilots to perform effective precise load placements.

- Power Line Construction
- Pipeline Construction
- Rooftop HVAC Install/Removal
- Sky Lift Tower Construction
- General Construction Support
- Material and Equipment Transport and Placement

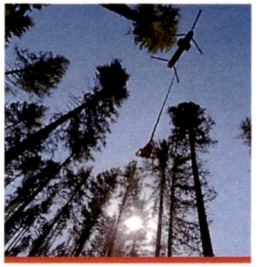
Oil and Gas Support



Columbia Helicopters supports oil, gas, and mineral exploration and extraction with precise, safe, and reliable rig, cargo, and equipment lift operations. Our aircraft have performed heavy-lift operations with power and precision in terrain ranging from mountain sites at 9,000 feet to dense jungles. On-site maintenance, a robust parts supply, and our world class Load Management Program allows us to deliver turnkey service and maintain the industry's highest heavy-lift availability rate.

- Rig Moves
- Material Transport
- Logistical Support
- Specialized Rigging
- Various Cargo Delivery Options
- Equipment Transport and Placement

Forestry and Stream Restoration



Columbia Helicopters has supported forest and stream restoration operations for more than six decades. Biologists use our helicopters to place boulders, logs, and root wads into streams and creeks for enhanced fish habitat. Our aircraft are also highly effective in low impact logging operations, able to carry large loads with little environmental effect in sensitive areas.

- Helicopter Logging
- Land Management Support
- Placement of Large Trees and Debris
- Habitat Improvement and Restoration
- Stream Improvement and Restoration

Defense & Government Services



Columbia Helicopters helped redefine heavy-lift aircraft use in the military, supporting U.S. and NATO forces since 2011.

As a civilian contractor, Columbia pairs its strong customer service culture with unparalleled long line transport, precision placement, internal cargo, passenger movement, mail delivery, night vision operations, and construction experience to create new opportunities and increase support for troops.



Columbia Helicopters

Over the course of 65 years, Columbia Helicopters established and redefined the heavy-lift helicopter industry with continuous innovation, capabilities, and support.

Founded in 1957 by Wes Lematta on the belief that helicopters could lift more than just people, Columbia has grown to become a leading OEM of heavy-lift helicopters.

With a strong emphasis on exceptional OEM and MRO capabilities, Columbia continues to push the boundaries of what is possible in the industry.

As Columbia's heavy-lift capabilities grew over the years, so did its ability to expand the company's potential. In 2006, Columbia purchased the 107-II Vertol type certificate and 234 type certificate from Boeing. It then purchased the CH-47D type certificate in 2014.

Since that time, Columbia has grown and expanded the capabilities of each aircraft through innovative modifications to meet today's heavy-lift needs while also exceptionally expanding its OEM and MRO capabilities, including parts availability, to provide a turnkey, one-stop sales, lease, and support service for operators of the aircraft.



YOUR HEAVY-LIFT EXPERTS

CONTACT US TODAY

Columbia Helicopters is your complete heavy-lift helicopter OEM, MRO, lifetime support, and operations solution.

*Performance data may differ depending on aircraft operating conditions and configuration.

503.678.1222 | colheli.com

14452 Arndt Rd NE, Aurora, OR 97002
bdmarketing@colheli.com

Exhibit 52, page 1 of 16

ROTOR-WING FLEET







FLEET

Bell 429

The Bell 429 is the most advanced air medical helicopter in the Pacific Northwest and contains the best IFR capabilities in the industry. With an expansive patient care cabin, the Bell 429 provides clinical teams with unhindered full-body access and maneuverability for treating patients. This access allows our expertly trained clinicians to provide comprehensive, ICU-level care to any patient, regardless of illness or injury.

The Bell 429 also offers:

- An enhanced communications platform that enables our team to seamlessly communicate with the dispatching agency or receiving hospital when en route, on approach for landing, or at any time during the patient transfer process.
- A large double-side door configuration for ease and speed of patient loading.
- Terrain-mapping software that provides for enhanced safety and situational awareness.
- An advanced touchscreen GPS and four-axis autopilot capabilities.
- A range of 449 nautical miles at a cruising speed of 170 miles per hour.

BELL 429 WEBSITE (HTTPS://WWW.BELLFLIGHT.COM/PRODUCTS/BELL-429)





FLEET

Bell 407GXi

The Bell 407GXi is highly reliable and lives up to its reputation as a proven air medical helicopter. With its ultra-advanced avionics suite, the Bell 407GXi includes three-dimensional terrain mapping for the pilot and a two-axis autopilot for increased safety. Its power-to-weight ratio provides for excellent performance at high altitudes. An enhanced communications platform allows teams to seamlessly communicate with the dispatching agency or receiving hospital en route, on approach for landing, or at any other time during the patient transfer process.

The Bell 407GXi also offers:

- A large bi-fold side door for ease and speed of patient loading.
- Three-dimensional terrain mapping, providing for a more robust safety envelope.
- A power-to-weight ratio that provides for excellent performance at high altitudes, allowing crews to get to more stable air for a smoother patient transport.
- A range of 350 nautical miles at a cruising speed of 157 miles per hour.
- A state-of-the-art autopilot system, which reduces pilot workload and contributes to enhanced safety.

BELL 407GXI WEBSITE (HTTPS://WWW.BELLFLIGHT.COM/PRODUCTS/BELL-407)







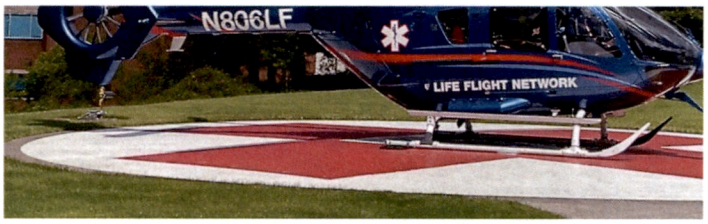
FLEET

AW119Kx "Koala"

Life Flight Network is proud of our fleet of AgustaWestland AW119Kx "Koala" helicopters. The Koala cruises at 166 miles per hour and comes equipped with a state of the art Garmin G-1000H cockpit. The Garmin G1000H is simple and intuitive and provides exceptional situational awareness for the pilot. This highly nimble aircraft has the capability to transport two patients or to house a specialty team with unencumbered full-body access.

3D TOUR (HTTPS://VISITINGMEDIA.COM/TT8/?TTID=LIFE-FLIGHT-NETWORK-ICMS#/3D-MODEL/0/0?B11T0=1&A10PH=1&J2CK2=1)

AW119KX WEBSITE (HTTPS://WWW.AGUSTA.COM/RANGE/AW-119KX)



FLEET

Eurocopter EC135

The Eurocopter (now Airbus) EC135 twin-engine helicopter is a popular aircraft in the air medical industry. Similar to the AgustaWestland aircraft, the EC135 is capable of transporting a specialty team. The rear patient care compartment is separate from the pilot area. Our fleet has five EC135s. Some capable of flying under instrument flight rules in the foggy and cloudy region west of the Cascade Mountains.

3D TOUR (HTTPS://VISITINGMEDIA.COM/TT8/?TTID=LIFE-FLIGHT-NETWORK-ICMS#/3D-MODEL/0/1?B11T0=1&A10PH=1&J2CK2=1)

EC135 WEB (HTTPS://WWW.AIRBUS.SERVICES/HELICOPTE

EXPLORE THE FLEET

AIR MEDICAL

Fixed-Wing Fleet

Our most effective tools in reaching patients at greater distances, the fixed-wing fleet is strategically placed at bases throughout the Pacific Northwest and Intermountain West.

FIXED-WING FLEET (HTTPS://WWW.LIFEFLIGHT.ORG/SERVICES/AIR-MEDICAL-TRANSPORT/FIXED-WING-FLEET/)

GROUND MEDICAL

Ground Fleet

ICU-level transport is as vital on the ground as it is in the air. And because we are at the ready for nearly any situation, Life Flight Network maintains a fleet of ground ambulances at bases in Oregon, Washington, Idaho, and Montana.

GROUND FLEET (HTTPS://WWW.LIFEFLIGHT.ORG/SERVICES/GROU MEDICAL-TRANSPORT/)

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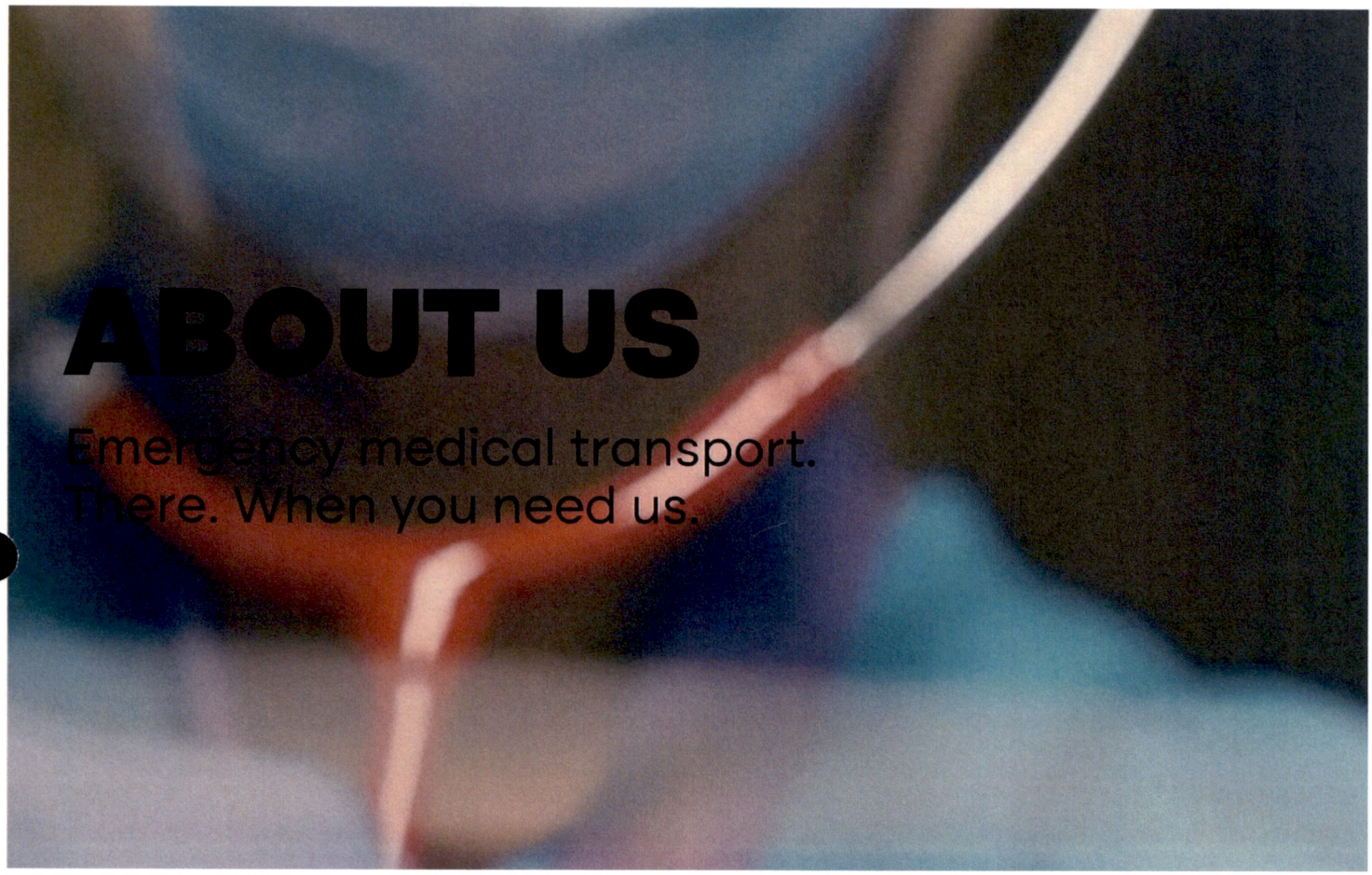
ABOUT US
Emergency medical transport.
There. When you need us.

Saving Lives

Life Flight Network is a not-for-profit patient transport service providing helicopter, fixed-wing, and ground ambulance transport throughout Oregon (https://www.lifeflight.org/service-areas/oregon/), Washington (https://www.lifeflight.org/service-areas/washington/), Idaho (https://www.lifeflight.org/service-areas/idaho/), and Montana (https://www.lifeflight.org/service-areas/montana/). Our mission is saving lives with industry-leading care and transport. This aligns with the values of Life Flight Network's owner consortium of non-profit, world-class healthcare systems.

Every employee at Life Flight Network is dedicated to saving lives by providing exceptional, safe, and expeditious ICU-level care and transport. For over 45 years, Life Flight Network has provided award-winning service and support to patients, hospitals, and EMS, ensuring all patients receive the highest quality care and transport.

From the mountains of Montana and the backcountry of Idaho to the plains of Washington and the Oregon coastline, our services are woven into the regions we serve. We live, work, and play in these communities. Residents and visitors alike entrust us to come to their aid when they need us most—a responsibility we do not take lightly.

OUR MISSION

The mission of Life Flight Network is saving lives with industry leading care and transport.

OUR VALUES

The key values of Life Flight Network are **safety, customer service**, **excellence**, **efficiency**, **compassion**, and **social justice**.

OWNERSHIP

Life Flight Network, LLC is an Oregon limited liability company. The members of Life Flight Network, LLC are non-profit hospital systems and public corporations. Life Flight Network operates the air medical program on a not-for-profit basis.

(https://www.providence.org/)	(https://www.ohsu.edu/)	(http://www.providence.org)	(https://www.saintalphonsus.(
providence.org (https://www.providence.org/)	legacyhealth.org (https://www.legacyhealth.org/)	ohsu.edu (https://www.ohsu.edu/)	saintalphonsus.org (https://www.saintalphonsus.(

FOR EVERYONE

Every person, no matter where they choose to live, deserves access to high-quality, compassionate healthcare. Life Fight Network prioritizes placing lifesaving air medical resources in rural communities that are often underfunded and overlooked, providing a much-needed lifeline to specialty care resources. Life Flight Network's aircraft are staffed 24/7/365 with board-certified flight registered nurses, paramedics, or registered respiratory therapists. When time is of the essence, our teams' ability to respond rapidly means we can be to a patient's side in minutes, improving patient outcomes.

ACCREDITATIONS & ASSOCIATIONS

Air Medical Operators Association

airmedicaloperators.com (https://www.airmedicaloperators.com/)

Save Our Air Medical Resources

soarcampaign.com (https://www.soarcampaign.com/)

Commission on Accreditation of Medical Transport Systems

camts.org (http://www.camts.org)

Association of Air Medical Services

aams.org (https://aams.org/)

National Business Aviation Association

nbaa.org (https://nbaa.org/)

North West Association of Aeromedical Responders

MedEvac Foundation International

medevacfoundation.org (https://medevacfoundation.org/)

Pilatus Owners and Pilots Association

pilatusowners.org (https://pilatusowners.org/)

National Accreditation Alliance Medical Transport Applications

naamta.com (https://intranet.naamta.com/)

International Standard for Business Aircraft Operators

ibac.org/is-bao (https://ibac.org/is-bao/)

Helicopter Association International

www.rotor.org (https://rotor.org/)

AWARDS & ACCOLADES

2022 Neonatal/Pediatric Award of Excellence

The AAMS Neonatal/Pediatric Transport Award of Excellence recognizes an individual or team that has made an outstanding contribution to a neonatal/pediatric transport service in any of the following areas: enhancing safety, education, leadership, and patient advocacy by developing or promoting the improvement of patient care in the medical transport community.

2021 AAMS Program of the Year Award

The Program of the Year Award recognizes an emergency medical transport service (national or international) that has demonstrated a superior level of patient care, management prowess, high quality leadership through visionary and innovative approaches, customer service, safety consciousness, marketing ingenuity, community service, and a commitment to the medical transport community as a whole.

2021 FAAST Award

This award is a cooperative effort between the Federal Aviation Administration (FAA) and aviation industry sponsors to recognize outstanding work in aviation Maintenance. The award highlights the important roles these individuals play in promoting aviation safety, education, and professionalism.

2018 Medical Director of the Year by Oregon Health Authority

Life Flight Network's former Medical Director, Dr. Jim Bryan, was honored as Medical Director of the Year by the Oregon Health Authority for his commitment to excellence and education in Emergency Medical Services (EMS). Read the entire story. (https://www.lifeflight.org/jim-bryan-md-phd-honored-as-ems-medical-director-of-the-year/)

2018 "100 Best Nonprofits to work for in Oregon"

2016 Named "Most Admired Companies"

2015 AAMS Program Director of the Year

2015 AAMS Excellence in Community

Life Flight Network was again named by *Oregon Business magazine* as one of the 100 Best Nonprofits to work for in Oregon, recognizing our focus on employment engagement, safety and patient care.

Life Flight Network was recognized by the *Portland Business Journal* as one of the Most Admired Companies and became the first air medical program in the world to achieve dual HAI-APS and IS-BAO safety accreditations.

Former CEO Michael Griffiths received the AAMS Program Director of the Year Award in 2015 and was a finalist for the EY Entrepreneur of the Year.

Service Award

Life Flight Network received the AAMS Excellence in Community Service Award in recognition of our continuing broad-based commitment to the communities served and our dedication to various outreach and training programs.



2012 Named "Best Large Nonprofit to Work for in Oregon"

Life Flight Network was named the Best Large Nonprofit to Work for in Oregon by *Oregon Business* magazine, after previous top 15 rankings in 2010 and 2011. Since then, Life Flight Network has consistently ranked in the top 10 and was named #1 again in 2016.



2011 Named "Oregon's Fastest Growing Private Company"

The program was named Oregon's Fastest Growing Private Company by the *Portland Business Journal*, and former CEO Michael Griffiths received the Oregon EMS Administrator of the Year Award.



2009 AAMS Program of the Year award

Life Flight Network proudly accepted the AAMS Program of the Year award. This prestigious honor established a benchmark of excellence the program incorporates into current planning and operations and is dedicated to building upon into the future.



2008 EMS Commitment to Quality Award

Life Flight Network received the Oregon EMS Commitment to Quality Award.

ABOUT

Careers

We are always looking for highly qualified, motivated people eager to join our team. Our exceptional compensation and benefits packages exceed industry standards for many positions. Let's work together.

ABOUT

History

For over 45 years, we have set the region's standard for air medical care. As the largest not-for-profit transport provider in the west, our trusted model is built upon safety, quality, and service.

ABOUT

Leadership

Throughout our history, we have led an emerging air medical industry by way of excellence. Because our own leadership has never settled for less, it's what our patients, partners, and people deserve.

CAREER OPPORTUNITIES (HTTPS://WWW.LIFEFLIGHT.ORG/ABOUT-US/CAREERS/)		OUR HISTORY (HTTPS://WWW.LIFEFLIGHT.ORG/ABOUT-US/HISTORY/)		LEADERSHIP TEAM (HTTPS://WWW.LIFEFLIGHT.ORG/ABOUT-US/LEADERSHIP/)

SERVICES

- Services Overview
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- Ground Transport
- Communications Center
- Quality Management
- Membership

SERVICE AREA

- Service Area Overview
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- Idaho
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- Specialty Teams
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- Life Flight Network
- History
- Leadership
- Life Flight Network Foundation
- Careers
- Newsroom
- Patient Stories

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- Phone & Addresses
- Base Locations
- Email Inquiries

SOCIAL

Patient Services(https://www.lifeflight.org/patient-services/)

Membership Renewal(https://www.lifeflight.

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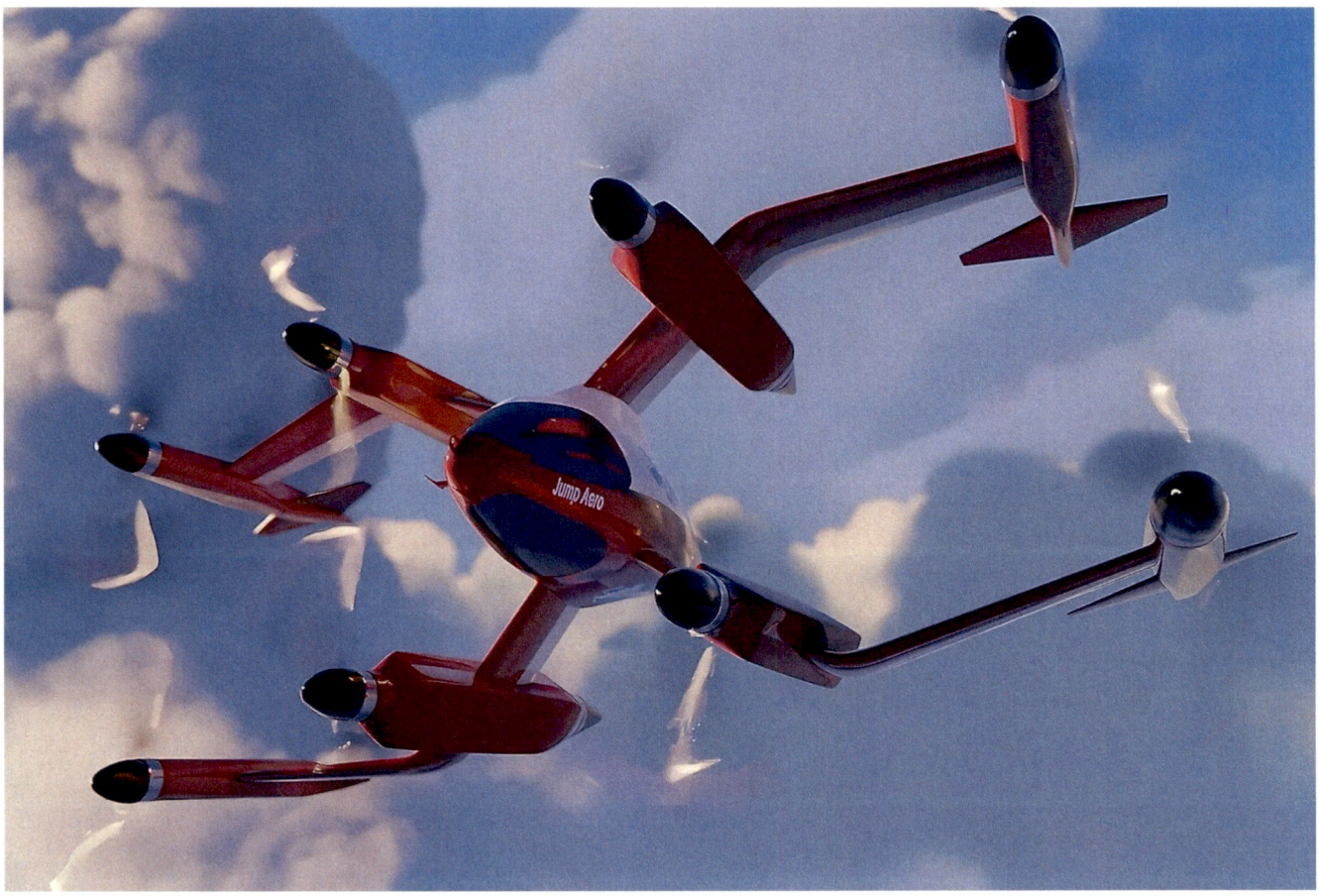
Privacy Policy

Sitemap

More Than 100 Electric Aircraft for First Responders May Be Headed to Oregon

A tentative agreement between manufacturer Jump Aero and Oregon's Department of Aviation calls for the delivery of up to 126 eVTOL aircraft.

Jack Daleo November 28, 2023



A digital rendering depicts what Jump Aero's JA1 Pulse eVTOL might look like in forward flight. [Courtesy: Jump Aero]

An electric vertical takeoff and landing (eVTOL) design purpose-built for first responders may soon fly in Oregon skies.

Jump Aero, a manufacturer of eVTOL aircraft for emergency response, on Tuesday announced it is working with the Oregon Department of Aviation to bring its JA1 Pulse to the state's rural population.

A memorandum of understanding (MOU) between the partners cements Oregon as the latest state with plans to introduce the model, which Jump Aero bills as the "world's fastest sustainable personal aircraft."

Capable of reaching a top speed of 250 knots in short dashes—above the speed limit under Class B airspace around many metro areas, but suitable for rural areas—it's designed to cut emergency response times in half, allowing first responders to fly within a 31 sm (27 nm) radius in as little as eight minutes under certain limitations.

The announcement follows Jump Aero's collaboration with the Utah Department of Transportation's Aeronautics Division, which is exploring how the Pulse could augment the state's first responders.

"We are confident that the JA1 Pulse will be a critical lifesaving tool in Oregon and look forward to working with first responders there and in the growing list of partner regions," said Carl Dietrich, president and CEO of Jump Aero. "This MOU and the work it represents is directly in line with Jump Aero's mission."

The MOU predicts that Oregon will need up to 126 Pulse eVTOLs to "ensure that a trained professional is on the scene as quickly as possible." The agreement also states that the aircraft "can make a dramatic impact by helping save lives of Oregon residents and tourists" because of its ability to traverse long distances and challenging terrain in as little as eight minutes.

According to research from the Journal of the American Medical Association, emergency medical services typically take seven minutes to arrive on scene after a 911 call is made. However, the median response time rises to 14 minutes in rural areas, with about 1 in 10 victims waiting close to half an hour for personnel to arrive. Such trips can span longer distances, but winding roads and hilly geography can pose obstacles for ground-based support.

"We look forward to building a long-term relationship with Jump Aero as we explore providing rapid first response to our rural communities with the JA1 Pulse," said Kenji Sugahara, director of the Oregon Department of Aviation. "We are excited to be bringing cutting-edge solutions to Oregon residents which will positively impact their health and lives in such a dramatic way."

The Pulse's 330-pound payload allows it to carry a pilot as well as emergency supplies, though it will not transport patients. And despite its VTOL architecture, the aircraft won't replace helicopters.

Rather, Pulse is designed to complement ambulances and rotorcraft by providing initial on-scene support to locations where helicopters typically can't land, such as a two-way residential street. An ambulance would also be dispatched in this scenario, though the expectation is that it would arrive later.

The tail-sitter biplane—which stands nose-up on the runway—can be deployed in less than 60 seconds, while piston- or turbine-engine rotorcraft take a bit longer to start and initialize for flight. While fully assembled, it's compact enough to fit in a flatbed trailer, allowing personnel to transport and deploy it where needed.

The Pulse cruises on a pair of fixed wings and runs on eight independent batteries powering eight motors, four on each set of wings. During takeoff, the pilot stands upright before transitioning to a prone position—à la

Superman—as the aircraft tilts forward.

A large belly window gives the pilot—who would be looking straight down—an unobstructed view of the ground below, helping to enable trickier landings on slopes as steep as 10 degrees. Safety features include simplified flight controls with full envelope protection, ballistic airframe parachute, and adaptive flight controller. The aircraft can continue hovering at about 9,500 feet with a failed propulsor.

So far, Jump Aero has yet to announce a hard entry-into-service deadline for the Pulse. Some eVTOL manufacturers, including Joby Aviation and Archer Aviation, hope to launch commercial air taxi services as soon as 2025. Others, such as Wisk, are looking further out, eyeing the range of 2028 to 2030.

When Pulse is eventually rolled out, it will have a few early customers. In an announcement unveiling the design, Jump Aero revealed that Falck Ambulance Services purchased an option to order a single aircraft, making the Danish firm its first prospective buyer. Just a few weeks later, a second customer, Australian sustainable innovation holdings company Electro Ventures, placed an order for 10 aircraft.

Jump Aero is backed by AFWERX, the innovation arm of the U.S. Air Force—a recent $1.8 million tactical funding increase (TACFI) brought its total contract value with the department to $5.4 million. AFWERX will partially fund Jump Aero's first full-scale, proof-of-concept prototype and work with the company to mature its technology.

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81st OREGON LEGISLATIVE ASSEMBLY--2021 Regular Session

House Bill 2180

Sponsored by Representative WILDE (Presession filed.)

SUMMARY

The following summary is not prepared by the sponsors of the measure and is not a part of the body thereof subject to consideration by the Legislative Assembly. It is an editor's brief statement of the essential features of the measure **as introduced.**

Requires Director of Department of Consumer and Business Services to amend state building code to require that new construction of certain buildings include provisions for electrical service capacity for specified percentage of parking spaces. Allows municipality to adopt local percentage of parking space requirements higher than state building code requirements.

Requires director to make code amendments effective July 1, 2022.

A BILL FOR AN ACT

Relating to vehicles.

Be It Enacted by the People of the State of Oregon:

SECTION 1. (1) As used in this section:

(a) "Electric vehicle charging station" means a device or facility for delivering electricity for motor vehicles that use electricity for propulsion.

(b) "Municipality" has the meaning given that term in ORS 455.010.

(c) "Provisions for electrical service capacity" means:

(A)(i) Building electrical service, sized for the anticipated load of electric vehicle charging stations, that has overcurrent devices necessary for electric vehicle charging stations or has adequate space to add the overcurrent devices; and

(ii) A conduit system installed from building electrical service to parking spaces that can support, at a minimum, electrical wiring for installation of level 2 electric vehicle charging stations and, if the conduit is for future installation of electric vehicle charging stations, that labels both ends of the conduit to mark the conduit as provided for future electric vehicle charging stations;

(B) Space within a building to add additional building electrical service for installation of electrical service capacity for electric vehicle charging stations; or

(C) A designated location on building property, in or adjacent to a landscaping area, to install remote service for electric vehicle charging stations.

(d) "Townhouse" has the meaning given that term in ORS 197.758.

(2) The Director of the Department of Consumer and Business Services shall adopt amendments to the state building code to require newly constructed buildings described in subsection (3)(a) of this section to include provisions for electrical service capacity for charging electric vehicles. The code must require that each building include, at a minimum, provisions for electrical service capacity at no less than 20 percent of the vehicle parking spaces in the garage or parking area for the building. Fractional numbers derived from a calculation of the vehicle parking spaces must be rounded up to the nearest whole number.

(3)(a) The director shall make code requirements under subsection (2) of this section applicable only to:

NOTE: Matter in **boldfaced** type in an amended section is new; matter [*italic and bracketed*] is existing law to be omitted. New sections are in **boldfaced** type.

(A) Commercial buildings under private ownership;

(B) Multifamily residential buildings with five or more residential dwelling units; and

(C) Mixed-use buildings consisting of privately owned commercial space and five or more residential dwelling units.

(b) The director may not make code requirements under subsection (2) of this section applicable to townhouses.

(4) Notwithstanding ORS 455.040, a municipality may, by ordinance, rule or land use process, require that each newly constructed building described in subsection (3)(a) of this section include provisions for electrical service capacity to accommodate more than 20 percent of vehicle parking spaces in the garage or parking area for the building.

SECTION 2. The Director of the Department of Consumer and Business Services shall ensure that initial amendments to the state building code required by section 1 of this 2021 Act:

(1) Take effect on July 1, 2022; and

(2) Apply to new construction for which a person first applies for a building permit on or after July 1, 2022.

August 1, 2023

To the Joint Office of Energy and Transportation:

Thank you for your leadership and management of the National Electric Vehicle Infrastructure (NEVI) program and overall transportation electrification efforts.

Along with this letter, I respectfully submit the Oregon Department of Transportation's (ODOT's) FY 2024 NEVI Plan – Oregon National Electric Vehicle Infrastructure Plan – for your review and approval. As specified by the Joint Office of Energy and Transportation, this plan is an update of our FY 2022 – 2023 plan submitted on July 15, 2022.

Oregon's NEVI Plan and overall NEVI strategy has been developed collaboratively by ODOT and the Oregon Department of Energy and informed by feedback from hundreds of stakeholders. The Plan addresses each of the requirements set forth by your office and includes updates on FY 2022 -2023 implementation as well as ODOT's deployment approach for FY 2024. In addition to restating ODOT's five-year deployment strategy, the plan summarizes ODOT's envisioned contracting mechanisms, highlighting upcoming milestones in implementation, and details ODOT's past, ongoing and planned public outreach efforts, including a Community Engagement Outcomes Report outlining the lessons learned from early stakeholder engagement and how we will continue to engage diverse stakeholders and meet Justice40 goals, ensuring a minimum of 40% of the NEVI benefits accrue to disadvantaged communities.

Oregon is "all in" on transportation electrification and is supporting a rapid scale-up of EV charging infrastructure throughout the state. ODOT is committed to investing in charging infrastructure over and above the NEVI program, providing over $100 million total toward EV charging infrastructure over the next several years, and recently launched a Community Charging Rebates Program to facilitate development of Level 2 charging in public venues and multi-family housing, prioritizing rural and disadvantaged communities. Oregon is well-positioned to build out charging infrastructure and target the highest-need locations, addressing charging deserts in rural, underserved and disadvantaged communities. The NEVI funding for public fast-charging stations along EV Alternative Fuel Corridors is an important next step in meeting identified needs, and ODOT looks forward to continuing to work with your office on implementation of this program.

ODOT appreciates the ongoing guidance in Plan development provided by your office. We look forward to continued collaboration to achieve our vision of creating a network of EV charging stations to increase Oregonians' confidence that EV charging will be as ubiquitous and convenient as fueling with gasoline.

Respectfully,

Kris Strickler
Director

July 24, 2023

To the Joint Office of Energy and Transportation:

The Oregon Department of Energy (ODOE) is proud to support the Oregon Department of Transportation's (ODOT) update to its National Electric Vehicle Infrastructure Program State Plan. ODOE's mission is to help Oregonians make informed decisions and maintain a resilient and affordable energy system. We advance solutions to shape an equitable clean energy transition, protect the environment and public health, and responsibly balance energy needs and impacts for current and future generations. The transportation sector accounts for about 40 percent of Oregon's harmful greenhouse emissions, so strengthening the state's electric transportation infrastructure can help reduce those emissions and support our mission to protect the environment and public health. ODOT's plan builds on long-standing collaborative work between our agencies to identify electric vehicle charging needs across the state and ensure equitable access to EVs and their many benefits.

Oregon is a leader in electric vehicle adoption and has supported access to EV charging for over a decade. In 2009, ODOE and ODOT partnered on a successful application for Transportation Investment Generating Economic Recovery (TIGER) grants and used the funds to establish the West Coast Electric Highway EV charging station network along Interstate 5. This work, in collaboration with California and Washington, built a charging corridor for EV drivers from Mexico to Canada. This history of partnership and collaboration continues as our two agencies work together on EV program and policy development. Our agencies collaborate to support Oregon's *Every Mile Counts* initiative to reduce greenhouse gas emission in the transportation sector, and zero-emission vehicles are a critical piece of the state's transportation climate strategy.

Today the need for transportation electrification cannot be overstated. Oregon has witnessed first-hand the devastating effects of climate change, from damaging wildfires, lingering drought conditions, and deadly heat waves. With the state's electricity providers moving toward 100 percent clean energy goals, now is the time to invest in bolstering EV adoption. Currently about 2 percent of registered passenger vehicles in Oregon are electric vehicles, and adoption levels are expected to climb sharply in the next 5 to 10 years. The Oregon Environmental Quality Commission recently adopted California's Advanced Clean Cars II rule, which requires more zero-emission vehicles to be available in Oregon and bans the sale of new internal combustion engine vehicles by 2035. Significant investments in electric vehicle charging infrastructure are crucial to meet the growing number of EVs on Oregon roads. ODOT's plan is a major step in supporting this clean transportation system future, and ODOE is pleased to support it.

Sincerely,



Janine Benner, Director
Oregon Department of Energy

Oregon Department of Transportation

Oregon National Electric Vehicle Infrastructure Plan – FY 2024 Update

August 2023



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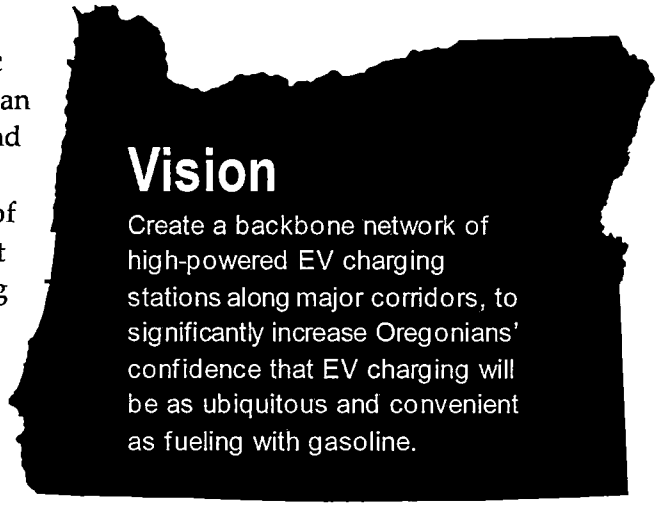
Executive Summary

The Oregon Department of Transportation (ODOT) is pleased to submit this FY 2024 Oregon National Electric Vehicle Infrastructure (NEVI) State Plan Update (State Plan Update or Plan Update) to the Joint Office of Energy and Transportation (JOET). This Plan Update, developed collaboratively by ODOT and the Oregon Department of Energy (ODOE), addresses each of the requirements set forth by JOET to secure Oregon's portion of the funding allocated to states through the National EV Infrastructure (NEVI) program, and includes updates on FY 2022- FY 2023 implementation as well as ODOT's deployment approach for FY 2024.



Oregon is all in on transportation electrification and is supporting a rapid scale-up of EV charging infrastructure in the state. ODOT is committed to charging infrastructure over and above the NEVI funds-plus-match, providing over $100 million total toward EV charging infrastructure. Oregon is well-positioned to build out charging infrastructure and target the highest-need locations because of its recent Transportation Electrification Infrastructure Needs Analysis (TEINA) report, submitted in July 2021. The NEVI funding for public fast-charging stations along alternative fuel corridors is an important next step to meeting identified needs, and ODOT looks forward to working with JOET to complete its planning and begin implementation of this program.

Plan Summary

ODOT's vision for the NEVI program is to create a backbone network of high-powered EV charging stations along major corridors to significantly increase Oregonians' confidence that EV charging will be as ubiquitous and convenient as fueling with gasoline.

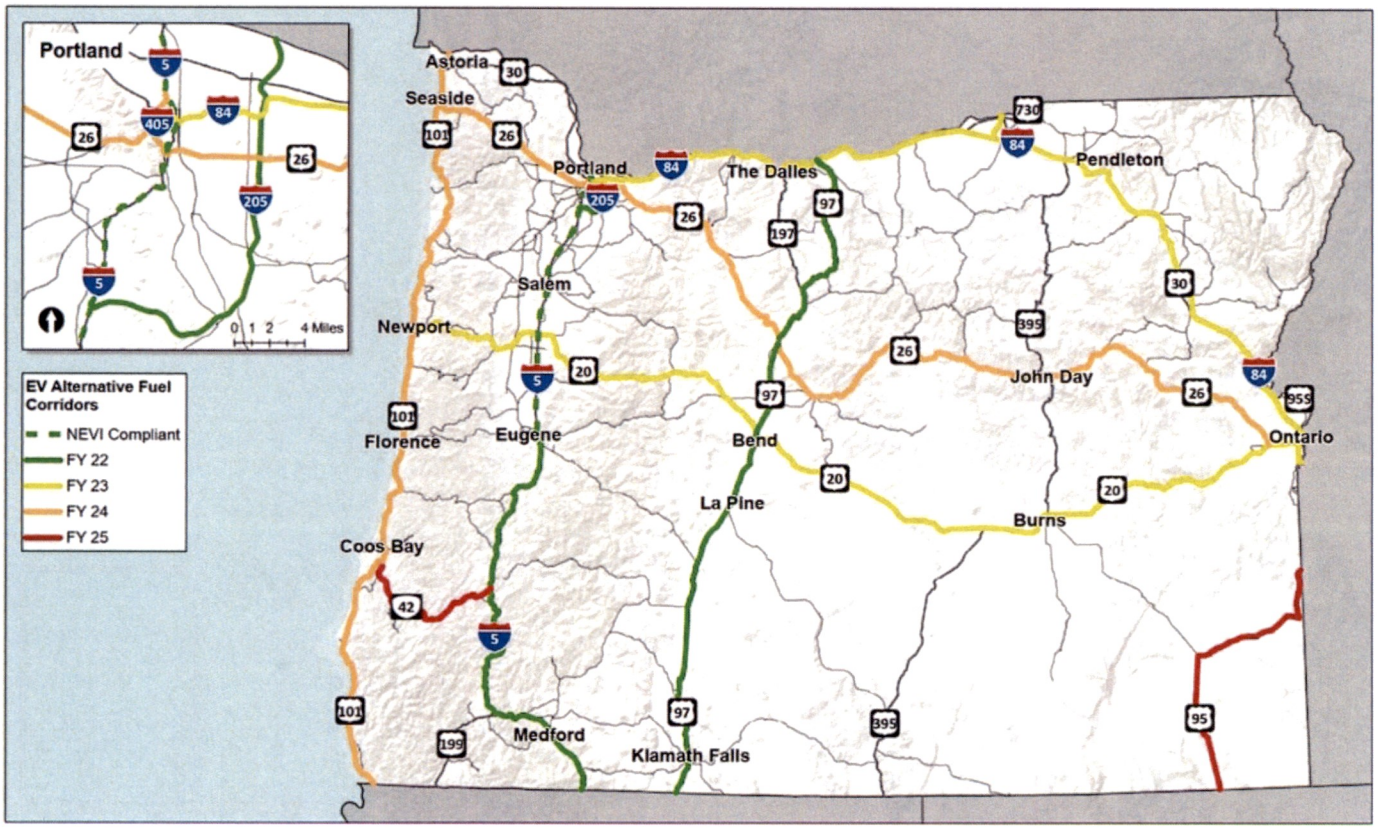
This Plan Update lays out how ODOT will use NEVI funding to achieve the above vision. In addition to restating ODOT's five-year deployment strategy, the plan summarizes ODOT's envisioned contracting mechanisms, upcoming milestones in implementation, and ODOT's past, ongoing, and planned public outreach efforts. This includes a Community Engagement Outcomes Report outlining lessons learned from early stakeholder engagement and how we will continue to engage diverse stakeholders and meet Justice40 goals, ensuring a minimum of 40% of the NEVI benefits accrue to disadvantaged communities.

Guiding Principles

ODOT's charging infrastructure deployment strategy is based on several guiding principles, which align with the goals articulated in both TEINA and the NEVI program. With NEVI funding, ODOT aims to:

Achieve **geographic balance** between urban and rural charging needs to develop infrastructure across the entire state.	Provide **charging access** to all Oregonians, including disadvantaged community (DAC) populations.	Focus on **high-traffic corridors** to the extent practicable.	**Leverage existing and planned EV charging infrastructure.**	Emphasize **connectivity with neighboring states** to establish an interstate charging network.

Figure 1: Planned Implementation Year for Electric Vehicle Alternative Fuel Corridors



Overarching Strategy

With FY 2022 funding ODOT aims to build out I-5, US 97, and I-205. I-5 is one of the most critical, high-traffic routes in the state, and US 97 is a key route through central Oregon that carries high traffic volumes and serves both urban and rural areas. I-205 serves high traffic volumes in the Portland metropolitan area and travels through or adjacent to numerous disadvantaged communities (DACs).

FY 2023 funding will focus on I-84, I-82, and US 20, all of which are high volume routes that provide for east-west travel. I-84 provides service to numerous DACs and accommodates a high proportion of long-distance trips. I-82 connects directly with I-84 and enhances Oregon's connectivity with Washington. US 20 is a route of strategic statewide importance and a freight corridor that will provide additional rural EV charging coverage across the central part of Oregon.

With FY 2024 funding Oregon anticipates build out of US 26, US 101, and I-405. Build out of US 26 and US 101 will represent completion of the remaining seven designated Alternative Fuel Corridors (AFCs) approved during Rounds 1 – 5. US 26 will add additional coverage to Central Oregon, and completion of US 101 will bolster the existing DC Fast Charging (DCFC) infrastructure along Oregon's coast. Completion of I-405 will support the high traffic volumes and DAC populations it serves in the Portland metropolitan area.

ODOT envisions using FY 2025 and FY 2026 funding for completion of US 95 and OR 42, both of which are approved EV AFCs from Round 6. More broadly, ODOT intends to reserve funding for these later years to either develop additional EV AFCs that have yet to be proposed, and/or to build redundancy in charging stations along the other AFCs to strengthen the overall network and accommodate increasing EV traffic in the coming years.

Over the course of the five-year NEVI program, ODOT anticipates using the $65 million in total funding (Federal funds and 20% non-Federal match) to develop and/or upgrade approximately 65 DCFC stations across Oregon's roadways, totaling a minimum of 260 DCFC ports (doubling Oregon's public DCFC ports).

Contracting Mechanisms

ODOT has broad authority to use the Oregon Innovative Partnerships Program (OIPP) to develop public-private partnerships (P3s) for a full range of transportation projects. OIPP procurements offer many benefits over traditional contracting, including the ability to select projects based on best value rather than lowest cost, the ability to customize Requests for Proposals (RFPs) to meet the needs of a particular project, and maximum flexibility to change an agreement to accommodate unanticipated events. Therefore, ODOT is working to enter P3s with one EV Service Providers (EVSPs) per corridor to design, develop, operate and maintain fast charging stations funded through NEVI. ODOT has chosen to pursue a Design-Build P3 contracting approach and has received a Special Experimental Project – No. 14 Exemption for additional flexibility in contracting to best utilize the Oregon Innovative Partnerships Program state procedures and contracting tools.

Figure 2: Process for Developing DCFC Along Alternative Fuel Corridors



Deployment Approach

ODOT's deployment approach will be consistently grounded in the following five overarching objectives and is expected to evolve and adapt throughout the five-year NEVI program in response to experience gained and lessons learned.



Partner with private sector. ODOT will not own, install, maintain, or operate any of the EV charging stations deployed with NEVI funds while leveraging private sector expertise.



Target reliability. Public confidence in the reliability of EV charging infrastructure is one of the most significant factors in accelerating EV adoption. NEVI requires the achievement of a greater than 97% uptime.



Develop/design competitive corridor RFPs. ODOT intends to issue corridor-specific competitive RFPs in concert with the strategy described above.



Expand coverage. ODOT is committed to prioritizing equity while transitioning the state's transportation system to be powered by electricity. Through NEVI and complementary state programs, access to EV charging will expand across socioeconomic and geographic areas throughout the state, potentially adding new EV AFCs. ODOT will also work with the private sector to intentionally develop sites that serve both highway traffic and local EV charging needs, maximizing utilization and economic development opportunities, where practical.



Build new *and* upgrade existing. ODOT will maximize the benefits of the five-year NEVI program funding by building new charging infrastructure where needed, aiming to exceed the minimum standards where possible, and upgrading existing infrastructure facilities to meet NEVI standards where practical.

Public Outreach

Stakeholder engagement was a key part of the earlier Transportation Electrification Infrastructure Needs Analysis (TEINA) process and included a diverse 17-member Advisory Group; four public Advisory Group meetings; 12 stakeholder listening sessions; and a project-dedicated web page. ODOT has used this extensive input as the starting point for an expanded and more comprehensive stakeholder engagement effort supporting the five-year program. Combined with lessons learned from FY22 deployment, this public process will continue to help ODOT to refine annual updates of this plan through the duration of the NEVI program.

Added elements of the expanded stakeholder engagement process for the NEVI program include:

- Introductory and follow-up webinars providing both background material and updates.
- A NEVI-specific web page that includes detailed responses to frequently asked questions.
- Public opinions and insights obtained from four surveys conducted via the web page, supplemented by an interactive map displaying the public's selected charging locations.
- Stakeholder engagement sessions with five targeted groups – EV drivers; EV charging companies; cities and counties; utilities; and environmental justice and advocacy groups.
- Community meetings in advance of building out NEVI-funded fast chargers along the electric AFCs. These meetings were held in Winter 2023 for first-year corridors (I-5, I-205 and US 97) and included discussion with local communities to explore priority benefits and appropriate metrics to ensure Justice40 goals are met or exceeded. Additional community meetings will be planned prior to build-out for each corridor.

Stakeholder input was incorporated as ODOT developed the FY 2022 State Plan and updates have been made to the FY 2024 State Plan Update to incorporate feedback received in the last year, most notably in the Community Engagement Outcomes Report. As this Plan Update, and future updates, continue the creation of a living State Plan document, new input will be integrated as outreach to new groups takes place and additional perspective is heard.

Figure 3: Stakeholder Outreach Opportunities

Key Activities

- Community meetings along corridors
  - Engage with communities prior to each year's corridor build out
  - First year build out: communities along I-5, US 97, and I-205
  - Listen to learn EV community goals, prioritize desired benefits
  - Work with EV charging providers to match goals with opportunities along corridors
- Webinars
- Guest speaking engagements
- Targeted Information Sessions
  - Specific outreach to voices who haven't yet been heard
- Reporting back – What we hear and how it impacts activities



The NEVI funding for public DCFC stations is an important next step in helping Oregon achieve its ambitious zero emission vehicle adoption goals, providing funding to develop a critical backbone of DCFC stations along key highway corridors. ODOT, and its partner agency the ODOE, look forward to continued collaboration with JOET as ODOT continues its planning and advances implementation of the NEVI program.

Introduction

The Bipartisan Infrastructure Law was established on November 15, 2021. Among other programs, this legislation – also known as the Infrastructure Investment and Jobs Act (IIJA) – established a $5 billion National Electric Vehicle Infrastructure (NEVI) Formula Program, an initial step towards developing a nationwide network of 500,000 electric vehicle (EV) chargers by 2030.

To secure Oregon's FY 2024 NEVI program funding, the Oregon Department of Transportation (ODOT) respectfully submits its second annual Oregon National Electric Vehicle Infrastructure Plan Update (State Plan Update or Plan Update) to the Joint Office of Energy and Transportation (JOET). The Plan Update reiterates ODOT's guiding principles and overarching strategy, provides updates on contracting mechanisms and milestones, and outlines a more detailed deployment approach for DC fast charging (DCFC) stations funded with FY 2024 funding through the NEVI program.

Oregon is committed to transitioning its transportation system to be powered by electricity, and ODOT is supporting a rapid scale-up of EV charging infrastructure in the state. Drivers need equitable, convenient, and reliable access to public EV chargers in order to take advantage of electric vehicles, and more public charging will help give Oregonians the confidence that an EV will get them where they need to go just as reliably as a vehicle powered by gasoline or diesel. EVs can also offer significant cost reductions for vehicle operation - fueling an EV can cost 80% less than a similar gasoline vehicle. This can help reduce the transportation energy burden on low-income Oregonians.

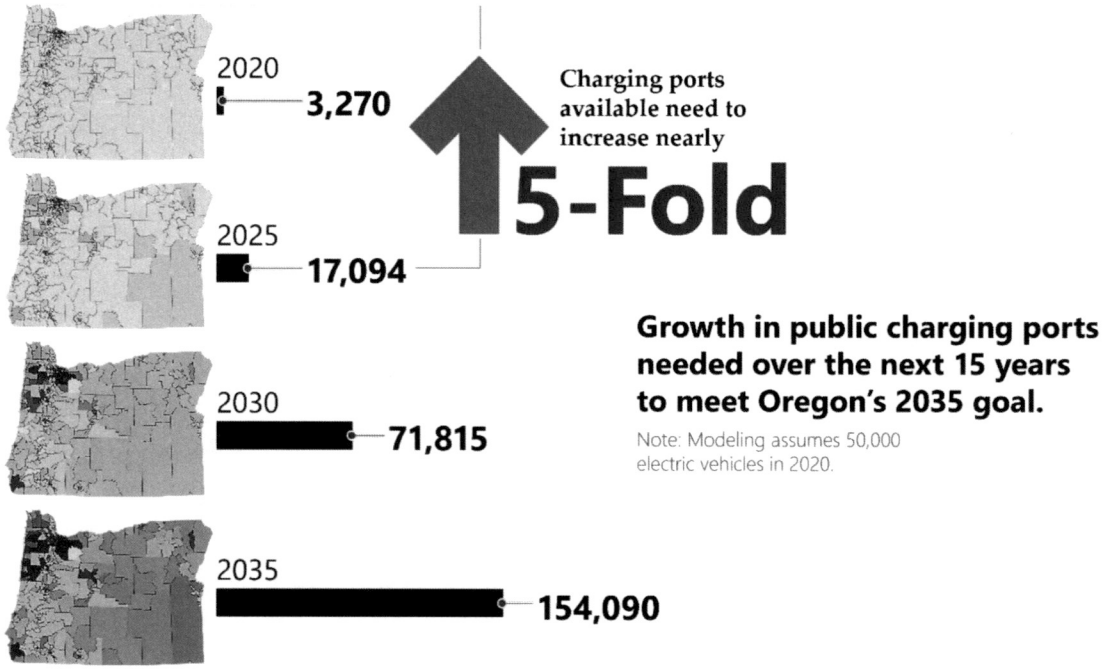
Transportation electrification affords many benefits, including reductions in tailpipe emissions and the associated public health benefits, decreased greenhouse gas emissions (GHGs) and the related climate benefits – in Oregon, transportation is responsible for about 40% of total GHGs – and the opportunity to take advantage of reliable, domestically produced electricity rather than relying on petroleum-based fuels.

Oregon is all in on transportation electrification and ODOT is committing additional dollars to charging infrastructure over and above the NEVI funds-plus-match, providing over $100 million total toward EV charging infrastructure. ODOT's funding plans will better support a transition to EVs, by focusing infrastructure along highways, on major roads, and within communities. The NEVI funding constitutes approximately two-thirds of this commitment at approximately $65 million, including local match. The remaining third—over $35 million—will be largely used to close EV infrastructure gaps beyond the areas supported by NEVI funding. Specifically, ODOT plans to support additional charging sites in rural and urban areas, underserved communities, and at apartment complexes, allowing more Oregonians to charge their vehicles where they live, work, and play.

Transportation Electrification Infrastructure Needs Analysis

Oregon is well-positioned for this funding and will be able to target the highest-need locations based on a recent ODOT study that assessed statewide charging needs to meet aggressive state Zero Emission Vehicle (ZEV) adoption goals. In 2020 - 2021, ODOT conducted a Transportation Electrification Infrastructure Needs Analysis (TEINA), aiming to identify the required EV charging needs for different vehicle types and use cases in order to meet the state's ZEV goals. Throughout the eight-month study, ODOT continuously engaged with stakeholders and the general public. The study – which explored these charging needs for nine use cases over 15 years – found that, relative to 2020 levels, Oregon needs a 5-fold increase in public charging ports by 2025, and a more than 40-fold increase by 2035 in the "business as usual" scenario.

Figure 4: Anticipated Growth in Public EV Charging Needs in Oregon, 2020 – 2035



The NEVI funding for public DCFC stations is an important next step in meeting some of these needs, and ODOT and the Oregon Department of Energy look forward to working with the JOET as the planning and implementation of this program is completed.

State Plan Milestones for EV Infrastructure Deployment, Development and Adoption

Oregon's State Plan was developed primarily by ODOT, in close collaboration with the Oregon Department of Energy (ODOE). Final State Plan approval and adoption will be authorized by the ODOT Director.

The following key milestones for FY 2024:

- August 1st: Oregon's NEVI State Plan due to the Federal Highway Administration (FHWA) and JOET
- September 30th: Anticipated date of FHWA approvals of State Plans
- Summer 2024: ODOT issuance of initial public-private partnership (P3) Requests for Proposals (RFP) for FY 2024 corridors
- Winter 2024: ODOT selection of FY 2024 contractor(s)
- Spring 2025: Initiation of FY 2024 charging station build out.
- Ongoing: Community workshops along Alternative Fuel Corridors prior to build out.
- Ongoing: Online Open House & Surveys prior to the drafting of each AFCs associated RFP

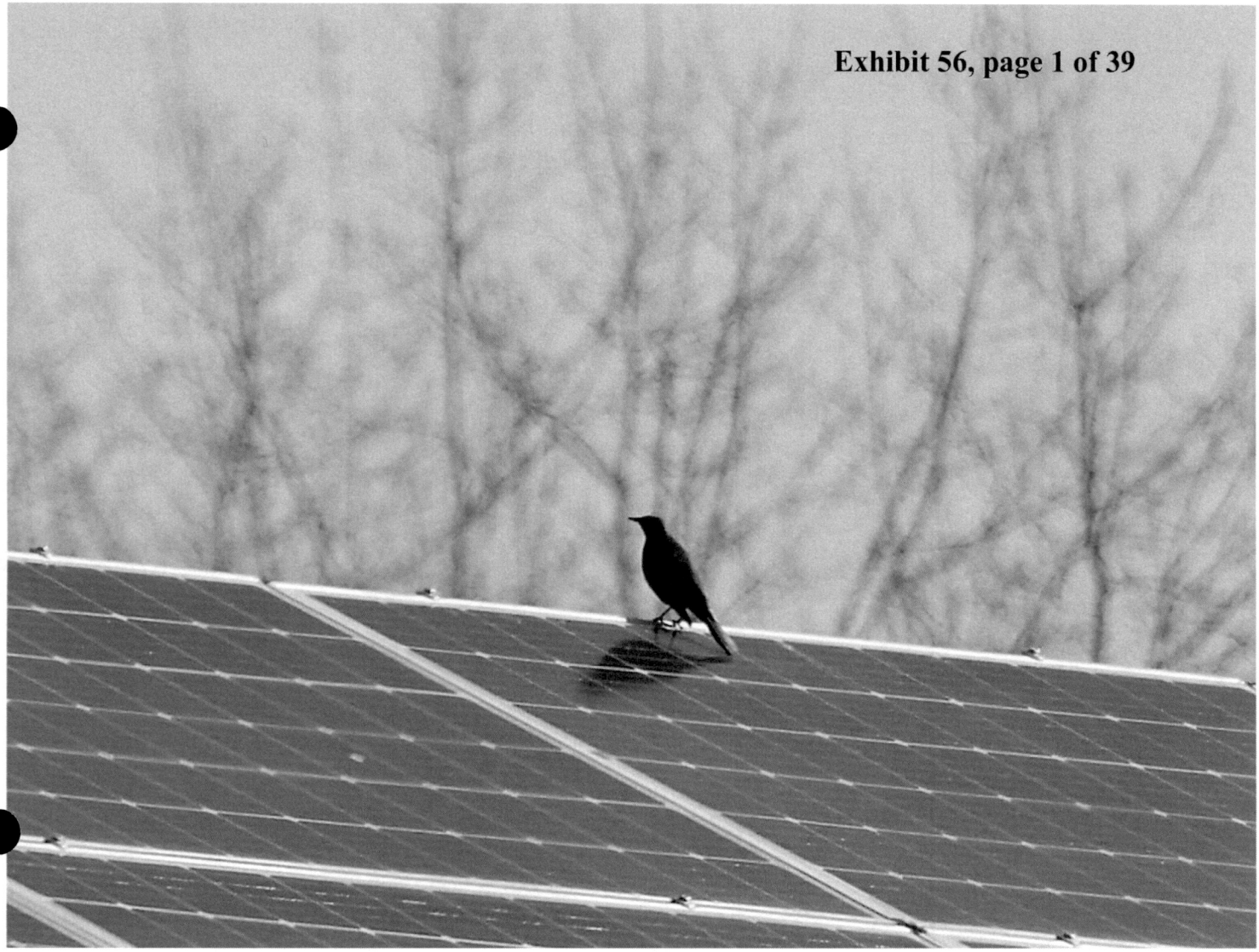
Longer term anticipated plan timing:

- Review of previous years' findings (Program Evaluation)
- Annual community and stakeholder engagement along future corridors and check in on existing corridors.
- Annual issuance of future years' P3 RFPs (Fall or Spring of each year)
- Annual initiation of future years' charging builds out (Winter to Spring of each year)
- Annual *Community Engagement Outcomes* report Annual updates to the Oregon NEVI State Plan

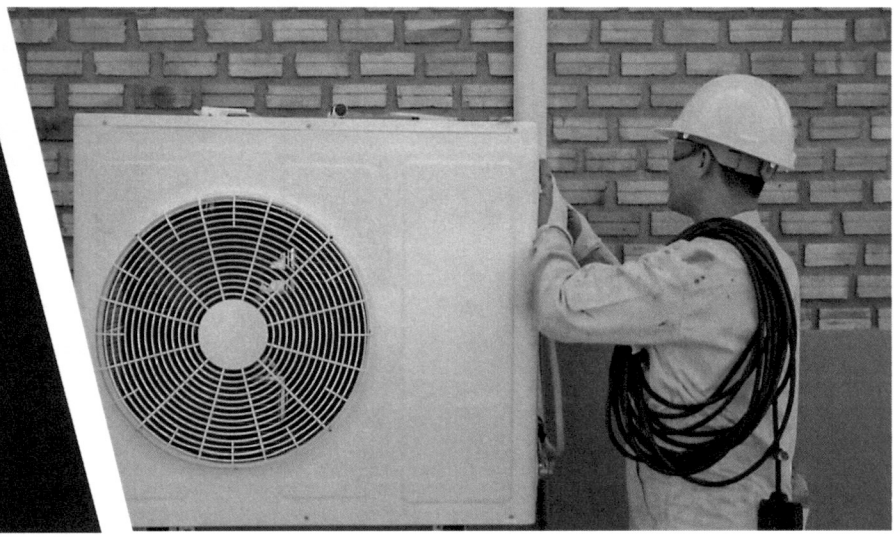
Updates from Prior Plan

The following chapters include the most significant updates from ODOT's FY 2022 State Plan:

- **Public Engagement**, specifically the inclusion of a Community Engagement Outcomes Report, that details engagement activities conducted, and lessons learned since the submission ODOT's FY 2022 State Plan, as well as updates on Tribal engagement, utility engagement and plans for site-specific public engagement (Pages 14-21).
- **Contracting,** including updated milestones through FY 2024 and new sections outlining the status of the contracting process, scoring methodologies utilized and a plan for compliance with Federal requirements (Pages 28-32).
- **EV Charging Infrastructure Deployment**, specifically a new section detailing ODOT's strategy for FY 2024 funding implementation, including planned charging stations along FY 2024 corridors (I-405, US 101 and US 26) (Pages 49-62).
- **Implementation,** specifically the section on Strategies to Promote Strong Labor, Safety, Training, and Installation Standards (Pages 67-68).
- **Discretionary Exceptions,** which has been updated to reflect exceptions requested for FY 2024 corridors (Page 80-82).



2023 Legislative Session Report



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For questions about this report or if you see that there's a bill we ought to have included or something else of concern, please email our Government Relations Coordinator, Christy Splitt at christy.splitt@energy.oregon.gov.

Contact us: https://www.oregon.gov/energy/About-Us/Pages/Contact-Us.aspx

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INTRODUCTION

Oregon's 2023 legislative session adjourned on June 25. There were 2970 bills, memorials, and resolutions introduced during the session. Of those, the legislature passed 653. At the time of initial publication of this document, the Governor is still in the process of signing bills. This report will be updated accordingly.

ODOE at the Capitol

The Oregon Department of Energy helps Oregonians make informed decisions and maintain a resilient and affordable energy system. We advance solutions to shape an equitable clean energy transition, protect the environment and public health, and responsibly balance energy needs and impacts for current and future generations.

On behalf of Oregonians across the state, the Oregon Department of Energy achieves its mission by providing:

- A Central Repository of Energy Data, Information, and Analysis
- A Venue for Problem-Solving Oregon's Energy Challenges
- Energy Education and Technical Assistance
- Regulation and Oversight
- Energy Programs and Activities

With all these roles in mind, we track each legislative session carefully. This session, the Oregon Department of Energy shared energy data, information, and analysis and provided energy education about federal funding opportunities for energy and climate change, energy facility siting, energy planning, and more. We also tracked bills that make changes to regulatory roles and add new programs and activities at the agency, and we provided technical advice to legislators and staff along the way.

As the legislative session closed on June 25, the legislature had passed several bills giving the Oregon Department of Energy new work to do toward achieving our mission. Most of this work is in a three-bill "Climate Package," which is fully summarized starting on page 7. For example, one of those bills, HB 3630, includes several new tasks: a community navigator program to help environmental justice communities connect to technical resources and funding opportunities for energy projects, a grant program to support county energy resilience planning, direction to work with interested parties and sister agencies to craft a state energy strategy, and a kick-start to agency work establishing two federal home energy efficiency programs. The agency was also directed to establish a Building Performance Standard to reduce emissions from existing large buildings, update the work of the Oregon Global Warming Commission, and much more. In addition, the Oregon Solar + Storage Program and the Rental Home Heat Pump Program were extended, and the Community Renewable Energy Grant Program budget was increased by 80 percent for the next two years.

About the 2023 Legislative Session Report

This document is designed with several purposes in mind:

- For energy stakeholders to use as a quick reference of energy bills during the 2023 session
- For the general public to use as a place for quick, easy-to-read summaries of bills that relate to energy and other issues that relate to the mission or work of the Oregon Department of Energy
- To serve as a record of the bills ODOE tracked most closely during the Legislative session

Following this introduction, there are three sections:

- *Bills Passed* that relate to energy or the work of the Oregon Department of Energy
- *Budget Bills* that relate to energy or the work of the Oregon Department of Energy
- *Bills Considered* that relate to energy in Oregon, but did not pass

For each bill listed, there is a summary, the effective date, and related Oregon Revised Statute chapter. For more information, click the hyperlinks on the right above each bill summary to go to the Oregon Legislative Information System overview page for each bill. From there, you can find the text of each measure, testimony, and votes on the bills as they moved (or did not move) through the process.

One of ODOE's roles is to provide analysis of energy issues to inform state energy planning, regulation, program administration, and policy development. In that vein, we have also provided a narrative summary of the energy landscape as the 2023 legislative session came to a close.

This is an online report, which means that ODOE can update it – if you see that there's a bill we ought to have included or something else of concern, please email christy.splitt@energy.oregon.gov.

A Brief Overview of Energy Issues in the 2023 Legislative Session

The 2023 Legislative Session was in some ways a return to normalcy after the COVID-19 pandemic. Once again, committee meetings were in-person, and the building was bustling with lobbyists, staff, and members of the public after relative quiet for the last three sessions. But that bustle was happening in a smaller space and with even more noise than usual; a major, multi-year seismic retrofit of the Capitol left half of it closed and all of it a construction zone.

Like the 2022 session, there was a remarkable amount of change. There were 22 new legislators experiencing their first session, joining 11 who were new a year ago – so it was the first long legislative session for over one-third of the legislators. Last year, there was new leadership atop the House. This year, there was new leadership in the Senate, with a new Senate President, Rob Wagner, and a new Senate Majority Leader, Kate Lieber. Oregon also had a new Governor, Tina Kotek.

Despite new legislators and new leadership, partisan tensions remained high. Tactics to slow the legislative process as a form of protest continued. The minority party also objected to bill summaries that failed to meet a state statute requiring them to pass the Flesch Readability Test. When two especially controversial bills passed the House, rancor reached its apex. To avoid a final vote on both bills, 10 members of the State Senate denied quorum for nearly six weeks – the longest legislative walkout in American history.

The walkout framed what happened as the clock started to run out on session. While business continued as usual in many ways, with committees working bills and budgets, tactics to allow for a speedier end to session should the 10 senators come back emerged. Many bills were packaged together in the budget process, creating omnibus bills on topics such as education and workforce, housing, and rural economic development. In the end a deal was reached, the Senate reconvened, and those packages – including one addressing climate change and energy – may have helped session end ahead of the constitutional deadline for adjournment.

The 2023 session followed energy-packed 2021 and 2022 sessions. Conventional wisdom at the Capitol says that if there was recent major legislation on an issue, it is quieter on that topic the next time around. But with the urgency of climate change clear, every session seems to be an energy session now. Legislators on both sides of the aisle are interested in the clean energy transition and dealing with the effects of climate change, such as wildfire and drought. The Climate Package developed in the last week of session combined 20 bills into two, HB 3409 and HB 3630, with some funding in the budget reconciliation bill.

One area of significant interest in the 2023 session can be viewed as a climate trifecta: energy efficiency. Weatherization can help keep smoky air out, while heat pumps can offer more efficient winter heating with life-saving summer cooling – mitigation, adaptation, and lower energy bills. Several concepts passed that will improve both home and commercial building efficiency (HB 3409 and HB 3630). These concepts were the result of the Resilient Efficient Buildings Task Force and designed to leverage major investments in energy efficiency in the federal Inflation Reduction Act, passed in August 2022. You can read more about them in the Climate Package summary starting on page 7.

There was also momentum around planning for climate change and a clean energy future. Legislation passed to create a state energy strategy that will evaluate trade-offs and consider pathways to meet Oregon's energy and climate objectives (HB 3630), consider ways to measure and encourage climate solutions on natural and working lands (HB 3409), and bolster the Oregon Global Warming Commission's scope of work — complete with a name change to the Oregon Climate Action Commission (HB 3409). The Climate Package also included provisions to help communities build their own energy projects and become more resilient in the face of natural disasters and power outages.

The question of how the state can balance its legacy of protecting farm and forestland with the demand for new clean energy development was also at the forefront in 2023. Multiple placeholder bills (bills with the intent to add policy later) were introduced at the start of session awaiting amendments as conversations unfolded. Some of these placeholders were meant to capture the results of stakeholder conversations that had started in late summer 2022. Those conversations became negotiations and continued right up to deadline week – when bills have to move out of committee in their first chamber. In the end, a rulemaking at the Department of Land Conservation and Development will take on low-conflict solar development (HB 3409), counties will take on review and regulation for more solar projects (HB 3179), and facility and transmission siting will certainly be central to a state energy strategy (HB 3630).

Other topics were subject of multiple bills that did not pass but may resurface in future legislative sessions. The state will have to decide how to adapt to lower gas tax revenues, the state's primary source of funding for transportation maintenance and construction, as the transportation sector transitions away from gasoline. Legislative attempts to address this issue fell short this year. Conversations about disposal and recycling of clean energy technology, like wind turbines, solar panels,

and lithium batteries have come up for several sessions now. We have included a section on bills that didn't pass starting on page 26 to provide a sense of what policy issues or concepts may be considered in the future.

The 2023 Legislative Session was not without surprises. The biggest surprise was likely the May Revenue Forecast, which sets the amount of money legislators have for the two-year state budget. Throughout session, budget cuts were expected. But instead, the May forecast found that the state had more resources than anticipated. While most of that overage will come back to taxpayers with a kicker next year, some of it was able to go into the 2023-2035 budget. This led to an unexpected $90 million investment in climate programs over the next two years – the Climate Package – which funded most of the bills mentioned above. The Climate Package also included additional investments in existing programs like the Oregon Solar + Storage Rebate Program ($10 million, SB 5506) and the Community Renewable Energy Grant Program ($20 million, SB 5506).

Bill Information: Effective Dates, Operational Dates, Publication

Normal Effective Dates

ORS 171.022 provides that unless otherwise stated, all bills take effect on January 1 of the year after the bill is signed into law. This means that unless a bill specifically names a different effective date or has an emergency clause, the bill will take effect on January 1 of the next year.

Emergency Clause

The Oregon Constitution prohibits a bill from taking effect "until ninety days from the end of the session" unless an emergency is declared. An emergency clause will appear in the bill if it is to take effect before the 91st day after adjournment sine die. Bills with emergency clauses are not subject to a referendum of the voters; all other bills are subject to possible referral under the Oregon Constitution. Because of this provision, the Constitution gives the Governor the power to veto an emergency clause without affecting the rest of the bill. The Constitution also prohibits the use of an emergency clause in bills that regulate taxation or exemption. An emergency clause must apply to an entire bill.

Operative Date

If a bill requires administrative preparation before the bill is fully operative, an operative date is used to delay operation of all or part of the bill. If an operative date is used, the entire bill takes effect on its effective date. However, a specified part of an Act does not become operational until a later specified date. It is important to distinguish between items that are authorized on and after the effective date, and items that are not authorized until the operative date.

Example of an emergency clause for a bill that will take effect on its passage:

> SECTION 30. This 2023 Act being necessary for the immediate preservation of the public peace, health and safety, an emergency is declared to exist, and this 2023 Act takes effect on its passage.

Note: A bill with an emergency clause takes effect when the Governor signs it, not when passed by both houses of the Legislative Assembly.

Example of an emergency clause for a bill that takes effect on a specific date after passage but before the 91st day after the end of session:

> SECTION 30. This 2023 Act being necessary for the immediate preservation of the public peace, health and safety, an emergency is declared to exist, and this 2023 Act takes effect July 1, 2023.

Note: If the July 1 date is used and the Governor signs the bill before July 1, the bill takes effect on July 1. If the Governor signs the bill after July 1, the bill takes effect on the date the Governor signs it.

Bill Publication

Copies of the 2023 enrolled bills (the copy the Governor signs) may be found on the legislative website: https://olis.leg.state.or.us/liz/2023R1/Measures/list/. Measures signed into law are known as "session laws" and are available on the legislative website under Oregon Laws. Permanent Laws passed during the 2023 Legislative Session will not be codified until the 2023 edition of Oregon Revised Statutes is released.

LEGISLATION PASSED

The Climate Package

With the session in doubt due to lack of quorum in the Senate, a decision was made to combine bills related to climate change into one package to reduce the number of bills that would need to pass should the session have to end in short order. The resulting two bills, HB 3409 and HB 3630, along with some expenditures in SB 5506, the end of session bill, resulted in a $90 million investment in addressing climate change. These investments, along with underlying programs and policies, became known as the "Climate Package."

This report includes references to the "Climate Package" omnibus bills and to the underlying bills that make up the Climate Package. This is because it will be necessary to look back at the underlying bills to view more in-depth public hearings and work sessions, testimony, committee deliberations, and other pieces of legislative history.

HB 3630/SB 852: Community Navigator

HB 3630/SB 852
ORS Chapter: To Be Assigned
Effective Date: July 31, 2023

Since 2021, the state legislature created new energy incentive programs and Congress passed both the Infrastructure Investment and Jobs Act and the Inflation Reduction Act — investments that will bring state and federal dollars for energy projects to Oregon communities. In many cases these communities, especially rural and Tribal communities, do not have the resources, time, or capacity to learn about and apply for these funds. Language in those new federal and state laws makes clear that energy dollars should flow to the communities that need them most.

SB 852 was absorbed into HB 3630, Section 1. The bill establishes a program to provide information about potential funding resources and other technical assistance to Tribal governments, local governments, rural communities, and other environmental justice communities as they work to develop energy projects or build energy-related capacity. To serve this need, ODOE has already hired for a full-time position to help communities navigate funding opportunities for projects and capacity-building.

HB 3630/HB 2534: State Energy Strategy

HB 3630/HB 2534
ORS Chapter: To Be Assigned
Effective Date: September 24, 2023

HB 2534 was amended into HB 3630, Sections 2-4, without any changes. The bill directs ODOE to develop a comprehensive state energy strategy for Oregon that identifies options and implementation gaps to achieve the state's policy objectives. The state energy strategy must be informed by stakeholder perspectives, existing climate and energy laws, resource plans, studies, and policy goals. The bill lists several factors that ODOE must consider when identifying optimized pathways, such as energy demands, resource choices, environmental justice, resilience, and land use considerations. ODOE is required to engage with other state agencies, Tribes, and stakeholders representing a diverse range of perspectives, backgrounds, and interests, and the department may convene an advisory work group to inform its work. The strategy must reflect the best available information and forecasts, and other state agencies are directed to share information with ODOE as needed.

HB 3630 requires ODOE to produce a report describing the state energy strategy and submit it to the legislature by Nov. 1, 2025. ODOE is required to periodically update the state energy strategy to reflect new information and policy objectives. The bill authorizes ODOE to contract with third parties for technical assistance and facilitation services.

While this is not mentioned in the legislation, the State of Oregon has included developing a state energy strategy as part of its application for a Climate Pollution Reduction Grant from US EPA as part of the Inflation Reduction Act.

HB 3630/HB 3378: County Resilience Planning Grants

HB 3630/HB 3378
ORS Chapter: To Be Assigned
Effective Date: September 24, 2023

HB 3630, Sections 5-7 and 10, provide support to Oregon counties to develop and adopt energy resilience plans to be incorporated into county natural hazard mitigation plans. This concept was initially included in HB 3378. The bill specifically directs ODOE to establish a program to award $50,000 in technical assistance grants to support development of county energy resilience plans.

To qualify for grants, energy resilience plans must:

- Be based on a plan for short, medium and long term power outages.
- Identify and map energy infrastructure, natural hazard risks and – in consultation with representatives from local environmental justice communities – areas that experience social vulnerability.
- Identify potential locations for community resilience centers, prioritizing areas that experience social vulnerability.

- Inventory the energy consumption needs of critical public services facilities.
- Identify critical public services that could enhance community resilience if served with a backup power system.
- Identify opportunities to align energy infrastructure development with critical public services.
- Identify schedules, priorities, and potential funding sources for developing energy resilience.
- Identify other actions and resources needed to implement the energy resilience plan.

The program sunsets on January 2, 2026 and ODOE is required to report on program results by September 15, 2025.

HB 3630/HB 3166: Home Energy Programs and a One-Stop Shop

HB 3630/HB 3166
ORS Chapter: To Be Assigned
Effective Date: July 31, 2023

Sections 8-9 of HB 3630, also found in HB 3166, are intended to prepare Oregon to receive funding under two rebate programs for energy efficiency retrofits in existing homes that were part of the Inflation Reduction Act. The first program is the High Efficiency Electric Home Rebate program (HEEHR). This is a point-of-sale rebate program that allocates $56,714,440 to Oregon for qualifying electrification projects in low- (defined as up to 80 percent Area Median Income) and moderate-income (80 - 150 percent AMI) households. Qualifying projects include heat pumps, heat pump water heaters, electric stoves, heat pump clothes dryers, associated electrical upgrades, and weatherization. The second program is the Home Energy Performance-Based, Whole-House Rebates program (HOMES). Oregon will receive $57,046,250 for this program, which will support performance-based rebates for residential energy efficiency retrofits that save a minimum of 20 percent of household energy use.

The bill directs ODOE, in consultation with Oregon Housing and Community Services Development (OHCS), to establish these two programs after consultation with stakeholders and while ensuring that the measure maximizes benefits by leveraging federal and state resources.

The new federally funded programs, combined with Oregon's new heat pump program and a variety of existing incentives and rebates, has created a need for a more streamlined approach to connecting Oregonians with available funds for energy-related projects. This bill aims to address this by tasking ODOE with creating a single resource that Oregonians can use to navigate the variety of incentives and rebates available to them. This "one-stop shop" is directed to provide information, technical assistance, and assistance in identifying contractors and financing options related to energy efficiency incentives and programs.

ODOE is responsible for coordinating the exchange of data and information necessary to administer the resource. This includes coordination with federal agencies, utilities, and energy efficiency program providers. All entities involved in exchanging, coordinating, and maintaining these data are subject to best practices and regulations per federal and state laws, including the Oregon Consumer Information

Protection Act and ORS 192.355. ODOE may contract with a nonprofit or other entity to conduct this work.

HB 3409/SB 868: Energy Efficiency – Heat Pumps, Education, and Training

HB 3409/SB 868
ORS Chapter: To Be Assigned
Effective Date: September 24, 2023

HB 3409 includes the full text from SB 868. Sections 1-5 set guidelines to align existing and new programs related to the resilience, energy efficiency, and GHG emissions of homes and commercial buildings with overall state climate goals. The provisions also aim to maximize Oregon's allocation from federal funding and guide the use of state and federal funds.

The bill sets a heat pump deployment target of 500,000 new heat pumps by 2030, with a priority on installations in low-income and environmental justice communities throughout the state. It requires that ODOE report to the legislature on the progress toward this goal every two years beginning September 15, 2025. The bill appropriated $525,467 to ODOE to carry out the provisions of this section of the bill.

Sections 4 and 5 establish the Energy Efficient Technologies Information and Training program and fund to prioritize workforce and contractor training, education and awareness of programs, rebates, and the need for heat pumps and other energy efficiency upgrades. There is $2,000,000 appropriated to start this fund.

For more information on energy efficient building technologies, please refer to the 2022 Biennial Energy Report's Energy Resource & Technology Review: Energy Efficient Building Technologies.

HB 3409/SB 869: Energy Efficiency in New Buildings

HB 3409/SB 869
ORS Chapter: 442
Effective Date: January 1, 2024 and September 24, 2023

Sections 6 and 7 of HB 3409 give general directives to the Department of Consumer and Business Services (DCBS) to use existing authority to facilitate greenhouse gas (GHG) emissions reductions in buildings consistent with state GHG reduction goals, and to prioritize, consider, and integrate these goals in agency operations.

- The measure directs DCBS to set goals for improved energy efficiency in new residential and commercial buildings by consulting with its boards, committees, and ODOE. These goals should achieve a 60 percent reduction in annual energy consumption by 2030 compared to 2006-era codes. Beginning December 31, 2023, and every three years after, DCBS is to report to a legislative committee their progress and options toward achieving the specified goals.

DCBS is also directed to update the reach code described in ORS 455.500 each time the statewide and specialty codes are updated, and to investigate the potential benefits and feasibility of updating ventilation standards and specifying standards for air cleaners in building mechanical systems.

In Section 7, DCBS is directed to provide a report to the Legislature by December 31, 2024 that includes DBCS's findings, recommendations, and options for reducing GHG emissions from materials used in building construction, after consultation with DEQ.

Section 6 becomes operative on January 1, 2024, although DCBS may act before this operative date. Section 7 becomes operative on the 91st day after sine die.

Sections 6 and 7 of HB 3409 were originally found in SB 869.

HB 3409/SB 870: Building Performance Standard

HB 3409/SB 870
ORS Chapter: 442
Effective Date: July 27, 2023

Sections 8-17 of HB 3409 create a Building Performance Standard (BPS) program to regulate the energy consumption of many existing commercial buildings in Oregon. These sections were taken from SB 870. Under this new program, buildings would be grouped into two tiers.

Tier 1 includes hotel, motel, and nonresidential buildings equal to or larger than 35,000 square feet (excluding parking garages). Tier 1 building owners are required to comply with a building performance standard by the following dates:

- 200,000+ square feet: June 1, 2028
- 90,000 ≤ square feet < 200,000: June 1, 2029
- 35,000 ≤ square feet < 90,000: June 1, 2030

Tier 2 includes hotel, motel, and nonresidential buildings larger than 20,000 square feet and less than 35,000 square feet, in addition to multifamily residential, schools, dormitories, universities, and hospitals that are equal to or greater than 35,000 square feet (excluding parking garages). By July 1, 2028, Tier 2 covered commercial building owners must submit energy benchmarking reports to ODOE.

Building Performance Standards generally require energy tracking, management, energy auditing, and identification and implementation of energy measures to achieve target energy performance levels for a building. ODOE will be tasked with rulemaking to establish a program and to set appropriate building energy targets for Tier 1 buildings. ODOE will also establish a program for energy benchmarking (energy use reporting) for Tier 2 buildings, as well as convene an advisory group to help the agency create a recommended building performance standard for Tier 2 buildings. It is expected that Tier 1 and Tier 2 buildings will include tens of thousands of buildings across the state. This will require creating a comprehensive database to support building reporting and program administration, as well as

multimodal outreach, training, and education to stakeholders and building owners on project requirements.

BPS program administration will also include a regulatory and compliance component and this bill would provide ODOE with the authority to impose civil penalties on building owners for non-compliance.

This bill also directs ODOE to establish and administer a $2 million incentive program for early and voluntary adopters of Tier 1 and Tier 2 building requirements.

For more information on building performance standards, please refer to the Oregon 2022 Biennial Energy Report policy brief entitled Energy Efficiency Policy Opportunities in Existing Buildings.

HB 3409/SB 871: State Building Efficiency

HB 3409/SB 871
ORS Chapter: 442
Effective Date: September 24, 2023

Sections 18-21 of HB 3409, which includes some contents of SB 871, direct Oregon's Department of Administrative Services to take several actions related to efficiency in state-owned buildings.

The bill directs DAS, in cooperation with ODOE, to develop a methodology and work plan for state agencies to implement a comprehensive assessment of energy use and greenhouse gas emissions in state buildings. These assessments must do the following:

- Examine and quantify GHG emissions using existing data where feasible.
- Identify equipment and usage contributing to emissions from each building.
- Determine and quantify useful life of equipment.

DAS may use a contractor to conduct these assessments. Agencies must cooperate with DAS or the contractor for the assessments. DAS, with support from ODOE, shall create a searchable and modifiable database that maintains the information from the assessment.

DAS, in collaboration with DEQ and ODOE, will oversee all capital projects involving major building renovations or new construction, more than $1 million, and implement guidelines for sustainable design that apply to these projects. The bill also directs DAS and ODOE to participate on behalf of the state in the National Building Performance Standards Coalition.

The bill also updates ORS 469.754, which sets rules for states to engage in energy projects. The key change is that 100 percent of net savings from energy efficiency projects are now deposited in a revolving fund, instead of 50 percent.

HB 3409/HB 3016: Community Green Infrastructure

HB 3409/HB 3016
ORS Chapter: 442
Effective Date: July 27, 2023

HB 3409, Sections 22-27 (originally HB 3016), make a series of findings about the benefits of green infrastructure to communities and creates the Community Green Infrastructure Grant Program to be administered by the Department of Land Conservation and Development. Eligible entities to receive grants include public bodies, local workforce development boards, manufactured dwelling park nonprofit cooperatives, Tribes, watershed councils, and nonprofit or faith-based organizations. Eligible applicants may partner with state agencies or private businesses owning business sites or rental property in Oregon and must consult with local government bodies and electric and water utilities where the project will be located. Projects must be located in Oregon and must benefit an environmental justice community. The bill provides a list of factors for prioritizing applications, including projects that involve low-maintenance and drought-resistant tree plantings and native or pollinator-friendly species and projects that include partnerships with "green communities nurseries" as defined by the bill.

HB 3409/HB 3590: Woody Biomass for Low-Carbon Fuels

HB 3409/HB 3590
ORS Chapter: 442
Effective Date: September 24, 2023

HB 3409 Section 30 directs the College of Forestry at Oregon State University to develop methods and data to establish clean fuels pathways for low carbon fuels derived from woody biomass, with a particular focus on wood slash piles that would otherwise be burned. The College must coordinate with the Oregon Department of Environmental Quality (ODEQ) to ensure its methods and data are consistent with those used to determine lifecycle greenhouse gas emissions and carbon intensities under Oregon's clean fuels program. The college must also collaborate with the Oregon Department of Forestry (ODF). The College must submit a report to the legislature by July 31, 2025. HB 3409 Section 105 appropriated $3 million from the General Fund to the College to carry out the directives in section 30.

HB 3409 Section 31 revised ORS 530.050 to authorize the State Forester to establish a woody biomass conversion program to market woody biomass conversion offtakes; offtakes refer to the energy available after biomass has been converted feedstock to energy. To establish such a program, the bill allows the State Forester to enter into contracts or agreements to create opportunities for woody biomass conversion offtakes, and to sell or purchase offtakes for at least fair market value.

HB 3409 Sections 30-31 were originally found in HB 3590.

HB 3409/HB 2714: Medium- and Heavy-Duty Zero-Emission Vehicle Rebates

HB 3409/HB 2714
ORS Chapter: 442
Effective Date: January 1, 2024

HB 3409, in Sections 32-34 (previously HB 2714), directs DEQ to establish a rebate program for purchasers of qualifying medium- or heavy-duty ZEVs. It also establishes a Zero-Emission Medium and Heavy-Duty Vehicle Incentive Fund.

The bill defines a "qualifying vehicle" but allows DEQ to specify design features for the program, establish procedures to prioritize available moneys for specific qualifying vehicles, and limit the number of rebates available for each type of qualifying vehicle. It allows DEQ to hire or contract with a third-party nonprofit organization to implement and serve as the administrator of the program.

The bill requires DEQ to prescribe the rebate application procedure and the Environmental Quality Commission to set rebate amounts annually. The Commission may establish separate rebate amounts for different classes of vehicles and an additional rebate for fleet owners that purchase qualifying vehicles that will be registered, or frequently operated, in areas disproportionately burdened by air pollution. More than 50 percent of the vehicle operation must occur in Oregon and in each of the three years following receipt of a rebate, the recipient shall maintain records of the miles driven or hours of use for the qualifying vehicle and whether the miles used occurred in Oregon and report this annually to DEQ.

Other features of the program align with existing light duty programs, such as: the applicant must apply for a rebate within six months after the date of purchase and either retain registration of the qualifying vehicle for a minimum of 36 consecutive months or reimburse the administrator for the rebate in a prorated amount.

Administrative costs of the program are limited to 15 percent, and 40 percent of funds must be spent in communities disproportionately burdened by diesel pollution, and the bill appropriates $3,000,000 for the biennium beginning July 1, 2023.

HB 3409/HB 3181: Low-Conflict Solar Siting

HB 3409/HB 3181
ORS Chapter: 442
Effective Date: September 24, 2023

Sections 35-37 of HB 3409, which were inspired by HB 3181 and a several-month conversation around energy facility siting, require the Department of Land Conservation and Development (DLCD) to conduct a rulemaking on solar energy facilities. Section 35 directs DLCD to create rules that allow local governments to permit solar facilities and prioritize solar facility siting that does not conflict with natural resource lands and areas of valuable habitat. It also directs DLCD to consider solar facilities as a "rural industrial use" for purposes of a goal exception under Chapter 660 of Oregon's administrative rules.

Sections 36 directs DLCD to create a Rules Advisory Committee (RAC) to make recommendations for these solar siting rules from Section 35. The RAC will include members from tribes, state agencies, local governments, solar development interests, energy and conservation advocates, environmental justice advocates, and various other industry groups. This group is also to make recommendations as to additional data that could be included in the Oregon Renewable Energy Siting Assessment tool. DLCD is required to adopt rules by July 1, 2025 and submit a final report to the Legislature no later than December 31, 2025.

HB 3409/SB 522: Oregon Global Warming Commission Modernization

HB 3409/SB 522
ORS Chapter: 442
Effective Date: January 1, 2024

Sections 39-52 of HB 3409 rename the Oregon Global Warming Commission (OGWC) as the Oregon Climate Action Commission (OCAC). These sections, which were initially found in SB 522, also mark an update to the Commission's governing statute for the first time since 2007. These changes were inspired by the Commission's recent Oregon Climate Action Roadmap to 2030.

The bill amends ORS 468A.215 to increase the size of the OGWC/OCAC from 25 members to 35 members. It adds three new voting members, one of whom must have significant experience in environmental justice; one of whom must be appointed as a youth representative who must be 16 to 24 years old when appointed and will have a two-year term; and one of whom must have significant experience in the fishing industry (replacing one formerly at-large seat). The bill also adds eight new non-voting members, including the directors of the Oregon Departments of Land Conservation and Development, Business Development, Administrative Services, Consumer and Business Services, Fish and Wildlife, and Housing and Community Services, as well as the Oregon Health Authority and the Oregon Watershed Enhancement Board.

Sections 39-52 of HB 3409 direct state agencies to provide regular reports to the OCAC on their efforts and progress in reducing greenhouse gas (GHG) emissions and preparing for the effects of climate change. The bill also adds a directive in ORS 468A.250 for the OCAC to prepare detailed forecasts of expected GHG emissions reductions. The bill changes the date by which the OCAC must submit a report to the legislature from March 31 of odd-numbered years to December 1 of even-numbered years. Finally, it requires DEQ, in consultation with the OCAC, to evaluate opportunities to address consumption-based emissions (i.e., GHG emissions due to the state's consumption of goods and services).

While the bill was ultimately amended to remove updated GHG emission reduction goals that reflected the Commission's Roadmap to 2030 recommendations, the Commission is now specifically directed to periodically make recommendations to the Legislature on updating the goals in the future based on best available science.

HB 3409/SB 530: Climate Solutions on Natural and Working Lands

HB 3409/SB 530
ORS Chapter: 442
Effective Date: September 24, 2023

HB 3409 Sections 53-67, originally found in SB 530, were inspired by the Oregon Global Warming Commission's Natural and Working Lands Proposal. The bill declares a state policy to implement strategies to advance natural climate solutions and improve understanding of natural climate solutions. The bill also declares a state policy to direct state agencies to incentivize and implement natural climate solutions by taking a variety of actions and achieving a variety of policy objectives.

HB 3409 establishes the $10 million Natural and Working Lands Fund, appropriated to the Oregon Watershed Enhancement Board (OWEB), for allocation to certain state agencies to provide incentives and conduct research related to natural climate solutions. The bill directs the newly renamed Oregon Climate Action Commission (OCAC) to annually determine allocation amounts and provide factors that must be evaluated when determining allocation amounts. OWEB is directed to transfer money at OCAC's instruction. ODOE is directed to provide staff support to the OCAC in carrying out its responsibilities under these provisions.

The bill directs every agency receiving an allocation from the Natural and Working Lands Fund to provide an accounting of funding uses to the OCAC, and the OCAC must provide an annual report to the legislature summarizing the uses of the Fund and identifying additional funding needs. This report is due by September 15th of each year, starting in 2024. The OCAC must submit a separate report to the legislature by December 1st of each even-numbered year that provides information on funded and planned projects, projects in environmental justice communities, and funding sources (state, federal, and private) for projects funded by the Natural and Working Lands Fund. ODOE is directed to provide staff support to the OCAC for these two reports.

Sections 53-67 of HB 3409 direct ODOE and the OCAC, in coordination with the Departments of Forestry, Agriculture, and Fish and Wildlife, as well as OWEB (and other state agencies and relevant federal agencies as directed), to take the following actions:

- Establish a net carbon sequestration and storage baseline for natural and working lands;
- Develop activity-based metrics for evaluating progress and community impact metrics for evaluating implementation impacts on landowners, land managers, and communities;
- Establish carbon sequestration and storage goals no later than Jan. 1, 2025, and update those goals as new information becomes available; and
- Develop a natural and working lands net carbon sequestration and storage inventory, which ODOE must update and describe in biennial reports to the OGWC.

The bill also directs ODOE, in coordination with the OCAC, to study workforce and training programs needed to support natural climate solutions on natural and working lands. ODOE must submit a report on its findings to the legislature by Sept. 15, 2024. This report may include recommendations for legislation.

The bill gives the OCAC discretion to appoint a natural and working lands advisory committee. This committee must have at least 15 members representing tribes, local governments, and specified stakeholder interests. ODOE must provide staff support for this committee.

The OCAC is directed to establish a process for consultation with the nine federally recognized Tribes, including identifying relevant indigenous practices and knowledge.

The bill allows the OCAC and ODOE to contract out work laid out in these sections.

HB 3409/SB 5506/HB 3418: Renewable Energy Incentive Program Updates

HB 3409/SB 5506/HB 3418
ORS Chapter: 442
Effective Date: January 1, 2024

HB 3409, Section 68, extends the sunset of the Oregon Solar + Storage Rebate Program to January 2, 2029. SB 5506, generally known as the End of Session Bill, also included an additional investment of $10 million in the program.

Existing language in Section 1 of Oregon Laws 2019 Chapter 655 requires that a contractor purchase, construct, and install a paired solar and storage system together. HB 3409 amends the language and requires that only the purchase need occur at the same time. The solar electric system and energy storage system must still be paired once fully installed.

Section 70 relates to the Renewable Energy Development Grant Program. HB 3409 requires the agency to waive the requirement that a renewable energy production system awarded a Renewable Energy Development Grant begin construction within 12 months of the grant award if the delay was due to supply chain or workforce disruption or shortages related to the COVID-19 pandemic, and construction began between March 1, 2020, and March 31, 2022.

Sections 68-70 on HB 3409 were initially found in HB 3418.

HB 3409/HB 3056: Cooling Relief Updates

HB 3409/HB 3056
ORS Chapter: 442
Effective Date: July 27, 2023

HB 3049, Sections 71-78, makes changes to the Heat Relief Bill, SB 1536, passed in 2022. It extends the Oregon Rental Home Heat Pump Program by one year until January 2, 2026. The bill also corrects a drafting error by removing a reference to loans and it amends existing budget reservation language to require that 25 percent of the available funds for rebates and grants in a calendar year benefit the owners of units occupied by low- or moderate-income households.

The bill adjusts the existing reporting requirement for eligible entities in the Community Heat Pump Deployment Program to report the status and use of grant funds to the Oregon Department of Energy. Annual reports will be required for the period July 1 to June 30 and will be due on a schedule determined by the Oregon Department of Energy. It also amends the timing of the Oregon Department of Energy's first biennial report to the Legislative Assembly, adjusting it from December 31, 2023 to October 15, 2023.

Section 24, chapter 86, of the Oregon Laws 2022 is amended to incorporate changes to the definition of an 'extreme heat event' and the use of 'forecast zone' rather than 'county' where the premises is located. This change affects the Community Cooling Spaces grant. The bill also modifies website requirements for Oregon Housing and Community Services related to extreme heat events.

The reporting deadline on the Oregon Rental Home Heat Pump Program, community cooling spaces, and cooling needs study detailed in Section 29, chapter 86, Oregon Laws 2022 is extended to December 31, 2023, from September 15.

Sections 71-78 on HB 3409 were initially found in HB 3056.

HB 3409/HB 3196: Climate Protection Program Fees

HB 3409/HB 3196
ORS Chapter: 442
Effective Date: January 1, 2024

The Climate Protection Program is a regulatory program administered by the Oregon Department of Environmental Quality that sets a declining limit on greenhouse gas emissions from fossil fuels used in Oregon, including gasoline, diesel, propane, and natural gas used in transportation, buildings, and industrial processes. Regulated fuel suppliers and natural gas distributors have the option to meet a portion of their compliance obligations through community climate investments that reduce emissions and provide meaningful co-benefits in environmental justice communities across the state. HB 3409 Sections 79-80, originally HB 3196, authorizes the Environmental Quality Commission to establish a fee to be paid by community climate investment entities that will be used by DEQ for administration and oversight related to community climate investments.

HB 3409/HB 2647: Reducing Harmful Algal Blooms

HB 3409/HB 2647
ORS Chapter: 442
Effective Date: January 1, 2024

HB 3409, sections 82-85 (originally HB 2647), directs the Oregon Health Authority in coordination with Oregon DEQ to identify drinking water sources that are either susceptible to harmful algal blooms or

downstream of water bodies that are susceptible to harmful algal blooms, and to develop a system for regular monitoring and testing and protocols for issuing public advisory alerts. The bill also directs Oregon DEQ to work with OHA to develop and maintain a coordinated state agency monitoring and response strategy, to produce timely and high-quality data to help determine the level of public health risk, to identify sources of pollutants causing blooms, and to develop and implement pollution reduction strategies.

HB 3409/HB 2990: Resilience Hubs

HB 3409/HB 2990
ORS Chapter: 442
Effective Date: January 1, 2024

HB 3409, sections 86 and 107, establish a new grant program for planning and developing resilience hubs and networks. The grant program would be administered by the Oregon Department of Human Services with support from ODOE and the Oregon Health Authority.

Resilience hubs and networks are intended to:

- Facilitate communication and coordination of community services.
- Serve as a gathering place in the event of a disruption in the community.
- Enhance the ability of a community to respond to a disruption.
- Operate on a day-to-day basis to distribute food, water, information, charging stations, and medical supplies.
- Support community cache sites and community members who shelter in place.
- Provide childcare, training, food distribution and other services for unmet social needs in the event of an emergency.
- Provide heating, cooling, air filtration and weather protection.
- Accommodate individuals with accessibility needs.

The program will allow eligible applicants to apply for grants for expenses related to planning and organizing Resilience Hubs, to support and expand development and operation of Resilience Hubs and Networks, and to provide resources and services needed by the community to prepare for and respond to disasters.

Individuals and organizations can apply for these grants. Applications must include a description of the purpose of the funds, a plan for enhancing resilience, any additional resources being invested, and a description of the project's ability to serve vulnerable populations and disadvantaged communities.

The Department of Human Services is directed to adopt rules and is appropriated $10,187,615 to provide grants in the new program.

HB 2530: Defining Renewable Hydrogen

HB 2530
ORS Chapter: 98
Effective Date: January 1, 2024

HB 2530 provides definitions for the terms "green electrolytic hydrogen" and "renewable hydrogen." To support the state's transition to clean energy, the bill directs ODOE to seek and apply for federal funds that may be used to support green electrolytic hydrogen and renewable hydrogen. Additionally, ODOE must provide education and increase awareness regarding these types of hydrogen among groups that include Tribes, local governments, state agencies, federal agencies, private entities, academia, labor unions, and environmental justice communities.

Green electrolytic hydrogen is defined as hydrogen produced through electrolysis using one of three sources of electricity:

- Electricity generated using a resource eligible for the Renewable Portfolio Standard;
- Non-emitting electricity that is not derived from fossil fuels; or
- Electricity that has a carbon intensity equal to or less than the average Oregon grid carbon intensity in the commercial operation date of the electrolysis facility.

The definition in statute for "non-emitting electricity" includes hydropower.

The renewable hydrogen definition in the bill is nearly identical to the one for green electrolytic hydrogen except that it does not specify a production pathway. This leaves the door open for inclusion of other hydrogen production pathways.

Subsequent to this bill passing, SB 5506 – the end of session bill – included $200,000 for Oregon's share of upfront monies for a proposal to establish a regional hub intended to move towards producing green hydrogen fuels.

To learn more about renewable hydrogen, please refer to the 2022 Oregon Department of Energy report entitled Renewable Hydrogen in Oregon: Opportunities and Challenges.

HB 3031: Air Ventilation in Schools

HB 3031
ORS Chapter: To Be Assigned
Effective Date: January 1, 2024

During the pandemic, it became evident that public schools throughout Oregon had air quality issues. HB 3031 requires school districts, whenever they make heating, ventilation, and air conditioning – often called HVAC – improvements, to ensure that air quality is considered in those changes. For example, carbon dioxide monitors will be required to assess classroom airflow. Because of the Oregon

Department of Energy's Energy Efficient Schools Program, the agency will track this work and continue to support school districts as they adapt to a warming climate, which often includes HVAC updates.

HB 3097: Water Rights and In-Conduit Hydropower

HB 3097
ORS Chapter: 49
Effective Date: January 1, 2024

HB 3097 allows a municipality or people's utility district to apply directly to the Oregon Water Resources Department for a certificate to use a water right for in-conduit hydroelectric purposes. To do so, the application would have to include written authorization from the holder of the underlying water right. This shift will make it easier for municipalities to install "microhydro" projects, taking advantage of water moving through piped municipal water delivery systems to generate electricity.

HB 3143: Debt Securitization for Utilities in Emergencies

HB 3143
ORS Chapter: To Be Assigned
Effective Date: July 31, 2023

HB 3143 allows public energy utilities (electric and natural gas) to issue bonds and securitize debt to fund business investments, costs, and expenses associated with events that are the subject of a federal or state declaration of emergency – except any costs and expenses associated with criminal or civil judgments related to the event. Current law on this topic allows utilities to issue bonds and securitize debt tied to energy conservation costs. This new law creates a new class of "rate recovery expenditures," which include the costs incurred or to be incurred by a public utility associated with a conservation program and those associated with an emergency event (i.e., severe weather, catastrophic wildfire, pandemic, or other event that causes or could cause widespread loss of life, injury to person or property, human suffering, or financial loss).

HB 3161: Aligning Clean Energy Planning Requirements

HB 3161
ORS Chapter: 54
Effective Date: January 1, 2024

ORS 469A.075 currently requires an electric company subject to Oregon's RPS to develop an RPS implementation plan (often called an "RPIP") and file updated plans with the Oregon Public Utility Commission every two years. HB 3161 amends ORS 469A.075 to eliminate the requirement to develop and file an RPIP with the OPUC, and instead directs an electric company to describe its plan for complying with the RPS in the company's Integrated Resource Plan that must be filed with and reviewed

by the OPUC. HB 3161 does not eliminate the requirement for electric companies to submit RPS compliance reports to the OPUC pursuant to ORS 469A.170.

There is a lot of overlap between a utility's IRP and its RPS implementation plan, and HB 2021 established a third planning requirement by requiring utilities to file clean energy plans with the OPUC. HB 2021 gave the OPUC discretion to incorporate clean energy plans into utility IRPs, which the OPUC has chosen to do. By also integrating the RPIP process into the IRP process, HB 3161 would combine three planning processes into one planning process, creating additional efficiencies.

HB 3179: County Jurisdiction for Solar Projects

HB 3179
ORS Chapter: 336
Effective Date: January 1, 2024

HB 3179 marks a major change in the regulatory jurisdiction of most large solar projects, away from the process and standards of the Energy Facility Siting Council (EFSC) and instead to a county-by-county approach.

During the 2019 legislative session, HB 2329 marginally decreased EFSC jurisdiction and increased county jurisdiction over wind and geothermal projects and substantially decreased EFSC jurisdiction and increased county jurisdiction over solar facilities. HB 3179 decreases the EFSC jurisdiction further. These thresholds for projects that are now subject to county instead of EFSC jurisdiction are outlined in the following table:

	Pre-HB 2329 County Thresholds and Current Conditional Use Permit (CUP) Process Only	Current County Thresholds and Current CUP/HB 2329 Process	HB 3179 County Thresholds (CUP and HB 2329 Process)
Solar on High Value Farmland	<=100 Acres	>100 acres to <=160 Acres	>100 acres to <=240 Acres
Solar on predominantly cultivated land	<=100 Acres	>100 Acres to <=1,280 Acres (2 square miles)	>100 Acres to <=2,560 Acres (4 square miles)
Solar on other land	<=320 Acres	>320 Acres to <=1,920 Acres (3 square miles)	>320 Acres to <=3,840 Acres (6 square miles)

HB 2329 included some protections of natural resources and habitat that counties are required to follow. HB 3179 made changes to those protections related to site clean-up for energy facilities that are no longer producing energy.

HB 3550: State Agencies and Emissions Reductions

HB 3550
ORS Chapter: To Be Assigned
Effective Date: January 1, 2024

HB 3550 directs state agencies to purchase zero-emission vehicles when feasible and provides guidance on alternative vehicle options. If a zero-emission vehicle is not feasible, then agencies will either purchase a vehicle that can use alternative fuels or a vehicle that is considered low-emission by DAS and DEQ. Light duty vehicles are defined as those with a gross vehicle weight rating of 8,500 pounds or less, such as a passenger car, sedan, station wagon, pickup truck, minivan equipped for passengers or cargo, sport utility vehicle, crossover vehicle, or a similar specialty vehicle.

The bill will also require DAS to use biofuel to power facilities that use diesel fuel in a stationary or backup generator to maintain their systems. This would apply to all existing and new facilities in their portfolio. Many facilities in DAS' portfolio have backup generators to maintain basic services in the event of a power outage. DAS maintains the generators and their storage tanks as needed.

SB 54/HB 2080: Property Tax Exemption for Community Solar

SB 54 passed as part of HB 2080
ORS Chapter: 398
Effective Date: September 24, 2023

This measure – which was introduced as SB 54 and passed as part of HB 2080, an omnibus bill of property tax-related provisions – would remove the residential-only restriction associated with property tax exemptions on community solar projects, allowing the exemption for all parts of community solar projects. The expanded exemption would apply to property tax years beginning on or after July 1, 2024.

Prior to the passage of HB 2080, state law provided a property tax exemption for portions of community solar projects associated with residential owners or subscribers. All other portions of a project, including unsubscribed or those with commercial or industrial owners or subscribers, were *not* exempt from property taxes.

SB 582: Electric Vehicle Infrastructure Training Program

SB 582
ORS Chapter: To Be Assigned
Effective Date: January 1, 2024

This bill directs any state agency that funds installation of EV charging systems on the customer side of the meter to require all legally required licenses and to ensure that at least one electrician that holds Electric Vehicle Infrastructure Training Program (EVITP) certification supervises or completes the

installation. After 500 individuals in Oregon have completed the EVITP training, the bill requires at least 25 percent of electricians who are present and working on installation to hold EVTP certifications when installation will supply 25 or more kilowatts.

HCR 38: 2024 Legislative Assembly Rules

HCR 38
Filed with Secretary of State

Every legislative session, energy policy is discussed and addressed — and ODOE expects that there will be energy policy-related measures in the 2024 session as well. HCR 38 sets out the following limitations for the 2024 Legislative Session, when legislators next plan to come together for a regular session:

- Each Senator and each Representative may request or submit no more than two drafts of measures.
- Each interim committee of the Senate and of the House of Representatives may request no more than three drafts of measures.
- On behalf of the executive branch, the Governor may request or submit no more than three drafts of measures.
- The Chief Justice of the Supreme Court may request or submit no more than three drafts of measures.
- Members, committees, the Governor, and the Chief Justice must submit requests for draft measures to the Office of the Legislative Counsel by 5:00 p.m. on November 9, 2023.
- The Office of the Legislative Counsel must deliver drafts of measures to requesters by 5:00 p.m. on January 8, 2024.
- Requestors of measure must submit drafts for introduction to the Senate Desk and the House Desk by 5:00 p.m. on January 12, 2024.

The limitations on the introduction of measures and deadlines do not apply to the Joint Committee on Ways and Means, the President of the Senate, the House Committee on Rules, and, in some cases, the Joint, House, and Senate Committees on Conduct.

Bills Affecting Public Records and Public Meetings

Each session, bills pass that affect every state agency. This is a summary of bills that will affect how the Oregon Department of Energy handles public records and public meetings.

HB 2112 – HB 2112 updates definitions and terminology used in public records law regarding records retention and adds retention language to ensure the preservation of public records of value for legal, administrative, fiscal, tribal, cultural, historical, or research purposes. The State Court Administrator is required to make sure that minimum record retention schedules and standards conform with policies and standards established by the State Archivist under ORS 192.105, 357.825 and 357.835 (1). This bill also updates technological language and allows for public records to be captured digitally or recorded by audio or video technology. It requires that records are filed for ease of access and retrieval.

HB 2490 – This is a public records exemption, which will exempt from required disclosure records concerning cybersecurity plans, devices, and systems. It includes contractual and insurance records, and sets forth specifications, applications, and coverages.

HB 2805 – This specifies that the use of serial electronic written communication or use of intermediaries to communicate may constitute a meeting of a governing body subject to public meetings law if other specified conditions are satisfied. It defines convening as gathering in person, using electronic, video or phone technology to communicate among participants simultaneously, using serial electronic communication between participants, or using an intermediary to communicate among participants.

It does not apply to deliberations of state agencies conducting hearings on contested cases (under ORS chapter 183); communications of a governing body that are purely factual or educational in nature; communications not related to a matter that could come before the governing body for deliberation with a decision that is non-substantive in nature.

The Oregon Government Ethics Commission is required to annually prepare trainings on the requirements of ORS 192.610 to 192.690, along with best practices to enhance compliance with the requirements. The bill details the grievance process, and that the OGEC may move to a contested case proceeding if they determine that there is sufficient evidence to make a preliminary finding of a violation. It lays out civil penalties and liabilities imposed on the members of the governing body.

HB 2806 – This authorizes a governing body of a public body to meet in executive session to consider matters relating to the safety of the governing body, public body staff and public body volunteers, and to consider security of public body facilities and meeting spaces. It also has a focus on cyber security infrastructure and responses to cyber security threats and takes effect upon passage.

SB 11 – This requires state boards or commissions who conduct public meetings through electronic or telephonic means[1] to record and promptly publish the recording on a website or hosting service available to the public, so that they may observe or listen to meetings free of charge. This does not apply to a state board or commission meeting that was lawfully held in executive session under ORS 192.660. The requirement to record and publish applies to any state board or commission under ORS 174.112, whose members are subject to Senate confirmation under ORS 171.562 and 171.565.

SB 510 – This directs the Public Records Advocate to estimate biennial costs to carry out the Advocate's duties and to allocate and assess costs amongst public bodies of the state government to carry out the provisions of ORS 192.461 to 192.475.

The Public Records Advocate will report the estimate to DAS and the LFO. Each public body will pay to the credit of the advocate the amount assessed as administrative expense from funds or appropriations available to the public body in the manner that claims against the public body are paid. The advocate will adopt rules to determine the method of allocating the expenses among the public bodies and for collecting the assessments, which go to the Public Records Advocate's fund.

HB 3167 – This modifies definitions to allow established newspapers to publish public notices in digital form, and in print if the newspaper meets certain standards and definitions. A digital newspaper is defined as online and delivered in electronic form; circulated in both print and digital format and is

[1] in accordance with ORS 192.610 to 192.690

archivable. It must be formatted identically to the printed newspaper. The newspaper must conduct regular coverage of local news with 25 percent being originally composed by the paper. The subscribership must be more than half of the total distribution of printed and paid for digital copies, and it must have published at least weekly for the last 12 months.

BUDGET BILLS

HB 5016: Oregon Department of Energy Budget

HB 5016
ORS Chapter: 451
Effective Date: July 27, 2023

HB 5016 is the budget bill for the Oregon Department of Energy. The bill provides resources to allow the agency to meet our mission and serve the needs of energy stakeholders and all Oregonians. The bill established $121.2 million in expenditure authority for the department in the 2023-2025 biennium. HB 5016 mostly ensured that existing work could continue at the agency, and also provided authority and funding for new positions to deepen work on diversity, equity, and inclusion, enhance the agency's use of data and mapping tools, and allow for the Siting Division to add staff if demand for energy facility permitting increases.

SB 5506: Budget Reconciliation Bill

SB 5506
ORS Chapter: To Be Assigned
Effective Date: August 4, 2023

SB 5506, the budget reconciliation bill, makes changes to the state budget for the 2023-2025 biennium. It includes several components relevant to energy and climate change:

- $10 million general fund for the Oregon Solar + Storage Rebate Program at the Oregon Department of Energy
- $20 million general fund added to the Community Renewable Energy Grant Program at the Oregon Department of Energy
- $4.9 million toward drought-related projects and programs (part of a larger Water and Drought Package mostly found in HB 2010 and HB 2929)
- $3 million to the Department of Land Conservation and Development to hire a position and otherwise support local governments in implementing climate friendly and equitable communities measures
- $1 million to the Oregon Worker Relief Climate Change Fund
- $250,000 to support the State Climatologist position at Oregon State University

- Extends staffing and resources for the Oregon Rental Home Heat Pump Program at the Oregon Department of Energy
- $200,000 for Oregon's share of upfront monies for a proposal to establish a regional hub intended to move towards producing green hydrogen fuels
- Provides funding for additional positions at the Oregon Department of Energy for oversight and support for implementation of new state and federal energy programs.

LEGISLATION NOT PASSED

Multiple Bills: Hydrogen Fuel

HB 2170, HB 2718, SB 124, SB 125, SB 961
Did Not Pass

The 2023 Legislature considered but did not adopt several bills relating to hydrogen as a fuel. Please note that HB 2530 passed into law, which defined "renewable hydrogen" and "green electrolytic hydrogen" and directed ODOE to support the acceleration of the adoption of these fuels as part of Oregon's clean energy transition. HB 2530 is summarized on page 19.

HB 2170 A would have directed ODOE to study the feasibility of establishing a renewable hydrogen hub at the Oregon International Port of Coos Bay, and to consult with U.S. Department of Energy, Pacific Northwest National Laboratory, the International Port of Coos Bay, the Oregon Business Development Department, and the U.S. Department of Defense in conducting the study.

HB 2718 and SB 124 A would have directed ODOE to establish a $5 million grant program for the replacement of backup electric systems or generators fueled with fossil fuels with generators fueled by renewable hydrogen with priority given for replacements powering critical public services. The bill would have also required ODOE to develop "planning goals" for the development of hydrogen infrastructure related to wide-scale adoption and use of hydrogen as a fuel in the state.

SB 125 A would have established a $25 million grant program at ODOT for public and private entities to develop projects demonstrating the potential for wide-scale adoption and use of fuel cell electric vehicles and hydrogen fueling in the state's transportation sector. Projects could have included production, storage, and/or use of renewable or green electrolytic hydrogen by a fleet of medium-duty or heavy-duty vehicles. The bill would also have directed ODOT to conduct a study of regulatory barriers to the wide-scale adoption and use of fuel cell vehicles and hydrogen fueling in Oregon and report findings and recommendations to the Legislature.

SB 961 would have directed ODOE to study policies for supporting the development of a renewable hydrogen industry in Oregon and to submit findings to the Legislature.

Multiple Bills: Transportation Efficiency, Taxes, and Fees

HB 2301, HB 2658, HB 3131, HB 3297, HB 3495, SB 945
Did Not Pass

Several bills were introduced that would have altered road usage taxes or registration fees for motor vehicles, seeking to address concerns about shortfalls in highway funding as consumers switch to more efficient internal combustion, hybrid, and electric vehicles.

HB 2301 would have created an electric vehicle charging tax, administered by the Oregon Department of Transportation and applying to commercially and publicly owned charging stations and to charging stations in commercial and private residential structures. Commercial charging station owners could collect the tax from vehicle owners using the charger, and ODOT could place a lien on the electric vehicle owned by a delinquent taxpayer and ultimately seize EVs under lien after giving required notices.

HB 2658 would have directed the Oregon Department of Environmental Quality to determine the average carbon emissions per motor vehicle and to use that determination as the basis for a "carbon emissions fee" that would be charged to vehicle owners in addition to existing registration fees. DEQ would use the proceeds of the carbon emissions fees to fund a competitive grant program to assist cities and counties in constructing, operating, and maintaining infrastructure projects within highway right-of-way or roadside rest areas to reduce greenhouse gas emissions from motor vehicles.

HB 3131 would have directed ODOE to study means of imposing a tax on electricity used to charge electric vehicles at a rate equivalent to the tax rate imposed per gallon on motor vehicle fuel and to report findings to the Legislature.

HB 3297 would have imposed a mandatory per-mile road usage charge for registered owners and lessees of passenger vehicles model year 2028 or later with a rating of 30 miles per gallon or greater, beginning July 1, 2027. Beginning July 1, 2035, the threshold for the per-mile fee would be reduced to 20 MPG for passenger vehicles model year 2036 or later. On July 1, 2030 the bill would have repealed the voluntary per-mile road usage charge (OReGO). The bill would have allowed for an annual fee based upon the average number of miles traveled by passenger vehicles during the most recent 12-month period for which data is available, in lieu of the per-mile fee through 2031.

The bill would have required ODOT to complete a series of reports on its findings relating to a per-mile usage charge, including: an analysis of administrative and operating costs for implementation; technological readiness; other pricing mechanisms for road fees; the best method to make a transition from current funding mechanisms to a per-mile road usage fees, considering impacts according to income, race, socioeconomic status, and location (urban, rural and suburban); and development and implementation of a weight-mile or per-mile road usage charge for heavy duty, non-passenger vehicles. The bill would have required approval by a three-fifths majority.

HB 3495 would have made electric vehicles exempt from motor vehicle privilege and use taxes, applicable to sales of taxable motor vehicles that occur on or after the effective date.

SB 945 would have required the owner of an electric vehicle to pay a mileage tax for use on Oregon highways and would have directed the Oregon Department of Transportation to calculate the tax rate

and to determine methods for owners to show the number of miles travelled out-of-state or on non-public highways.

Multiple Bills: Clean Energy Materials - Disposal and Recycling

HB 2406, HB 2769, HB 2770, SB 64, SB 444
Did Not Pass

Several bills introduced during the 2023 Legislative session would have addressed concerns with the disposition of waste materials from renewable energy facilities and/or batteries electric vehicles, either by disposal or recycling.

HB 2406 would have added requirements to the state and county permitting processes relating to waste recycling and disposal. The bill would have directed the Energy Facility Siting Council to adopt a new standard requiring large renewable energy facilities to account for waste recycling and waste disposal needs over the lifetime of the facility. Energy facilities subject to county land use permitting would have been required to develop a mitigation plan addressing waste recycling and disposal needs.

HB 2769 would have required DEQ to study the disposal of EV batteries in Oregon and report to the legislature on a series of findings, including existing and additional regulatory authority, estimated volume of EV batteries disposed annually, potential locations for disposal sites, potential for recycling EV batteries, costs associated with disposal, and environmental costs and benefits of EV adoption relative to EV battery disposal.

HB 2770 would have directed DEQ to study impacts from disposal of waste materials generated by solar or wind energy facilities and report its findings to the legislature. The bill would have required DEQ to determine the average useful life of solar and wind facilities, identify the expected type and quantity of waste, estimate disposal site capacity needed and disposal costs, recommend disposal sites, and evaluate associated environmental hazards.

SB 64 would have required the Oregon Department of Environmental Quality to study and develop recommendations for disposal methods for batteries used in electric vehicles and renewable energy facilities and submit a report to the legislature.

SB 444 would have directed DEQ to establish a "Recycling Innovators Grant Program" offering grants up to $2 million to support projects developing innovative and demonstrable solutions to complex recycling issues. Eligible uses for grants under the program would have included research and development, as well as capital investments in new or expanded facilities using innovative technologies to reuse or recycle materials. Under the proposed program, DEQ would have established priorities for materials to recycle, including plastics, electronics not already covered under Oregon E-Cycles, electric vehicle components and batteries, and wood products not useable as a biofuel.

HB 2613: Oregon Clean Vehicle Rebate Program

HB 2613
Did Not Pass

HB 2613 would have appropriated $30,000,000 to the DEQ for deposit into the Zero-Emission Incentive Fund. The Oregon Clean Vehicle Rebate Program ran short of funds during 2023. The funds proposed by this bill would have been in addition to and not in lieu of any other appropriation, including a privilege tax on vehicle sales that funds the program. The program has been suspended as of May 1, 2023. Once funding is available again via the privilege tax, the program will announce its reopening.

HB 2614: Transportation Networks and Electric Vehicles

HB 2614
Did Not Pass

HB 2614 would have required transportation network companies to report to DEQ annual miles and what percent of those miles were driven using zero emission vehicles. It also specifies targets for percent ZEV service miles and authorizes a civil penalty of 50 cents for each service mile that did not meet the ZEV service mile target required for that calendar year. The bill also directed DEQ to establish financial incentives for: the purchase or lease of ZEV transportation network company vehicles and for vehicle charging stations at or near multifamily dwellings in which transportation network company drivers reside; or for installation and purchase of electric vehicle charging stations, including upgrades necessary to install a charger at a single-family dwelling in which transportation network company drivers reside. It also placed a limit on how many Clean Vehicle Rebates could be granted to a single organization.

HB 2685: Tax Credit for Biomass

HB 2685
Did Not Pass

HB 2685A would have created a tax credit, administered by the Oregon Department of Forestry, for biomass producers or collectors between 2024 and 2030 for biomass produced or collected in Oregon that is used for biofuel or used to produce biofuel or biochar in Oregon. The tax credit would be available at a rate of $10 per bone dry ton for biomass produced or collected in Oregon as a feedstock for biochar, bioenergy, or biofuel production in Oregon. Eligible biomass would include forest or rangeland woody debris, wood material from hardwood timber, agricultural residues, wood debris, and crops grown solely for energy. The bill would remove eligibility of offal, food waste, and wastewater solids from the original Biomass Producer or Collector Tax Credit. Canola grown, collected, or produced in the Willamette Valley and grain corn would also be excluded from eligible biomass products.

Multiple Bills: Local and State Action on Fossil Fuel Restrictions

HB 2713, HB 3152, SB 647, SB 834
Did Not Pass

State and local governments in Oregon have created climate action plans with decarbonization targets, leading to an evaluation of the role of natural gas and fossil fuel consumption within their communities. For example, on February 6, 2023, the City of Eugene passed an ordinance banning natural gas infrastructure in new low-rise residential construction.

Two introduced bills in the 2023 legislative session would have limited the ability of local jurisdictions to ban natural gas. SB 647 would have restricted municipalities in Oregon from adopting local ordinances or land use regulations that prohibit the installation or use of natural gas or its infrastructure in residential or commercial buildings. SB 834 would have prohibited a unit of local government from adopting or enforcing regulations that restrict residential use of any energy source.

HB 2713 was introduced to *support* the authority of local governments to implement local bans of fossil fuels. The bill would have granted local jurisdictions the ability to ban or limit the use of natural gas, petroleum, coal, or similar fossil fuels. The authority would have applied to all Oregon cities and counties whether they are home rule cities and counties or not. HB 2713 specifically would have allowed them to limit or ban:

- The use of fossil fuels in new building construction projects
- Appliances that use fossil fuels in new building construction projects
- Installation of fossil fuel infrastructure

HB 2713 also declared fossil fuel use and its regulation to be a public peace, health, and safety emergency.

HB 3152 addressed GHG emission targets from EO 20-04 and Oregon Public Utility Commission (OPUC) oversight of utilities by setting a state policy objective to protect residential ratepayers from stranded fossil fuel asset risks and energy burdens while reducing GHG emissions. The bill would have prohibited the OPUC from allowing ratepayer funds to support residential gas appliance incentives or line extension allowances.

HB 2816: High Energy Use Facilities and Clean Electricity

HB 2816
Did Not Pass

HB 2816, as it would have been amended by the -3 amendments, would have required any new data center or cryptocurrency operation in Oregon that is deemed a "high energy use facility" to comply with declining greenhouse gas (GHG) emissions limits for electricity consumed on-site. A facility was defined as a "high energy use facility" if it is a data center or cryptocurrency operation, its base electricity load equals or exceeds 10 average megawatts of electricity per year, and it uses electricity that is not supplied by an investor-owned electric utility or electricity service supplier subject to the clean energy

targets established by HB 2021 (2021) and codified in ORS 469A.410. The bill would have allowed a temporary exemption from any of the requirements due to certain significant constraints or disruptions and would have allowed certain renewable energy certificates (RECs) to be used for compliance. Because HB 2816 would have imposed GHG limits on high energy use facilities served by consumer-owned utilities (COUs) (which are not subject to the clean energy targets established by HB 2021), the bill included a compliance exemption for a facility if the COU serving the facility would have had to comply by reducing its purchases of lowest-priced electricity from Bonneville Power Administration (BPA).

HB 2989 and HB 3180: Energy Facility Siting

HB 2989 and HB 3180
Did Not Pass

HB 2989 was a study bill directing the Department of Land Conservation and Development and ODOE to convene a broad stakeholder group to assess the following and generate a report to the legislature by September 15, 2024 with findings and recommendations about:

- Current state and local regulatory framework for siting renewable energy and transmission projects
- Barriers in the current state and local regulatory framework to renewable energy and transmission projects to meeting Oregon's energy goals
- Issues and opportunities in the current regulatory framework for numerous identified elements
- The amount of generation that is needed to meet Oregon's energy goals
- Incentives for renewable energy and transmission projects

This bill was one of two placeholders stemming from a months-long conversation among parties interested in energy siting. The other, HB 3181, was amended into HB 3409. You can find a summary for that concept on page 13.

HB 3180 was not part of the months-long process among parties interested in energy siting, but was also a study bill directing the Department of Land Conservation and Development to explore solar generation facilities. Amendments proposed to HB 3180 would have changed parameters for the jurisdiction of solar facility siting and made significant changes to how land use decisions are made regarding the siting of solar facilities on farmland. After much negotiation, some of the contents of this bill were then placed in HB 3179, which passed into law and is summarized on page 21.

HB 3003: Tax Credit for Western Juniper Biomass

HB 3003
Did Not Pass

HB 3003 would have created a tax credit for investor-owned and consumer-owned electric utilities that purchase electricity produced by a fuel source that is at least 50 percent qualifying western juniper biomass. "Qualifying western juniper biomass" refers to western juniper that has been removed from a riparian area in which the removal of western juniper will benefit water resources and ecological health. HB 3003 would have directed the Oregon Watershed Enhancement Board to adopt rules identifying qualifying riparian areas; ODOE would have administered other aspects of the program.

HB 3004: Tax Credit for Transmission Services

HB 3004
Did Not Pass

HB 3004A would have established a tax credit for expenses related to transmission services incurred by owners of solar, wind or energy storage facilities that are placed into service in Oregon in 2025 through 2030. The owner of an eligible facility would have been entitled to receive a tax credit for up to 100 percent of the facility's transmission expenses for a period of 20 years. For the first five years, the tax credit could have offset up to 100 percent of the owner's tax liability. For years six through twenty, the tax credit could have offset up to 75 percent of the owner's tax liability. Electric utilities would not have been eligible for the tax credit.

HB 3055: Solar Facilities and PURPA

HB 3055
Did Not Pass

HB 3055A would have amended the minimum criteria for qualifying facilities under Oregon's PURPA (Public Utility Regulatory Policies Act of 1978) implementation statute. The bill would have established a qualifying facility eligibility cap of no less than 10 MW for standard avoided cost rates and standard offer contracts. This would make solar qualifying facilities with nameplate capacities up to 10 MW eligible for standard avoided cost rates. The bill would also allow an energy storage system to be paired with a qualifying facility to provide storage capacity for the energy produced by the facility.

The OPUC has opened two dockets in recent years to investigate issues related to PURPA implementation in Oregon. In Docket UM 2000, the OPUC is conducting a general investigation into several PURPA implementation issues, including issues related to interconnection and avoided costs.

To learn more about PURPA, see the PURPA 101 article in the 2022 Biennial Energy Report.

HB 3459: Low-Income Bill Payment and Crisis Assistance

HB 3459
Did Not Pass

This bill would have extended and amended key aspects of the COVID-era funding mechanism put in place to provide additional funding for low-income bill payment and crisis assistance. This mechanism also included a prohibition on shutoffs for non-payment. HB 3459 would have extended the program through 2026 and also removed the requirement that the fund could only be accessed by customers in need of assistance due to COVID. The provisions would have applied to all electric companies in the state.

HB 3579: Clean Technology Procurement and Manufacturing

HB 3579
Did Not Pass

HB 3579A would have required that DAS adopt rules to govern procurement of clean energy technology that DAS conducts on behalf of state agencies. Clean energy technology would have included renewable energy generation and storage systems and components, energy conservation equipment, and equipment that facilitates the manufacturing or expansion of EV infrastructure. The bill would have established a Task Force on Establishing, Attracting and Sustaining Manufacturing of Clean Energy Technology. The task force would have been responsible for the evaluation and recommendation of policies to foster, attract, and sustain clean energy technology manufacturing firms and operations. HB 3579A would have also established the Oregon Clean Technology Manufacturing Opportunity Fund with $10,000,000 to attract and support clean energy technology manufacturing.

SB 678: Direction for Floating Offshore Wind Development

SB 678
Did Not Pass

SB 678A would have established state policies to: support engagement between offshore wind (OSW) energy developers, coastal communities, and local, state, and regional organizations; ensure benefits from OSW flow to local & regional communities (i.e., coastal, fishing, Tribal), ecosystems, and economies; and ensure the interconnection of OSW promotes the reliability and resilience of the state's electric grid and reduces dependency on importing out-of-state energy. To further these policies, the bill would also have directed the Department of Land Conservation and Development (DLCD) to conduct outreach on these matters with coastal communities and local, state, and regional agencies/organizations; and to summarize the Department's activities on this topic, review state policies related to OSW development, and provide recommendations for improving state policies or further agency action in a report to the legislature.

SB 803: Study on the Phase-Out of Conventional Diesel

SB 803
Did Not Pass

Transportation fuel use is Oregon's largest source of greenhouse gas emissions, primarily from direct combustion of petroleum fuels, including emissions from on- and off-road vehicles. SB 803A directed DEQ, in consultation with other agencies, to study the feasibility of phasing out high carbon intensity fossil diesel fuels as transportation fuels in Oregon. The study would have evaluated impacts of requiring a lower carbon intensity value for diesel, prices and availability of renewable fuels and blends, incentives for increasing the production of renewable fuel and estimates of current and future demand by region.

Multiple Bills: Nuclear Power Production in Oregon

HB 2215, SB 676, SB 831, SB 832, SB 833
Did Not Pass

Four bills this session sought to change or explore the existing prerequisites that functionally prevent the siting of a new nuclear power generating facility within the state. Existing statute requires any development of new nuclear power capacity in Oregon to meet the following prerequisites:

1. Prior to issuance of a site certificate by the Energy Facility Siting Council, the Council must find that an "adequate" permanent national repository for high-level radioactive waste be licensed to operate (ORS 469.595); and
2. Prior to approval of a site certificate for a nuclear power facility, the Energy Facility Siting Council must submit the proposal for a site certificate to a vote by the people of Oregon (469.597).

HB 2215, SB 676, and SB 831 would have repealed the restrictions on nuclear facilities; HB 2215 and SB 676 would have referred the changes to the ballot.

SB 832 would have removed small modular nuclear reactors from the various restrictions on nuclear power plants in the state. For more information on SMRs, see the 2020 Biennial Energy Report's Technology Review: Small Modular Nuclear Reactors.

SB 833 would have directed Oregon State University to study the use of thorium as a nuclear fuel for power plants.

FOR MORE INFORMATION

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OREGON
DEPARTMENT OF
ENERGY

82nd OREGON LEGISLATIVE ASSEMBLY--2023 Regular Session

Enrolled
House Bill 2530

Introduced and printed pursuant to House Rule 12.00. Presession filed (at the request of House Interim Committee on Environment and Natural Resources for Representative Pam Marsh)

CHAPTER .....

AN ACT

Relating to development of a state renewable hydrogen economy.

Be It Enacted by the People of the State of Oregon:

SECTION 1. As used in this section and section 2 of this 2023 Act:

(1)(a) "Green electrolytic hydrogen" means hydrogen produced through electrolysis using:

(A) A renewable energy source as defined in ORS 469A.005;

(B) Nonemitting electricity that is not derived from a fossil fuel; or

(C) Electricity that has a carbon intensity that is equal to or less than the average carbon intensity of the electricity served in this state in the calendar year in which construction or expansion of the facility that produces the green electrolytic hydrogen began.

(b) "Green electrolytic hydrogen" does not include hydrogen manufactured using any conversion technology or steam reforming that produces hydrogen from a fossil fuel feedstock.

(2) "Nonemitting electricity" has the meaning given that term in ORS 469A.400.

(3) "Renewable hydrogen" means hydrogen produced using:

(a) A renewable energy source as defined in ORS 469A.005;

(b) Nonemitting electricity that is not derived from a fossil fuel; or

(c) Electricity that has a carbon intensity that is equal to or less than the average carbon intensity of the electricity served in this state in the calendar year in which construction or expansion of the facility that produces the renewable hydrogen began.

SECTION 2. To support the state's transition to clean energy by accelerating the production, distribution and end use of renewable hydrogen and green electrolytic hydrogen fuels, the State Department of Energy shall:

(1) Where appropriate, seek and apply for federal funds for which the state is eligible, and support other applications for federal funds, that may be used to support the development and deployment of renewable hydrogen and green electrolytic hydrogen in this state; and

(2) Provide education and increase awareness regarding renewable hydrogen and green electrolytic hydrogen for federally recognized Indian tribes, local governments, other state agencies, federal agencies, private entities, this state's four-year public institutions of higher education, labor unions, environmental justice communities and other relevant entities.

Passed by House March 14, 2023

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Timothy G. Sekerak, Chief Clerk of House

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Dan Rayfield, Speaker of House

Passed by Senate May 2, 2023

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Rob Wagner, President of Senate

Received by Governor:

.....M.,....., 2023

Approved:

.....M.,....., 2023

.....
Tina Kotek, Governor

Filed in Office of Secretary of State:

.....M.,....., 2023

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Secretary of State