PRELIMINARY STORMWATER SITE PLAN

Freeman Logistics
22nd Ave NW and 82nd Ave E
Puyallup, WA

Prepared for: Vector Development Company
11411 NE 124th Street, Suite 190
Kirkland, WA 98034

October 14th, 2022
Our Job No. 21585

BENJAMIN H. ELDRIDGE
STATE OF WASHINGTON
42766
REGISTERED
PROFESSIONAL ENGINEER
10-14-2022

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PROJECT ENGINEER'S CERTIFICATION

"I hereby state that this Stormwater Site Plan for Freeman Logistics has been prepared by me or under my supervision and meets the standards of care and expertise that is usual and customary in this community for professional engineers. I understand that the City of Puyallup does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me."

Ben Eldridge, PE, Senior Project Engineer

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Tab 1.0

1.0 ANALYSIS OF THE MINIMUM REQUIREMENTS

1.0 ANALYSIS OF THE MINIMUM REQUIREMENTS

This is a new development project where Minimum Requirements #1 through #9 are applicable. Please see the applicable flow charts for determining the minimum requirements.

Minimum Requirement No. 1: Preparation of Stormwater Site Plan.

Response: This Stormwater Site Plan prepared for the project meets the requirements of Minimum Requirement No. 1.

Minimum Requirement No. 2: Construction Stormwater Pollution Prevention Plan.

Response: A Construction Stormwater Pollution Prevention Plan will be provided within a separate construction submittal.

Minimum Requirement No. 3: Source Control of Pollution.

Response: Available and reasonable Source Control BMPs will be applied to this project for the type of source control pollution being produced on this project site.

Minimum Requirement No. 4: Preservation of Natural Drainage Systems and Outfalls.

Response: Under current conditions, the project site is predominantly flat, farmland with grades typically falling near the northwest corner of the site. Stormwater runoff then enters the existing open channel system running parallel with Freeman Road East. This outfall location has been maintained and improved for the proposed stormwater infrastructure.

Minimum Requirement No. 5: On-Site Stormwater Management.

Response: On-Site Stormwater Management is achieved by collecting storm water through catch basins and routing to one of two underground detention vaults. Stormwater is treated through a Modular Wetland per Enhanced water quality standards. After treatment, stormwater is pumped to the proposed outfall to the northwest corner of the site. Please see the Section 5.0 Permanent Stormwater Control Plan for the full narrative describing feasibility of LID BMPs.

Minimum Requirement No. 6: Runoff Treatment.

Response: Runoff treatment is proposed using the enhanced water quality standard, as required for the anticipated land use.

Minimum Requirement No. 7: Flow Control.

Response: The proposal uses detention vaults to store and release stormwater in accordance with the Flow Control Performance Standard. Please see Section 5.0 Permanent Stormwater Control Plan for the WWHM report.

Minimum Requirement No. 8: Wetlands Protection.

Response: There are no wetlands on site. A wetland is located to the south of the site on an adjacent parcel, as described in the critical areas report prepared for the project. The project site is not tributary to the wetland and the proposed stormwater infrastructure will not outlet to the wetland.

Minimum Requirement No. 9: Operation and Maintenance.

Response: An Operations and Maintenance Manual is provided within this stormwater site plan. See section 9.0 for more details.

MINIMUM REQUIREMENT FLOW CHARTS

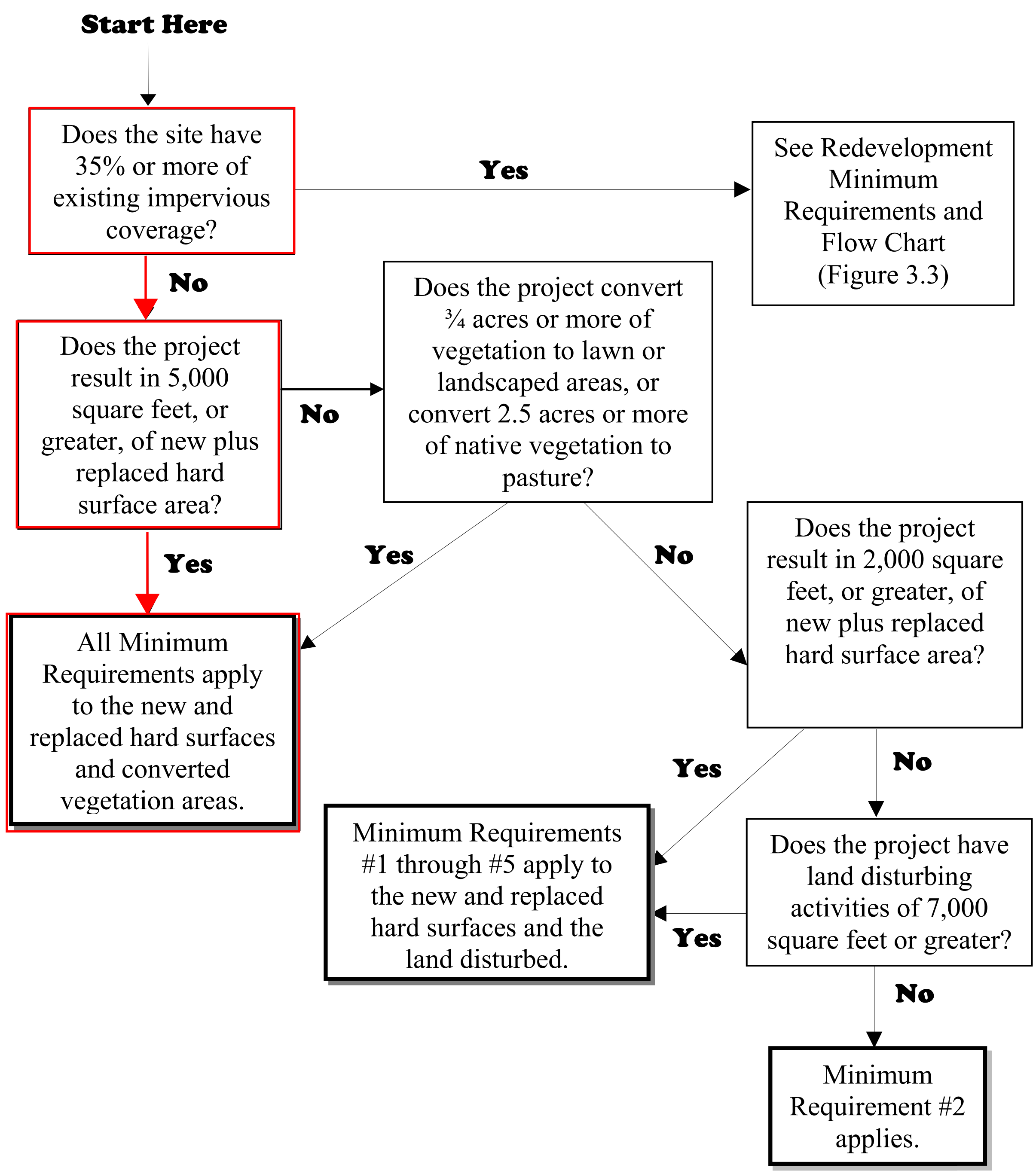

Figure 2.4.1 – Flow Chart for Determining Requirements for New Development

Tab 2.0

2.0 PROJECT OVERVIEW

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The proposed Freeman Logistics is an approximately 24.05-acre site located in the northeast and southeast corners of the 22nd Ave NW and Freeman Road East (also known as 82nd Ave E) intersection, Puyallup, Washington, within a portion of Section 17, Township 20 North, Range 4 East, and a portion of section 20, Township 20 North, Range 4 East, Willamette Meridian, City of Puyallup, Pierce County, Washington. The site is comprised of 15 parcels plus the right-of-way dedication to improve 22nd Ave NW to the east of Freeman Road East. Please see the attached Vicinity Map on the following pages of the report.

Under existing conditions, this site is lightly developed, consisting of farmland and scattered single-family houses. Housing is concentrated in the middle of the site and along the southwestern border. The site is very flat and has no single point of exit for stormwater. No manmade drainage structures exist onsite to convey stormwater.

The developed site will include two commercial warehouse buildings with dock high loading, associated parking, storm drainage facilities, and frontage improvements.

The frontage improvements along the entirety of Freeman Road East are proposed to provide sufficient travel lanes for the anticipated traffic. Proposed improvements include widening the road pavement and installing curb & gutter, planter strip, sidewalk, street trees, and lights per City of Fife standards. Right-of-way dedication is proposed to create a 35-ft wide half street on the project side. Full grind and overlay improvements to the existing 2 lanes are proposed to facilitate truck loading from the site. Public stormwater infrastructure is proposed along Freeman Road East to maintain the natural flow paths.

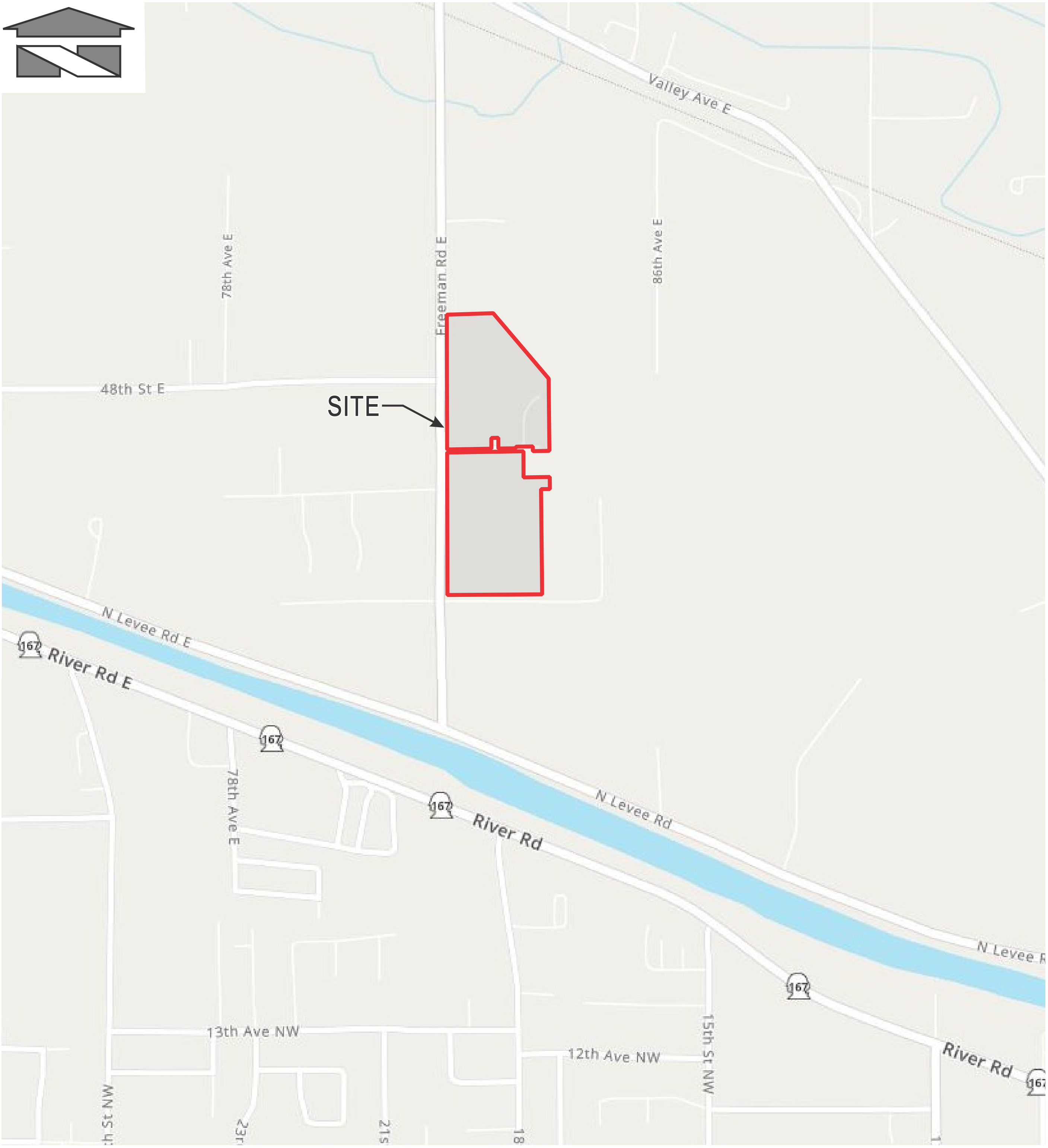
In total the site plus frontage area is 26.89 acres. The impervious coverage after development will be approximately 80%. The proposed stormwater management system is designed to collect the full proposed conditions and meet the flow control duration standards up to the 100-year storm event.

Summary of Land Coverage Areas

Land Use Category	Area (square feet)	Area (acres)
New Asphalt/Concrete	446,789	10.26
New buildings	494,789	11.34
New landscape/undisturbed area	230,443	5.29
Total	1,171,445	26.89

This stormwater site plan is prepared in accordance with the 2019 Department of Ecology Stormwater Manual for Western Washington, as adopted by the City of Puyallup. The proposed facilities include catch basins and conveyance pipe which direct storm flows to one of two underground detention vaults onsite and a public detention vault offsite. Stormwater will be conveyed to underground detention systems and upon release treated by proprietary, water quality facilities that provide enhanced treatment. Onsite flows will then be conveyed to a lift station which will pump stormwater to a discharge point along the northwest corner of the site, with improvements to the existing offsite, open channel system proposed to maintain the natural discharge location.

VICINITY MAP



REFERENCE: MapQuest (2022)

Scale:
Horizontal: ***N.T.S.*** *Vertical:* ***N/A***

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For:
Freeman Road Logistics
Fife, Washington

Title:
VICINITY MAP

Job Number
21585

DATE: 09/01/22

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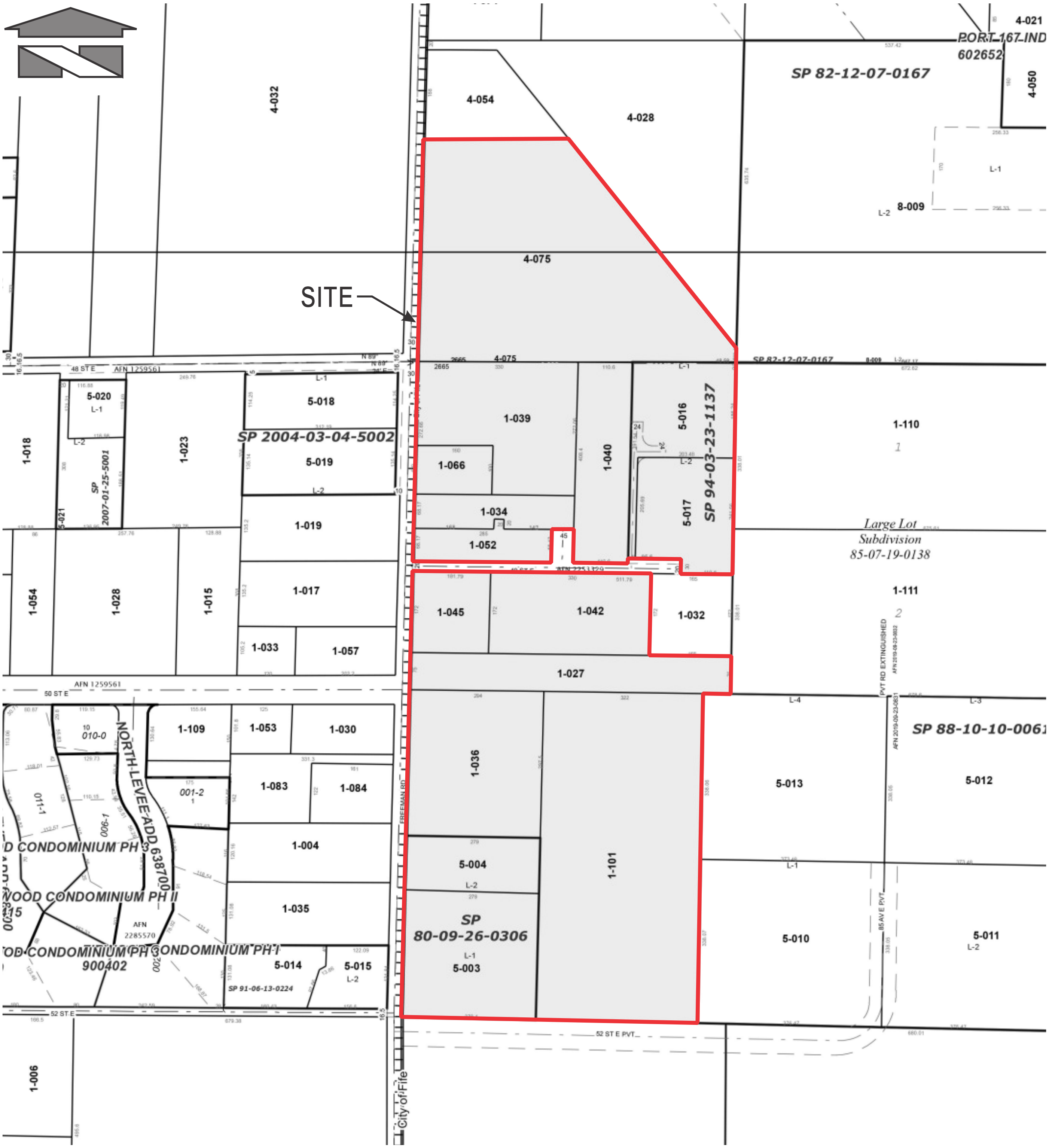
ASSESSOR MAP



REFERENCE: Pierce County Department of Assessments (Feb. 2021)

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Fife, Washington

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21585

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ASSESSOR MAP

DATE: 09/01/22

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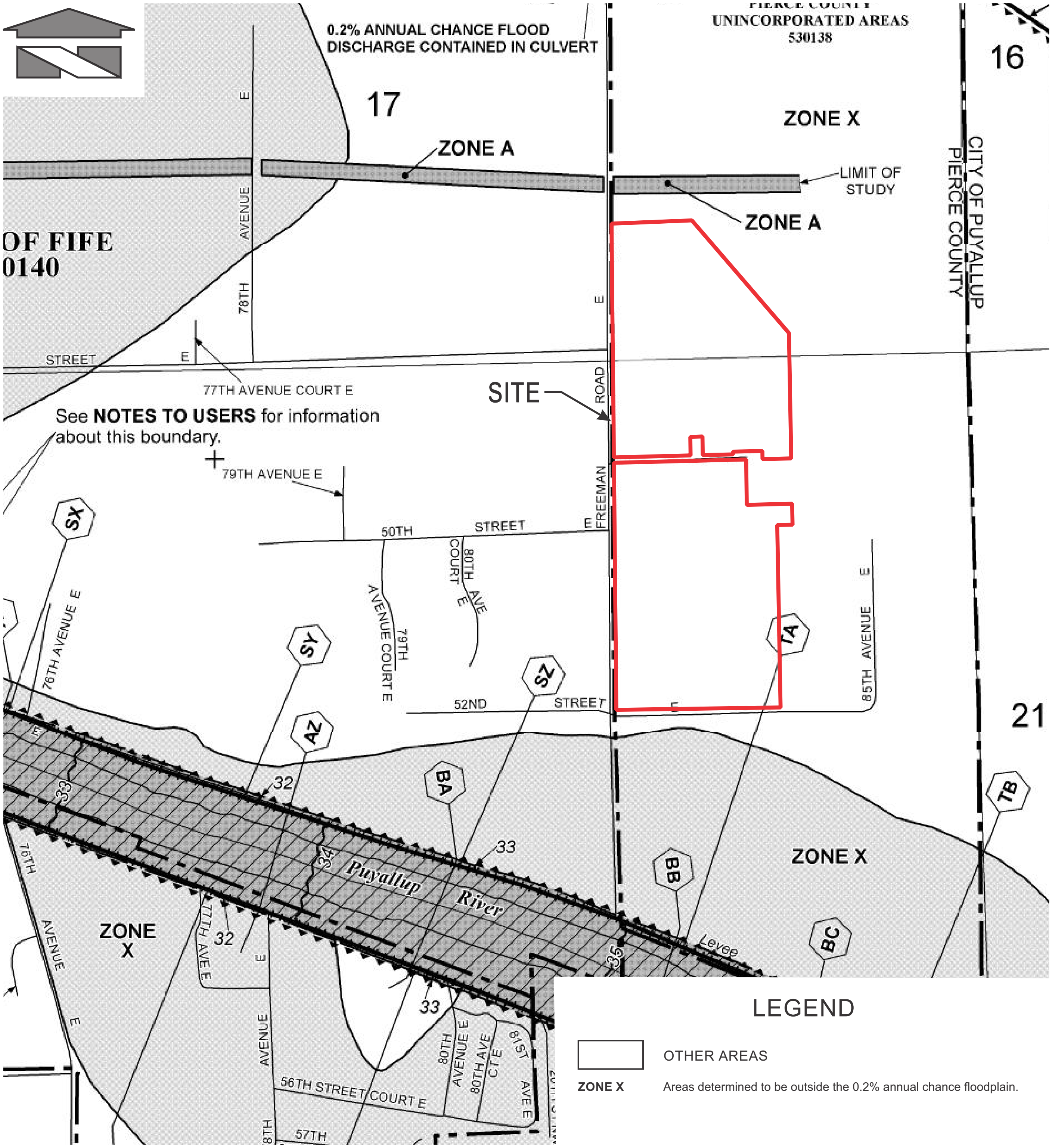
FEMA MAP



REFERENCE: Federal Emergency Management Agency (Portion of Map 53053C0329E, March 2017)

Scale:
Horizontal: **N.T.S.** Vertical: **N/A**

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Freeman Road Logistics
Fife, Washington

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21585

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FEMA MAP

DATE: 09/01/22

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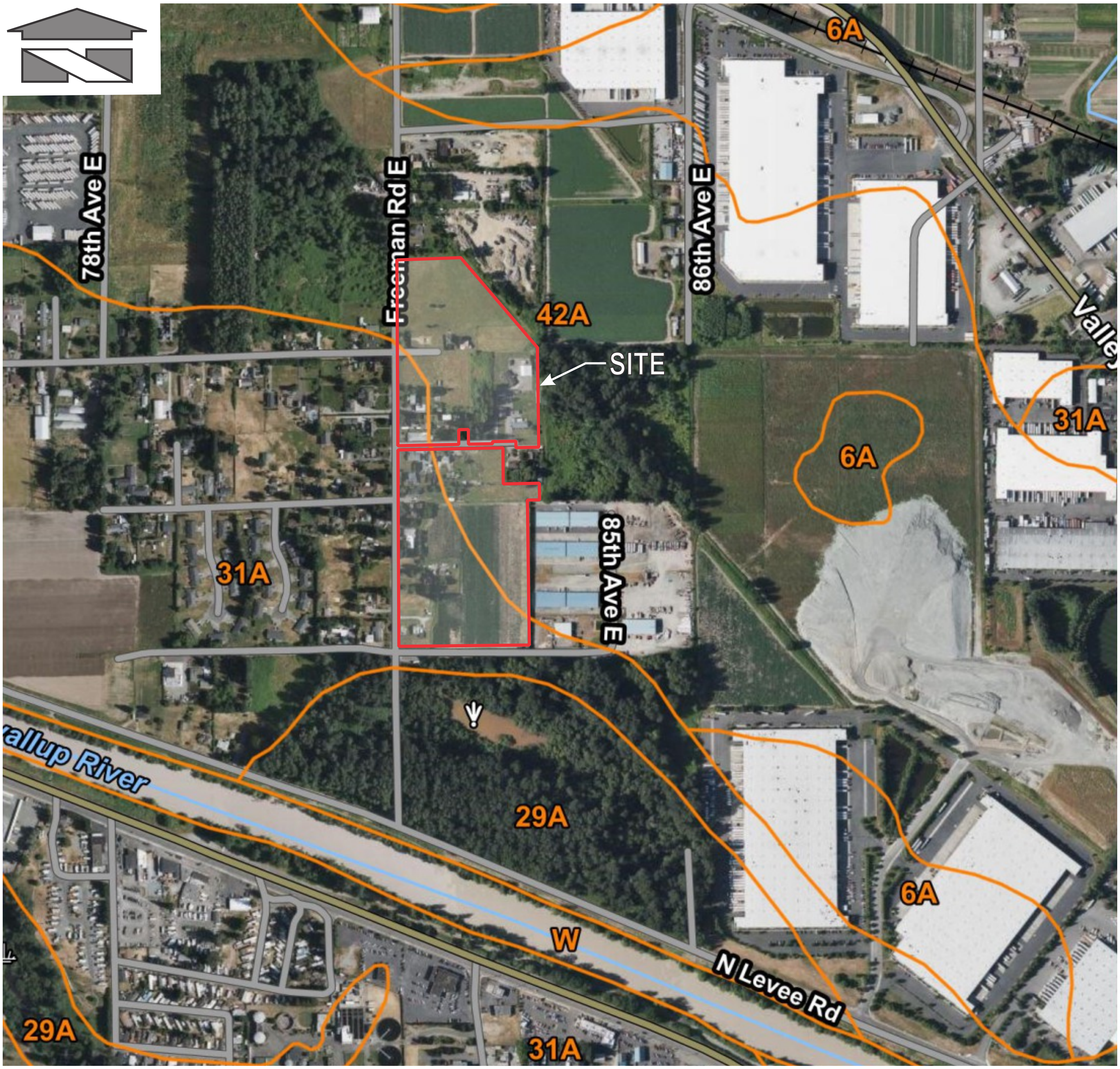
SOILS MAP



REFERENCE: USDA, Natural Resources Conservation Service

LEGEND:	HSG
42A = Sultan silt loam	C/D
31A = Puyallup fine sandy loam	A

Scale:
Horizontal: ***N.T.S.*** *Vertical:* ***N/A***

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Freeman Road Logistics
Fife, Washington

Title:
SOIL SURVEY MAP

Job Number
21585

DATE: 09/01/22

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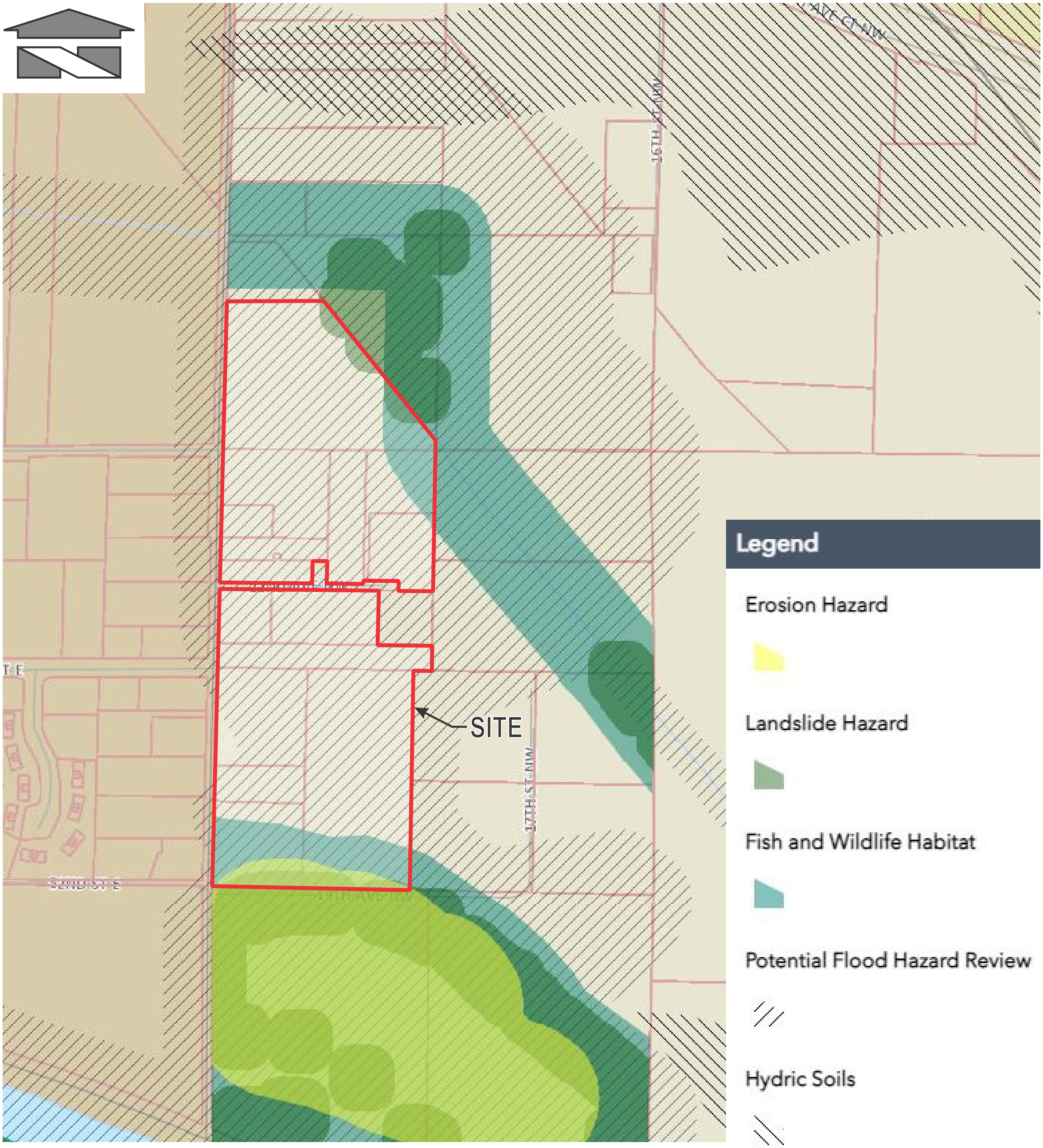
SENSITIVE AREAS MAP



REFERENCE: Pierce County PublicGIS

Scale: *Horizontal:* ***N.T.S.*** *Vertical:* ***N/A***	*For:* Freeman Road Logistics Fife, Washington	Job Number 21585
Barghausen Consulting Engineers, Inc. 18215 72nd Avenue South Kent, WA 98032 425.251.6222 **barghausen.com**	*Title:* SENSITIVE AREAS MAP	DATE: 09/01/22

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Tab 3.0

3.0 EXISTING CONDITIONS SUMMARY

3.0 EXISTING CONDITIONS SUMMARY

Under existing conditions, the project site consists of farmland and scattered single-family houses. The Geotechnical report (included as a separate document in this submittal) and Soil Survey Map indicates that the site is mainly comprised of Alluvium. Further discussion of the soils can be found in the soils report prepared for this project. A soils map has also been provided. The site has very little slope and no defined point of exit for stormwater. There are no water features onsite. A wetland is located on an adjacent parcel to the south. The project is not anticipated to impact the wetland. Refer to the Critical Areas Report prepared for the project for more information, included in Section 6.0 of this report.

EXISTING CONDITIONS MAP

Tab 4.0

4.0 OFF-SITE ANALYSIS REPORT

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Onsite Description

The project site lies in a very flat section of the valley which has historically been used mostly for agriculture. The soils are fine grained alluvial deposits. Infiltration potential is minimal per the geotechnical engineering report. The topography does not have a consistent gradient, with the southern half generally trending to the northeast, while the north of the site generally slopes to the northwest. There are no drainage devices onsite and all drainage consists of sheet flow and shallow concentrated flow. The outlet point for the majority of runoff from the site is a 12" concrete culvert which crosses under Freeman Road at the northwest property corner. Some runoff appears to drain offsite along the east edge of the property into an adjacent agricultural ditch just offsite. This ditch routes flows north and then west and eventually crosses Freeman Road about 200' north of the project site, where the two downstream paths merge.

Upstream Description

There does not appear to be an upstream basin tributary to the site under typical drainage conditions. The Schenk property (Parcels 042020-5010, -5011, -5012, -5013) to the SE of the site has a private drainage system which collects runoff. The undeveloped properties immediately east and northeast of the site drain to the agricultural ditch which routes flow north and then west away from the subject property. Properties to the north are graded away from the site. Freeman road is higher than surrounding grade and prevents runoff from single family properties to the west. The parcel to the south is located at a lower elevation and separated from the site by 19th Ave NW. The site does not typically receive runoff from surrounding properties.

During heavy winter storm events, the site experiences a small amount of overtopping from the adjacent agricultural ditch to the east. Stormwater which overtops the ditch sheet flows northwest across the north site edge and then leaves the site via the main 12" outlet pipe crossing Freeman Road. This condition appears to be infrequent and does not present a significant flooding or erosion hazard to the site.

Downstream Description

Stormwater runoff from the site initially takes one of two paths. The majority of runoff leaves the NW site corner through a shallow 12" concrete culvert and crosses under Freeman Road to the west. From there, runoff travels in a roadside vegetated ditch along the west side of Freeman Road north for approximately 230 feet. The ditch then joins a larger agricultural ditch which flows to the west through private property. The ag ditch has approximately 3' depth, 3' bottom width, variable side slopes, and relatively smooth bottom. A second runoff path involves sheet flow leaving the site along the east and then entering the same agricultural ditch at a further point upstream. The ditch then travels north and west around neighboring properties and rejoins the main downstream path at the approximate 1/4-mile point. The site is effectively a single threshold discharge area.

After merging in the agricultural ditch on the west side of Freeman Road, runoff from the site continues to the west across private property for 1/4 mile until approximately 78th Ave East. The observable portion of this ditch appears to have relatively consistent characteristics and no obstructions. From 78th Ave, the downstream path meanders through several developed commercial/industrial properties in a general westward progression through manmade conveyance elements. The size and type of the conveyance elements vary along this stretch. Some are open channels while others are tight-line systems (typically 48-inch diameter pipe). Most of the connected properties are developed with onsite detention systems to mitigate stormwater flow rates. The downstream system eventually crosses under 70th Ave East in a 48-inch pipe and then outlets to the oxbow wetland located between 54th Ave E and 70th Ave E. The oxbow is approximately 1.25 miles downstream of the project site.

Oxbow Wetland Analysis

The oxbow wetland drains via 54" culvert crossing under Levee Rd into the Puyallup River. The oxbow is noted by the City of Fife to be sensitive to water level rise during heavy or prolonged storms, in part due to a tide gate which restricts drainage while the Puyallup River level is elevated. An analysis of the potential for the proposed development to increase the oxbow water level has been requested. The following analysis is provided showing a comparison of pre-developed and post-developed project conditions and the resulting effect on the oxbow wetland water level.

Existing Conditions

The oxbow wetland is located between 54th and 70th Ave East, north of Levee Rd in the City of Fife. A rough surface area of the wetland was estimated at 60 acres. The wetland is very flat and covered in dense grass and marsh-type plants with trees scattered around the perimeter. A tide gate is located within the outlet channel at the west end of the wetland, just upstream of the connection to the Puyallup River. The wetland is jointly managed by the City of Fife and the Puyallup Tribe of Indians. Housing developments comprise most of the property immediately adjacent the oxbow. A delineation of tributary area was made using the best available topographic information. The total basin area is estimated at 825 acres, which includes residential, commercial, industrial, farmland, and undeveloped properties.

WWHM was used to model the existing basin and wetland. Soils were modeled as till to account for the alluvial deposits typical of the general area. Land cover was modeled as 90% pervious and 10% impervious to account for the mix of undeveloped and developed properties. We noted that most of the effective impervious cover tributary to the oxbow is mitigated through some form of flow control. A conveyance element was modeled to account for transit of flows from the more distant eastern portion of the basin. The subject property and surrounding "eastern basin" were modeled as pasture. A summary of the model areas is provided below.

Wetland (trapezoidal pond)	60 acres
Western Basin - Lawn	396 acres
Western Basin - Impervious	44 acres
Eastern Basin - Pasture	300 acres
Freeman Logistics	25 acres
Total	**825**

Developed Conditions

The developed conditions were modeled using similar conditions as existing, with substitution of the impervious coverage and detention system to simulate the development on the subject property.

Modeling Assumptions

The oxbow wetland was modeled as a shallow trapezoidal pond with 5-ft of live storage depth and nearly 240 ac-ft of storage volume. An 18-inch diameter orifice was utilized to simulate a restricted outlet condition imposed by the tide gate and drainage channel leading to the Puyallup River. The modeling effect is such that peak 100-yr flows cause a rise in the "pond" nearly to the system capacity. The model is not designed to be an exact simulation of the real wetland function, but to demonstrate the expected change imparted by the proposed development on a comparably sized receiving body. An accurate model of the complete watershed hydrology, including flooding effects from the Puyallup River, is beyond the scope of this analysis.

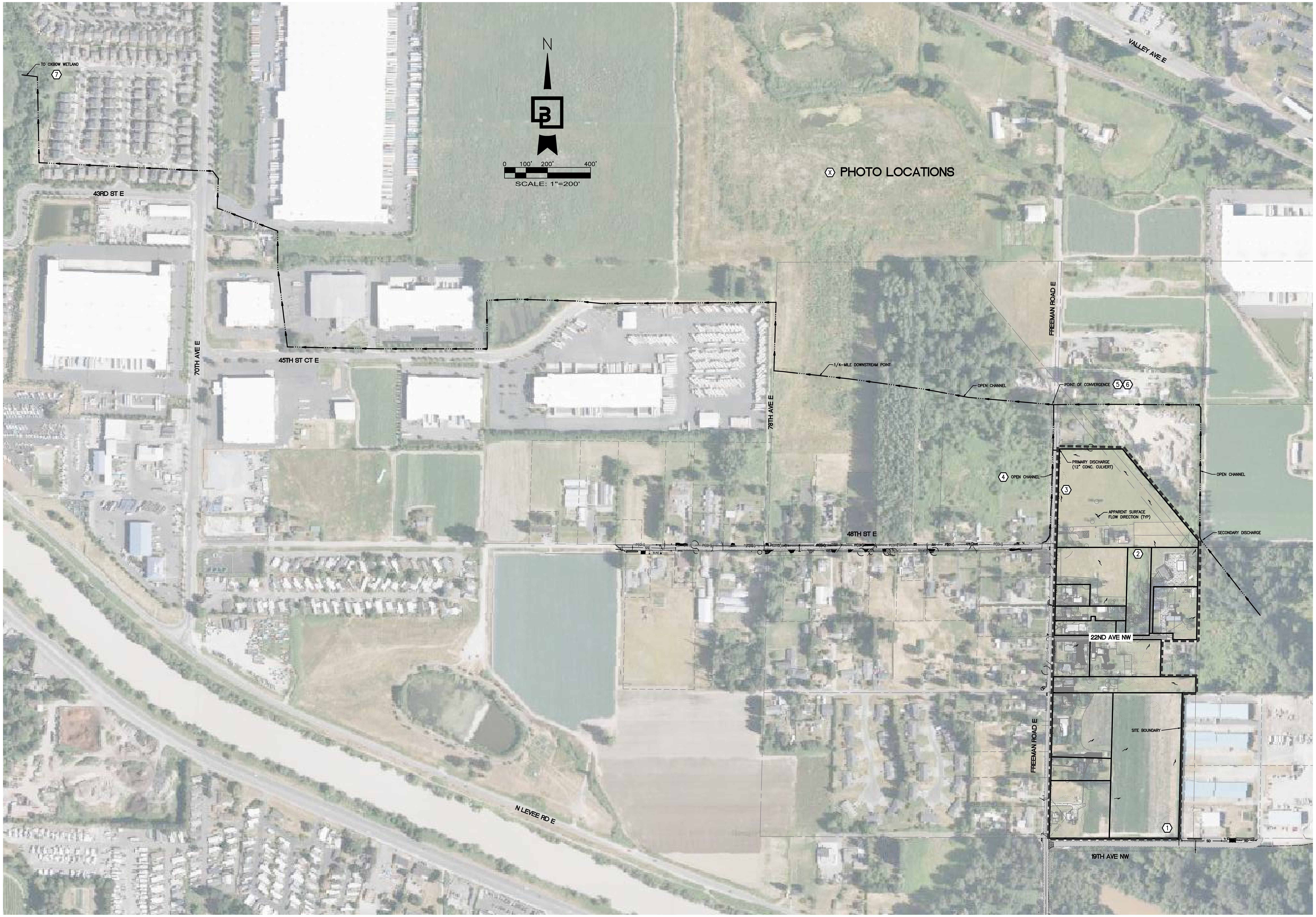
Model Results and Conclusion

Refer to the WWHM report provided on the following pages. Water surface elevations of the simulated oxbow wetland were compared at storm recurrence intervals ranging from 2 to 100-years. The existing condition (1015 column) and developed condition (1017 column) facility elevations are tabulated below.

Stage Frequency			
(feet)		1015 15m	1017 15m
2 Year	=	1.3493	1.3461
5 Year	=	2.1263	2.1117
10 Year	=	2.6554	2.6314
25 Year	=	3.3270	3.2898
50 Year	=	3.8251	3.7771
100 Year	=	4.3189	4.2596

The post-developed stage is lower at each storm recurrence interval. This result demonstrates the effect of the proposed detention system on downstream water bodies. The proposed detention system, designed to meet both the DOE flow duration standard and 100-year peak flow matching as requested by the City of Fife, provides a substantial amount of residence time for stormwater originating onsite. This is the highest level of flow control typically imposed on a development and is used to mitigate for severe flooding issues. Development of the site is not anticipated to raise the water lever within the oxbow wetland system or create any flooding issues along the downstream conveyance path.

OFFSITE ANALYSIS BASIN MAPS



No.	Date	By	Ckd.	Appr.	Revision

Title: DOWNSTREAM EXHIBIT

For: VECTOR DEVELOPMENT COMPANY
11411 NE 124TH STREET
SUITE 190
KIRKLAND, WA 98034

Scale:
Horizontal 1"=200'
Vertical N/A

Designed JSM
Drawn
Checked
Approved
Date 10/7/22

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Sheet 1 of 1

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No.	Date	By	Ckd.	Appr.	Revision

Title: OXBOW DRAINAGE BASIN EXHIBIT

For: VECTOR DEVELOPMENT COMPANY
11411 NE 124TH STREET
SUITE 190
KIRKLAND, WA 98034

Scale: Horizontal 1"=500'
Vertical N/A

Designed JSM
Drawn
Checked
Approved
Date 10/14/22

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Sheet 1 of 1

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OFFSITE ANALYSIS CALCULATIONS

WWHM2012

PROJECT REPORT

Calculations for Oxbow Wetland
Water Level Analysis - Freeman
Road Logistics

General Model Information

Project Name:	21585-oxbow analysis
Site Name:	
Site Address:	
City:	
Report Date:	10/14/2022
Gage:	40 IN EAST
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2019/09/13
Version:	4.2.17

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	396
Pervious Total	396
Impervious Land Use	acre
ROADS FLAT	44
Impervious Total	44
Basin Total	440

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Flat	325
Pervious Total	325
Impervious Land Use	acre
Impervious Total	0
Basin Total	325

Element Flows To:

Surface	Interflow	Groundwater
Channel 1	Channel 1	

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	396
Pervious Total	396
Impervious Land Use	acre
ROADS FLAT	44
Impervious Total	44
Basin Total	440

Element Flows To:

Surface	Interflow	Groundwater
Trapezoidal Pond 1	Trapezoidal Pond 1	

Basin 2

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	5
Pervious Total	5
Impervious Land Use	acre
ROADS FLAT	20
Impervious Total	20
Basin Total	25

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Basin 3

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Flat	300
Pervious Total	300
Impervious Land Use	acre
Impervious Total	0
Basin Total	300

Element Flows To:

Surface	Interflow	Groundwater
Channel 1	Channel 1	

Routing Elements
Predeveloped Routing

Channel 1

Bottom Length: 3000.00 ft.
Bottom Width: 3.00 ft.
Manning's n: 0.03
Channel bottom slope 1: 0.001 To 1
Channel Left side slope 0: 2 To 1
Channel right side slope 2: 2 To 1
Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Flows To:
Outlet 1 Outlet 2
Trapezoidal Pond 1

Channel Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.206	0.000	0.000	0.000
0.0444	0.218	0.009	0.026	0.000
0.0889	0.231	0.019	0.084	0.000
0.1333	0.243	0.030	0.167	0.000
0.1778	0.255	0.041	0.272	0.000
0.2222	0.267	0.052	0.399	0.000
0.2667	0.280	0.064	0.547	0.000
0.3111	0.292	0.077	0.714	0.000
0.3556	0.304	0.090	0.902	0.000
0.4000	0.316	0.104	1.110	0.000
0.4444	0.329	0.119	1.339	0.000
0.4889	0.341	0.133	1.588	0.000
0.5333	0.353	0.149	1.857	0.000
0.5778	0.365	0.165	2.148	0.000
0.6222	0.378	0.181	2.459	0.000
0.6667	0.390	0.199	2.793	0.000
0.7111	0.402	0.216	3.147	0.000
0.7556	0.414	0.234	3.524	0.000
0.8000	0.427	0.253	3.924	0.000
0.8444	0.439	0.272	4.346	0.000
0.8889	0.451	0.292	4.791	0.000
0.9333	0.463	0.312	5.260	0.000
0.9778	0.476	0.333	5.752	0.000
1.0222	0.488	0.355	6.269	0.000
1.0667	0.500	0.377	6.810	0.000
1.1111	0.512	0.399	7.375	0.000
1.1556	0.524	0.422	7.966	0.000
1.2000	0.537	0.446	8.583	0.000
1.2444	0.549	0.470	9.225	0.000
1.2889	0.561	0.495	9.894	0.000
1.3333	0.573	0.520	10.59	0.000
1.3778	0.586	0.546	11.31	0.000
1.4222	0.598	0.572	12.06	0.000
1.4667	0.610	0.599	12.83	0.000
1.5111	0.622	0.626	13.64	0.000
1.5556	0.635	0.654	14.47	0.000

1.6000	0.647	0.683	15.33	0.000
1.6444	0.659	0.712	16.23	0.000
1.6889	0.671	0.741	17.15	0.000
1.7333	0.684	0.772	18.10	0.000
1.7778	0.696	0.802	19.08	0.000
1.8222	0.708	0.833	20.09	0.000
1.8667	0.720	0.865	21.13	0.000
1.9111	0.733	0.897	22.20	0.000
1.9556	0.745	0.930	23.30	0.000
2.0000	0.757	0.964	24.44	0.000
2.0444	0.769	0.998	25.61	0.000
2.0889	0.782	1.032	26.81	0.000
2.1333	0.794	1.067	28.04	0.000
2.1778	0.806	1.103	29.31	0.000
2.2222	0.818	1.139	30.60	0.000
2.2667	0.831	1.176	31.94	0.000
2.3111	0.843	1.213	33.30	0.000
2.3556	0.855	1.251	34.71	0.000
2.4000	0.867	1.289	36.14	0.000
2.4444	0.880	1.328	37.61	0.000
2.4889	0.892	1.367	39.12	0.000
2.5333	0.904	1.407	40.66	0.000
2.5778	0.916	1.447	42.24	0.000
2.6222	0.929	1.488	43.85	0.000
2.6667	0.941	1.530	45.50	0.000
2.7111	0.953	1.572	47.19	0.000
2.7556	0.965	1.615	48.92	0.000
2.8000	0.978	1.658	50.68	0.000
2.8444	0.990	1.702	52.48	0.000
2.8889	1.002	1.746	54.32	0.000
2.9333	1.014	1.791	56.19	0.000
2.9778	1.026	1.836	58.11	0.000
3.0222	1.039	1.882	60.06	0.000
3.0667	1.051	1.929	62.06	0.000
3.1111	1.063	1.976	64.09	0.000
3.1556	1.075	2.023	66.17	0.000
3.2000	1.088	2.071	68.28	0.000
3.2444	1.100	2.120	70.43	0.000
3.2889	1.112	2.169	72.63	0.000
3.3333	1.124	2.219	74.87	0.000
3.3778	1.137	2.269	77.14	0.000
3.4222	1.149	2.320	79.46	0.000
3.4667	1.161	2.371	81.82	0.000
3.5111	1.173	2.423	84.23	0.000
3.5556	1.186	2.475	86.68	0.000
3.6000	1.198	2.528	89.17	0.000
3.6444	1.210	2.582	91.70	0.000
3.6889	1.222	2.636	94.27	0.000
3.7333	1.235	2.691	96.90	0.000
3.7778	1.247	2.746	99.56	0.000
3.8222	1.259	2.802	102.2	0.000
3.8667	1.271	2.858	105.0	0.000
3.9111	1.284	2.915	107.8	0.000
3.9556	1.296	2.972	110.6	0.000
4.0000	1.308	3.030	113.5	0.000
4.0444	1.320	3.088	116.4	0.000

Trapezoidal Pond 1

Bottom Length:	4500.00 ft.	
Bottom Width:	350.00 ft.	
Depth:	6 ft.	
Volume at riser head:	237.9861 acre-feet.	
Side slope 1:	20 To 1	
Side slope 2:	20 To 1	
Side slope 3:	20 To 1	
Side slope 4:	20 To 1	
Discharge Structure		
Riser Height:	5 ft.	
Riser Diameter:	54 in.	
Orifice 1 Diameter:	18 in.	Elevation:0 ft.
Element Flows To:		
Outlet 1	Outlet 2	

Pond Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	36.15	0.000	0.000	0.000
0.0667	36.45	2.420	2.270	0.000
0.1333	36.75	4.860	3.210	0.000
0.2000	37.04	7.320	3.932	0.000
0.2667	37.34	9.800	4.540	0.000
0.3333	37.64	12.30	5.076	0.000
0.4000	37.94	14.82	5.560	0.000
0.4667	38.24	17.35	6.006	0.000
0.5333	38.54	19.91	6.421	0.000
0.6000	38.84	22.49	6.810	0.000
0.6667	39.14	25.09	7.178	0.000
0.7333	39.44	27.71	7.529	0.000
0.8000	39.74	30.35	7.864	0.000
0.8667	40.04	33.01	8.185	0.000
0.9333	40.34	35.69	8.494	0.000
1.0000	40.64	38.39	8.792	0.000
1.0667	40.94	41.11	9.080	0.000
1.1333	41.25	43.85	9.360	0.000
1.2000	41.55	46.61	9.631	0.000
1.2667	41.85	49.39	9.895	0.000
1.3333	42.16	52.19	10.15	0.000
1.4000	42.46	55.01	10.40	0.000
1.4667	42.76	57.85	10.64	0.000
1.5333	43.07	60.72	10.88	0.000
1.6000	43.37	63.60	11.12	0.000
1.6667	43.68	66.50	11.35	0.000
1.7333	43.98	69.42	11.57	0.000
1.8000	44.29	72.36	11.79	0.000
1.8667	44.59	75.33	12.01	0.000
1.9333	44.90	78.31	12.22	0.000
2.0000	45.21	81.31	12.43	0.000
2.0667	45.51	84.34	12.64	0.000
2.1333	45.82	87.38	12.84	0.000
2.2000	46.13	90.45	13.04	0.000
2.2667	46.44	93.53	13.23	0.000
2.3333	46.74	96.64	13.43	0.000
2.4000	47.05	99.77	13.62	0.000

2.4667	47.36	102.9	13.80	0.000
2.5333	47.67	106.0	13.99	0.000
2.6000	47.98	109.2	14.17	0.000
2.6667	48.29	112.4	14.35	0.000
2.7333	48.60	115.7	14.53	0.000
2.8000	48.91	118.9	14.71	0.000
2.8667	49.22	122.2	14.88	0.000
2.9333	49.53	125.5	15.05	0.000
3.0000	49.84	128.8	15.22	0.000
3.0667	50.16	132.1	15.39	0.000
3.1333	50.47	135.5	15.56	0.000
3.2000	50.78	138.9	15.72	0.000
3.2667	51.09	142.3	15.89	0.000
3.3333	51.41	145.7	16.05	0.000
3.4000	51.72	149.1	16.21	0.000
3.4667	52.03	152.6	16.37	0.000
3.5333	52.35	156.1	16.52	0.000
3.6000	52.66	159.6	16.68	0.000
3.6667	52.98	163.1	16.83	0.000
3.7333	53.29	166.6	16.98	0.000
3.8000	53.61	170.2	17.13	0.000
3.8667	53.92	173.8	17.28	0.000
3.9333	54.24	177.4	17.43	0.000
4.0000	54.55	181.0	17.58	0.000
4.0667	54.87	184.6	17.73	0.000
4.1333	55.19	188.3	17.87	0.000
4.2000	55.51	192.0	18.01	0.000
4.2667	55.82	195.7	18.16	0.000
4.3333	56.14	199.4	18.30	0.000
4.4000	56.46	203.2	18.44	0.000
4.4667	56.78	207.0	18.58	0.000
4.5333	57.10	210.8	18.72	0.000
4.6000	57.42	214.6	18.85	0.000
4.6667	57.74	218.4	18.99	0.000
4.7333	58.06	222.3	19.12	0.000
4.8000	58.38	226.2	19.26	0.000
4.8667	58.70	230.1	19.39	0.000
4.9333	59.02	234.0	19.52	0.000
5.0000	59.34	237.9	19.66	0.000
5.0667	59.66	241.9	20.61	0.000
5.1333	59.98	245.9	22.24	0.000
5.2000	60.30	249.9	24.31	0.000
5.2667	60.63	253.9	26.74	0.000
5.3333	60.95	258.0	29.46	0.000
5.4000	61.27	262.1	32.45	0.000
5.4667	61.60	266.2	35.67	0.000
5.5333	61.92	270.3	39.10	0.000
5.6000	62.24	274.4	42.70	0.000
5.6667	62.57	278.6	46.44	0.000
5.7333	62.89	282.8	50.31	0.000
5.8000	63.22	287.0	54.28	0.000
5.8667	63.54	291.2	58.31	0.000
5.9333	63.87	295.4	62.38	0.000
6.0000	64.20	299.7	66.47	0.000
6.0667	64.52	304.0	70.53	0.000

Mitigated Routing

Vault 1

Width:	200 ft.	
Length:	395.5 ft.	
Depth:	7.5 ft.	
Discharge Structure		
Riser Height:	6.5 ft.	
Riser Diameter:	24 in.	
Orifice 1 Diameter:	2.64 in.	Elevation:0 ft.
Orifice 2 Diameter:	4 in.	Elevation:4.3 ft.
Orifice 3 Diameter:	4 in.	Elevation:5.5 ft.

Element Flows To:

Outlet 1	Outlet 2
Channel 1	

Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	1.815	0.000	0.000	0.000
0.0833	1.815	0.151	0.054	0.000
0.1667	1.815	0.302	0.077	0.000
0.2500	1.815	0.454	0.094	0.000
0.3333	1.815	0.605	0.109	0.000
0.4167	1.815	0.756	0.122	0.000
0.5000	1.815	0.907	0.133	0.000
0.5833	1.815	1.059	0.144	0.000
0.6667	1.815	1.210	0.154	0.000
0.7500	1.815	1.361	0.163	0.000
0.8333	1.815	1.513	0.172	0.000
0.9167	1.815	1.664	0.181	0.000
1.0000	1.815	1.815	0.189	0.000
1.0833	1.815	1.967	0.196	0.000
1.1667	1.815	2.118	0.204	0.000
1.2500	1.815	2.269	0.211	0.000
1.3333	1.815	2.421	0.218	0.000
1.4167	1.815	2.572	0.225	0.000
1.5000	1.815	2.723	0.231	0.000
1.5833	1.815	2.875	0.238	0.000
1.6667	1.815	3.026	0.244	0.000
1.7500	1.815	3.177	0.250	0.000
1.8333	1.815	3.329	0.256	0.000
1.9167	1.815	3.480	0.261	0.000
2.0000	1.815	3.631	0.267	0.000
2.0833	1.815	3.783	0.273	0.000
2.1667	1.815	3.934	0.278	0.000
2.2500	1.815	4.085	0.283	0.000
2.3333	1.815	4.237	0.288	0.000
2.4167	1.815	4.388	0.294	0.000
2.5000	1.815	4.539	0.299	0.000
2.5833	1.815	4.691	0.304	0.000
2.6667	1.815	4.842	0.308	0.000
2.7500	1.815	4.993	0.313	0.000
2.8333	1.815	5.145	0.318	0.000
2.9167	1.815	5.296	0.323	0.000
3.0000	1.815	5.447	0.327	0.000
3.0833	1.815	5.599	0.332	0.000

3.1667	1.815	5.750	0.336	0.000
3.2500	1.815	5.901	0.341	0.000
3.3333	1.815	6.053	0.345	0.000
3.4167	1.815	6.204	0.349	0.000
3.5000	1.815	6.355	0.353	0.000
3.5833	1.815	6.506	0.358	0.000
3.6667	1.815	6.658	0.362	0.000
3.7500	1.815	6.809	0.366	0.000
3.8333	1.815	6.960	0.370	0.000
3.9167	1.815	7.112	0.374	0.000
4.0000	1.815	7.263	0.378	0.000
4.0833	1.815	7.414	0.382	0.000
4.1667	1.815	7.566	0.386	0.000
4.2500	1.815	7.717	0.389	0.000
4.3333	1.815	7.868	0.473	0.000
4.4167	1.815	8.020	0.545	0.000
4.5000	1.815	8.171	0.595	0.000
4.5833	1.815	8.322	0.636	0.000
4.6667	1.815	8.474	0.671	0.000
4.7500	1.815	8.625	0.703	0.000
4.8333	1.815	8.776	0.732	0.000
4.9167	1.815	8.928	0.760	0.000
5.0000	1.815	9.079	0.786	0.000
5.0833	1.815	9.230	0.810	0.000
5.1667	1.815	9.382	0.834	0.000
5.2500	1.815	9.533	0.856	0.000
5.3333	1.815	9.684	0.878	0.000
5.4167	1.815	9.836	0.899	0.000
5.5000	1.815	9.987	0.919	0.000
5.5833	1.815	10.13	1.064	0.000
5.6667	1.815	10.29	1.135	0.000
5.7500	1.815	10.44	1.193	0.000
5.8333	1.815	10.59	1.245	0.000
5.9167	1.815	10.74	1.292	0.000
6.0000	1.815	10.89	1.336	0.000
6.0833	1.815	11.04	1.377	0.000
6.1667	1.815	11.19	1.417	0.000
6.2500	1.815	11.34	1.455	0.000
6.3333	1.815	11.50	1.491	0.000
6.4167	1.815	11.65	1.526	0.000
6.5000	1.815	11.80	1.560	0.000
6.5833	1.815	11.95	2.103	0.000
6.6667	1.815	12.10	3.063	0.000
6.7500	1.815	12.25	4.279	0.000
6.8333	1.815	12.40	5.666	0.000
6.9167	1.815	12.56	7.144	0.000
7.0000	1.815	12.71	8.633	0.000
7.0833	1.815	12.86	10.05	0.000
7.1667	1.815	13.01	11.32	0.000
7.2500	1.815	13.16	12.39	0.000
7.3333	1.815	13.31	13.24	0.000
7.4167	1.815	13.46	13.87	0.000
7.5000	1.815	13.61	14.37	0.000
7.5833	1.815	13.77	15.04	0.000
7.6667	0.000	0.000	15.56	0.000

Channel 1

Bottom Length: 3000.00 ft.
Bottom Width: 3.00 ft.
Manning's n: 0.03
Channel bottom slope 1: 0.001 To 1
Channel Left side slope 0: 2 To 1
Channel right side slope 2: 2 To 1
Discharge Structure
Riser Height: 0 ft.
Riser Diameter: 0 in.
Element Flows To:
Outlet 1 Outlet 2
Trapezoidal Pond 1

Channel Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.206	0.000	0.000	0.000
0.0444	0.218	0.009	0.026	0.000
0.0889	0.231	0.019	0.084	0.000
0.1333	0.243	0.030	0.167	0.000
0.1778	0.255	0.041	0.272	0.000
0.2222	0.267	0.052	0.399	0.000
0.2667	0.280	0.064	0.547	0.000
0.3111	0.292	0.077	0.714	0.000
0.3556	0.304	0.090	0.902	0.000
0.4000	0.316	0.104	1.110	0.000
0.4444	0.329	0.119	1.339	0.000
0.4889	0.341	0.133	1.588	0.000
0.5333	0.353	0.149	1.857	0.000
0.5778	0.365	0.165	2.148	0.000
0.6222	0.378	0.181	2.459	0.000
0.6667	0.390	0.199	2.793	0.000
0.7111	0.402	0.216	3.147	0.000
0.7556	0.414	0.234	3.524	0.000
0.8000	0.427	0.253	3.924	0.000
0.8444	0.439	0.272	4.346	0.000
0.8889	0.451	0.292	4.791	0.000
0.9333	0.463	0.312	5.260	0.000
0.9778	0.476	0.333	5.752	0.000
1.0222	0.488	0.355	6.269	0.000
1.0667	0.500	0.377	6.810	0.000
1.1111	0.512	0.399	7.375	0.000
1.1556	0.524	0.422	7.966	0.000
1.2000	0.537	0.446	8.583	0.000
1.2444	0.549	0.470	9.225	0.000
1.2889	0.561	0.495	9.894	0.000
1.3333	0.573	0.520	10.59	0.000
1.3778	0.586	0.546	11.31	0.000
1.4222	0.598	0.572	12.06	0.000
1.4667	0.610	0.599	12.83	0.000
1.5111	0.622	0.626	13.64	0.000
1.5556	0.635	0.654	14.47	0.000
1.6000	0.647	0.683	15.33	0.000
1.6444	0.659	0.712	16.23	0.000
1.6889	0.671	0.741	17.15	0.000
1.7333	0.684	0.772	18.10	0.000

1.7778	0.696	0.802	19.08	0.000
1.8222	0.708	0.833	20.09	0.000
1.8667	0.720	0.865	21.13	0.000
1.9111	0.733	0.897	22.20	0.000
1.9556	0.745	0.930	23.30	0.000
2.0000	0.757	0.964	24.44	0.000
2.0444	0.769	0.998	25.61	0.000
2.0889	0.782	1.032	26.81	0.000
2.1333	0.794	1.067	28.04	0.000
2.1778	0.806	1.103	29.31	0.000
2.2222	0.818	1.139	30.60	0.000
2.2667	0.831	1.176	31.94	0.000
2.3111	0.843	1.213	33.30	0.000
2.3556	0.855	1.251	34.71	0.000
2.4000	0.867	1.289	36.14	0.000
2.4444	0.880	1.328	37.61	0.000
2.4889	0.892	1.367	39.12	0.000
2.5333	0.904	1.407	40.66	0.000
2.5778	0.916	1.447	42.24	0.000
2.6222	0.929	1.488	43.85	0.000
2.6667	0.941	1.530	45.50	0.000
2.7111	0.953	1.572	47.19	0.000
2.7556	0.965	1.615	48.92	0.000
2.8000	0.978	1.658	50.68	0.000
2.8444	0.990	1.702	52.48	0.000
2.8889	1.002	1.746	54.32	0.000
2.9333	1.014	1.791	56.19	0.000
2.9778	1.026	1.836	58.11	0.000
3.0222	1.039	1.882	60.06	0.000
3.0667	1.051	1.929	62.06	0.000
3.1111	1.063	1.976	64.09	0.000
3.1556	1.075	2.023	66.17	0.000
3.2000	1.088	2.071	68.28	0.000
3.2444	1.100	2.120	70.43	0.000
3.2889	1.112	2.169	72.63	0.000
3.3333	1.124	2.219	74.87	0.000
3.3778	1.137	2.269	77.14	0.000
3.4222	1.149	2.320	79.46	0.000
3.4667	1.161	2.371	81.82	0.000
3.5111	1.173	2.423	84.23	0.000
3.5556	1.186	2.475	86.68	0.000
3.6000	1.198	2.528	89.17	0.000
3.6444	1.210	2.582	91.70	0.000
3.6889	1.222	2.636	94.27	0.000
3.7333	1.235	2.691	96.90	0.000
3.7778	1.247	2.746	99.56	0.000
3.8222	1.259	2.802	102.2	0.000
3.8667	1.271	2.858	105.0	0.000
3.9111	1.284	2.915	107.8	0.000
3.9556	1.296	2.972	110.6	0.000
4.0000	1.308	3.030	113.5	0.000
4.0444	1.320	3.088	116.4	0.000

Trapezoidal Pond 1

Bottom Length:	4500.00 ft.	
Bottom Width:	350.00 ft.	
Depth:	6 ft.	
Volume at riser head:	237.9861 acre-feet.	
Side slope 1:	20 To 1	
Side slope 2:	20 To 1	
Side slope 3:	20 To 1	
Side slope 4:	20 To 1	
Discharge Structure		
Riser Height:	5 ft.	
Riser Diameter:	54 in.	
Orifice 1 Diameter:	18 in.	Elevation:0 ft.

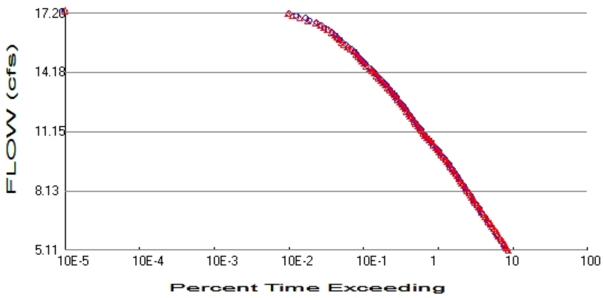
Element Flows To:
Outlet 1 Outlet 2

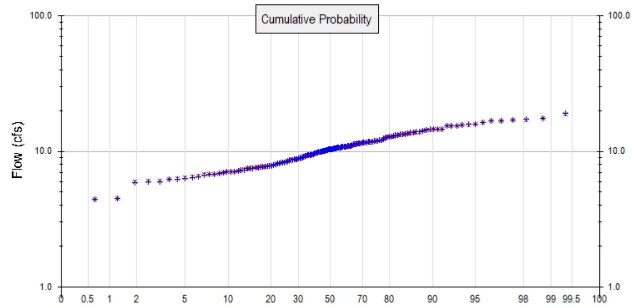
Pond Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	36.15	0.000	0.000	0.000
0.0667	36.45	2.420	2.270	0.000
0.1333	36.75	4.860	3.210	0.000
0.2000	37.04	7.320	3.932	0.000
0.2667	37.34	9.800	4.540	0.000
0.3333	37.64	12.30	5.076	0.000
0.4000	37.94	14.82	5.560	0.000
0.4667	38.24	17.35	6.006	0.000
0.5333	38.54	19.91	6.421	0.000
0.6000	38.84	22.49	6.810	0.000
0.6667	39.14	25.09	7.178	0.000
0.7333	39.44	27.71	7.529	0.000
0.8000	39.74	30.35	7.864	0.000
0.8667	40.04	33.01	8.185	0.000
0.9333	40.34	35.69	8.494	0.000
1.0000	40.64	38.39	8.792	0.000
1.0667	40.94	41.11	9.080	0.000
1.1333	41.25	43.85	9.360	0.000
1.2000	41.55	46.61	9.631	0.000
1.2667	41.85	49.39	9.895	0.000
1.3333	42.16	52.19	10.15	0.000
1.4000	42.46	55.01	10.40	0.000
1.4667	42.76	57.85	10.64	0.000
1.5333	43.07	60.72	10.88	0.000
1.6000	43.37	63.60	11.12	0.000
1.6667	43.68	66.50	11.35	0.000
1.7333	43.98	69.42	11.57	0.000
1.8000	44.29	72.36	11.79	0.000
1.8667	44.59	75.33	12.01	0.000
1.9333	44.90	78.31	12.22	0.000
2.0000	45.21	81.31	12.43	0.000
2.0667	45.51	84.34	12.64	0.000
2.1333	45.82	87.38	12.84	0.000
2.2000	46.13	90.45	13.04	0.000
2.2667	46.44	93.53	13.23	0.000
2.3333	46.74	96.64	13.43	0.000
2.4000	47.05	99.77	13.62	0.000

2.4667	47.36	102.9	13.80	0.000
2.5333	47.67	106.0	13.99	0.000
2.6000	47.98	109.2	14.17	0.000
2.6667	48.29	112.4	14.35	0.000
2.7333	48.60	115.7	14.53	0.000
2.8000	48.91	118.9	14.71	0.000
2.8667	49.22	122.2	14.88	0.000
2.9333	49.53	125.5	15.05	0.000
3.0000	49.84	128.8	15.22	0.000
3.0667	50.16	132.1	15.39	0.000
3.1333	50.47	135.5	15.56	0.000
3.2000	50.78	138.9	15.72	0.000
3.2667	51.09	142.3	15.89	0.000
3.3333	51.41	145.7	16.05	0.000
3.4000	51.72	149.1	16.21	0.000
3.4667	52.03	152.6	16.37	0.000
3.5333	52.35	156.1	16.52	0.000
3.6000	52.66	159.6	16.68	0.000
3.6667	52.98	163.1	16.83	0.000
3.7333	53.29	166.6	16.98	0.000
3.8000	53.61	170.2	17.13	0.000
3.8667	53.92	173.8	17.28	0.000
3.9333	54.24	177.4	17.43	0.000
4.0000	54.55	181.0	17.58	0.000
4.0667	54.87	184.6	17.73	0.000
4.1333	55.19	188.3	17.87	0.000
4.2000	55.51	192.0	18.01	0.000
4.2667	55.82	195.7	18.16	0.000
4.3333	56.14	199.4	18.30	0.000
4.4000	56.46	203.2	18.44	0.000
4.4667	56.78	207.0	18.58	0.000
4.5333	57.10	210.8	18.72	0.000
4.6000	57.42	214.6	18.85	0.000
4.6667	57.74	218.4	18.99	0.000
4.7333	58.06	222.3	19.12	0.000
4.8000	58.38	226.2	19.26	0.000
4.8667	58.70	230.1	19.39	0.000
4.9333	59.02	234.0	19.52	0.000
5.0000	59.34	237.9	19.66	0.000
5.0667	59.66	241.9	20.61	0.000
5.1333	59.98	245.9	22.24	0.000
5.2000	60.30	249.9	24.31	0.000
5.2667	60.63	253.9	26.74	0.000
5.3333	60.95	258.0	29.46	0.000
5.4000	61.27	262.1	32.45	0.000
5.4667	61.60	266.2	35.67	0.000
5.5333	61.92	270.3	39.10	0.000
5.6000	62.24	274.4	42.70	0.000
5.6667	62.57	278.6	46.44	0.000
5.7333	62.89	282.8	50.31	0.000
5.8000	63.22	287.0	54.28	0.000
5.8667	63.54	291.2	58.31	0.000
5.9333	63.87	295.4	62.38	0.000
6.0000	64.20	299.7	66.47	0.000
6.0667	64.52	304.0	70.53	0.000

Analysis Results
POC 1





+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 721
Total Impervious Area: 44

Mitigated Landuse Totals for POC #1
Total Pervious Area: 701
Total Impervious Area: 64

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	10.211837
5 year	12.820782
10 year	14.328271
25 year	16.039444
50 year	17.198873
100 year	18.2759

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	10.199805
5 year	12.776693
10 year	14.263198
25 year	15.94867
50 year	17.089654
100 year	18.148861

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	10.099	10.096
1903	8.426	8.412
1904	9.409	9.402
1905	8.580	8.683
1906	4.502	4.517
1907	11.921	11.861
1908	9.631	9.582
1909	8.670	8.684
1910	10.203	10.121
1911	10.503	10.471

1912	12.369	12.281
1913	13.740	13.660
1914	5.939	5.947
1915	10.510	10.541
1916	10.338	10.293
1917	5.905	6.038
1918	12.661	12.651
1919	10.820	10.779
1920	10.254	10.233
1921	11.839	11.800
1922	10.681	10.679
1923	11.275	11.297
1924	7.514	7.541
1925	8.240	8.237
1926	8.779	8.735
1927	7.758	7.870
1928	9.383	9.392
1929	11.171	11.095
1930	8.837	8.861
1931	9.173	9.208
1932	9.913	9.961
1933	10.826	10.785
1934	15.408	15.383
1935	12.857	12.920
1936	10.901	10.865
1937	10.428	10.361
1938	10.606	10.561
1939	4.367	4.447
1940	11.744	11.713
1941	6.334	6.374
1942	16.815	16.814
1943	9.699	9.724
1944	13.400	13.361
1945	11.010	10.966
1946	7.106	7.100
1947	6.798	6.787
1948	13.307	13.197
1949	14.216	14.178
1950	7.542	7.543
1951	8.160	8.146
1952	15.966	15.879
1953	15.473	15.337
1954	12.049	12.016
1955	8.135	8.095
1956	6.523	6.571
1957	11.739	11.659
1958	17.175	17.085
1959	16.407	16.367
1960	6.866	6.887
1961	14.475	14.505
1962	9.925	9.880
1963	7.141	7.132
1964	8.421	8.413
1965	13.606	13.519
1966	6.753	6.731
1967	9.304	9.274
1968	11.237	11.208
1969	8.671	8.649

1970	11.649	11.612
1971	15.464	15.404
1972	11.798	11.745
1973	14.527	14.424
1974	10.051	9.994
1975	14.600	14.618
1976	10.834	10.804
1977	6.953	6.945
1978	14.478	14.485
1979	8.212	8.222
1980	10.896	10.836
1981	11.636	11.595
1982	7.266	7.271
1983	13.911	13.818
1984	9.318	9.324
1985	11.658	11.588
1986	10.735	10.696
1987	15.760	15.707
1988	10.880	10.952
1989	10.534	10.478
1990	11.649	11.576
1991	9.999	9.990
1992	13.125	13.197
1993	11.246	11.176
1994	13.116	13.019
1995	8.807	8.863
1996	17.067	16.981
1997	7.718	7.689
1998	10.866	10.811
1999	6.405	6.471
2000	11.401	11.373
2001	6.178	6.225
2002	10.409	10.383
2003	11.963	11.905
2004	8.956	8.946
2005	10.148	10.140
2006	8.041	8.021
2007	8.775	8.769
2008	10.925	10.872
2009	9.344	9.332
2010	9.817	9.858
2011	7.316	7.330
2012	10.000	9.947
2013	7.615	7.592
2014	7.759	7.768
2015	8.738	8.718
2016	6.244	6.310
2017	10.970	10.896
2018	19.002	18.914
2019	15.708	15.613
2020	7.871	7.878
2021	11.488	11.410
2022	7.495	7.506
2023	10.493	10.435
2024	10.388	10.323
2025	11.474	11.427
2026	12.960	12.907
2027	9.580	9.567

2028	7.068	7.083
2029	10.321	10.372
2030	14.395	14.295
2031	7.504	7.461
2032	6.670	6.735
2033	7.823	7.818
2034	8.302	8.322
2035	16.807	16.831
2036	10.716	10.711
2037	5.943	6.031
2038	10.155	10.169
2039	4.401	4.437
2040	9.466	9.464
2041	8.971	8.937
2042	17.529	17.489
2043	12.178	12.145
2044	13.839	13.735
2045	11.965	11.948
2046	12.680	12.764
2047	9.824	9.840
2048	10.622	10.559
2049	10.145	10.115
2050	7.743	7.712
2051	11.421	11.392
2052	9.333	9.338
2053	13.410	13.446
2054	13.876	13.803
2055	7.094	7.098
2056	7.697	7.689
2057	9.824	9.835
2058	10.327	10.336
2059	12.881	12.792

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	**Predeveloped**	**Mitigated**
1	19.0017	18.9142
2	17.5286	17.4894
3	17.1753	17.0853
4	17.0674	16.9813
5	16.8153	16.8313
6	16.8072	16.8135
7	16.4067	16.3671
8	15.9662	15.8787
9	15.7603	15.7066
10	15.7078	15.6131
11	15.4730	15.4037
12	15.4637	15.3825
13	15.4077	15.3369
14	14.5998	14.6181
15	14.5269	14.5054
16	14.4782	14.4848
17	14.4750	14.4241
18	14.3945	14.2952
19	14.2159	14.1784
20	13.9108	13.8179
21	13.8755	13.8029
22	13.8385	13.7351

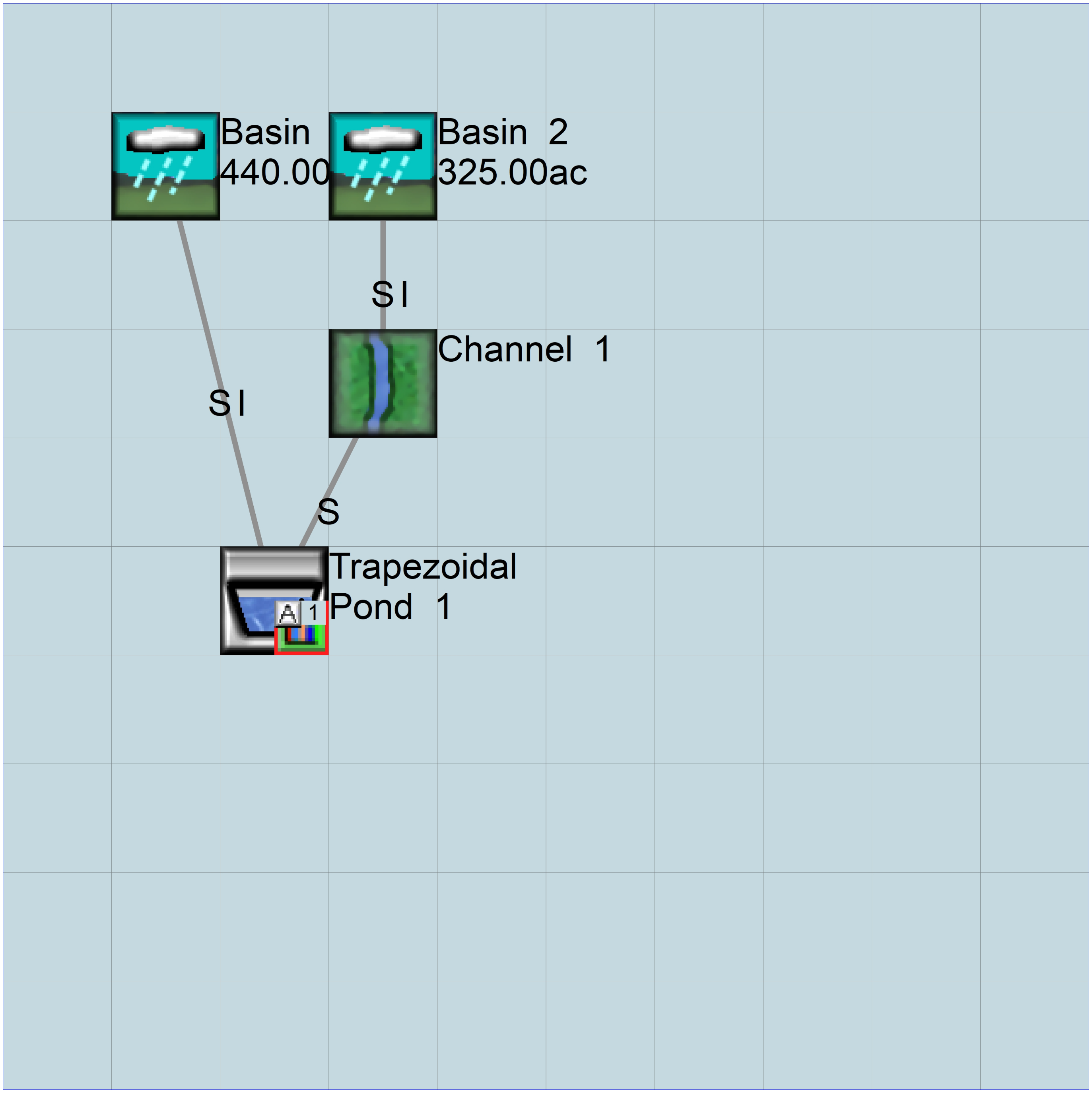
23	13.7399	13.6601
24	13.6056	13.5190
25	13.4096	13.4457
26	13.3997	13.3612
27	13.3074	13.1971
28	13.1253	13.1967
29	13.1162	13.0187
30	12.9595	12.9201
31	12.8806	12.9074
32	12.8566	12.7924
33	12.6798	12.7643
34	12.6613	12.6506
35	12.3690	12.2813
36	12.1779	12.1452
37	12.0489	12.0164
38	11.9648	11.9482
39	11.9626	11.9045
40	11.9206	11.8608
41	11.8391	11.8004
42	11.7977	11.7445
43	11.7440	11.7132
44	11.7392	11.6591
45	11.6584	11.6115
46	11.6490	11.5948
47	11.6486	11.5881
48	11.6362	11.5755
49	11.4882	11.4274
50	11.4738	11.4102
51	11.4206	11.3922
52	11.4006	11.3727
53	11.2748	11.2970
54	11.2455	11.2078
55	11.2367	11.1763
56	11.1711	11.0949
57	11.0095	10.9661
58	10.9698	10.9517
59	10.9247	10.8964
60	10.9014	10.8716
61	10.8956	10.8652
62	10.8798	10.8355
63	10.8657	10.8105
64	10.8340	10.8038
65	10.8261	10.7845
66	10.8196	10.7788
67	10.7345	10.7109
68	10.7159	10.6959
69	10.6807	10.6790
70	10.6221	10.5611
71	10.6058	10.5589
72	10.5338	10.5410
73	10.5099	10.4776
74	10.5034	10.4713
75	10.4933	10.4348
76	10.4282	10.3826
77	10.4088	10.3720
78	10.3876	10.3605
79	10.3382	10.3362
80	10.3270	10.3226

81	10.3211	10.2926
82	10.2537	10.2334
83	10.2029	10.1693
84	10.1553	10.1398
85	10.1478	10.1206
86	10.1448	10.1150
87	10.0985	10.0959
88	10.0508	9.9936
89	9.9999	9.9901
90	9.9988	9.9610
91	9.9250	9.9474
92	9.9132	9.8799
93	9.8237	9.8577
94	9.8235	9.8400
95	9.8169	9.8345
96	9.6986	9.7242
97	9.6313	9.5824
98	9.5797	9.5670
99	9.4657	9.4637
100	9.4094	9.4023
101	9.3825	9.3919
102	9.3437	9.3383
103	9.3334	9.3323
104	9.3176	9.3243
105	9.3042	9.2737
106	9.1731	9.2083
107	8.9714	8.9464
108	8.9555	8.9374
109	8.8370	8.8635
110	8.8071	8.8615
111	8.7792	8.7690
112	8.7746	8.7345
113	8.7379	8.7183
114	8.6711	8.6837
115	8.6697	8.6829
116	8.5798	8.6492
117	8.4259	8.4129
118	8.4209	8.4122
119	8.3016	8.3224
120	8.2397	8.2366
121	8.2122	8.2225
122	8.1604	8.1460
123	8.1353	8.0954
124	8.0410	8.0206
125	7.8706	7.8779
126	7.8231	7.8696
127	7.7587	7.8181
128	7.7584	7.7679
129	7.7433	7.7123
130	7.7185	7.6893
131	7.6971	7.6889
132	7.6146	7.5924
133	7.5422	7.5432
134	7.5141	7.5415
135	7.5040	7.5055
136	7.4954	7.4614
137	7.3163	7.3296
138	7.2656	7.2708

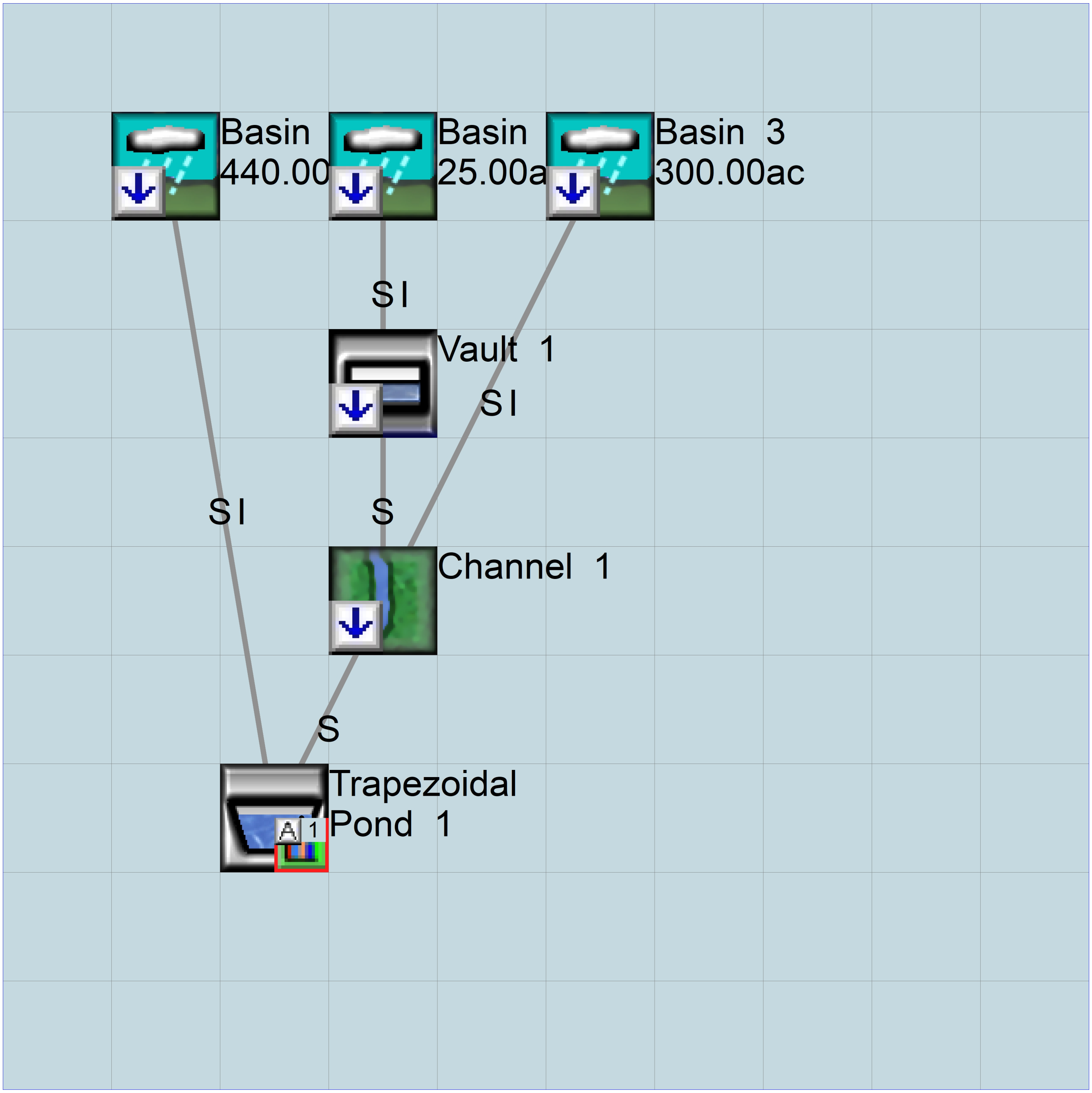
139	7.1414	7.1320
140	7.1061	7.1005
141	7.0941	7.0979
142	7.0683	7.0829
143	6.9533	6.9454
144	6.8660	6.8868
145	6.7978	6.7868
146	6.7529	6.7347
147	6.6695	6.7310
148	6.5234	6.5709
149	6.4054	6.4713
150	6.3335	6.3741
151	6.2444	6.3098
152	6.1783	6.2252
153	5.9430	6.0378
154	5.9394	6.0310
155	5.9049	5.9473
156	4.5022	4.5166
157	4.4010	4.4470
158	4.3673	4.4370

Appendix

Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                              ***
WDM        26   21585-oxbow analysis.wdm
MESSU      25   Pre21585-oxbow analysis.MES
           27   Pre21585-oxbow analysis.L61
           28   Pre21585-oxbow analysis.L62
           30   POC21585-oxbow analysis1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       1
      PERLND      13
      RCHRES       1
      RCHRES       2
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                     1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   16      C, Lawn, Flat          1    1    1    1   27    0
   13      C, Pasture, Flat       1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
   13         0    0    1    0    0    0    0    0    0    0    0    0
  END ACTIVITY
```

```
  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   13         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
   13         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16              0       4.5      0.03       400      0.05       0.5     0.996
   13              0       4.5      0.06       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16              0         0         2         2         0         0         0
   13              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                                     ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      0.25
   13           0.15       0.4       0.3         6       0.5       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16              0         0         0         0       2.5         1         0
   13              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out          ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
    1         0    0    0    0    0
  END IWAT-PARM1
```

```
  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                         396     RCHRES   2      2
PERLND  16                         396     RCHRES   2      3
IMPLND   1                          44     RCHRES   2      5
Basin  2***
PERLND  13                         325     RCHRES   1      2
PERLND  13                         325     RCHRES   1      3

******Routing******
RCHRES   1                           1     RCHRES   2      6
RCHRES   2                           1     COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                         in  out                             ***
    1     Channel  1              1    1    1    1   28    0    1
    2     Trapezoidal Pond-015    1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
```

```
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                       ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    2        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50        ***
  <------><--------><--------><--------><--------><--------><-------->        ***
    1             1      0.57       0.0       0.0       0.5       0.0
    2             2      0.85       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                          ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1          0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2          0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  0.206612  0.000000  0.000000
  0.044444  0.218855  0.009455  0.026431
  0.088889  0.231099  0.019454  0.084510
  0.133333  0.243343  0.029997  0.167456
  0.177778  0.255586  0.041084  0.272892
  0.222222  0.267830  0.052716  0.399624
  0.266667  0.280074  0.064891  0.547016
  0.311111  0.292317  0.077611  0.714746
  0.355556  0.304561  0.090875  0.902685
  0.400000  0.316804  0.104683  1.110836
  0.444444  0.329048  0.119035  1.339290
  0.488889  0.341292  0.133932  1.588206
  0.533333  0.353535  0.149373  1.857787
  0.577778  0.365779  0.165357  2.148274
  0.622222  0.378023  0.181886  2.459936
  0.666667  0.390266  0.198959  2.793058
  0.711111  0.402510  0.216577  3.147947
  0.755556  0.414754  0.234738  3.524917
  0.800000  0.426997  0.253444  3.924295
  0.844444  0.439241  0.272693  4.346413
  0.888889  0.451485  0.292487  4.791612
  0.933333  0.463728  0.312825  5.260233
  0.977778  0.475972  0.333708  5.752624
  1.022222  0.488216  0.355134  6.269134
  1.066667  0.500459  0.377105  6.810112
  1.111111  0.512703  0.399619  7.375912
  1.155556  0.524947  0.422678  7.966886
  1.200000  0.537191  0.446281  8.583386
  1.244444  0.549434  0.470428  9.225765
  1.288889  0.561678  0.495120  9.894376
  1.333333  0.573922  0.520355  10.58957
  1.377778  0.586165  0.546135  11.31170
  1.422222  0.598409  0.572459  12.06112
  1.466667  0.610653  0.599327  12.83817
  1.511111  0.622896  0.626739  13.64320
  1.555556  0.635140  0.654695  14.47656
```

1.600000	0.647384	0.683196	15.33861
1.644444	0.659627	0.712241	16.22967
1.688889	0.671871	0.741830	17.15011
1.733333	0.684115	0.771963	18.10025
1.777778	0.696358	0.802640	19.08044
1.822222	0.708602	0.833861	20.09102
1.866667	0.720846	0.865627	21.13232
1.911111	0.733089	0.897936	22.20470
1.955556	0.745333	0.930790	23.30847
2.000000	0.757577	0.964188	24.44398
2.044444	0.769820	0.998130	25.61156
2.088889	0.782064	1.032617	26.81154
2.133333	0.794308	1.067647	28.04424
2.177778	0.806552	1.103222	29.31001
2.222222	0.818795	1.139341	30.60916
2.266667	0.831039	1.176004	31.94202
2.311111	0.843283	1.213211	33.30893
2.355556	0.855526	1.250962	34.71019
2.400000	0.867770	1.289257	36.14613
2.444444	0.880014	1.328097	37.61708
2.488889	0.892257	1.367481	39.12335
2.533333	0.904501	1.407409	40.66526
2.577778	0.916745	1.447881	42.24313
2.622222	0.928988	1.488897	43.85727
2.666667	0.941232	1.530458	45.50800
2.711111	0.953476	1.572562	47.19563
2.755556	0.965720	1.615211	48.92048
2.800000	0.977963	1.658404	50.68285
2.844444	0.990207	1.702141	52.48306
2.888889	1.002451	1.746422	54.32141
2.933333	1.014694	1.791248	56.19821
2.977778	1.026938	1.836618	58.11377
3.022222	1.039182	1.882531	60.06838
3.066667	1.051425	1.928989	62.06237
3.111111	1.063669	1.975991	64.09602
3.155556	1.075913	2.023538	66.16965
3.200000	1.088157	2.071628	68.28354
3.244444	1.100400	2.120263	70.43801
3.288889	1.112644	2.169441	72.63335
3.333333	1.124888	2.219164	74.86986
3.377778	1.137131	2.269431	77.14783
3.422222	1.149375	2.320243	79.46756
3.466667	1.161619	2.371598	81.82934
3.511111	1.173863	2.423498	84.23348
3.555556	1.186106	2.475941	86.68026
3.600000	1.198350	2.528929	89.16997
3.644444	1.210594	2.582461	91.70290
3.688889	1.222837	2.636538	94.27935
3.733333	1.235081	2.691158	96.89960
3.777778	1.247325	2.746323	99.56394
3.822222	1.259569	2.802031	102.2727
3.866667	1.271812	2.858284	105.0260
3.911111	1.284056	2.915081	107.8244
3.955556	1.296300	2.972423	110.6679
4.000000	1.308543	3.030308	113.5570

END FTABLE 1
FTABLE 2
91 4

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	36.15702	0.000000	0.000000		
0.066667	36.45410	2.420371	2.270169		
0.133333	36.75149	4.860557	3.210503		
0.200000	37.04922	7.320581	3.932047		
0.266667	37.34727	9.800464	4.540337		
0.333333	37.64565	12.30023	5.076251		
0.400000	37.94435	14.81989	5.560755		
0.466667	38.24338	17.35949	6.006301		
0.533333	38.54274	19.91902	6.421006		
0.600000	38.84242	22.49853	6.810506		

0.666667	39.14243	25.09802	7.178903
0.733333	39.44277	27.71753	7.529297
0.800000	39.74343	30.35707	7.864095
0.866667	40.04442	33.01667	8.185209
0.933333	40.34574	35.69634	8.494193
1.000000	40.64738	38.39611	8.792325
1.066667	40.94935	41.11600	9.080674
1.133333	41.25165	43.85603	9.360145
1.200000	41.55427	46.61623	9.631509
1.266667	41.85722	49.39661	9.895435
1.333333	42.16049	52.19720	10.15250
1.400000	42.46410	55.01802	10.40322
1.466667	42.76802	57.85909	10.64803
1.533333	43.07228	60.72044	10.88735
1.600000	43.37686	63.60208	11.12151
1.666667	43.68177	66.50403	11.35084
1.733333	43.98700	69.42632	11.57563
1.800000	44.29256	72.36897	11.79614
1.866667	44.59845	75.33201	12.01260
1.933333	44.90466	78.31545	12.22523
2.000000	45.21120	81.31931	12.43423
2.066667	45.51807	84.34362	12.63976
2.133333	45.82526	87.38839	12.84201
2.200000	46.13278	90.45366	13.04113
2.266667	46.44063	93.53944	13.23724
2.333333	46.74880	96.64576	13.43050
2.400000	47.05730	99.77263	13.62101
2.466667	47.36613	102.9201	13.80890
2.533333	47.67528	106.0881	13.99426
2.600000	47.98476	109.2768	14.17720
2.666667	48.29456	112.4861	14.35781
2.733333	48.60469	115.7161	14.53617
2.800000	48.91515	118.9667	14.71237
2.866667	49.22594	122.2381	14.88649
2.933333	49.53705	125.5302	15.05859
3.000000	49.84848	128.8431	15.22875
3.066667	50.16025	132.1767	15.39703
3.133333	50.47234	135.5311	15.56349
3.200000	50.78476	138.9063	15.72819
3.266667	51.09750	142.3024	15.89118
3.333333	51.41057	145.7193	16.05252
3.400000	51.72397	149.1572	16.21225
3.466667	52.03769	152.6159	16.37042
3.533333	52.35174	156.0955	16.52708
3.600000	52.66612	159.5961	16.68226
3.666667	52.98082	163.1177	16.83602
3.733333	53.29585	166.6603	16.98839
3.800000	53.61120	170.2238	17.13940
3.866667	53.92689	173.8084	17.28909
3.933333	54.24289	177.4141	17.43750
4.000000	54.55923	181.0408	17.58465
4.066667	54.87589	184.6887	17.73058
4.133333	55.19288	188.3576	17.87533
4.200000	55.51019	192.0477	18.01890
4.266667	55.82783	195.7590	18.16135
4.333333	56.14580	199.4914	18.30268
4.400000	56.46410	203.2451	18.44294
4.466667	56.78272	207.0200	18.58213
4.533333	57.10166	210.8161	18.72029
4.600000	57.42094	214.6336	18.85744
4.666667	57.74054	218.4723	18.99359
4.733333	58.06046	222.3323	19.12878
4.800000	58.38072	226.2137	19.26302
4.866667	58.70130	230.1164	19.39633
4.933333	59.02220	234.0405	19.52873
5.000000	59.34343	237.9861	19.66024
5.066667	59.66499	241.9530	20.61296
5.133333	59.98688	245.9414	22.24442
5.200000	60.30909	249.9513	24.31608
5.266667	60.63163	253.9826	26.74138

```
  5.333333  60.95449  258.0355  29.46798
  5.400000  61.27769  262.1099  32.45747
  5.466667  61.60120  266.2059  35.67806
  5.533333  61.92505  270.3234  39.10122
  5.600000  62.24922  274.4625  42.69987
  5.666667  62.57372  278.6233  46.44737
  5.733333  62.89854  282.8057  50.31704
  5.800000  63.22369  287.0098  54.28185
  5.866667  63.54917  291.2356  58.31435
  5.933333  63.87497  295.4830  62.38668
  6.000000  64.20110  299.7522  66.47074
  END FTABLE  2
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1              RCHRES   2     EXTNL  PREC
WDM      1 EVAP     ENGL    1              RCHRES   2     EXTNL  POTEV

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   2 HYDR   RO     1 1        1      WDM   1014 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1        1      WDM   1015 STAG     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    501 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        6
RCHRES     ROFLOW                          RCHRES         INFLOW
  END MASS-LINK    6

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16


END MASS-LINK

END RUN
```

Mitigated UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1901 10 01        END    2059 09 30
  RUN INTERP OUTPUT LEVEL    3    0
  RESUME     0 RUN     1                   UNIT SYSTEM     1
END GLOBAL

FILES
<File>  <Un#>   <-----------File Name------------------------------>***
<-ID->                                                             ***
WDM        26   21585-oxbow analysis.wdm
MESSU      25   Mit21585-oxbow analysis.MES
           27   Mit21585-oxbow analysis.L61
           28   Mit21585-oxbow analysis.L62
           30   POC21585-oxbow analysis1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND       1
      PERLND      13
      RCHRES       1
      RCHRES       2
      RCHRES       3
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Trapezoidal Pond  1         MAX                    1    2   30    9
  END DISPLY-INFO1
END DISPLY
COPY
  TIMESERIES
    # -  #  NPT  NMN ***
    1         1    1
  501         1    1
  END TIMESERIES
END COPY
GENER
  OPCODE
    #    # OPCD ***
  END OPCODE
  PARM
    #    #         K ***
  END PARM
END GENER
PERLND
  GEN-INFO
    <PLS ><-------Name------->NBLKS   Unit-systems   Printer ***
    # -  #                          User  t-series Engl Metr ***
                                          in  out           ***
   16     C, Lawn, Flat           1    1    1    1   27    0
   13     C, Pasture, Flat        1    1    1    1   27    0
  END GEN-INFO
  *** Section PWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC ***
   16         0    0    1    0    0    0    0    0    0    0    0    0
   13         0    0    1    0    0    0    0    0    0    0    0    0
```

```
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ***************************** PIVL  PYR
    # -  # ATMP SNOW PWAT  SED  PST  PWG PQAL MSTL PEST NITR PHOS TRAC  *********
   16         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   13         0    0    4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  PWAT-PARM1
    <PLS >  PWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP UZFG  VCS  VUZ  VNN VIFW VIRC  VLE INFC  HWT ***
   16         0    0    0    0    0    0    0    0    0    0    0
   13         0    0    0    0    0    0    0    0    0    0    0
  END PWAT-PARM1

  PWAT-PARM2
    <PLS >      PWATER input info: Part 2         ***
    # -  # ***FOREST      LZSN    INFILT      LSUR     SLSUR     KVARY     AGWRC
   16              0       4.5      0.03       400      0.05       0.5     0.996
   13              0       4.5      0.06       400      0.05       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   16              0         0         2         2         0         0         0
   13              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   16            0.1      0.25      0.25         6       0.5      0.25
   13           0.15       0.4       0.3         6       0.5       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   16              0         0         0         0       2.5         1         0
   13              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
  END GEN-INFO
  *** Section IWATER***

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
    1         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
    1         0    0    4    0    0    0    1    9
  END PRINT-INFO

  IWAT-PARM1
    <PLS >  IWATER variable monthly parameter value flags  ***
    # -  # CSNO RTOP  VRS  VNN RTLI     ***
```

```
    1         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
    1            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1             0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                        396      RCHRES   3      2
PERLND  16                        396      RCHRES   3      3
IMPLND   1                         44      RCHRES   3      5
Basin  2***
PERLND  16                          5      RCHRES   1      2
PERLND  16                          5      RCHRES   1      3
IMPLND   1                         20      RCHRES   1      5
Basin  3***
PERLND  13                        300      RCHRES   2      2
PERLND  13                        300      RCHRES   2      3

******Routing******
PERLND  16                        396      COPY     1     12
IMPLND   1                         44      COPY     1     15
PERLND  16                        396      COPY     1     13
RCHRES   1                          1      RCHRES   2      6
RCHRES   2                          1      RCHRES   3      6
RCHRES   2                                 COPY     1     16
RCHRES   3                          1      COPY   501     16
END SCHEMATIC

NETWORK
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
COPY   501 OUTPUT MEAN   1 1   48.4        DISPLY   1     INPUT  TIMSER 1



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
END NETWORK

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG            ***
                                           in  out                           ***
    1     Vault  1                1    1    1    1   28    0    1
    2     Channel  1              1    1    1    1   28    0    1
    3     Trapezoidal Pond-016    1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***
```

```
  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # HYFG ADFG CNFG HTFG SDFG GQFG OXFG NUFG PKFG PHFG ***
    1         1    0    0    0    0    0    0    0    0    0
    2         1    0    0    0    0    0    0    0    0    0
    3         1    0    0    0    0    0    0    0    0    0
  END ACTIVITY

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
    1         4    0    0    0    0    0    0    0    0    0    1    9
    2         4    0    0    0    0    0    0    0    0    0    1    9
    3         4    0    0    0    0    0    0    0    0    0    1    9
  END PRINT-INFO

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                     ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
    1        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    2        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
    3        0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.07       0.0       0.0       0.5       0.0
    2             2      0.57       0.0       0.0       0.5       0.0
    3             3      0.85       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                        ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
         *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1           0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    2           0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
    3           0          4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   92    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)    (cfs)  (ft/sec)    (Minutes)***
  0.000000  1.815886  0.000000  0.000000
  0.083333  1.815886  0.151324  0.054598
  0.166667  1.815886  0.302648  0.077213
  0.250000  1.815886  0.453972  0.094566
  0.333333  1.815886  0.605295  0.109196
  0.416667  1.815886  0.756619  0.122085
  0.500000  1.815886  0.907943  0.133737
  0.583333  1.815886  1.059267  0.144452
  0.666667  1.815886  1.210591  0.154426
  0.750000  1.815886  1.361915  0.163794
  0.833333  1.815886  1.513238  0.172654
  0.916667  1.815886  1.664562  0.181081
  1.000000  1.815886  1.815886  0.189133
  1.083333  1.815886  1.967210  0.196856
  1.166667  1.815886  2.118534  0.204287
  1.250000  1.815886  2.269858  0.211457
  1.333333  1.815886  2.421182  0.218392
  1.416667  1.815886  2.572505  0.225113
  1.500000  1.815886  2.723829  0.231639
```

1.583333	1.815886	2.875153	0.237987
1.666667	1.815886	3.026477	0.244169
1.750000	1.815886	3.177801	0.250199
1.833333	1.815886	3.329125	0.256087
1.916667	1.815886	3.480448	0.261842
2.000000	1.815886	3.631772	0.267474
2.083333	1.815886	3.783096	0.272990
2.166667	1.815886	3.934420	0.278396
2.250000	1.815886	4.085744	0.283699
2.333333	1.815886	4.237068	0.288905
2.416667	1.815886	4.388391	0.294019
2.500000	1.815886	4.539715	0.299045
2.583333	1.815886	4.691039	0.303988
2.666667	1.815886	4.842363	0.308852
2.750000	1.815886	4.993687	0.313641
2.833333	1.815886	5.145011	0.318358
2.916667	1.815886	5.296335	0.323006
3.000000	1.815886	5.447658	0.327587
3.083333	1.815886	5.598982	0.332106
3.166667	1.815886	5.750306	0.336564
3.250000	1.815886	5.901630	0.340964
3.333333	1.815886	6.052954	0.345307
3.416667	1.815886	6.204278	0.349597
3.500000	1.815886	6.355601	0.353835
3.583333	1.815886	6.506925	0.358022
3.666667	1.815886	6.658249	0.362162
3.750000	1.815886	6.809573	0.366254
3.833333	1.815886	6.960897	0.370301
3.916667	1.815886	7.112221	0.374304
4.000000	1.815886	7.263545	0.378265
4.083333	1.815886	7.414868	0.382185
4.166667	1.815886	7.566192	0.386065
4.250000	1.815886	7.717516	0.389907
4.333333	1.815886	7.868840	0.472983
4.416667	1.815886	8.020164	0.545782
4.500000	1.815886	8.171488	0.595386
4.583333	1.815886	8.322811	0.636024
4.666667	1.815886	8.474135	0.671488
4.750000	1.815886	8.625459	0.703468
4.833333	1.815886	8.776783	0.732892
4.916667	1.815886	8.928107	0.760335
5.000000	1.815886	9.079431	0.786182
5.083333	1.815886	9.230755	0.810707
5.166667	1.815886	9.382078	0.834112
5.250000	1.815886	9.533402	0.856552
5.333333	1.815886	9.684726	0.878149
5.416667	1.815886	9.836050	0.899000
5.500000	1.815886	9.987374	0.919186
5.583333	1.815886	10.13870	1.064110
5.666667	1.815886	10.29002	1.135069
5.750000	1.815886	10.44135	1.193451
5.833333	1.815886	10.59267	1.245125
5.916667	1.815886	10.74399	1.292381
6.000000	1.815886	10.89532	1.336410
6.083333	1.815886	11.04664	1.377924
6.166667	1.815886	11.19796	1.417398
6.250000	1.815886	11.34929	1.455162
6.333333	1.815886	11.50061	1.491464
6.416667	1.815886	11.65194	1.526490
6.500000	1.815886	11.80326	1.560391
6.583333	1.815886	11.95458	2.103347
6.666667	1.815886	12.10591	3.063763
6.750000	1.815886	12.25723	4.279504
6.833333	1.815886	12.40856	5.666049
6.916667	1.815886	12.55988	7.144385
7.000000	1.815886	12.71120	8.633146
7.083333	1.815886	12.86253	10.05127
7.166667	1.815886	13.01385	11.32512
7.250000	1.815886	13.16517	12.39840
7.333333	1.815886	13.31650	13.24400

7.416667	1.815886	13.46782	13.87759
7.500000	1.815886	13.61915	14.37264
7.583333	1.815886	13.77047	15.04723

END FTABLE 1
FTABLE 2
91 4

Depth (ft)	Area (acres)	Volume (acre-ft)	Outflow1 (cfs)	Velocity (ft/sec)	Travel Time*** (Minutes)***
0.000000	0.206612	0.000000	0.000000		
0.044444	0.218855	0.009455	0.026431		
0.088889	0.231099	0.019454	0.084510		
0.133333	0.243343	0.029997	0.167456		
0.177778	0.255586	0.041084	0.272892		
0.222222	0.267830	0.052716	0.399624		
0.266667	0.280074	0.064891	0.547016		
0.311111	0.292317	0.077611	0.714746		
0.355556	0.304561	0.090875	0.902685		
0.400000	0.316804	0.104683	1.110836		
0.444444	0.329048	0.119035	1.339290		
0.488889	0.341292	0.133932	1.588206		
0.533333	0.353535	0.149373	1.857787		
0.577778	0.365779	0.165357	2.148274		
0.622222	0.378023	0.181886	2.459936		
0.666667	0.390266	0.198959	2.793058		
0.711111	0.402510	0.216577	3.147947		
0.755556	0.414754	0.234738	3.524917		
0.800000	0.426997	0.253444	3.924295		
0.844444	0.439241	0.272693	4.346413		
0.888889	0.451485	0.292487	4.791612		
0.933333	0.463728	0.312825	5.260233		
0.977778	0.475972	0.333708	5.752624		
1.022222	0.488216	0.355134	6.269134		
1.066667	0.500459	0.377105	6.810112		
1.111111	0.512703	0.399619	7.375912		
1.155556	0.524947	0.422678	7.966886		
1.200000	0.537191	0.446281	8.583386		
1.244444	0.549434	0.470428	9.225765		
1.288889	0.561678	0.495120	9.894376		
1.333333	0.573922	0.520355	10.58957		
1.377778	0.586165	0.546135	11.31170		
1.422222	0.598409	0.572459	12.06112		
1.466667	0.610653	0.599327	12.83817		
1.511111	0.622896	0.626739	13.64320		
1.555556	0.635140	0.654695	14.47656		
1.600000	0.647384	0.683196	15.33861		
1.644444	0.659627	0.712241	16.22967		
1.688889	0.671871	0.741830	17.15011		
1.733333	0.684115	0.771963	18.10025		
1.777778	0.696358	0.802640	19.08044		
1.822222	0.708602	0.833861	20.09102		
1.866667	0.720846	0.865627	21.13232		
1.911111	0.733089	0.897936	22.20470		
1.955556	0.745333	0.930790	23.30847		
2.000000	0.757577	0.964188	24.44398		
2.044444	0.769820	0.998130	25.61156		
2.088889	0.782064	1.032617	26.81154		
2.133333	0.794308	1.067647	28.04424		
2.177778	0.806552	1.103222	29.31001		
2.222222	0.818795	1.139341	30.60916		
2.266667	0.831039	1.176004	31.94202		
2.311111	0.843283	1.213211	33.30893		
2.355556	0.855526	1.250962	34.71019		
2.400000	0.867770	1.289257	36.14613		
2.444444	0.880014	1.328097	37.61708		
2.488889	0.892257	1.367481	39.12335		
2.533333	0.904501	1.407409	40.66526		
2.577778	0.916745	1.447881	42.24313		
2.622222	0.928988	1.488897	43.85727		
2.666667	0.941232	1.530458	45.50800		
2.711111	0.953476	1.572562	47.19563		

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2.755556  0.965720  1.615211  48.92048
2.800000  0.977963  1.658404  50.68285
2.844444  0.990207  1.702141  52.48306
2.888889  1.002451  1.746422  54.32141
2.933333  1.014694  1.791248  56.19821
2.977778  1.026938  1.836618  58.11377
3.022222  1.039182  1.882531  60.06838
3.066667  1.051425  1.928989  62.06237
3.111111  1.063669  1.975991  64.09602
3.155556  1.075913  2.023538  66.16965
3.200000  1.088157  2.071628  68.28354
3.244444  1.100400  2.120263  70.43801
3.288889  1.112644  2.169441  72.63335
3.333333  1.124888  2.219164  74.86986
3.377778  1.137131  2.269431  77.14783
3.422222  1.149375  2.320243  79.46756
3.466667  1.161619  2.371598  81.82934
3.511111  1.173863  2.423498  84.23348
3.555556  1.186106  2.475941  86.68026
3.600000  1.198350  2.528929  89.16997
3.644444  1.210594  2.582461  91.70290
3.688889  1.222837  2.636538  94.27935
3.733333  1.235081  2.691158  96.89960
3.777778  1.247325  2.746323  99.56394
3.822222  1.259569  2.802031  102.2727
3.866667  1.271812  2.858284  105.0260
3.911111  1.284056  2.915081  107.8244
3.955556  1.296300  2.972423  110.6679
4.000000  1.308543  3.030308  113.5570
END FTABLE  2
FTABLE      3
 91    4
   Depth      Area    Volume  Outflow1 Velocity  Travel Time***
    (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
0.000000  36.15702  0.000000  0.000000
0.066667  36.45410  2.420371  2.270169
0.133333  36.75149  4.860557  3.210503
0.200000  37.04922  7.320581  3.932047
0.266667  37.34727  9.800464  4.540337
0.333333  37.64565  12.30023  5.076251
0.400000  37.94435  14.81989  5.560755
0.466667  38.24338  17.35949  6.006301
0.533333  38.54274  19.91902  6.421006
0.600000  38.84242  22.49853  6.810506
0.666667  39.14243  25.09802  7.178903
0.733333  39.44277  27.71753  7.529297
0.800000  39.74343  30.35707  7.864095
0.866667  40.04442  33.01667  8.185209
0.933333  40.34574  35.69634  8.494193
1.000000  40.64738  38.39611  8.792325
1.066667  40.94935  41.11600  9.080674
1.133333  41.25165  43.85603  9.360145
1.200000  41.55427  46.61623  9.631509
1.266667  41.85722  49.39661  9.895435
1.333333  42.16049  52.19720  10.15250
1.400000  42.46410  55.01802  10.40322
1.466667  42.76802  57.85909  10.64803
1.533333  43.07228  60.72044  10.88735
1.600000  43.37686  63.60208  11.12151
1.666667  43.68177  66.50403  11.35084
1.733333  43.98700  69.42632  11.57563
1.800000  44.29256  72.36897  11.79614
1.866667  44.59845  75.33201  12.01260
1.933333  44.90466  78.31545  12.22523
2.000000  45.21120  81.31931  12.43423
2.066667  45.51807  84.34362  12.63976
2.133333  45.82526  87.38839  12.84201
2.200000  46.13278  90.45366  13.04113
2.266667  46.44063  93.53944  13.23724
2.333333  46.74880  96.64576  13.43050
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  2.400000  47.05730  99.77263  13.62101
  2.466667  47.36613  102.9201  13.80890
  2.533333  47.67528  106.0881  13.99426
  2.600000  47.98476  109.2768  14.17720
  2.666667  48.29456  112.4861  14.35781
  2.733333  48.60469  115.7161  14.53617
  2.800000  48.91515  118.9667  14.71237
  2.866667  49.22594  122.2381  14.88649
  2.933333  49.53705  125.5302  15.05859
  3.000000  49.84848  128.8431  15.22875
  3.066667  50.16025  132.1767  15.39703
  3.133333  50.47234  135.5311  15.56349
  3.200000  50.78476  138.9063  15.72819
  3.266667  51.09750  142.3024  15.89118
  3.333333  51.41057  145.7193  16.05252
  3.400000  51.72397  149.1572  16.21225
  3.466667  52.03769  152.6159  16.37042
  3.533333  52.35174  156.0955  16.52708
  3.600000  52.66612  159.5961  16.68226
  3.666667  52.98082  163.1177  16.83602
  3.733333  53.29585  166.6603  16.98839
  3.800000  53.61120  170.2238  17.13940
  3.866667  53.92689  173.8084  17.28909
  3.933333  54.24289  177.4141  17.43750
  4.000000  54.55923  181.0408  17.58465
  4.066667  54.87589  184.6887  17.73058
  4.133333  55.19288  188.3576  17.87533
  4.200000  55.51019  192.0477  18.01890
  4.266667  55.82783  195.7590  18.16135
  4.333333  56.14580  199.4914  18.30268
  4.400000  56.46410  203.2451  18.44294
  4.466667  56.78272  207.0200  18.58213
  4.533333  57.10166  210.8161  18.72029
  4.600000  57.42094  214.6336  18.85744
  4.666667  57.74054  218.4723  18.99359
  4.733333  58.06046  222.3323  19.12878
  4.800000  58.38072  226.2137  19.26302
  4.866667  58.70130  230.1164  19.39633
  4.933333  59.02220  234.0405  19.52873
  5.000000  59.34343  237.9861  19.66024
  5.066667  59.66499  241.9530  20.61296
  5.133333  59.98688  245.9414  22.24442
  5.200000  60.30909  249.9513  24.31608
  5.266667  60.63163  253.9826  26.74138
  5.333333  60.95449  258.0355  29.46798
  5.400000  61.27769  262.1099  32.45747
  5.466667  61.60120  266.2059  35.67806
  5.533333  61.92505  270.3234  39.10122
  5.600000  62.24922  274.4625  42.69987
  5.666667  62.57372  278.6233  46.44737
  5.733333  62.89854  282.8057  50.31704
  5.800000  63.22369  287.0098  54.28185
  5.866667  63.54917  291.2356  58.31435
  5.933333  63.87497  295.4830  62.38668
  6.000000  64.20110  299.7522  66.47074
  END FTABLE  3
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    1              PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    1              IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    1              PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    1              IMPLND   1 999 EXTNL  PETINP
WDM      2 PREC     ENGL    1              RCHRES   3     EXTNL  PREC
WDM      1 EVAP     ENGL    1              RCHRES   3     EXTNL  POTEV

END EXT SOURCES
```

```
EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
RCHRES   3 HYDR   RO     1 1        1      WDM   1016 FLOW     ENGL      REPL
RCHRES   3 HYDR   STAGE  1 1        1      WDM   1017 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

  MASS-LINK        3
PERLND     PWATER IFWO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    3

  MASS-LINK        5
IMPLND     IWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    5

  MASS-LINK        6
RCHRES     ROFLOW                          RCHRES         INFLOW
  END MASS-LINK    6

  MASS-LINK       12
PERLND     PWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   12

  MASS-LINK       13
PERLND     PWATER IFWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   13

  MASS-LINK       15
IMPLND     IWATER SURO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   15

  MASS-LINK       16
RCHRES     ROFLOW                          COPY           INPUT  MEAN
  END MASS-LINK   16

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
DATE/TIME: 1913/ 7/31 24: 0

RCHRES :    1

RELERR        STORS        STOR       MATIN      MATDIF
-6.272E-03     0.00000  0.0000E+00     0.00000  -7.443E-09

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR  is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
DATE/TIME: 1960/ 8/31 24: 0

RCHRES :    1

RELERR        STORS        STOR       MATIN      MATDIF
-6.129E-02     0.00000  0.0000E+00     0.00000  -2.304E-10

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR  is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

```
ERROR/WARNING ID:   238   1

The continuity error reported below is greater than 1 part in 1000 and is
therefore considered high.

Did you specify any "special actions"?  If so, they could account for it.

Relevant data are:
```

DATE/TIME: 1974/ 8/31 24: 0

RCHRES : 1

RELERR	STORS	STOR	MATIN	MATDIF
-1.767E-02	0.00000	0.0000E+00	0.00000	-2.613E-09

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR is the storage of material in the processing unit (land-segment or reach/reservior) at the end of the present interval.
STORS is the storage of material in the pu at the start of the present printout reporting period.
MATIN is the total inflow of material to the pu during the present printout reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the present printout reporting period.

ERROR/WARNING ID: 238 1

The continuity error reported below is greater than 1 part in 1000 and is therefore considered high.

Did you specify any "special actions"? If so, they could account for it.

Relevant data are:
DATE/TIME: 1980/ 8/31 24: 0

RCHRES : 1

RELERR	STORS	STOR	MATIN	MATDIF
-6.862E-02	0.00000	0.0000E+00	0.00000	-6.380E-10

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR is (STOR-STORS) - MATDIF.
REFVAL is the reference value (STORS+MATIN).
STOR is the storage of material in the processing unit (land-segment or reach/reservior) at the end of the present interval.
STORS is the storage of material in the pu at the start of the present printout reporting period.
MATIN is the total inflow of material to the pu during the present printout reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the present printout reporting period.

ERROR/WARNING ID: 238 1

The continuity error reported below is greater than 1 part in 1000 and is therefore considered high.

Did you specify any "special actions"? If so, they could account for it.

Relevant data are:
DATE/TIME: 1981/ 8/31 24: 0

RCHRES : 1

RELERR	STORS	STOR	MATIN	MATDIF
-3.894E-03	0.00000	0.0000E+00	0.00000	-1.204E-08

Where:

RELERR is the relative error (ERROR/REFVAL).
ERROR is (STOR-STORS) - MATDIF.

```
REFVAL is the reference value (STORS+MATIN).
STOR   is the storage of material in the processing unit (land-segment or
reach/reservior) at the end of the present interval.
STORS  is the storage of material in the pu at the start of the present
printout reporting period.
MATIN  is the total inflow of material to the pu during the present printout
reporting period.
MATDIF is the net inflow (inflow-outflow) of material to the pu during the
present printout reporting period.
```

```
The count for the WARNING printed above has reached its maximum.

If the condition is encountered again the message will not be repeated.
```

Disclaimer

Legal Notice

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6200 Capitol Blvd. Ste F
Olympia, WA. 98501
Toll Free 1(866)943-0304
Local (360)943-0304

www.clearcreeksolutions.com

OFFSITE ANALYSIS PHOTO EXHIBIT

Photo Exhibit

The following photos are provided with reference to the Downstream Exhibit included at the end of this section.

Photo 1. Looking north from the SE property corner. Existing farmland is flat. There is no concentrated discharge point from this portion of the site.

Photo 2. Looking northwest toward the north, central portion of the site. Stormwater appears to drain in a general NW direction within this part of the site.

Photo 3. Looking north at the NW site corner during heavy rain event. Stormwater collects in this corner and passes under Freeman Rd within a 12-inch concrete culvert.

Photo 4. Looking north along roadside ditch on the west side of Freeman Rd opposite the north end of the site.

Photo 5. Looking west along ditch on the west side of Freeman Rd where the roadside ditch joins the larger agricultural ditch and then heads west.

Photo 6. Photo of the agricultural ditch during dry season.

Tab 5.0

5.0 PERMANENT STORMWATER CONTROL PLAN

5.0 PERMANENT STORMWATER CONTROL PLAN

Part A Existing Site Hydrology

Under existing conditions, this site is largely undeveloped, consisting of farmland and scattered single family houses. Housing is concentrated in the middle of the site and the along southwestern border. Determined from the geotechnical report, the soil on site is loamy to sandy loam, this soil type has minimal infiltration. The project site has a high-water table, approximately 2-9 feet below the existing grade, varying with the season and location. Runoff from the site typically sheet flows toward the northwest. There are no existing manmade structures to collect and convey runoff onsite. There exists a shallow 12” concrete culvert in the northwest corner of the project area where sheet flow is conveyed further downstream, see Section 4.0 for a more detailed analysis. The onsite area totals 24.05 acres. An additional 2.44 acres of frontage improvement area along Freeman Road is tributary to the site. The tributary frontage includes approximately 1.58 acres of impervious surface which will be tributary to the proposed detention system. The overall predeveloped site basin totals 26.89 acres.

Part B Developed Site Hydrology

The developed site will include two commercial warehouse buildings with dock high loading, associated parking, and storm drainage facilities. The impervious coverage after development will be approximately 80%, including frontage improvements. The proposed stormwater management system is designed for the full, proposed conditions of impervious and landscaped area. Flow control and water quality are required for this project site and have been provided to meet local requirements. Please refer to the later sections of this report for the sizing calculations for the detention and water quality facilities.

Part C Performance Standards and Goals

This stormwater site plan is prepared in accordance with the 2019 Department of Ecology Stormwater Manual for Western Washington, as adopted by the City of Puyallup. The standard flow control criteria (50% of the 2-year, up to the full 50-yr duration matching) is applicable. In addition, the proposed conditions will not exceed the existing 100-year peak flow rate. Enhanced water quality treatment is required due to the intended commercial site use. A feasibility analysis is required for implementation of LID BMPs.

Low Impact Development Features

This development triggers all the minimum requirements, including Minimum Requirement #5 – On-site Stormwater Management. To meet this requirement, the LID performance standards will be implemented to the greatest extent feasible. See below for the feasibility analysis.

- <u>Lawn and Landscaped Areas</u>
  - Post-Construction Soil Quality and Depth (BMP T5.13)
    - This BMP is feasible and will be used onsite to the greatest extent possible.
- <u>Roof Areas</u>
  - Full dispersion
    - Full dispersion has been determined to be infeasible for this project due to the project site being within a mapped floodplain, per Pierce County GIS.
  - Downspout Full Infiltration
    - Downspout full infiltration has been determined to be infeasible for this project due to the lack of clearance from the seasonal high groundwater table. See the geotechnical report, included as a separate document in this submittal.
  - Bioretention
    - Bioretention has been determined to be infeasible for this project due to the project site being within a mapped floodplain, per Pierce County GIS. Furthermore, bioretention facilities would not be able to have sufficient

clearance from the seasonal high groundwater table.

- Downspout Dispersion
  - Downspout dispersion has been determined to be infeasible for this project due to the project site being within a mapped floodplain, per Pierce County GIS.
- Perforated Stub-Out Connections
  - Perforated stub-out connections have been determined to be infeasible for this project due to the lack of clearance from the seasonal high groundwater table.

- <u>Other hard surfaces</u>
  - Full Dispersion
    - Full dispersion has been determined to be infeasible for this project due to the project site being within a mapped floodplain, per Pierce County GIS.
  - Permeable Pavement
    - Permeable pavement has been determined to be infeasible due to the lack of sufficient strength to support the anticipated truck traffic.
  - Bioretention
    - Bioretention has been determined to be infeasible for this project due to the project site being within a mapped floodplain, per Pierce County GIS. Furthermore, bioretention facilities would not be able to have sufficient clearance from the seasonal high groundwater table.
  - Sheet Flow/Concentrated Dispersion
    - Both sheet flow and concentrated dispersion have been determined to be infeasible for this project due to the project site being within a mapped floodplain, per Pierce County GIS.

Part D Flow Control System

The proposed onsite flow control system for the project site uses a catch basin system to collect water and route to two underground detention vaults, with each outlet having water quality facilities that meet enhanced treatment standards. After treatment, stormwater is pumped to the natural discharge location to the northwest of the site. The detention vaults are sized using WWHM. The stormwater pump system is comprised of two pumps, which in tandem will accommodate the 100-year release flow rate from both of the proposed detention vaults. These pumps are proposed with a float switch level and variable frequency driver to vary power as flows change from the vault outlets. This configuration allows the pump system to accommodate expected flows from storm events within the flow control duration standard recurrence interval. See attached pump details in this section.

The proposed offsite flow control system for the offsite Freeman Road East improvements uses a catch basin system to collect water and route runoff to two underground detention tanks in series, with a single control structure that releases stormwater to the natural discharge location. After release from the detention system, stormwater is treated by a proprietary water quality facility designed for basic treatment and then released to a rock protected pad to the west of the Freeman Road East and North Levee Road East intersection.

The required detention size for the northern section of the site per the WWHM model is 5.13 acre-feet. The proposed vault system provides 5.31 acre-feet of storage volume.

The required detention size for the southern section of the site per the WWHM model is 6.67 acre-feet. The proposed vault system provides 6.89 acre-feet of storage volume.

The required detention size for the offsite detention system per the WWHM model is 0.238 acre-feet. The proposed detention vault provided 0.244 acre-feet of storage volume.

Further design details to be provided during final engineering. See the attached exhibits for more information regarding the basins and proposed detention systems.

Part E Water Quality System

Enhanced water quality treatment is being proposed for onsite improvements of the project site. Basic water quality treatment is being proposed for offsite improvements south of the project site. See water quality calculations provided within this section.

Part F Conveyance System Analysis and Design

A conveyance system analysis, as required in the 2019 SWMM will be included in this report during the final design phase. The conveyance system will be sized for the 25-year storm event without flooding. The rational method will be used to size all conveyance pipes.

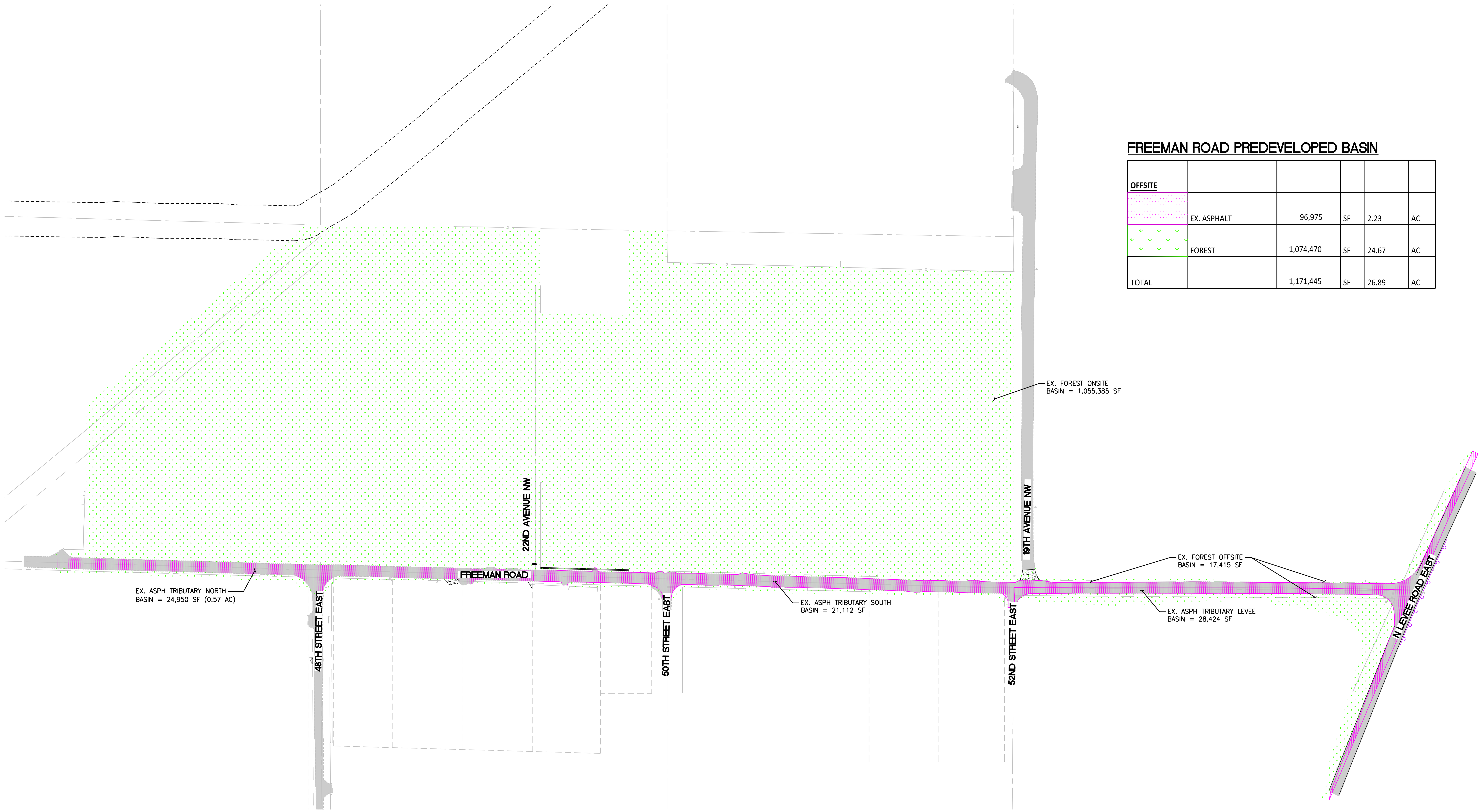
STORMWATER TRIBUTARY BASIN MAPS

PREDEVELOPED BASIN - FREEMAN ROAD
FOR
FREEMAN ROAD LOGISTICS

A PORTION OF THE SE¼ OF SEC. 17, TWP. 20 NORTH, RGE. 4 EAST AND
A PORTION OF THE NE¼ OF SEC. 20, TWP. 20 NORTH, RGE. 4 EAST, W.M.
CITY OF FIFE, PIERCE COUNTY, WASHINGTON

811 Know what's below. Call before you dig.

SCALE: 1"=100'



FREEMAN ROAD PREDEVELOPED BASIN

OFFSITE					
	EX. ASPHALT	96,975	SF	2.23	AC
	FOREST	1,074,470	SF	24.67	AC
TOTAL		1,171,445	SF	26.89	AC

No. | Date | By | Ckd. | Appr. | Revision

Title: **PREDEVELOPED BASIN**
FREEMAN ROAD LOGISTICS

For: VECTOR DEVELOPMENT COMPANY
11335 NE 122ND WAY, SUITE 105
KIRKLAND, WA 98034

Scale: Horizontal 1"=100' Vertical N/A

Designed JSM
Drawn DTC
Checked JSM
Approved BHE
Date 7/8/21

Barghausen Consulting Engineers, Inc.
18215 72nd Avenue South
Kent, WA 98032
425.251.6222
barghausen.com

Job Number 21585
Sheet 1 of 4

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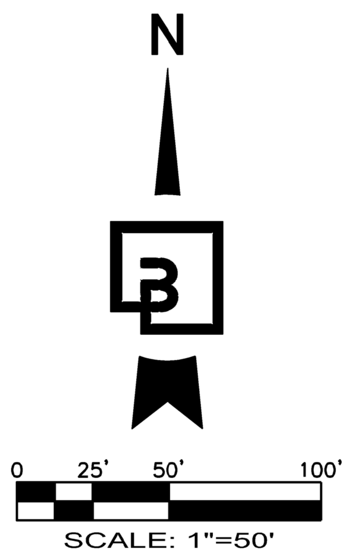
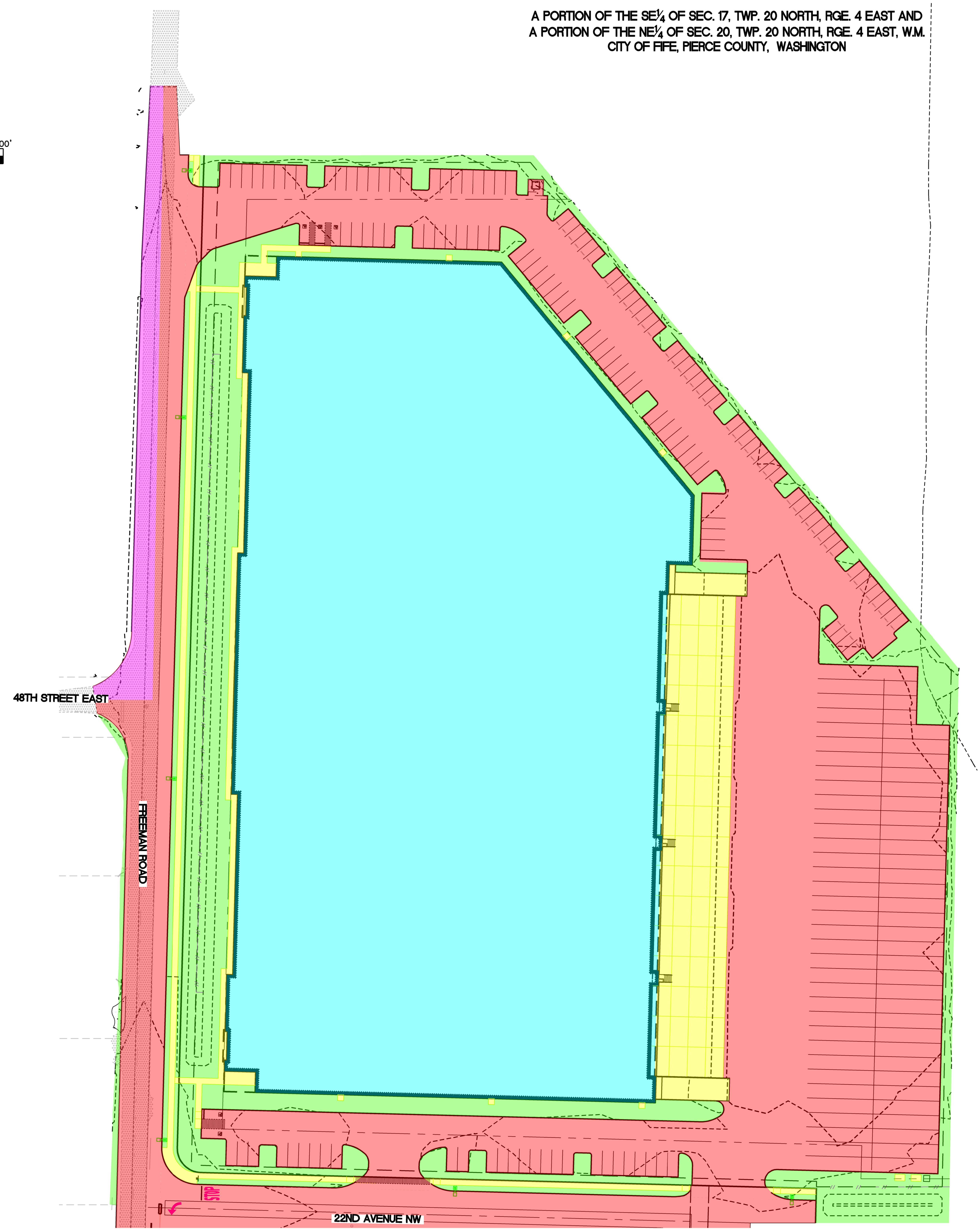
DEVELOPED BASIN - NORTH
FOR
FREEMAN ROAD LOGISTICS

A PORTION OF THE SE¼ OF SEC. 17, TWP. 20 NORTH, RGE. 4 EAST AND
A PORTION OF THE NE¼ OF SEC. 20, TWP. 20 NORTH, RGE. 4 EAST, W.M.
CITY OF FIFE, PIERCE COUNTY, WASHINGTON



Know what's below.
Call before you dig.



FREEMAN ROAD DEVELOPED BASIN - NORTH

NORTH	TRIBUTARY				
	BUILDING	234,381	SF	5.38	AC
	ASPHALT	182,457	SF	4.19	AC
	ASPHALT BYPASS	9,583	SF	0.22	AC
	SIDEWALK	31,501	SF	0.72	AC
	TOTAL PAVEMENT	223,541	SF	5.13	AC
	LANDSCAPE	77,988	SF	1.79	AC
TOTAL		535,910	SF	12.30	AC

Revision
No. Date By Ckd. Appr.

Title: DEVELOPED BASIN - NORTH
FREEMAN ROAD LOGISTICS

For: VECTOR DEVELOPMENT COMPANY
11335 NE 122ND WAY, SUITE 105
KIRKLAND, WA 98034

Scale: Horizontal 1"=50' Vertical N/A

Designed JSM
Drawn DTC
Checked JSM
Approved BHE
Date 7/8/21

Barghausen
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18215 72nd Avenue South
Kent, WA 98032
425.251.6222
barghausen.com

Job Number 21585

Sheet 2 of 4

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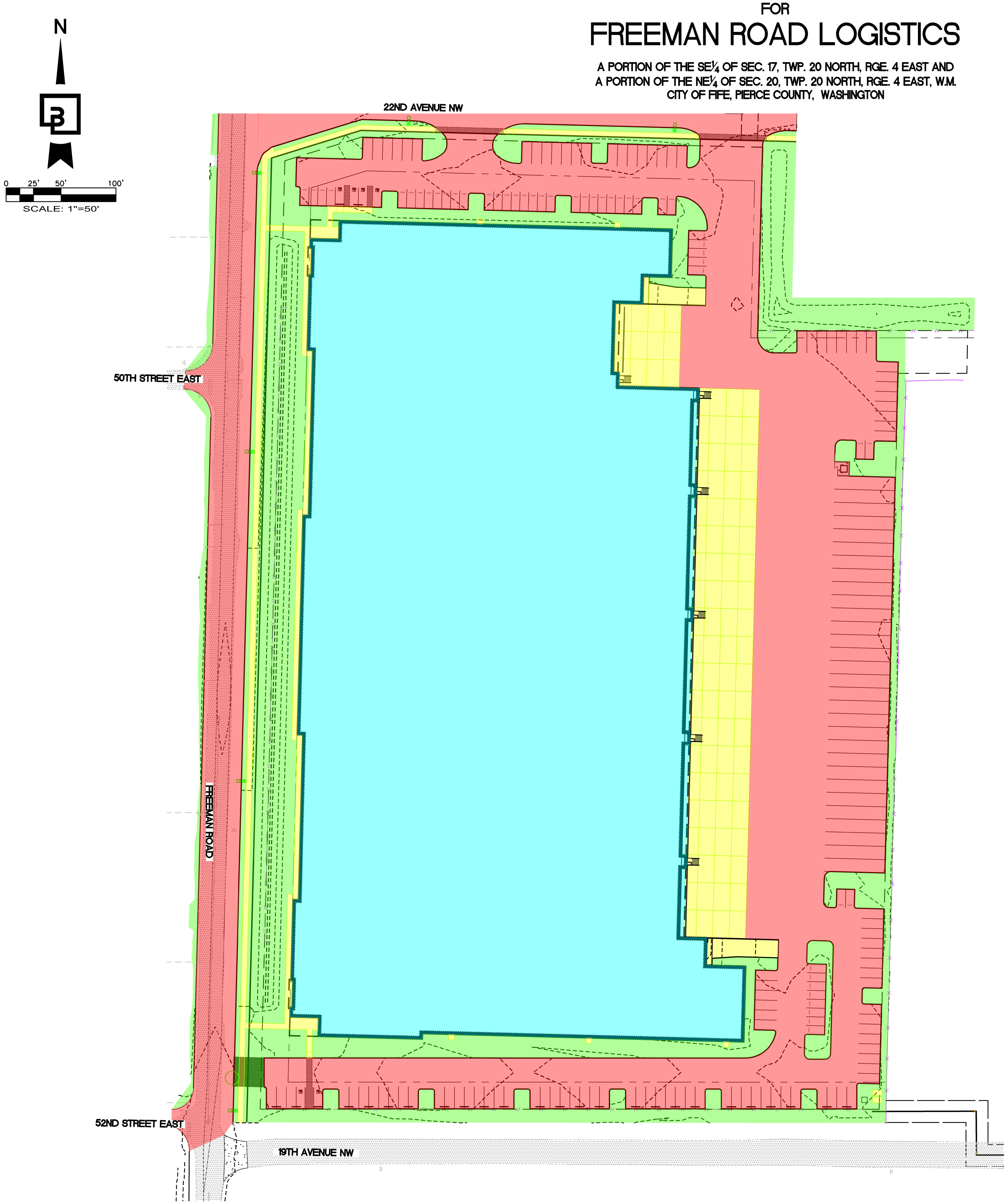
DEVELOPED BASIN - SOUTH
FOR
FREEMAN ROAD LOGISTICS

A PORTION OF THE SE¼ OF SEC. 17, TWP. 20 NORTH, RGE. 4 EAST AND
A PORTION OF THE NE¼ OF SEC. 20, TWP. 20 NORTH, RGE. 4 EAST, W.M.
CITY OF FIFE, PIERCE COUNTY, WASHINGTON

Know what's below. Call before you dig.



FREEMAN ROAD DEVELOPED BASIN - SOUTH

SOUTH	TRIBUTARY				
	BUILDING	257,271	SF	5.91	AC
	ASPHALT	182,527	SF	4.19	AC
	SIDEWALK	40,721	SF	0.93	AC
	TOTAL PAVEMENT	223,248	SF	5.13	AC
	LANDSCAPE	90,163	SF	2.07	AC
TOTAL		570,682	SF	13.10	AC

No.	Date	By	Ckd.	Appr.	Revision

Title: DEVELOPED BASIN - SOUTH
FREEMAN ROAD LOGISTICS

For: VECTOR DEVELOPMENT COMPANY
11335 NE 122ND WAY, SUITE 105
KIRKLAND, WA 98034

Scale: Horizontal 1"=50' Vertical N/A

Designed JSM
Drawn DTC
Checked JSM
Approved BHE
Date 7/8/21

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Job Number 21585

Sheet 3 of 4

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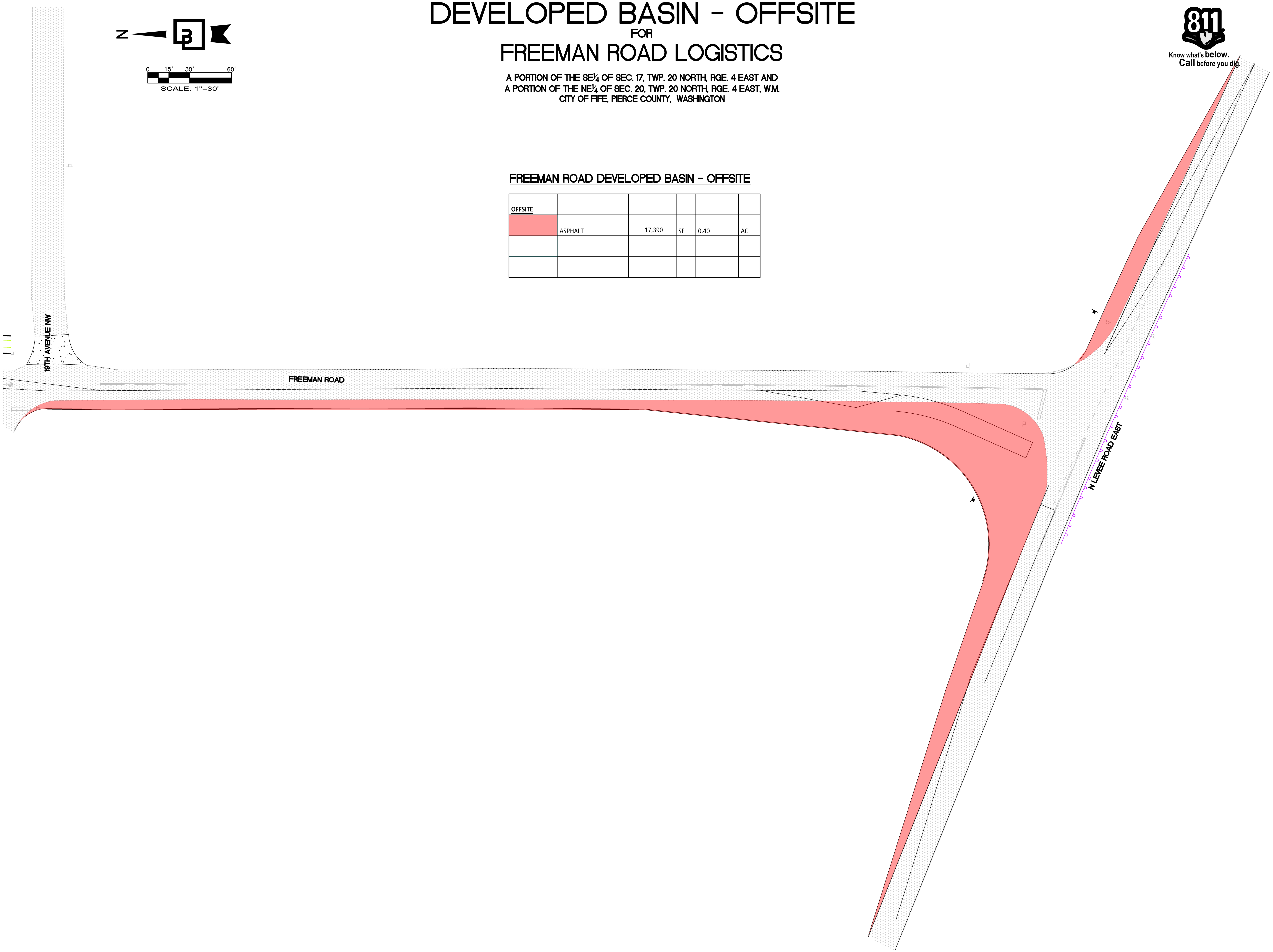
DEVELOPED BASIN - OFFSITE
FOR
FREEMAN ROAD LOGISTICS

A PORTION OF THE SE¼ OF SEC. 17, TWP. 20 NORTH, RGE. 4 EAST AND
A PORTION OF THE NE¼ OF SEC. 20, TWP. 20 NORTH, RGE. 4 EAST, W.M.
CITY OF FIFE, PIERCE COUNTY, WASHINGTON



FREEMAN ROAD DEVELOPED BASIN - OFFSITE

OFFSITE					
	ASPHALT	17,390	SF	0.40	AC

No.	Date	By	Ckd.	Appr.	Revision

Title: DEVELOPED BASIN - OFFSITE
FREEMAN ROAD LOGISTICS

For: VECTOR DEVELOPMENT COMPANY
11335 NE 122ND WAY, SUITE 105
KIRKLAND, WA 98034

Scale: Horizontal 1"=30' Vertical N/A

Designed JSM
Drawn DTC
Checked JSM
Approved BHE
Date 7/8/21

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barghausen.com

Job Number 21585

Sheet 4 of 4

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FLOW CONTROL AND WATER QUALITY CALCULATIONS

WWHM2012

PROJECT REPORT

Flow Control and Water Quality Calculations
Northern Basin - Freeman Road Logistics

General Model Information

Project Name:	21585-CALC-DRNG-NORTH-DETN-2022-08-16
Site Name:	FREEMAN ROAD LOGISTICS
Site Address:	
City:	PUYALLUP
Report Date:	8/16/2022
Gage:	42 IN EAST
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/08/18
Version:	4.2.18

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	11.73
Pervious Total	11.73
Impervious Land Use	acre
ROADS FLAT	0.57
Impervious Total	0.57
Basin Total	12.3

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	1.79
Pervious Total	1.79
Impervious Land Use	acre
ROOF TOPS FLAT	5.38
SIDEWALKS FLAT	0.72
PARKING FLAT	4.19
Impervious Total	10.29
Basin Total	12.08

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Basin 2

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.22
Impervious Total	0.22
Basin Total	0.22

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Routing

Vault 1

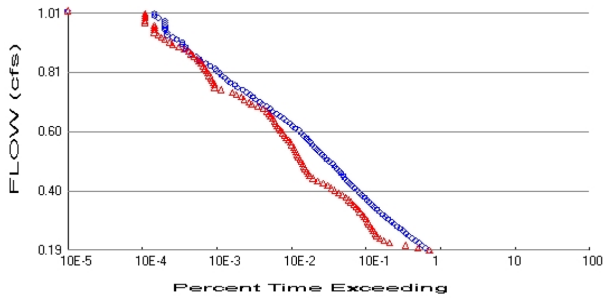
Width:	185.5 ft.	
Length:	185.5 ft.	
Depth:	7.5 ft.	
Discharge Structure		
Riser Height:	6.5 ft.	
Riser Diameter:	18 in.	
Orifice 1 Diameter:	1.928 in.	Elevation:0 ft.
Orifice 2 Diameter:	2.8 in.	Elevation:4.64 ft.
Orifice 3 Diameter:	3.6 in.	Elevation:5.5 ft.
Element Flows To:		
Outlet 1	Outlet 2	

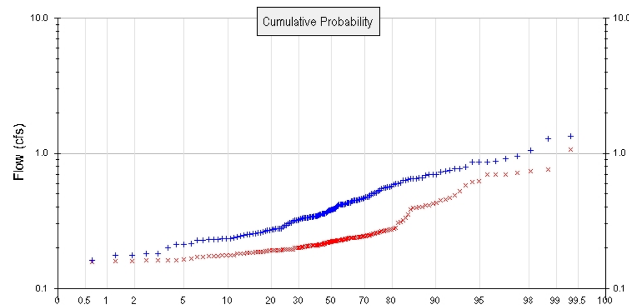
Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	0.790	0.000	0.000	0.000
0.0833	0.790	0.065	0.029	0.000
0.1667	0.790	0.131	0.041	0.000
0.2500	0.790	0.197	0.050	0.000
0.3333	0.790	0.263	0.058	0.000
0.4167	0.790	0.329	0.065	0.000
0.5000	0.790	0.395	0.071	0.000
0.5833	0.790	0.460	0.077	0.000
0.6667	0.790	0.526	0.082	0.000
0.7500	0.790	0.592	0.087	0.000
0.8333	0.790	0.658	0.092	0.000
0.9167	0.790	0.724	0.096	0.000
1.0000	0.790	0.790	0.100	0.000
1.0833	0.790	0.855	0.105	0.000
1.1667	0.790	0.921	0.109	0.000
1.2500	0.790	0.987	0.112	0.000
1.3333	0.790	1.053	0.116	0.000
1.4167	0.790	1.119	0.120	0.000
1.5000	0.790	1.184	0.123	0.000
1.5833	0.790	1.250	0.126	0.000
1.6667	0.790	1.316	0.130	0.000
1.7500	0.790	1.382	0.133	0.000
1.8333	0.790	1.448	0.136	0.000
1.9167	0.790	1.514	0.139	0.000
2.0000	0.790	1.579	0.142	0.000
2.0833	0.790	1.645	0.145	0.000
2.1667	0.790	1.711	0.148	0.000
2.2500	0.790	1.777	0.151	0.000
2.3333	0.790	1.843	0.154	0.000
2.4167	0.790	1.909	0.156	0.000
2.5000	0.790	1.974	0.159	0.000
2.5833	0.790	2.040	0.162	0.000
2.6667	0.790	2.106	0.164	0.000
2.7500	0.790	2.172	0.167	0.000
2.8333	0.790	2.238	0.169	0.000
2.9167	0.790	2.304	0.172	0.000
3.0000	0.790	2.369	0.174	0.000
3.0833	0.790	2.435	0.177	0.000

3.1667	0.790	2.501	0.179	0.000
3.2500	0.790	2.567	0.181	0.000
3.3333	0.790	2.633	0.184	0.000
3.4167	0.790	2.699	0.186	0.000
3.5000	0.790	2.764	0.188	0.000
3.5833	0.790	2.830	0.190	0.000
3.6667	0.790	2.896	0.193	0.000
3.7500	0.790	2.962	0.195	0.000
3.8333	0.790	3.028	0.197	0.000
3.9167	0.790	3.094	0.199	0.000
4.0000	0.790	3.159	0.201	0.000
4.0833	0.790	3.225	0.203	0.000
4.1667	0.790	3.291	0.205	0.000
4.2500	0.790	3.357	0.208	0.000
4.3333	0.790	3.423	0.210	0.000
4.4167	0.790	3.488	0.212	0.000
4.5000	0.790	3.554	0.214	0.000
4.5833	0.790	3.620	0.216	0.000
4.6667	0.790	3.686	0.252	0.000
4.7500	0.790	3.752	0.290	0.000
4.8333	0.790	3.818	0.315	0.000
4.9167	0.790	3.883	0.335	0.000
5.0000	0.790	3.949	0.353	0.000
5.0833	0.790	4.015	0.369	0.000
5.1667	0.790	4.081	0.383	0.000
5.2500	0.790	4.147	0.397	0.000
5.3333	0.790	4.213	0.410	0.000
5.4167	0.790	4.278	0.422	0.000
5.5000	0.790	4.344	0.433	0.000
5.5833	0.790	4.410	0.546	0.000
5.6667	0.790	4.476	0.599	0.000
5.7500	0.790	4.542	0.641	0.000
5.8333	0.790	4.608	0.679	0.000
5.9167	0.790	4.673	0.712	0.000
6.0000	0.790	4.739	0.743	0.000
6.0833	0.790	4.805	0.773	0.000
6.1667	0.790	4.871	0.800	0.000
6.2500	0.790	4.937	0.826	0.000
6.3333	0.790	5.003	0.851	0.000
6.4167	0.790	5.068	0.875	0.000
6.5000	0.790	5.134	0.899	0.000
6.5833	0.790	5.200	1.303	0.000
6.6667	0.790	5.266	2.017	0.000
6.7500	0.790	5.332	2.902	0.000
6.8333	0.790	5.398	3.867	0.000
6.9167	0.790	5.463	4.817	0.000
7.0000	0.790	5.529	5.663	0.000
7.0833	0.790	5.595	6.337	0.000
7.1667	0.790	5.661	6.816	0.000
7.2500	0.790	5.727	7.152	0.000
7.3333	0.790	5.793	7.567	0.000
7.4167	0.790	5.858	7.901	0.000
7.5000	0.790	5.924	8.220	0.000
7.5833	0.790	5.990	8.526	0.000
7.6667	0.000	0.000	8.821	0.000

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 11.73
Total Impervious Area: 0.57

Mitigated Landuse Totals for POC #1
Total Pervious Area: 1.79
Total Impervious Area: 10.51

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	Flow(cfs)
2 year	0.386715
5 year	0.561304
10 year	0.690443
25 year	0.869277
50 year	1.014084
100 year	1.169011

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	Flow(cfs)
2 year	0.23031
5 year	0.325386
10 year	0.404886
25 year	0.526888
50 year	0.635407
100 year	0.760873

Water quality design flow rate equal to the 2-year release rate from vault (downstream of detention).

Annual Peaks
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	Predeveloped	Mitigated
1902	0.354	0.228
1903	0.276	0.191
1904	0.628	0.218
1905	0.270	0.238
1906	0.163	0.171
1907	0.568	0.248
1908	0.367	0.189
1909	0.378	0.214
1910	0.589	0.256
1911	0.333	0.194

1912	1.339	0.271
1913	0.506	0.244
1914	0.696	0.351
1915	0.275	0.232
1916	0.334	0.225
1917	0.155	0.175
1918	0.381	0.270
1919	0.313	0.205
1920	0.345	0.201
1921	0.429	0.245
1922	0.452	0.236
1923	0.352	0.236
1924	0.303	0.181
1925	0.226	0.171
1926	0.416	0.200
1927	0.294	0.207
1928	0.341	0.215
1929	0.599	0.233
1930	0.357	0.206
1931	0.357	0.195
1932	0.320	0.209
1933	0.388	0.223
1934	0.747	0.615
1935	0.346	0.386
1936	0.338	0.209
1937	0.592	0.232
1938	0.335	0.191
1939	0.175	0.200
1940	0.347	0.238
1941	0.321	0.191
1942	0.452	0.694
1943	0.339	0.209
1944	0.725	0.393
1945	0.423	0.205
1946	0.359	0.189
1947	0.211	0.185
1948	0.692	0.247
1949	0.648	0.413
1950	0.234	0.187
1951	0.305	0.209
1952	0.950	0.488
1953	0.858	0.433
1954	0.374	0.220
1955	0.275	0.161
1956	0.180	0.159
1957	0.429	0.234
1958	0.866	0.735
1959	0.643	0.698
1960	0.230	0.175
1961	0.555	0.579
1962	0.378	0.212
1963	0.175	0.157
1964	0.467	0.224
1965	0.608	0.457
1966	0.248	0.193
1967	0.408	0.208
1968	0.338	0.221
1969	0.326	0.192

1970	0.462	0.234
1971	0.645	0.522
1972	0.628	0.307
1973	0.655	0.319
1974	0.451	0.241
1975	0.787	0.718
1976	0.533	0.227
1977	0.213	0.161
1978	0.645	0.402
1979	0.256	0.194
1980	0.416	0.226
1981	0.343	0.211
1982	0.259	0.176
1983	0.564	0.271
1984	0.338	0.231
1985	0.452	0.231
1986	0.384	0.218
1987	0.739	0.425
1988	0.416	0.276
1989	0.382	0.203
1990	0.414	0.207
1991	0.360	0.211
1992	0.428	0.399
1993	0.445	0.202
1994	0.654	0.238
1995	0.231	0.221
1996	0.770	0.621
1997	0.360	0.181
1998	0.488	0.236
1999	0.234	0.175
2000	0.335	0.222
2001	0.256	0.156
2002	0.695	0.272
2003	0.454	0.244
2004	0.451	0.238
2005	0.876	0.254
2006	0.267	0.192
2007	0.294	0.225
2008	0.389	0.195
2009	0.305	0.187
2010	0.245	0.247
2011	0.238	0.182
2012	0.415	0.211
2013	0.279	0.167
2014	0.252	0.175
2015	0.500	0.204
2016	0.181	0.177
2017	0.526	0.392
2018	0.915	0.753
2019	1.058	0.466
2020	0.425	0.213
2021	0.475	0.334
2022	0.320	0.199
2023	0.398	0.253
2024	1.277	0.241
2025	0.362	0.218
2026	0.561	0.260
2027	0.272	0.183

2028	0.199	0.158
2029	0.390	0.228
2030	0.682	0.259
2031	0.251	0.164
2032	0.229	0.175
2033	0.215	0.162
2034	0.269	0.191
2035	0.768	1.060
2036	0.476	0.227
2037	0.227	0.182
2038	0.501	0.240
2039	0.442	0.264
2040	0.284	0.194
2041	0.240	0.185
2042	0.866	0.695
2043	0.462	0.267
2044	0.475	0.263
2045	0.333	0.224
2046	0.418	0.446
2047	0.330	0.217
2048	0.387	0.187
2049	0.431	0.225
2050	0.329	0.194
2051	0.554	0.281
2052	0.263	0.199
2053	0.419	0.413
2054	0.509	0.312
2055	0.233	0.162
2056	0.276	0.207
2057	0.257	0.194
2058	0.345	0.210
2059	0.551	0.239

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.3391	1.0596
2	1.2766	0.7534
3	1.0580	0.7347
4	0.9503	0.7179
5	0.9145	0.6980
6	0.8757	0.6948
7	0.8660	0.6945
8	0.8659	0.6212
9	0.8581	0.6145
10	0.7873	0.5787
11	0.7699	0.5223
12	0.7675	0.4877
13	0.7470	0.4664
14	0.7388	0.4567
15	0.7252	0.4462
16	0.6965	0.4328
17	0.6953	0.4254
18	0.6917	0.4133
19	0.6820	0.4125
20	0.6553	0.4018
21	0.6540	0.3994
22	0.6479	0.3930

23	0.6452	0.3923
24	0.6447	0.3863
25	0.6428	0.3508
26	0.6283	0.3339
27	0.6280	0.3190
28	0.6083	0.3123
29	0.5989	0.3074
30	0.5919	0.2811
31	0.5892	0.2762
32	0.5676	0.2717
33	0.5642	0.2714
34	0.5608	0.2707
35	0.5554	0.2698
36	0.5539	0.2673
37	0.5508	0.2639
38	0.5326	0.2625
39	0.5264	0.2596
40	0.5085	0.2593
41	0.5064	0.2562
42	0.5014	0.2538
43	0.5005	0.2525
44	0.4884	0.2477
45	0.4759	0.2474
46	0.4750	0.2471
47	0.4750	0.2452
48	0.4674	0.2439
49	0.4624	0.2435
50	0.4616	0.2414
51	0.4536	0.2408
52	0.4522	0.2403
53	0.4519	0.2388
54	0.4516	0.2383
55	0.4513	0.2378
56	0.4507	0.2376
57	0.4453	0.2375
58	0.4418	0.2361
59	0.4307	0.2356
60	0.4294	0.2356
61	0.4289	0.2342
62	0.4280	0.2339
63	0.4254	0.2331
64	0.4233	0.2317
65	0.4189	0.2317
66	0.4175	0.2313
67	0.4165	0.2310
68	0.4162	0.2283
69	0.4161	0.2279
70	0.4152	0.2270
71	0.4137	0.2269
72	0.4083	0.2260
73	0.3984	0.2254
74	0.3900	0.2251
75	0.3889	0.2247
76	0.3877	0.2242
77	0.3867	0.2238
78	0.3837	0.2233
79	0.3819	0.2222
80	0.3807	0.2210

81	0.3782	0.2207
82	0.3776	0.2202
83	0.3739	0.2182
84	0.3672	0.2180
85	0.3624	0.2179
86	0.3601	0.2167
87	0.3599	0.2152
88	0.3586	0.2135
89	0.3575	0.2129
90	0.3570	0.2116
91	0.3540	0.2114
92	0.3520	0.2113
93	0.3474	0.2113
94	0.3462	0.2100
95	0.3446	0.2091
96	0.3445	0.2090
97	0.3432	0.2087
98	0.3411	0.2085
99	0.3393	0.2075
100	0.3382	0.2073
101	0.3380	0.2073
102	0.3379	0.2067
103	0.3353	0.2060
104	0.3352	0.2053
105	0.3340	0.2052
106	0.3330	0.2035
107	0.3327	0.2025
108	0.3298	0.2023
109	0.3289	0.2014
110	0.3257	0.2001
111	0.3205	0.1999
112	0.3199	0.1993
113	0.3196	0.1989
114	0.3129	0.1953
115	0.3053	0.1953
116	0.3052	0.1943
117	0.3031	0.1941
118	0.2943	0.1938
119	0.2938	0.1936
120	0.2843	0.1936
121	0.2787	0.1926
122	0.2763	0.1918
123	0.2762	0.1917
124	0.2754	0.1909
125	0.2750	0.1909
126	0.2717	0.1909
127	0.2703	0.1906
128	0.2691	0.1890
129	0.2673	0.1889
130	0.2631	0.1875
131	0.2589	0.1867
132	0.2571	0.1865
133	0.2562	0.1854
134	0.2561	0.1849
135	0.2522	0.1830
136	0.2513	0.1825
137	0.2482	0.1823
138	0.2453	0.1812

139	0.2403	0.1808
140	0.2379	0.1767
141	0.2344	0.1757
142	0.2337	0.1752
143	0.2334	0.1749
144	0.2306	0.1746
145	0.2296	0.1746
146	0.2290	0.1745
147	0.2272	0.1714
148	0.2264	0.1706
149	0.2153	0.1672
150	0.2129	0.1643
151	0.2114	0.1620
152	0.1989	0.1618
153	0.1811	0.1612
154	0.1801	0.1610
155	0.1751	0.1592
156	0.1749	0.1583
157	0.1626	0.1569
158	0.1548	0.1565

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1934	38897	39046	100	Pass
0.2016	35063	27595	78	Pass
0.2099	31506	18820	59	Pass
0.2182	28094	11401	40	Pass
0.2265	25440	9601	37	Pass
0.2348	23058	8526	36	Pass
0.2431	20764	7767	37	Pass
0.2514	18980	7318	38	Pass
0.2597	17368	6947	39	Pass
0.2680	15939	6637	41	Pass
0.2763	14487	6338	43	Pass
0.2845	13252	6100	46	Pass
0.2928	12127	5900	48	Pass
0.3011	10958	5568	50	Pass
0.3094	10066	5242	52	Pass
0.3177	9246	4980	53	Pass
0.3260	8415	4628	54	Pass
0.3343	7745	4345	56	Pass
0.3426	7169	4077	56	Pass
0.3509	6620	3805	57	Pass
0.3592	6094	3470	56	Pass
0.3675	5690	3222	56	Pass
0.3757	5270	2967	56	Pass
0.3840	4857	2644	54	Pass
0.3923	4521	2355	52	Pass
0.4006	4192	2099	50	Pass
0.4089	3898	1903	48	Pass
0.4172	3582	1695	47	Pass
0.4255	3344	1479	44	Pass
0.4338	3126	1234	39	Pass
0.4421	2915	1077	36	Pass
0.4504	2750	977	35	Pass
0.4586	2563	926	36	Pass
0.4669	2405	887	36	Pass
0.4752	2231	848	38	Pass
0.4835	2106	811	38	Pass
0.4918	1960	785	40	Pass
0.5001	1776	751	42	Pass
0.5084	1644	726	44	Pass
0.5167	1526	691	45	Pass
0.5250	1424	661	46	Pass
0.5333	1300	639	49	Pass
0.5415	1221	616	50	Pass
0.5498	1134	594	52	Pass
0.5581	1052	562	53	Pass
0.5664	987	535	54	Pass
0.5747	932	505	54	Pass
0.5830	874	467	53	Pass
0.5913	800	443	55	Pass
0.5996	748	419	56	Pass
0.6079	699	397	56	Pass
0.6162	625	373	59	Pass
0.6244	575	354	61	Pass

0.6327	531	339	63	Pass
0.6410	483	327	67	Pass
0.6493	432	313	72	Pass
0.6576	389	292	75	Pass
0.6659	348	276	79	Pass
0.6742	309	255	82	Pass
0.6825	284	230	80	Pass
0.6908	258	194	75	Pass
0.6991	226	162	71	Pass
0.7073	210	149	70	Pass
0.7156	184	129	70	Pass
0.7239	167	117	70	Pass
0.7322	152	101	66	Pass
0.7405	137	89	64	Pass
0.7488	122	63	51	Pass
0.7571	105	52	49	Pass
0.7654	96	51	53	Pass
0.7737	84	50	59	Pass
0.7820	77	47	61	Pass
0.7902	71	46	64	Pass
0.7985	65	43	66	Pass
0.8068	60	42	70	Pass
0.8151	55	40	72	Pass
0.8234	53	38	71	Pass
0.8317	45	36	80	Pass
0.8400	39	34	87	Pass
0.8483	33	32	96	Pass
0.8566	32	30	93	Pass
0.8649	29	27	93	Pass
0.8732	25	25	100	Pass
0.8814	23	23	100	Pass
0.8897	21	20	95	Pass
0.8980	21	17	80	Pass
0.9063	19	14	73	Pass
0.9146	19	13	68	Pass
0.9229	16	11	68	Pass
0.9312	14	10	71	Pass
0.9395	12	9	75	Pass
0.9478	12	8	66	Pass
0.9561	11	8	72	Pass
0.9643	11	8	72	Pass
0.9726	11	8	72	Pass
0.9809	11	6	54	Pass
0.9892	11	6	54	Pass
0.9975	9	6	66	Pass
1.0058	8	6	75	Pass
1.0141	8	6	75	Pass

Appendix
Predeveloped Schematic

Mitigated Schematic

Disclaimer

Legal Notice

Clear Creek Solutions, Inc.
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Local (360)943-0304

www.clearcreeksolutions.com

WWHM2012

PROJECT REPORT

Flow Control and Water Quality Calculations
Southern basin - Freeman Logistics

General Model Information

Project Name:	21585-CALC-DRNG-SOUTH-DETN-2022-08-16
Site Name:	FREEMAN ROAD LOGISTICS
Site Address:	
City:	PUYALLUP
Report Date:	8/17/2022
Gage:	42 IN EAST
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/08/18
Version:	4.2.18

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data

Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	12.31
Pervious Total	12.31
Impervious Land Use	acre
ROADS FLAT	0.79
Impervious Total	0.79
Basin Total	13.1

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Lawn, Flat	2.07
Pervious Total	2.07
Impervious Land Use	acre
ROOF TOPS FLAT	5.91
SIDEWALKS FLAT	0.93
PARKING FLAT	4.19
Impervious Total	11.03
Basin Total	13.1

Element Flows To:

Surface	Interflow	Groundwater
Vault 1	Vault 1	

Mitigated Routing

Vault 1

Width:	211.5 ft.	
Length:	211.5 ft.	
Depth:	7.5 ft.	
Discharge Structure		
Riser Height:	6.5 ft.	
Riser Diameter:	18 in.	
Orifice 1 Diameter:	1.66 in.	Elevation:0 ft.
Orifice 2 Diameter:	2.9 in.	Elevation:4 ft.
Orifice 3 Diameter:	1.99 in.	Elevation:6 ft.

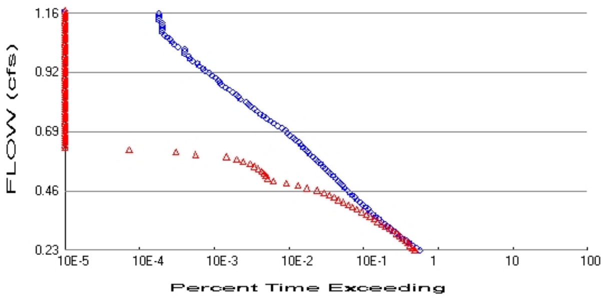
Element Flows To:
Outlet 1 Outlet 2

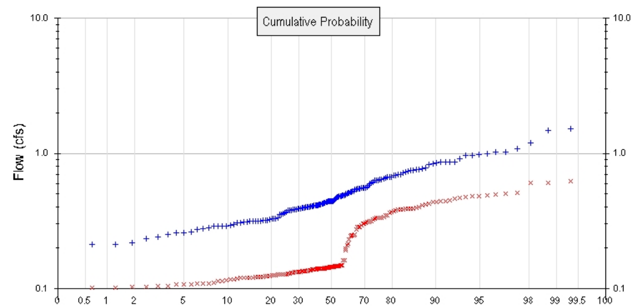
Vault Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	1.026	0.000	0.000	0.000
0.0833	1.026	0.085	0.021	0.000
0.1667	1.026	0.171	0.030	0.000
0.2500	1.026	0.256	0.037	0.000
0.3333	1.026	0.342	0.043	0.000
0.4167	1.026	0.427	0.048	0.000
0.5000	1.026	0.513	0.052	0.000
0.5833	1.026	0.599	0.057	0.000
0.6667	1.026	0.684	0.061	0.000
0.7500	1.026	0.770	0.064	0.000
0.8333	1.026	0.855	0.068	0.000
0.9167	1.026	0.941	0.071	0.000
1.0000	1.026	1.026	0.074	0.000
1.0833	1.026	1.112	0.077	0.000
1.1667	1.026	1.198	0.080	0.000
1.2500	1.026	1.283	0.083	0.000
1.3333	1.026	1.369	0.086	0.000
1.4167	1.026	1.454	0.089	0.000
1.5000	1.026	1.540	0.091	0.000
1.5833	1.026	1.625	0.094	0.000
1.6667	1.026	1.711	0.096	0.000
1.7500	1.026	1.797	0.098	0.000
1.8333	1.026	1.882	0.101	0.000
1.9167	1.026	1.968	0.103	0.000
2.0000	1.026	2.053	0.105	0.000
2.0833	1.026	2.139	0.107	0.000
2.1667	1.026	2.225	0.110	0.000
2.2500	1.026	2.310	0.112	0.000
2.3333	1.026	2.396	0.114	0.000
2.4167	1.026	2.481	0.116	0.000
2.5000	1.026	2.567	0.118	0.000
2.5833	1.026	2.652	0.120	0.000
2.6667	1.026	2.738	0.122	0.000
2.7500	1.026	2.824	0.124	0.000
2.8333	1.026	2.909	0.125	0.000
2.9167	1.026	2.995	0.127	0.000
3.0000	1.026	3.080	0.129	0.000
3.0833	1.026	3.166	0.131	0.000

3.1667	1.026	3.251	0.133	0.000
3.2500	1.026	3.337	0.134	0.000
3.3333	1.026	3.423	0.136	0.000
3.4167	1.026	3.508	0.138	0.000
3.5000	1.026	3.594	0.139	0.000
3.5833	1.026	3.679	0.141	0.000
3.6667	1.026	3.765	0.143	0.000
3.7500	1.026	3.850	0.144	0.000
3.8333	1.026	3.936	0.146	0.000
3.9167	1.026	4.022	0.148	0.000
4.0000	1.026	4.107	0.149	0.000
4.0833	1.026	4.193	0.217	0.000
4.1667	1.026	4.278	0.245	0.000
4.2500	1.026	4.364	0.268	0.000
4.3333	1.026	4.449	0.287	0.000
4.4167	1.026	4.535	0.304	0.000
4.5000	1.026	4.621	0.320	0.000
4.5833	1.026	4.706	0.334	0.000
4.6667	1.026	4.792	0.347	0.000
4.7500	1.026	4.877	0.360	0.000
4.8333	1.026	4.963	0.372	0.000
4.9167	1.026	5.049	0.384	0.000
5.0000	1.026	5.134	0.395	0.000
5.0833	1.026	5.220	0.406	0.000
5.1667	1.026	5.305	0.416	0.000
5.2500	1.026	5.391	0.426	0.000
5.3333	1.026	5.476	0.436	0.000
5.4167	1.026	5.562	0.445	0.000
5.5000	1.026	5.648	0.454	0.000
5.5833	1.026	5.733	0.463	0.000
5.6667	1.026	5.819	0.472	0.000
5.7500	1.026	5.904	0.481	0.000
5.8333	1.026	5.990	0.489	0.000
5.9167	1.026	6.075	0.497	0.000
6.0000	1.026	6.161	0.505	0.000
6.0833	1.026	6.247	0.544	0.000
6.1667	1.026	6.332	0.565	0.000
6.2500	1.026	6.418	0.583	0.000
6.3333	1.026	6.503	0.598	0.000
6.4167	1.026	6.589	0.613	0.000
6.5000	1.026	6.674	0.627	0.000
6.5833	1.026	6.760	1.023	0.000
6.6667	1.026	6.846	1.727	0.000
6.7500	1.026	6.931	2.604	0.000
6.8333	1.026	7.017	3.560	0.000
6.9167	1.026	7.102	4.501	0.000
7.0000	1.026	7.188	5.339	0.000
7.0833	1.026	7.274	6.005	0.000
7.1667	1.026	7.359	6.476	0.000
7.2500	1.026	7.445	6.804	0.000
7.3333	1.026	7.530	7.212	0.000
7.4167	1.026	7.616	7.538	0.000
7.5000	1.026	7.701	7.850	0.000
7.5833	1.026	7.787	8.149	0.000
7.6667	0.000	0.000	8.437	0.000

Analysis Results
POC 1





+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 12.31
Total Impervious Area: 0.79

Mitigated Landuse Totals for POC #1
Total Pervious Area: 2.07
Total Impervious Area: 11.03

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.46302
5 year	0.65946
10 year	0.802695
25 year	0.998851
50 year	1.156159
100 year	1.323203

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.185794
5 year	0.299386
10 year	0.394371
25 year	0.539998
50 year	0.669149
100 year	0.817843

Water quality design flow rate equal to the 2-year release rate from vault (downstream of detention).

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.403	0.145
1903	0.382	0.113
1904	0.763	0.135
1905	0.327	0.306
1906	0.219	0.101
1907	0.665	0.139
1908	0.417	0.123
1909	0.453	0.145
1910	0.682	0.141
1911	0.382	0.138

1912	1.528	0.286
1913	0.561	0.392
1914	0.964	0.104
1915	0.318	0.303
1916	0.413	0.134
1917	0.195	0.125
1918	0.435	0.401
1919	0.354	0.133
1920	0.391	0.138
1921	0.500	0.313
1922	0.551	0.141
1923	0.423	0.335
1924	0.419	0.127
1925	0.263	0.124
1926	0.487	0.135
1927	0.335	0.139
1928	0.408	0.191
1929	0.686	0.325
1930	0.434	0.139
1931	0.421	0.147
1932	0.379	0.293
1933	0.460	0.147
1934	0.850	0.474
1935	0.400	0.373
1936	0.413	0.250
1937	0.696	0.136
1938	0.396	0.141
1939	0.241	0.102
1940	0.444	0.311
1941	0.443	0.109
1942	0.552	0.483
1943	0.415	0.145
1944	0.861	0.388
1945	0.481	0.144
1946	0.442	0.120
1947	0.257	0.126
1948	0.783	0.145
1949	0.740	0.414
1950	0.273	0.129
1951	0.387	0.126
1952	1.078	0.423
1953	0.996	0.500
1954	0.433	0.248
1955	0.313	0.117
1956	0.213	0.118
1957	0.477	0.363
1958	0.960	0.600
1959	0.745	0.484
1960	0.280	0.109
1961	0.664	0.498
1962	0.444	0.229
1963	0.212	0.105
1964	0.638	0.121
1965	0.698	0.436
1966	0.316	0.132
1967	0.506	0.120
1968	0.387	0.247
1969	0.398	0.142

1970	0.547	0.148
1971	0.730	0.440
1972	0.867	0.161
1973	0.754	0.384
1974	0.540	0.139
1975	0.919	0.509
1976	0.658	0.147
1977	0.259	0.103
1978	0.748	0.444
1979	0.321	0.129
1980	0.496	0.140
1981	0.378	0.198
1982	0.307	0.107
1983	0.642	0.332
1984	0.432	0.131
1985	0.558	0.132
1986	0.447	0.273
1987	0.843	0.437
1988	0.469	0.348
1989	0.426	0.133
1990	0.486	0.141
1991	0.410	0.215
1992	0.490	0.392
1993	0.499	0.141
1994	0.721	0.163
1995	0.291	0.136
1996	0.865	0.471
1997	0.412	0.123
1998	0.582	0.140
1999	0.323	0.121
2000	0.403	0.284
2001	0.317	0.101
2002	0.827	0.141
2003	0.528	0.150
2004	0.523	0.146
2005	1.018	0.244
2006	0.317	0.134
2007	0.362	0.145
2008	0.442	0.140
2009	0.367	0.133
2010	0.291	0.329
2011	0.290	0.126
2012	0.485	0.134
2013	0.330	0.106
2014	0.318	0.109
2015	0.629	0.127
2016	0.249	0.126
2017	0.601	0.382
2018	1.017	0.606
2019	1.202	0.464
2020	0.520	0.123
2021	0.559	0.348
2022	0.441	0.121
2023	0.551	0.249
2024	1.476	0.139
2025	0.408	0.147
2026	0.633	0.390
2027	0.354	0.127

2028	0.232	0.106
2029	0.442	0.379
2030	0.773	0.317
2031	0.290	0.114
2032	0.277	0.110
2033	0.298	0.117
2034	0.327	0.126
2035	0.862	0.624
2036	0.545	0.284
2037	0.315	0.120
2038	0.598	0.370
2039	0.611	0.094
2040	0.355	0.130
2041	0.305	0.122
2042	0.975	0.489
2043	0.537	0.392
2044	0.520	0.338
2045	0.393	0.331
2046	0.478	0.418
2047	0.378	0.302
2048	0.428	0.139
2049	0.511	0.147
2050	0.409	0.137
2051	0.671	0.146
2052	0.309	0.143
2053	0.478	0.451
2054	0.649	0.383
2055	0.311	0.113
2056	0.382	0.123
2057	0.293	0.207
2058	0.393	0.311
2059	0.632	0.332

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.5284	0.6240
2	1.4759	0.6056
3	1.2015	0.6002
4	1.0780	0.5085
5	1.0178	0.4997
6	1.0169	0.4979
7	0.9964	0.4894
8	0.9750	0.4841
9	0.9643	0.4833
10	0.9603	0.4741
11	0.9191	0.4710
12	0.8672	0.4641
13	0.8649	0.4511
14	0.8615	0.4435
15	0.8613	0.4402
16	0.8500	0.4368
17	0.8425	0.4363
18	0.8265	0.4234
19	0.7832	0.4184
20	0.7732	0.4140
21	0.7631	0.4007
22	0.7543	0.3925

23	0.7482	0.3921
24	0.7448	0.3916
25	0.7401	0.3900
26	0.7299	0.3881
27	0.7213	0.3844
28	0.6975	0.3828
29	0.6958	0.3818
30	0.6864	0.3789
31	0.6824	0.3729
32	0.6707	0.3703
33	0.6655	0.3633
34	0.6640	0.3481
35	0.6580	0.3477
36	0.6490	0.3375
37	0.6419	0.3350
38	0.6377	0.3321
39	0.6326	0.3315
40	0.6315	0.3310
41	0.6291	0.3292
42	0.6109	0.3246
43	0.6009	0.3167
44	0.5985	0.3132
45	0.5819	0.3113
46	0.5613	0.3113
47	0.5591	0.3064
48	0.5583	0.3033
49	0.5525	0.3025
50	0.5513	0.2933
51	0.5507	0.2859
52	0.5472	0.2845
53	0.5450	0.2844
54	0.5395	0.2725
55	0.5371	0.2498
56	0.5281	0.2488
57	0.5231	0.2485
58	0.5205	0.2469
59	0.5196	0.2439
60	0.5106	0.2289
61	0.5063	0.2150
62	0.4999	0.2072
63	0.4991	0.1976
64	0.4961	0.1914
65	0.4900	0.1627
66	0.4865	0.1608
67	0.4857	0.1495
68	0.4847	0.1476
69	0.4814	0.1475
70	0.4785	0.1467
71	0.4777	0.1467
72	0.4774	0.1467
73	0.4691	0.1465
74	0.4601	0.1456
75	0.4529	0.1455
76	0.4467	0.1453
77	0.4440	0.1452
78	0.4437	0.1452
79	0.4429	0.1448
80	0.4421	0.1447

81	0.4420	0.1440
82	0.4418	0.1430
83	0.4413	0.1415
84	0.4349	0.1415
85	0.4338	0.1414
86	0.4326	0.1413
87	0.4316	0.1410
88	0.4280	0.1407
89	0.4264	0.1407
90	0.4233	0.1403
91	0.4205	0.1402
92	0.4186	0.1399
93	0.4171	0.1395
94	0.4149	0.1394
95	0.4128	0.1393
96	0.4126	0.1392
97	0.4124	0.1389
98	0.4103	0.1387
99	0.4087	0.1381
100	0.4082	0.1377
101	0.4077	0.1369
102	0.4034	0.1364
103	0.4034	0.1359
104	0.4005	0.1353
105	0.3979	0.1351
106	0.3958	0.1344
107	0.3934	0.1341
108	0.3929	0.1341
109	0.3913	0.1333
110	0.3872	0.1333
111	0.3869	0.1326
112	0.3820	0.1324
113	0.3818	0.1319
114	0.3816	0.1306
115	0.3786	0.1304
116	0.3784	0.1293
117	0.3780	0.1290
118	0.3674	0.1269
119	0.3618	0.1267
120	0.3554	0.1267
121	0.3544	0.1265
122	0.3541	0.1263
123	0.3347	0.1261
124	0.3296	0.1256
125	0.3274	0.1255
126	0.3266	0.1252
127	0.3228	0.1237
128	0.3211	0.1231
129	0.3182	0.1231
130	0.3180	0.1226
131	0.3167	0.1226
132	0.3165	0.1224
133	0.3158	0.1212
134	0.3147	0.1207
135	0.3134	0.1205
136	0.3107	0.1199
137	0.3091	0.1198
138	0.3069	0.1196

139	0.3051	0.1182
140	0.2982	0.1174
141	0.2934	0.1166
142	0.2909	0.1142
143	0.2907	0.1133
144	0.2900	0.1131
145	0.2896	0.1102
146	0.2797	0.1088
147	0.2771	0.1087
148	0.2734	0.1085
149	0.2626	0.1065
150	0.2587	0.1065
151	0.2572	0.1064
152	0.2495	0.1048
153	0.2411	0.1041
154	0.2325	0.1029
155	0.2187	0.1021
156	0.2128	0.1013
157	0.2121	0.1006
158	0.1952	0.0940

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.2315	31174	26880	86	Pass
0.2408	28099	25141	89	Pass
0.2502	25024	23218	92	Pass
0.2595	22603	21606	95	Pass
0.2689	20498	20066	97	Pass
0.2782	18415	18216	98	Pass
0.2875	16820	16759	99	Pass
0.2969	15396	15196	98	Pass
0.3062	13944	13590	97	Pass
0.3156	12770	12194	95	Pass
0.3249	11712	10931	93	Pass
0.3342	10582	9678	91	Pass
0.3436	9673	8620	89	Pass
0.3529	8859	7629	86	Pass
0.3623	8044	6770	84	Pass
0.3716	7451	6022	80	Pass
0.3809	6886	5253	76	Pass
0.3903	6349	4508	71	Pass
0.3996	5872	3925	66	Pass
0.4090	5406	3441	63	Pass
0.4183	4964	2985	60	Pass
0.4276	4575	2545	55	Pass
0.4370	4236	2241	52	Pass
0.4463	3877	1921	49	Pass
0.4557	3600	1642	45	Pass
0.4650	3327	1327	39	Pass
0.4743	3103	967	31	Pass
0.4837	2890	729	25	Pass
0.4930	2672	514	19	Pass
0.5024	2504	342	13	Pass
0.5117	2327	287	12	Pass
0.5210	2147	270	12	Pass
0.5304	1987	255	12	Pass
0.5397	1837	240	13	Pass
0.5491	1690	215	12	Pass
0.5584	1571	189	12	Pass
0.5677	1471	168	11	Pass
0.5771	1366	135	9	Pass
0.5864	1272	111	8	Pass
0.5958	1164	81	6	Pass
0.6051	1060	31	2	Pass
0.6144	997	17	1	Pass
0.6238	920	4	0	Pass
0.6331	851	0	0	Pass
0.6425	805	0	0	Pass
0.6518	747	0	0	Pass
0.6611	675	0	0	Pass
0.6705	626	0	0	Pass
0.6798	573	0	0	Pass
0.6892	526	0	0	Pass
0.6985	496	0	0	Pass
0.7078	449	0	0	Pass
0.7172	388	0	0	Pass

0.7265	346	0	0	Pass
0.7359	315	0	0	Pass
0.7452	279	0	0	Pass
0.7545	253	0	0	Pass
0.7639	228	0	0	Pass
0.7732	208	0	0	Pass
0.7826	190	0	0	Pass
0.7919	172	0	0	Pass
0.8012	160	0	0	Pass
0.8106	149	0	0	Pass
0.8199	126	0	0	Pass
0.8293	117	0	0	Pass
0.8386	108	0	0	Pass
0.8479	99	0	0	Pass
0.8573	88	0	0	Pass
0.8666	78	0	0	Pass
0.8760	70	0	0	Pass
0.8853	66	0	0	Pass
0.8946	63	0	0	Pass
0.9040	58	0	0	Pass
0.9133	52	0	0	Pass
0.9227	47	0	0	Pass
0.9320	41	0	0	Pass
0.9413	39	0	0	Pass
0.9507	35	0	0	Pass
0.9600	33	0	0	Pass
0.9694	28	0	0	Pass
0.9787	26	0	0	Pass
0.9880	25	0	0	Pass
0.9974	22	0	0	Pass
1.0067	22	0	0	Pass
1.0161	22	0	0	Pass
1.0254	18	0	0	Pass
1.0347	16	0	0	Pass
1.0441	15	0	0	Pass
1.0534	14	0	0	Pass
1.0628	13	0	0	Pass
1.0721	12	0	0	Pass
1.0814	11	0	0	Pass
1.0908	11	0	0	Pass
1.1001	11	0	0	Pass
1.1095	11	0	0	Pass
1.1188	11	0	0	Pass
1.1281	10	0	0	Pass
1.1375	10	0	0	Pass
1.1468	10	0	0	Pass
1.1562	10	0	0	Pass

Appendix
Predeveloped Schematic

Mitigated Schematic

Disclaimer

Legal Notice

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Olympia, WA. 98501
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Local (360)943-0304

www.clearcreeksolutions.com

WWHM2012

PROJECT REPORT

FLOW CONTROL CALCULATIONS
OFFSITE FRONTAGE SIZING AND WQ

General Model Information

Project Name:	21585-CALC-DRNG-OFFSITE-DETN-2022-08-23
Site Name:	FREEMAN ROAD LOGISTICS
Site Address:	
City:	PUYALLUP
Report Date:	8/29/2022
Gage:	42 IN EAST
Data Start:	10/01/1901
Data End:	09/30/2059
Timestep:	15 Minute
Precip Scale:	1.000
Version Date:	2021/08/18
Version:	4.2.18

POC Thresholds

Low Flow Threshold for POC1:	50 Percent of the 2 Year
High Flow Threshold for POC1:	50 Year

Landuse Basin Data
Predeveloped Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Flat	0.4
Pervious Total	0.4
Impervious Land Use	acre
Impervious Total	0
Basin Total	0.4

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
Pervious Total	0
Impervious Land Use	acre
ROADS FLAT	0.4
Impervious Total	0.4
Basin Total	0.4

Element Flows To:

Surface	Interflow	Groundwater
Tank 1		

Mitigated Routing

Tank 1

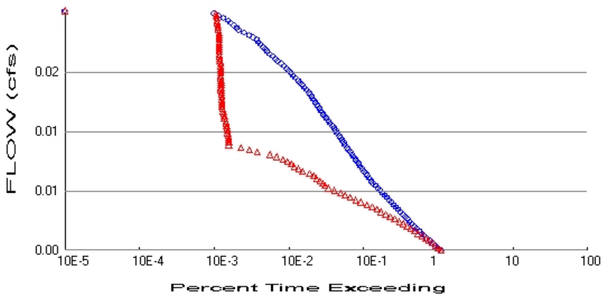
Dimensions		
Depth:	6 ft.	
Tank Type:	Circular	
Diameter:	6 ft.	
Length:	380 ft.	
Discharge Structure		
Riser Height:	5.5 ft.	
Riser Diameter:	18 in.	
Orifice 1 Diameter:	0.32 in.	Elevation:0.5 ft.
Orifice 2 Diameter:	0.32 in.	Elevation:3.4 ft.
Orifice 3 Diameter:	0.6 in.	Elevation:4 ft.
Element Flows To:		
Outlet 1	Outlet 2	

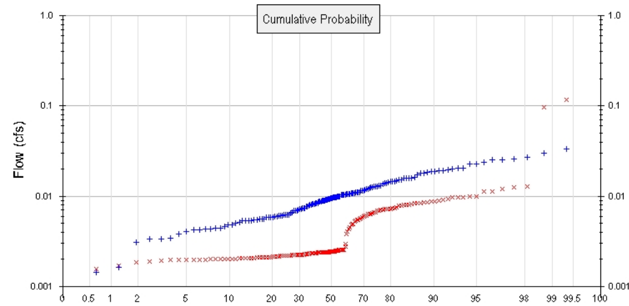
Tank Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	0.000	0.000	0.000	0.000
0.0667	0.011	0.000	0.000	0.000
0.1333	0.015	0.001	0.000	0.000
0.2000	0.018	0.002	0.000	0.000
0.2667	0.021	0.003	0.000	0.000
0.3333	0.024	0.005	0.000	0.000
0.4000	0.026	0.007	0.000	0.000
0.4667	0.028	0.008	0.000	0.000
0.5333	0.029	0.010	0.000	0.000
0.6000	0.031	0.012	0.000	0.000
0.6667	0.032	0.015	0.001	0.000
0.7333	0.034	0.017	0.001	0.000
0.8000	0.035	0.019	0.001	0.000
0.8667	0.036	0.022	0.001	0.000
0.9333	0.037	0.024	0.001	0.000
1.0000	0.039	0.027	0.002	0.000
1.0667	0.040	0.029	0.002	0.000
1.1333	0.041	0.032	0.002	0.000
1.2000	0.041	0.035	0.002	0.000
1.2667	0.042	0.037	0.002	0.000
1.3333	0.043	0.040	0.002	0.000
1.4000	0.044	0.043	0.002	0.000
1.4667	0.045	0.046	0.002	0.000
1.5333	0.045	0.049	0.002	0.000
1.6000	0.046	0.052	0.002	0.000
1.6667	0.046	0.055	0.003	0.000
1.7333	0.047	0.059	0.003	0.000
1.8000	0.048	0.062	0.003	0.000
1.8667	0.048	0.065	0.003	0.000
1.9333	0.048	0.068	0.003	0.000
2.0000	0.049	0.072	0.003	0.000
2.0667	0.049	0.075	0.003	0.000
2.1333	0.050	0.078	0.003	0.000
2.2000	0.050	0.082	0.003	0.000
2.2667	0.050	0.085	0.003	0.000
2.3333	0.051	0.088	0.003	0.000

2.4000	0.051	0.092	0.003	0.000
2.4667	0.051	0.095	0.003	0.000
2.5333	0.051	0.099	0.004	0.000
2.6000	0.051	0.102	0.004	0.000
2.6667	0.052	0.105	0.004	0.000
2.7333	0.052	0.109	0.004	0.000
2.8000	0.052	0.112	0.004	0.000
2.8667	0.052	0.116	0.004	0.000
2.9333	0.052	0.119	0.004	0.000
3.0000	0.052	0.123	0.004	0.000
3.0667	0.052	0.126	0.004	0.000
3.1333	0.052	0.130	0.004	0.000
3.2000	0.052	0.133	0.004	0.000
3.2667	0.052	0.137	0.004	0.000
3.3333	0.052	0.140	0.004	0.000
3.4000	0.051	0.144	0.004	0.000
3.4667	0.051	0.147	0.005	0.000
3.5333	0.051	0.151	0.005	0.000
3.6000	0.051	0.154	0.006	0.000
3.6667	0.051	0.157	0.006	0.000
3.7333	0.050	0.161	0.006	0.000
3.8000	0.050	0.164	0.006	0.000
3.8667	0.050	0.168	0.007	0.000
3.9333	0.049	0.171	0.007	0.000
4.0000	0.049	0.174	0.007	0.000
4.0667	0.048	0.178	0.010	0.000
4.1333	0.048	0.181	0.011	0.000
4.2000	0.048	0.184	0.012	0.000
4.2667	0.047	0.187	0.013	0.000
4.3333	0.046	0.190	0.013	0.000
4.4000	0.046	0.193	0.014	0.000
4.4667	0.045	0.196	0.015	0.000
4.5333	0.045	0.199	0.015	0.000
4.6000	0.044	0.202	0.016	0.000
4.6667	0.043	0.205	0.016	0.000
4.7333	0.042	0.208	0.017	0.000
4.8000	0.041	0.211	0.017	0.000
4.8667	0.041	0.214	0.018	0.000
4.9333	0.040	0.217	0.018	0.000
5.0000	0.039	0.219	0.019	0.000
5.0667	0.037	0.222	0.019	0.000
5.1333	0.036	0.224	0.020	0.000
5.2000	0.035	0.227	0.020	0.000
5.2667	0.034	0.229	0.020	0.000
5.3333	0.032	0.231	0.021	0.000
5.4000	0.031	0.233	0.021	0.000
5.4667	0.029	0.235	0.022	0.000
5.5333	0.028	0.237	0.119	0.000
5.6000	0.026	0.239	0.524	0.000
5.6667	0.024	0.241	1.097	0.000
5.7333	0.021	0.242	1.779	0.000
5.8000	0.018	0.244	2.525	0.000
5.8667	0.015	0.245	3.285	0.000
5.9333	0.011	0.246	4.013	0.000
6.0000	0.000	0.246	4.663	0.000
6.0667	0.000	0.000	5.203	0.000

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.4
Total Impervious Area: 0

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0
Total Impervious Area: 0.4

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.009633
5 year	0.014779
10 year	0.01794
25 year	0.021591
50 year	0.024065
100 year	0.026341

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.003244
5 year	0.006265
10 year	0.0095
25 year	0.015688
50 year	0.022411
100 year	0.031586

Water quality design flow rate equal to 2-year peak flow from detention tank.

Annual Peaks
Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.009	0.002
1903	0.006	0.002
1904	0.011	0.002
1905	0.005	0.002
1906	0.003	0.002
1907	0.015	0.002
1908	0.011	0.002
1909	0.010	0.002
1910	0.015	0.002
1911	0.010	0.002

1912	0.033	0.009
1913	0.015	0.011
1914	0.004	0.002
1915	0.007	0.004
1916	0.010	0.006
1917	0.003	0.002
1918	0.010	0.010
1919	0.008	0.002
1920	0.010	0.002
1921	0.011	0.007
1922	0.010	0.002
1923	0.009	0.007
1924	0.004	0.002
1925	0.006	0.002
1926	0.009	0.004
1927	0.008	0.002
1928	0.007	0.002
1929	0.015	0.008
1930	0.009	0.004
1931	0.009	0.005
1932	0.007	0.002
1933	0.008	0.006
1934	0.019	0.012
1935	0.009	0.002
1936	0.009	0.007
1937	0.013	0.003
1938	0.008	0.007
1939	0.001	0.002
1940	0.009	0.002
1941	0.006	0.002
1942	0.014	0.007
1943	0.006	0.002
1944	0.015	0.008
1945	0.011	0.006
1946	0.006	0.002
1947	0.005	0.002
1948	0.020	0.002
1949	0.018	0.003
1950	0.006	0.002
1951	0.007	0.002
1952	0.026	0.006
1953	0.024	0.010
1954	0.009	0.002
1955	0.008	0.002
1956	0.004	0.002
1957	0.013	0.006
1958	0.025	0.097
1959	0.016	0.010
1960	0.004	0.002
1961	0.016	0.009
1962	0.009	0.002
1963	0.004	0.002
1964	0.005	0.002
1965	0.018	0.010
1966	0.006	0.002
1967	0.008	0.002
1968	0.009	0.005
1969	0.008	0.002

1970	0.013	0.002
1971	0.019	0.007
1972	0.012	0.007
1973	0.016	0.007
1974	0.009	0.003
1975	0.020	0.009
1976	0.011	0.006
1977	0.005	0.002
1978	0.017	0.011
1979	0.005	0.002
1980	0.010	0.005
1981	0.010	0.003
1982	0.005	0.002
1983	0.016	0.006
1984	0.007	0.002
1985	0.012	0.002
1986	0.010	0.002
1987	0.018	0.008
1988	0.011	0.003
1989	0.011	0.002
1990	0.012	0.002
1991	0.010	0.007
1992	0.012	0.009
1993	0.013	0.006
1994	0.019	0.003
1995	0.005	0.002
1996	0.020	0.013
1997	0.009	0.002
1998	0.010	0.002
1999	0.001	0.002
2000	0.008	0.002
2001	0.004	0.002
2002	0.014	0.002
2003	0.012	0.002
2004	0.010	0.006
2005	0.020	0.007
2006	0.006	0.002
2007	0.007	0.002
2008	0.010	0.002
2009	0.007	0.002
2010	0.006	0.002
2011	0.006	0.002
2012	0.010	0.002
2013	0.006	0.002
2014	0.004	0.002
2015	0.008	0.002
2016	0.003	0.002
2017	0.014	0.006
2018	0.025	0.117
2019	0.027	0.012
2020	0.008	0.002
2021	0.013	0.008
2022	0.006	0.002
2023	0.011	0.008
2024	0.030	0.002
2025	0.010	0.002
2026	0.016	0.009
2027	0.006	0.002

2028	0.005	0.002
2029	0.011	0.008
2030	0.019	0.007
2031	0.006	0.002
2032	0.004	0.002
2033	0.006	0.002
2034	0.006	0.002
2035	0.023	0.003
2036	0.012	0.004
2037	0.003	0.002
2038	0.010	0.007
2039	0.002	0.002
2040	0.006	0.002
2041	0.007	0.002
2042	0.023	0.003
2043	0.011	0.008
2044	0.014	0.009
2045	0.009	0.008
2046	0.011	0.007
2047	0.008	0.003
2048	0.011	0.002
2049	0.010	0.002
2050	0.007	0.002
2051	0.011	0.007
2052	0.006	0.005
2053	0.011	0.008
2054	0.013	0.006
2055	0.005	0.002
2056	0.005	0.002
2057	0.007	0.005
2058	0.009	0.008
2059	0.015	0.010

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	0.0332	0.1172
2	0.0297	0.0973
3	0.0268	0.0128
4	0.0259	0.0125
5	0.0254	0.0120
6	0.0252	0.0113
7	0.0239	0.0112
8	0.0228	0.0099
9	0.0226	0.0099
10	0.0205	0.0097
11	0.0202	0.0097
12	0.0198	0.0097
13	0.0196	0.0094
14	0.0193	0.0092
15	0.0192	0.0090
16	0.0188	0.0087
17	0.0188	0.0087
18	0.0184	0.0085
19	0.0180	0.0085
20	0.0180	0.0084
21	0.0172	0.0084
22	0.0161	0.0083

23	0.0160	0.0081
24	0.0159	0.0081
25	0.0158	0.0080
26	0.0157	0.0080
27	0.0152	0.0079
28	0.0150	0.0079
29	0.0149	0.0075
30	0.0146	0.0074
31	0.0146	0.0074
32	0.0146	0.0072
33	0.0144	0.0072
34	0.0139	0.0072
35	0.0138	0.0072
36	0.0137	0.0071
37	0.0131	0.0071
38	0.0130	0.0070
39	0.0129	0.0069
40	0.0128	0.0066
41	0.0127	0.0066
42	0.0126	0.0065
43	0.0124	0.0064
44	0.0124	0.0063
45	0.0121	0.0063
46	0.0121	0.0061
47	0.0119	0.0061
48	0.0116	0.0059
49	0.0115	0.0058
50	0.0114	0.0057
51	0.0111	0.0056
52	0.0110	0.0055
53	0.0110	0.0055
54	0.0110	0.0054
55	0.0109	0.0052
56	0.0109	0.0050
57	0.0108	0.0049
58	0.0107	0.0049
59	0.0106	0.0045
60	0.0106	0.0043
61	0.0105	0.0040
62	0.0105	0.0038
63	0.0105	0.0030
64	0.0104	0.0028
65	0.0104	0.0025
66	0.0104	0.0025
67	0.0103	0.0025
68	0.0103	0.0025
69	0.0099	0.0025
70	0.0099	0.0025
71	0.0099	0.0025
72	0.0098	0.0025
73	0.0098	0.0025
74	0.0098	0.0025
75	0.0098	0.0025
76	0.0098	0.0024
77	0.0096	0.0024
78	0.0095	0.0024
79	0.0095	0.0024
80	0.0095	0.0024

81	0.0094	0.0024
82	0.0092	0.0024
83	0.0092	0.0024
84	0.0092	0.0024
85	0.0092	0.0024
86	0.0091	0.0024
87	0.0090	0.0024
88	0.0090	0.0024
89	0.0090	0.0024
90	0.0089	0.0024
91	0.0088	0.0024
92	0.0087	0.0024
93	0.0087	0.0024
94	0.0085	0.0024
95	0.0085	0.0024
96	0.0083	0.0024
97	0.0083	0.0024
98	0.0082	0.0023
99	0.0082	0.0023
100	0.0081	0.0023
101	0.0081	0.0023
102	0.0080	0.0023
103	0.0079	0.0023
104	0.0076	0.0023
105	0.0076	0.0023
106	0.0074	0.0023
107	0.0074	0.0023
108	0.0073	0.0023
109	0.0073	0.0022
110	0.0072	0.0022
111	0.0071	0.0022
112	0.0070	0.0022
113	0.0069	0.0022
114	0.0068	0.0022
115	0.0066	0.0022
116	0.0064	0.0022
117	0.0063	0.0022
118	0.0062	0.0022
119	0.0062	0.0022
120	0.0062	0.0022
121	0.0061	0.0022
122	0.0061	0.0022
123	0.0061	0.0022
124	0.0059	0.0022
125	0.0059	0.0021
126	0.0059	0.0021
127	0.0059	0.0021
128	0.0058	0.0021
129	0.0058	0.0021
130	0.0056	0.0021
131	0.0056	0.0021
132	0.0056	0.0021
133	0.0055	0.0021
134	0.0054	0.0021
135	0.0054	0.0021
136	0.0054	0.0021
137	0.0053	0.0021
138	0.0053	0.0021

139	0.0051	0.0020
140	0.0050	0.0020
141	0.0049	0.0020
142	0.0048	0.0020
143	0.0046	0.0020
144	0.0044	0.0020
145	0.0044	0.0020
146	0.0043	0.0020
147	0.0043	0.0020
148	0.0042	0.0020
149	0.0042	0.0020
150	0.0041	0.0020
151	0.0038	0.0020
152	0.0035	0.0020
153	0.0034	0.0019
154	0.0033	0.0019
155	0.0030	0.0019
156	0.0016	0.0017
157	0.0014	0.0016
158	0.0009	0.0015

Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.0048	60110	59722	99	Pass
0.0050	55046	54996	99	Pass
0.0052	50359	50714	100	Pass
0.0054	46176	45489	98	Pass
0.0056	42337	41124	97	Pass
0.0058	38969	37412	96	Pass
0.0060	35983	33706	93	Pass
0.0062	33263	29911	89	Pass
0.0064	30697	26670	86	Pass
0.0066	28315	23678	83	Pass
0.0068	26326	21013	79	Pass
0.0070	24482	18736	76	Pass
0.0071	22781	16653	73	Pass
0.0073	21235	14437	67	Pass
0.0075	19833	12593	63	Pass
0.0077	18532	10986	59	Pass
0.0079	17202	9462	55	Pass
0.0081	16005	8338	52	Pass
0.0083	14914	7202	48	Pass
0.0085	13900	6133	44	Pass
0.0087	12975	5125	39	Pass
0.0089	12133	4361	35	Pass
0.0091	11318	3681	32	Pass
0.0093	10587	3132	29	Pass
0.0095	9850	2701	27	Pass
0.0097	9174	2261	24	Pass
0.0099	8537	1886	22	Pass
0.0101	7978	1666	20	Pass
0.0103	7429	1563	21	Pass
0.0105	6964	1442	20	Pass
0.0106	6571	1292	19	Pass
0.0108	6205	1182	19	Pass
0.0110	5906	1043	17	Pass
0.0112	5579	834	14	Pass
0.0114	5282	751	14	Pass
0.0116	5010	654	13	Pass
0.0118	4772	594	12	Pass
0.0120	4527	531	11	Pass
0.0122	4297	460	10	Pass
0.0124	4082	381	9	Pass
0.0126	3862	308	7	Pass
0.0128	3659	209	5	Pass
0.0130	3443	163	4	Pass
0.0132	3288	126	3	Pass
0.0134	3124	87	2	Pass
0.0136	2979	87	2	Pass
0.0138	2829	86	3	Pass
0.0140	2687	86	3	Pass
0.0141	2580	85	3	Pass
0.0143	2452	84	3	Pass
0.0145	2360	83	3	Pass
0.0147	2239	82	3	Pass
0.0149	2141	81	3	Pass

0.0151	1991	80	4	Pass
0.0153	1869	79	4	Pass
0.0155	1757	76	4	Pass
0.0157	1673	76	4	Pass
0.0159	1588	74	4	Pass
0.0161	1506	73	4	Pass
0.0163	1430	71	4	Pass
0.0165	1354	70	5	Pass
0.0167	1297	70	5	Pass
0.0169	1234	70	5	Pass
0.0171	1186	70	5	Pass
0.0173	1120	70	6	Pass
0.0175	1074	69	6	Pass
0.0176	1027	69	6	Pass
0.0178	967	68	7	Pass
0.0180	898	68	7	Pass
0.0182	833	68	8	Pass
0.0184	783	68	8	Pass
0.0186	735	68	9	Pass
0.0188	679	67	9	Pass
0.0190	632	67	10	Pass
0.0192	589	67	11	Pass
0.0194	556	67	12	Pass
0.0196	510	67	13	Pass
0.0198	475	67	14	Pass
0.0200	431	67	15	Pass
0.0202	391	66	16	Pass
0.0204	367	65	17	Pass
0.0206	341	65	19	Pass
0.0208	309	64	20	Pass
0.0210	281	64	22	Pass
0.0211	266	64	24	Pass
0.0213	247	64	25	Pass
0.0215	233	64	27	Pass
0.0217	218	64	29	Pass
0.0219	205	64	31	Pass
0.0221	182	64	35	Pass
0.0223	161	64	39	Pass
0.0225	139	64	46	Pass
0.0227	117	62	52	Pass
0.0229	110	62	56	Pass
0.0231	101	62	61	Pass
0.0233	92	61	66	Pass
0.0235	85	60	70	Pass
0.0237	73	60	82	Pass
0.0239	62	59	95	Pass
0.0241	54	58	107	Pass

Appendix
Predeveloped Schematic

Mitigated Schematic

Disclaimer

Legal Notice

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STORMWATER PUMP CURVE AND DETAILS

Customer :
Reference :

Pump Performance Datasheet

Wilo Quotation System 22.3.0

Item number	: 001	Size	: EMU FA10.33E with Motor T17-4/16KEx
Service	:	Stages	: 1
Quantity	: 1	Based on curve number	: FA10.33E 1740
Quote number	: 796849	Article Number	:
		Date last saved	: 27 Sep 2022 5:45 PM

Operating Conditions

Flow, rated	: 400.0 USgpm
Head, rated (requested)	: 50.00 ft
Head, rated (actual)	: 50.13 ft
Suction pressure, rated / max	: 0.00 / 0.00 psi.g
NPSH available	: Ample
Site Supply Frequency	: 60 Hz

Performance

Speed criteria	: Synchronous
Speed	: 1715 rpm
Impeller dia.	: 8.43 in
Impeller diameter, maximum	: 9.80 in
Impeller diameter, minimum	: 7.64 in
Efficiency	: 71.46 %
NPSH required / margin required	: 7.58 / 0.00 ft
Ns (imp. eye flow) / Nss (imp. eye flow)	: 1,222 / 9,196 US Units
MCSF	: 98.56 USgpm
Head max.	: 80.37 ft
Head rise to shutoff	: 60.30 %
Flow, best eff. point	: 444.2 USgpm
Flow ratio, rated / BEP	: 90.05 %
Diameter ratio (rated / max)	: 85.94 %
Head ratio (rated dia / max dia)	: 65.36 %
Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
Selection status	: Acceptable

Liquid

Liquid type	: Water
Additional liquid description	:
Solids Diameter, required / pump max	: 0.00 in / 3.10 in
Solids concentration, by volume	: 0.00 %
Temperature	: 68.00 deg F
Fluid density	: 1.000 / 1.000 SG
Viscosity	: 1.00 cP
Vapor pressure, rated	: 0.34 psi.a

Material

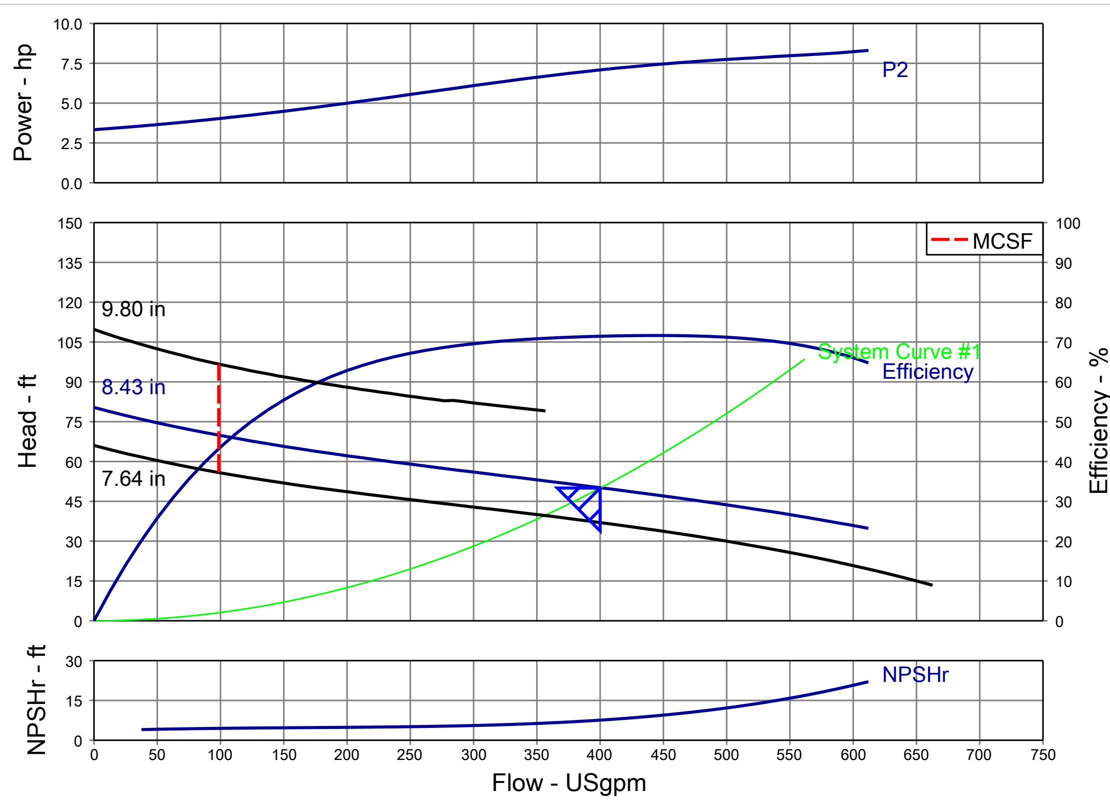
Material selected	: Standard

Pressure Data

Maximum working pressure	: 34.78 psi.g
Maximum allowable working pressure	: N/A
Maximum allowable suction pressure	: N/A
Hydrostatic test pressure	: N/A

Driver & Power Data (@Max density)

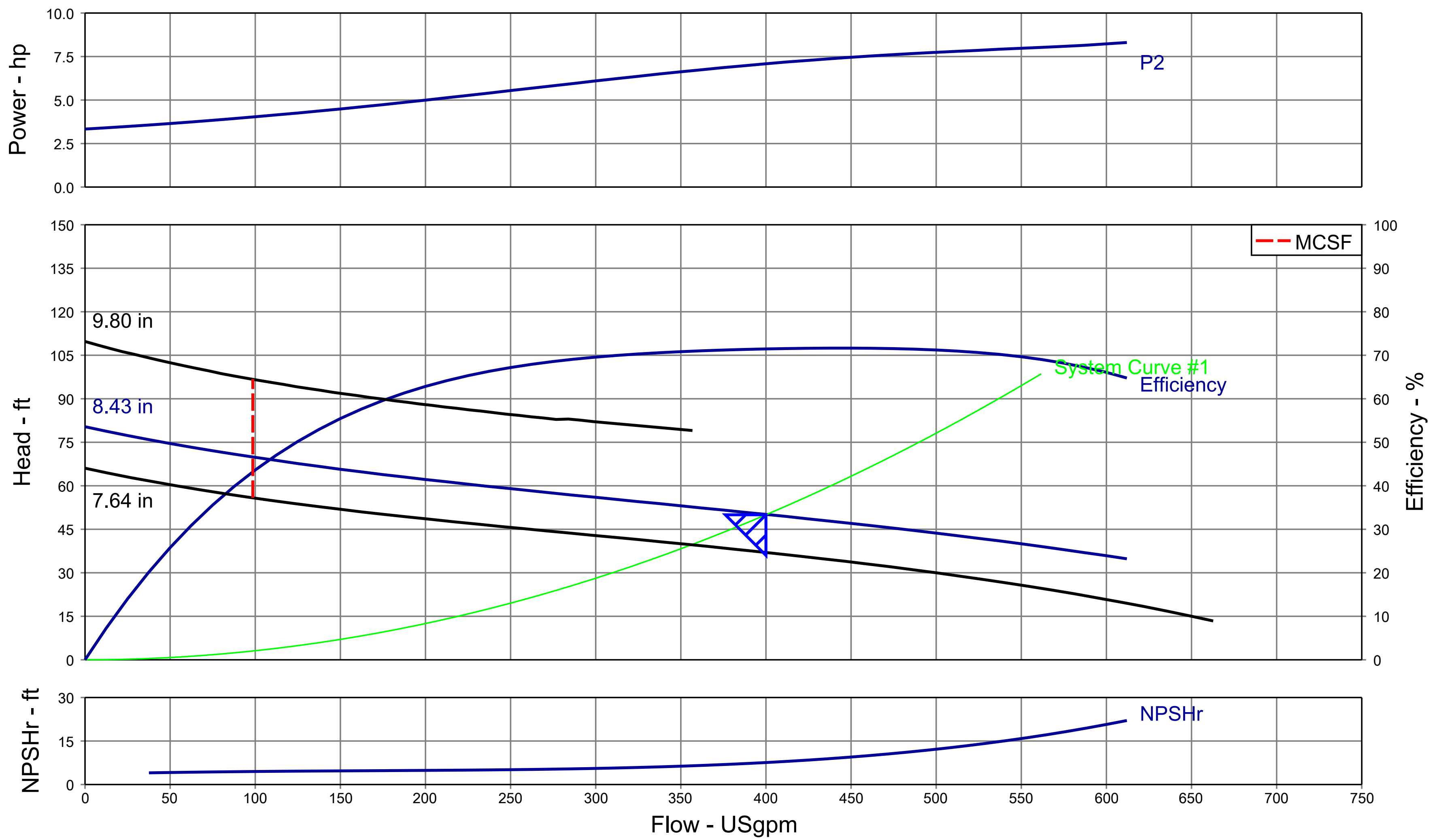
Driver sizing specification	: Rated power
Margin over specification	: 0.00 %
Service factor	: 1.00
Power, hydraulic	: 5.06 hp
Power, rated	: 7.09 hp
Power, maximum	: 8.31 hp
Motor rating	: 10.10 hp / 7.53 kW



Customer :
Reference :

Pump Performance Curve

Wilo Quotation System 22.3.0

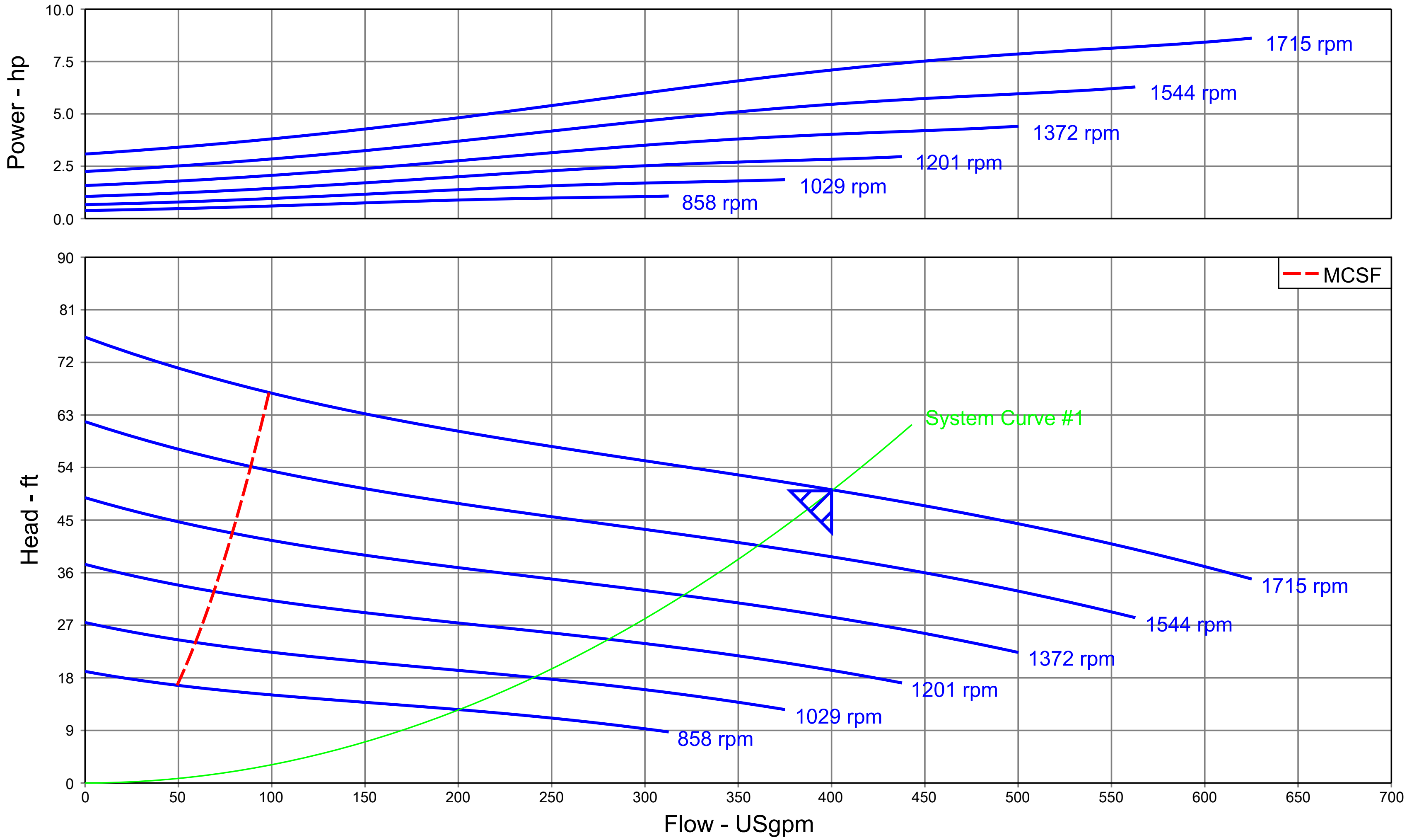


Item number	: 001	Size	: EMU FA10.33E with Motor T17-4/16KEx	Flow, rated	: 400.0 USgpm
Service	:			Head, rated	: 50.00 ft
Quantity	: 1	Stages	: 1	NPSH required	: 7.58 ft
Quote number	: 796849	Speed	: 1715 rpm	Fluid density	: 1.000 / 1.000 SG
Date last saved	: 27 Sep 2022 5:45 PM	Based on curve number	: FA10.33E 1740	Viscosity	: 1.00 cP
		Efficiency	: 71.46 %	Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
		Power, rated	: 7.09 hp		

Customer	:
Reference	:

Multi-Speed Performance Curve

Wilo Quotation System 22.3.0



Item number	: 001	Size	: EMU FA10.33E with Motor T17-4/16KEx	Flow, rated	: 400.0 USgpm
Service	:			Head, rated	: 50.00 ft
Quantity	: 1	Stages	: 1	Speed	: 1715 rpm
Quote number	: 796849	Efficiency	: 71.46 %	Impeller dia.	: 8.43 in
Based on curve number	: FA10.33E 1740	Power, rated	: 7.09 hp	Fluid density	: 1.000 / 1.000 SG
		NPSH required	: 7.58 ft	Viscosity	: 1.00 cP
Date last saved	: 27 Sep 2022 5:45 PM	Site Supply Frequency	: 60 Hz	Cq/Ch/Ce/Cn [ANSI/HI 9.6.7-2010]	: 1.00 / 1.00 / 1.00 / 1.00
		Nominal speed	: 1679 rpm		

wilo®

Customer :
Reference :

Life Cycle Cost Datasheet

Wilo Quotation System 22.3.0

Item number	: 001	Quantity	: 1	Size	: EMU FA10.33E with Motor T17-4/16KEx
Service	:	Quote number	: 796849	Stages	: 1
		Date last saved	: 27 Sep 2022 5:45 PM	Speed	: 1715 rpm

Load Profiles and Energy Costs

Expected pump life: 20 years	Load Profile #1	Load Profile #2	Load Profile #3	Load Profile #4	Load Profile #5	Total
Flow: (USgpm)	400.0	-	-	-	-	-
Operation: (hours per year)	8,760	-	-	-	-	8,760
Energy cost, present value ($ per kWh)	0.1	-	-	-	-	-
Speed (rpm)	1715	-	-	-	-	-
Head (ft)	50.13	-	-	-	-	-
Efficiency (%)	71.45	-	-	-	-	-
Power, rated (hp)	7.10	-	-	-	-	-
Motor efficiency (%)	100.00	-	-	-	-	-
Drive/gear efficiency (%)	100.00	-	-	-	-	-
System curve		-	-	-	-	-
Energy, total (kWh)	926,978.5	-	-	-	-	926,978.5
Energy cost, per year	$ 4,634.89	-	-	-	-	$ 4,634.89
Energy cost, total present value	$ 69,515.88	-	-	-	-	$ 69,515.88

Life Cycle Cost Calculation

Additional Annual Costs

Routine maintenance cost	:	0.00
Repair cost	:	0.00
Operating cost	:	0.00
Downtime cost	:	0.00
Environmental cost	:	0.00
Other annual costs	:	0.00
Total, present value	:	$ 0.00

Additional One-time Costs, Year 0

Initial investment cost	:	0.00
Installation and commissioning cost	:	0.00
Other one-time costs, year 0	:	0.00

Additional One-time Costs, Year 20

Decommissioning cost	:	0.00
Other one-time costs, year 20	:	0.00
Total, present value	:	$ 0.00

Interest and Inflation Rates

Interest rate, %	:	6.00
Inflation rate, %	:	3.00

Total Net Present Value Costs

Total energy cost	:	$ 69,515.88
Total additional annual cost	:	$ 0.00
Total additional one-time cost	:	$ 0.00
Total life cycle cost	:	$ 69,515.88

Customer :
Reference :

Pump Performance - Additional Data

Wilo Quotation System 22.3.0

Item number	: 001	Size	: EMU FA10.33E with Motor T17-4/16KEx
Service	:	Stages	: 1
Quantity	: 1	Speed	: 1715 rpm
Quote number	: 796849	Article Number	:
		Date last saved	: 27 Sep 2022 5:45 PM

Performance Data		**Stage, Speed and Solids Limits**	
Head, maximum diameter, rated flow	: 76.71 ft	Stages, maximum	: 1
Head, minimum diameter, rated flow	: 37.03 ft	Stages, minimum	: 1
Head max.	: 80.37 ft	Pump speed limit, maximum	: 1800 rpm
Efficiency adjustment factor, total	: 1.00	Pump speed limit, minimum	: 900 rpm
Power adjustment, total	: 0.00 hp	Curve speed limit, maximum	: 1800 rpm
Head adjustment factor, total	: 1.00	Curve speed limit, minimum	: 1200 rpm
Flow adjustment factor, total	: 1.00	Variable speed limit, maximum	: 1800 rpm
NPSHR adjustment factor, total	: 1.00	Variable speed limit, minimum	: 435 rpm
NPSH margin dictated by pump supplier	: 0.00 ft	Solids size limit	: 3.10 in
NPSH margin dictated by user	: 0.00 ft	**Typical Driver Data**	
NPSH margin used (added to 'required' values)	: 0.00 ft	Driver speed, full load	: 1679 rpm
Mechanical Limits		Driver speed, rated load	: 1714 rpm
Torque, rated power, rated speed	: 0.41 hp/100 rpm	Driver efficiency, 100% load	: 80.78 %
Torque, maximum power, rated speed	: 0.48 hp/100 rpm	Driver efficiency, 75% load	: 81.68 %
Torque, driver power, full load speed	: 0.60 hp/100 rpm	Driver efficiency, 50% load	: 80.56 %
Torque, driver power, rated speed	: 0.59 hp/100 rpm		
Torque, pump shaft limit	: -		
Radial load, worst case	: -		
Radial load limit	: -		
Impeller peripheral speed, rated	: -		
Impeller peripheral speed limit	: -		

Various Performance Data	**Flow (USgpm)**	**Head (ft)**	**Efficiency (%)**	**NPSHr (ft)**	**Power (hp)**
Shutoff, rated	0.00	80.37	-	-	3.33
Shutoff, maximum	0.00	109.8	-	-	5.23
MCSF	98.56	69.92	43.21	4.48	4.03
Rated flow, minimum	400.0	37.03	68.56	-	5.45
Rated flow, maximum	400.0	76.71	72.71	-	10.65
BEP flow, rated	444.2	47.36	71.65	9.21	7.41
120% rated flow, rated	480.0	45.02	71.48	10.98	7.63
End of curve, rated	612.0	34.82	64.77	22.06	8.31
End of curve, minimum	662.7	13.40	36.08	39.75	6.21
End of curve, maximum	356.8	79.05	70.28	5.36	10.13
Maximum value, rated	-	80.37	71.65	-	8.31
Maximum value, maximum	-	-	70.28	-	10.13

System differential pressure	**@ Density, rated**	**@ Density, max**
Differential pressure, rated flow, rated (psi)	21.70	21.70
Differential pressure, shutoff, rated (psi)	34.78	34.78
Differential pressure, shutoff, maximum (psi)	47.50	47.50

Discharge pressure	**@ Suction pressure, rated**	**@ Suction pressure, max**	**@ Suction pressure, rated**	**@ Suction pressure, max**
Discharge pressure, rated flow, rated (psi.g)	21.70	21.70	21.70	21.70
Discharge pressure, shutoff, rated (psi.g)	34.78	34.78	34.78	34.78
Discharge pressure, shutoff, maximum (psi.g)	47.50	47.50	47.50	47.50

Ratios

Maximum flow / rated flow, rated	: 153.01 %	Head rated diameter / head minimum diameter, rated flow	: 135.38 %

Construction

Installation Type	: Wet Pit	Motor Type	: Air Filled Motor

Construction Datasheet

EMU FA10.33E with Motor T17-4/16KEx

Customer	:
Customer Referance	:
Item Number	: 001
Service	:
Quanity of Pumps	: 1

Quote Number	: 796849
Pump Size	: EMU FA10.33E with Motor T17-4/16KEx
Stages	: 1
Speed	: 1715 rpm
Date Last Saved	: 27 Sep 2022 5:45 PM

Duty Point Data

Flow	: 400.0 USgpm
Head	: 50.00 ft
Shaft Power	: 7.09 hp
Pump Efficiency	: 71.46 %
Fluid	: Water
Speed	: 1715 rpm

Construction

Installation Type	: Wet Pit
Free Passage	: 3.10 in

Suction Port	**Pressure Rating**	**PN10**
	Rated Diameter	**3" ANSI Class 125**
	Standard	**EN1092-2-S**
Discharge Port	**Pressure Rating**	**PN10**
	Rated Diameter	**4" ANSI Class 125**
	Standard	**EN1092-2-D**

Materials

Material Combination Code	: 92
Pump Housing	: Grey Cast Iron, ASTM A48 Class 35/40B
Impeller	: Grey Cast Iron, ASTM A536 Gr.80-55-06
Stationary Wear Ring	: ANSI 304 CF8 / ASTM A351 Gr.CF8
Mobile Wear Ring	: ANSI 329 (2205) / ANSI 329
Suction Port	: -

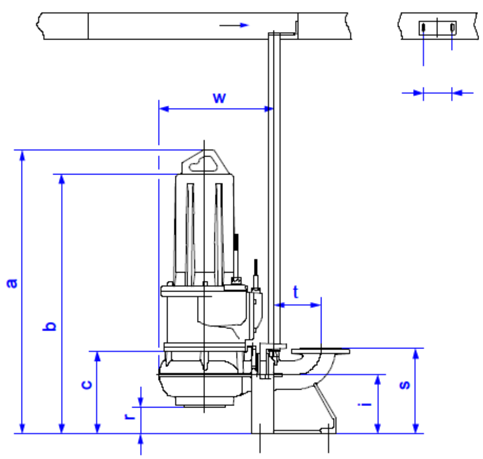
Weights

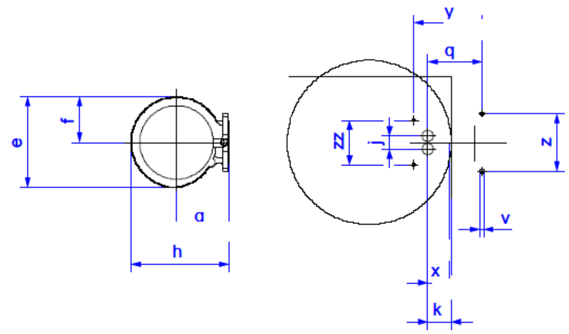
Weight of Pump End	: 68.34 lb
Weight of Motor	: 136.7 lb
Weight of Unit	: 205.0 lb

Driver Information

Motor Name	: T17-4/16KEx 10.1 HP
Motor Voltage	: 3/60/230V
Rated Power	: 10.10 hp
Rated Speed	: 1680 rpm
Power Input with Rated Power (P1)	: 12.61 hp
Current Input with Rated Power (FLA)	: 27.20 A
Efficiency with Rated Power	: 80.00 %
Cos Phi with Rated Power	: 0.87
Cos Phi with Starting Power	: 0
Starting Current, Direct Starting (LRA)	: 130.00 A
Starting Current, Star-Delta	: 43.40 A
Starting Torque	: 1.38 hp/100 rpm
Inertia Moment	: 0.32 lb.ft2
Max. Fluid Temperature	: 104.0 deg F
Starts per Hour, Max.	: 15
Degree of Protection	: IP 68
Selected Explosion Protection	: FM
	:
	:

General Arrangment Drawing





Dimensions	
Well Type	Wet Pit
a	30.35
b	27.76
c	11.57
d	4.33
e	14.72
f	7.76
g	10.59
h	18.19
i	8.86
j	1.97
k	3.86
l	-
m	-
mm	-
n	-
o	-
p	-
q	8.11
r	5.16
s	12.80
t	6.93
v	0.53
w	20.75
x	3.54
y	10.24
z	8.66
zz	6.69

Dimensions		
Suction Port	Rated Diameter	3" ANSI Class 125
	Pressure Rating	PN10
Discharge Port	Rated Diameter	4" ANSI Class 125
	Pressure Rating	PN10

Certification Content	
Customer	
Customer P.O.	
Location	
Service	
Pump Size/Motor	EMU FA10.33E with Motor T17-4/16KEx
Article Number	
Item Number	001
DRWN	
CHKD	
APVD	

EMU FA10.33E with Motor T17-4/16KEx	
	REV

Special Note
1. All weights and dimensions are approximate and should not be used as exact rough-in dimensions

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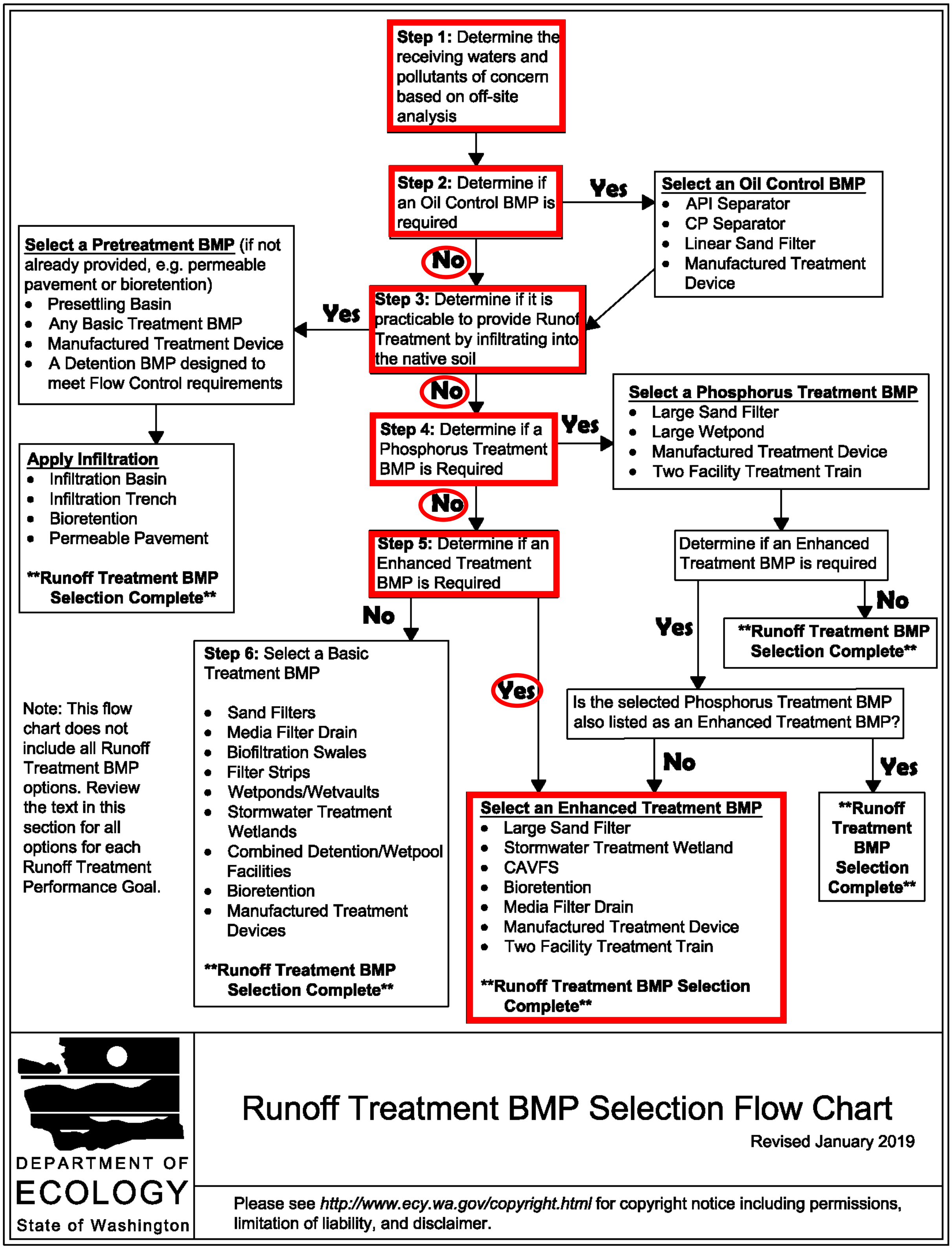
RUNOFF TREATMENT BMP SELECTION FLOW CHART

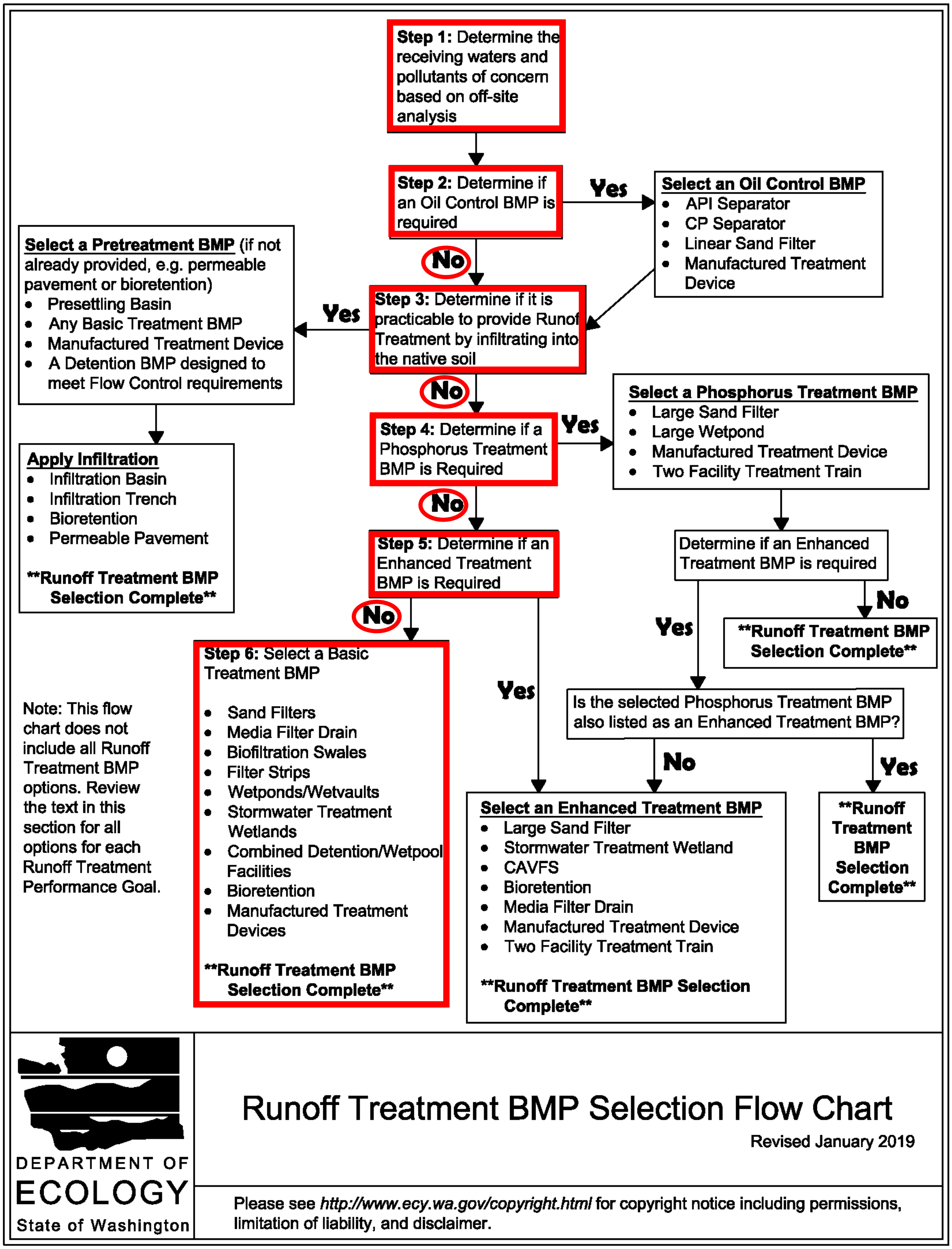
ONSITE

Figure III-1.1: Runoff Treatment BMP Selection Flow Chart



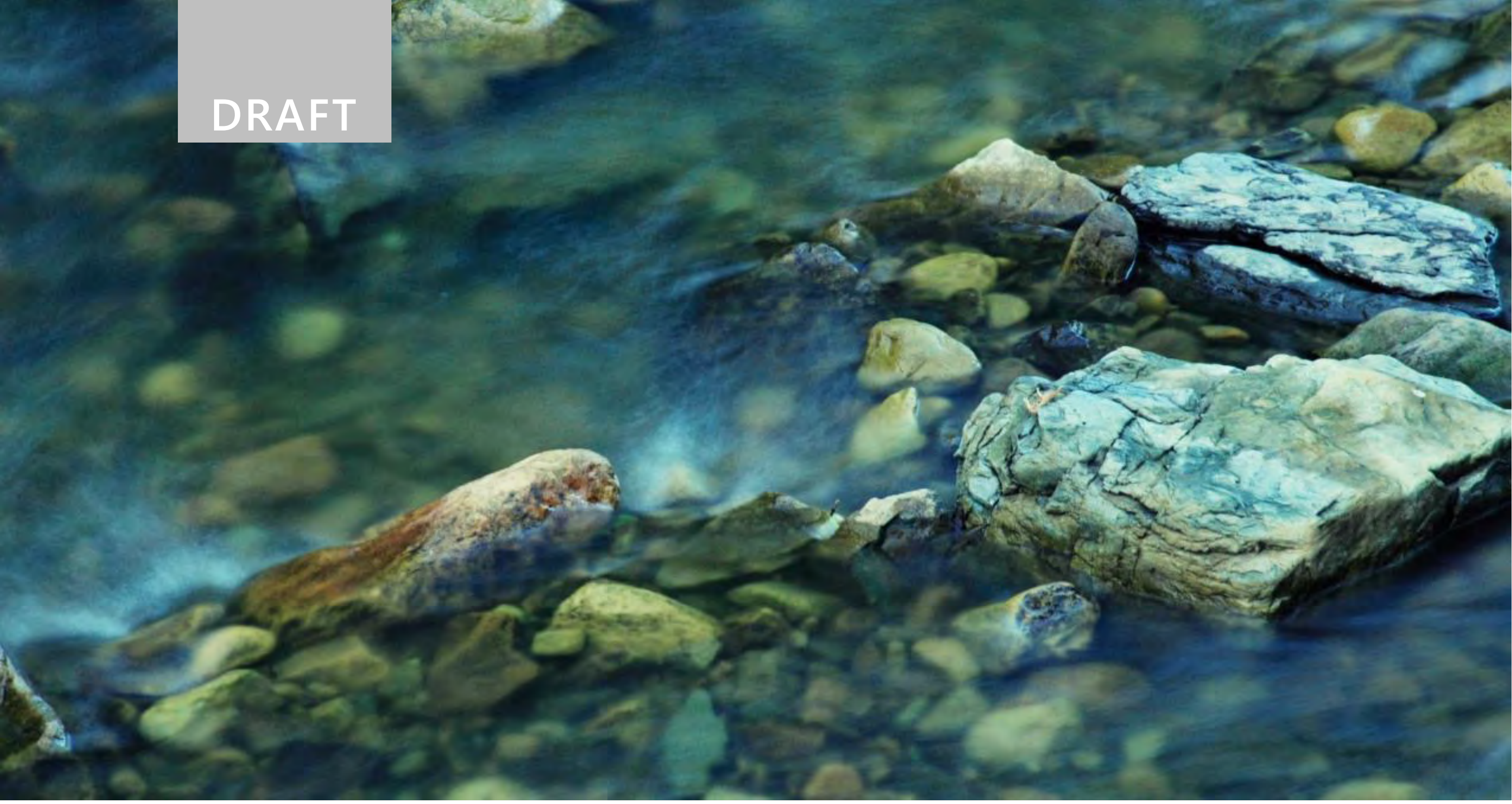
OFFSITE

Figure III-1.1: Runoff Treatment BMP Selection Flow Chart



Tab 6.0

6.0 SPECIAL REPORTS AND STUDIES



September 2022
Freeman Logistics

Critical Areas Report

Prepared for Vector Development Company

DRAFT

September 2022
Freeman Logistics

Critical Areas Report

Prepared for
Vector Development Company
11411 NE 124th Street
Kirkland, Washington 98034

Prepared by
Anchor QEA, LLC
1201 3rd Avenue, Suite 2600
Seattle, Washington 98101

Project Number: 212141-02.01
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FIGURES

APPENDICES

DRAFT

ABBREVIATIONS

2010 Regional Supplement	Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region
BFE	base flood elevation
BMP	best management practice
CAR	Critical Areas Report
City	City of Puyallup
DP	data plot
Ecology	Washington State Department of Ecology
ESA	Endangered Species Act
FAC	facultative
FACU	facultative upland
FACW	facultative wetland
HGM	hydrogeomorphic
NAVD88	North American Vertical Datum of 1988
NMFS	National Marine Fisheries Service
NRCS	National Resources Conservation Service
OBL	obligate wetland
PEM	palustrine emergent
PFO	palustrine forested
PHS	Priority Habitats and Species
PMC	Puyallup Municipal Code
Project	Freeman Logistics project
PSS	palustrine scrub-shrub
redox	redoximorphic
Third-Party Report	Third-Party Review of Critical Areas Report
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation

1 Introduction

Vector Development Company is proposing construction of new industrial buildings as part of the Freeman Logistics project (Project), east of Freeman Road and west of the future Washington State Department of Transportation (WSDOT) SR 167 Extension project. The Project includes redevelopment of 15 adjacent parcels (parcel numbers 0420174075, 0420201040, 0420201039, 0420201045, 0420201066, 0420201101, 0420205003, 0420205017, 0420201027, 0420201052, 0420201034, 0420201036, 0420201042, 0420205004, 0420205016) in Puyallup, Washington. A vicinity map is shown in Figure 1, and an aerial photograph of the Project area and relevant adjoining parcels is shown in Figure 2.

The proposed development would include two commercial warehouses, vehicle and truck parking, widening of access roads, stormwater management, landscaping, and improvements along Freeman Road (Appendix A). The Project has been designed to be consistent with local regulations.

This Critical Areas Report (CAR) has been prepared by Anchor QEA, LLC, ecologists to support the local permitting and land use review of the Project. The CAR evaluates the presence of critical areas within the Project area and potential impacts to existing critical areas and associated regulated buffers, as defined in the City of Puyallup (City) Municipal Code (PMC) Chapter 21 (City of Puyallup 2022a). The format of this CAR has been prepared consistent with PMC 21.06. Critical areas regulated under PMC Chapter 21 include wetlands, streams, fish and wildlife habitat conservation areas, frequently flooded areas, and minor lakes.

Anchor QEA ecologists gathered and reviewed existing information consistent with PMC Chapter 21 to identify and assess existing critical areas. To support this review, Anchor QEA ecologists performed critical areas site visits to the Project site on April 1 and September 28, 2021, and March 11, 2022. The information provided in this CAR has been prepared by professional ecologists using the best available science to provide an accurate evaluation of critical areas and potential impacts. This CAR identifies no wetlands or streams present within the Project area.

1.1 Review of Existing Information

As part of the analysis to identify critical areas, Anchor QEA ecologists reviewed the following sources of information to support field observations:

- PMC (City of Puyallup 2022a)
- City of Puyallup GIS Portal Wetland and Stream Maps (City of Puyallup 2022b)
- Pierce County PublicGIS Interactive Mapping Tool (Pierce County 2022a)
- U.S. Department of Agriculture Natural Resources Conservation Service Web Soil Survey (NRCS 2022)

- National Marine Fisheries Service (NMFS) Endangered Species Act (ESA) status reviews and listing information (NMFS 2022)
- U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory Wetlands Mapper (USFWS 2022a)
- USFWS ESA Status Reviews and Listing Information (USFWS 2022b)
- Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) Maps (WDFW 2022a)
- WDFW SalmonScape Mapping System (WDFW 2022b)
- Aerial photographs publicly available
- Third-Party Review of Critical Areas Report (Third-Party Report) produced by Confluence Environmental Company (Confluence Environmental Group 2022)

1.2 Qualifications

This CAR was prepared following site visits conducted by Anchor QEA on the following dates:

- April 1, 2021
- September 28, 2021
- March 11, 2022

Personnel who contributed to the surveys and preparation of this CAR are listed below:

- Calvin Douglas: Former Anchor QEA wetland scientist, now serving as Senior Ecologist at Confluence Environmental Company responsible for field investigations and reporting; BS Wildlife Biology, University of Washington; Pierce County Certified Wetland Scientist and Wildlife Biologist; Qualified Senior Writer for Biological Assessment, WSDOT, through 2024.
- Laura Caron: Staff 2 Wetland Biologist responsible for field investigations and reporting; BA Environmental Studies and Geology, University of Colorado; MNRS Natural Resource Management and Ecological Restoration, Colorado State University; Certified Wetland Delineator, USACE, 2021; Certified Wetland Rater, Ecology, 2022; Qualified Junior Author for Biological Assessment, WSDOT, through 2028; Qualified Biologist for Preliminary Hydraulic Stream Design and Restoration, WSDOT, 2022.
- Jakob Rowny: Senior Wetland Biologist and Environmental Scientist responsible for reporting; BS Ecology and Evolutionary Biology, University of California; MS Environmental Sciences and Engineering, University of North Carolina; 7 years of wetland delineation, categorization, and critical area assessment and reporting experience in Washington State and Oregon.
- Josh Jensen: Senior Managing Planner responsible for field oversight and code compliance; BS Economics and Environmental Studies, 2007, Western Washington University; MEM 2017, Duke University.

- Dan Berlin, PWS: Principal Scientist responsible for directing and reviewing all field work and documentation; BA Biology, Kalamazoo College; MEM Wetland Science, Duke University.

2 Study Area Description

The Study Area for this CAR includes the 15 adjacent parcels where the Project is located. The Project site encompasses 23.68 acres along Freeman Road (Figure 2). The Project site consists of open lawn areas, residential housing, active livestock and agricultural fields, and gravel roadways. A portion of the eastern boundary is developed; within the undeveloped portion, an agricultural drainage ditch is adjacent to the property on the northeast corner. The west boundary of the Project site is bounded by Freeman Road East. The project site is currently developed for residential and agricultural uses. Photographs of the Study Area are included in Appendix B. No wetlands or streams are located in the Project site. However, WSDOT is working with WDFW to provide a jurisdictional determination for the agricultural ditch and possible wetland boundary delineations and categorizations immediately off-site to the east. Depending on the findings, riparian and wetland habitat buffers may extend into the Study Area (per PMC 21.06).

2.1 Soils

The underlying soils in the Study Area consist of Sultan silt loam and Puyallup fine sandy loam (NRCS 2022). Natural Resources Conservation Service (NRCS) mapped soils are shown in Figure 3.

2.2 Hydrology

The Study Area is located within the Puyallup-White Watershed, Water Resource Inventory Area 10 (Ecology 2022). Hydrologic characteristics in the Study Area are influenced by the areas that drain to the Puyallup River, which originates on Mount Rainier, and Wapato Creek, which is located several thousand feet to the north.

No stream channels or seeps were identified within the Study Area's existing conditions during site visits. During our March 2022 field investigation, a small, disturbed area containing ponded water approximately 3 inches deep was identified at the east side of parcel number 0420174075. WDFW PHS and SalmonScape data do not identify any freshwater surface stream channels to the Puyallup River or Wapato Creek within the Study Area (WDFW 2022a, 2022b).

2.3 Plant Communities

Some undisturbed native vegetation communities are located within the Study Area, but most of the vegetation is composed of open lawn areas, residential homes, active livestock grazing pastures, and gravel roads, with small patches of planted native and ornamental trees and shrubs. The majority of the plantings are shrubs and ground cover species, which appear to receive regular maintenance. Areas of native vegetation are present along the central and eastern border of the Study Area. Photographs of the Study Area are included in Appendix B. Existing plant species within the Study Area are described in Section 3.4.1.

The USFWS National Wetlands Inventory Wetlands Mapper (USFWS 2022a), Pierce County critical area maps (Pierce County 2022), and City sensitive areas maps (City of Puyallup 2022b) do not identify any freshwater wetland habitat within the Study Area (see Figures 4, 5, and 6). Anchor QEA ecologists did not identify any freshwater wetlands in the Study Area during the field investigation in October 2021. During our March 2022 field investigation, Anchor QEA ecologists identified and delineated an artificial wetland in a disturbed area at the east side of parcel number 0420174075. It is our best professional opinion that this wetland is not jurisdictional. Additional information is provided in Section 3.2. Buffers in association with the off-site wetlands and potential riparian area in the WSDOT right-of-way are depicted in Figure 7.

3 Critical Areas Assessment

This section describes and assesses critical areas within and near the Study Area as defined per PMC Chapter 21 (City of Puyallup 2022a) including wetlands, streams, fish and wildlife habitat conservation areas, and frequently flooded areas.

3.1 Methods

To document and describe wetlands, streams, fish and wildlife habitat conservation areas, and frequently flooded areas within the Study Area, Anchor QEA reviewed existing information (Section 1.1) and performed an aerial photograph assessment. Anchor QEA ecologists performed critical areas site visits to the Study Area on April 1 and September 28, 2021, and March 11, 2022, as part of the analysis for the Project. The entire Study Area was accessible during the investigation. During the Project site visits, Anchor QEA ecologists documented general information regarding habitats and dominant plant species and communities. Potential wetland features were evaluated according to methods presented in the U.S. Army Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987); the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (2010 Regional Supplement; USACE 2010); and Field Indicators of Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils, Version 8.1, 2017 (USDA and NRCS 2016). Soil colors were classified by their numerical description as identified on a Munsell Soil Color Chart (Munsell 2000).

The ordinary high water mark of the agricultural ditch—located outside of the Study Area to the east—was not delineated during the Project site visit but was estimated using aerial photos because it is artificially created and the low and high water elevations are dependent upon irrigation in the adjacent agricultural fields east of the Study Area. All wildlife species, tracks, and other signs observed during the Project site visit were documented. All observations were qualitative; no quantitative wildlife surveys were performed. Photographs taken to document vegetation and habitat conditions are included in Appendix B.

This CAR evaluates terrestrial and aquatic habitats and plant communities based on physical observations. Existing information described in WDFW-documented species and priority habitats and ESA-listed species and critical habitats, within and near the Study Area, are also evaluated.

3.2 Wetlands

3.2.1 On-Site Areas

No on-site wetland conditions were observed by Anchor QEA ecologists within the Study Area during the Project site visits, except for the artificial wetland at the east side of parcel number 0420174075 identified in March 2022. Wetland data sheets completed during the September 2021 and March 2022 Project site visits are provided in Appendix C, corresponding to the locations shown in Figure 6. Test plot locations (Figure 6) were collected from the areas that contained an unverified wetland layer (Figure 5) according to City sensitive areas maps (City of Puyallup 2022b), but wetland conditions related to this unverified wetland area were not present anywhere within the Study Area. Additionally, USFWS National Wetlands Inventory data (Figure 4; USFWS 2022a), WDFW PHS data (WDFW 2022a), and Pierce County critical area maps (Pierce County 2022) do not identify wetland areas within at least 1,500 feet of the Study Area, except to the south of 19th Avenue Northwest.

During our March 2022 field investigation, a small disturbed and inundated area was identified at the east side of parcel number 04020174075 (Figures 1 and 7). A total of three Data Plots (DPs) were explored, and our results are included in Appendix C. At DP-9, located at the center and at the lowest elevation of the inundated area, we identified hydric soil and wetland hydrology, but the area had no vegetation. However, at the other two DPs (DP-10 and DP-11) we did not observe all three criteria. In a signed letter dated March 20, 2022 (Appendix D), the previous property owner writes:

> My wife and I have owned this property for over 20 years at the time of selling it in November 2021. During that time, there were two old barns as it was used as an animal farm. At no point in our ownership period was there standing water on the property. We had torn down the shed structures [...] In addition to this work, we had begun to relocate soil from the northeast corner of the property (adjacent to the WSDOT shared property line) to the location of the sheds, with the intent of raising the elevation in the footprint of the sheds. While excavating soil from the northeast, we noticed groundwater seeping up, which led us to stop using material from that location. We left the source material for the soil relocation bare and flat, which resulted in slightly lower elevations than surrounding areas. At no point during our 20+ year ownership was there ponding on-site or even puddles forming during heavy rain events.

Based on this information, and on our observations of site vegetation, soils, and hydrology, it is Anchor QEA's best professional opinion that the disturbed and partially inundated area is a created or artificial wetland and would be non-jurisdictional.

The same definition of wetlands is used in all three of the Washington State laws that regulate wetlands: the Growth Management Act, the Shoreline Management Act, and the Water Pollution Control Act. This definition distinguishes between "natural" and "artificial" wetlands:

> "Wetlands" means areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically

> adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from non-wetland sites including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from non-wetland areas to mitigate the conversion of wetlands.

Washington Department of Ecology provided additional guidance on artificial wetlands in a July 2010 memo titled Focus on Irrigation-Influenced Wetlands (Publication No. 10-06-015; Appendix F) and provides the following test for artificial wetlands:

> In order for a wetland to be considered artificial, it must meet both of the following characteristics:
>
> a. It was intentionally created; and
> b. It is in a formerly non-wetland (upland) site.

Our best professional judgment is that the on-site wetland meets both criteria and is therefore artificial and should be treated as exempt from regulation. The excavation was constructed intentionally. Additionally, the development proposed at the Project site may eliminate surface water runoff to the location of the artificial wetland, and this change may permanently deprive the area of the necessary hydrological input to support the artificial wetland's continuance. Even in cases where wetlands are found to have been unintentionally created—such as those resulting from a leaking irrigation or drainage pipe—repairs made to improve water conservation are not regulated, even if the repair or change in water regime results in the loss of the artificial wetlands.

Our review of Pierce soil mapping in this location (Figure 3*)* supports the determination that the wetlands are located in a formerly non-wetland area, with moderately well-drained soils typically associated with upland plant communities. NRCS maps soils across this portion of the Study Area as Sultan silt loam series and hydric soils are not indicated in close proximity by Pierce County PublicGIS. Because NRCS mapping does not include hydric soils in this area, it is unlikely that the Project site supported any wetlands prior to the excavation. Therefore, being both intentionally created and found in a formerly non-wetland (upland) site, the wetlands observed at the site are artificial and should be treated as exempt from regulation.

3.2.2 Southern Utility Easement Area

Adjacent properties south of 19th Avenue Northwest contain wetlands and associated buffers. These buffers do not extend onto the development area north of 19th Avenue Northwest, because the buffers are interrupted by the roadway. Regulatory buffers only occur on the same side of an existing roadway as the wetland and do not extend to the opposite side from the sensitive area. However, sewer and water lines will be installed in an easement just south of 19th Avenue Northwest that extends to the east and then south to North Levee Road East. During our March 2022 site investigation, Anchor QEA conducted additional wetland delineation work at the northern and eastern sides of the off-site wetland located south of 19th Avenue Northwest to confirm the utility easement would not extend into the wetland area. We recorded our findings in six Wetland Determination Data Forms (Appendix C). The wetland delineation is depicted in Figure 5. A preliminary rating is provided in Appendix C. Off-site Wetland A buffers will be temporarily impacted south of 19th Avenue Northwest during the construction of sewer and water utilities. Potential impacts to off-site Wetland A and associated buffers will be mitigated by construction stormwater best management practices following Pierce County's current Stormwater and Site Development Manual (Pierce County 2022b).

3.2.3 Eastern WSDOT Right-of-Way

As discussed, an agricultural ditch is present east of the Study Area. No wetlands were found to the west of the agricultural ditch during our March 2022 site visit that are in proximity to the Study Area. The Third-Party Report indicated the presence of potential wetland soils west of the ditch; however, our March 2022 site visit determined those soils to be side-cast soils from ditch maintenance that contained hydric soils. These soils are representative of the saturated condition of the ditch sediments prior to being side cast and do not qualify as wetland because they were relocated from the ditch.

However, our communications with the City and our review of the Third-Party Report indicate the presence of off-site wetlands to the east of the Study Area located at parcel numbers 0420201110 and 0420201111 within the WSDOT right-of-way. These two wetlands include Wetland 87, which is a small wetland east of the ditch, and Wetland 85, which is a large wetland located within active agricultural areas east of the ditch. These areas were not directly assessed as they are presumed to be delivered as part of the WSDOT SR 167 Extension project, currently in planning and design stages. Preliminary estimated wetland boundaries and associated buffers are presented in this report, which will be updated once those findings are finalized and made available.

3.2.4 Northwest of Study Area

The Third-Party Report also indicates an additional off-site wetland located to the northwest of the Study Area on the western edge of Freeman Road at parcel number 0420174032. As we did not have permission to access the property, no delineation or rating information is provided in this report. A review of historical aerial imagery and observations from Freeman Road made during the March 2022 site investigation support the likely presence of wetlands at this location. The wetlands likely cover much of the central portion of the parcel and likely has PM1C and PSS1C Cowardin components. Any wetland buffers associated with this wetland are interrupted by Freeman Road, which lies between the off-site wetland and the Study Area.

3.3 Streams

No streams, drainage channels, seeps, or associated riparian habitats were observed by Anchor QEA ecologists within the Study Area during the September or March Project site visits. Additionally, WDFW PHS data (WDFW 2022a), SalmonScape data (WDFW 2022b), and City sensitive areas maps (City of Puyallup 2022b) do not identify any stream channels within 2,000 feet of the Study Area. Pierce County critical area maps (Pierce County 2022) identify Wapato Creek north of the Study Area and the Puyallup River south of the Project site, but they are not located within the Study Area and will not be affected by the Project.

An agricultural ditch is located adjacent to the Study Area to the northeast. This appears to be an artificially created linear feature that may not be regulated as a stream or fish and wildlife habitat conservation area or a shoreline of statewide significance, per PMC Chapter 21 (City of Puyallup 2022a). However, our conversation with the City and review of the Third-Party Report indicates that this status may change based on the findings of WSDOT and WDFW in their critical area assessment related to the WSDOT SR 167 Extension project. For the purposes of this report, a stream buffer has been applied to the ditch, but it is preliminary and conservative in order to support the critical area review for this project. This report will be updated when those findings are made available to us.

3.4 Fish and Wildlife Habitat Conservation Areas

Per PMC 21.06, fish and wildlife habitat conservation areas are areas that provide important nesting territory, as well as spawning and protection areas, for state and federally listed endangered, threatened, and sensitive species that have a primary association with the habitat area and state priority habitats (including species of local importance). No fish and wildlife habitat conservation areas are located within the Study Area.

3.4.1 Vegetation

Some undisturbed native vegetation communities are located within the Study Area. Areas of native vegetation occur along the eastern border of the Project site but are primarily east of the Study Area. Native plant species observed include black cottonwood (*Populus balsamifera*), red alder (*Alnus rubra*), red osier dogwood (*Cornus sericea*), Oregon ash (*Fraxinus latifolia*), Pacific crabapple (*Malus fusca*), common snowberry (*Symphoricarpos albus*), Nootka rose (*Rosa nutkana*), salal (*Gaultheria* *shallon*), northern bracken fern (*Pteridium aquilinum*), English holly *(Ilex aquifolium*), and field horsetail (*Equisetum arvense*). Many invasive species or noxious weeds were also noted as present, including include English ivy (*Hedera helix*), Himalayan blackberry (*Rubus armeniacus*), Evergreen blackberry (*Rubus laciniatus*), Canada thistle (*Cirsium arvense*), and reed canary grass *(Phalarais arundinacea*).

Areas located west of the fence line in the agricultural pastures included varieties of *Agrostis* and *Fescue* grasses, which were regularly mowed or grazed by sheep and llamas. Photographs of vegetation in the Project area are included in Appendix B.

3.4.2 Wildlife and Habitat

The majority of the Study Area includes a managed landscape with mowed grass and ornamental vegetation. Potential habitat is limited to the small patches of native vegetation along the eastern property boundary. Wildlife use of the terrestrial habitat is likely dominated by disturbance-tolerant species typical of urban areas. Habitat surrounding the Project site includes fragmented and disturbed areas associated with residential and commercial development. Wildlife species observed during the September 2021 Project site visit included bird species common in urban areas of Pierce County, including crows (*Corvus brachyrhynchos*), house sparrows (*Passer domesticus*), and gull species (*Larus* spp.). No amphibian, reptile, or mammal species; tracks; or signs were observed during the Project site visits.

The on-site hydrology of the Study Area provides no habitat for aquatic species. The habitat within the agricultural ditch east of the Study Area is dominated by shallow standing water with little to no noticeable flow.

Our review of the Third-Party Report suggests that the off-site ditch may be reclassified from a non-jurisdictional ditch to a stream. According to PMC 21.06.1050, Type I, II, III, and IV streams require buffers widths of 150, 100, 50, and 35 feet, respectively. If the ditch is regulated as a stream, it would be categorized as a Type III stream with a 50-foot-wide buffer because it is not used by anadromous fish (no fish species have been documented in the ditch according to the WDFW PHS and SalmonScape websites) and it is wider than 2 feet (Figure 7).

3.4.3 Priority Species and Habitats

The WDFW PHS data (WDFW 2022a) do not document occurrences of any terrestrial species or priority habitats in the Study Area or within 3,000 feet of the Project site. No fish species have been documented in the off-site ditch according to the WDFW PHS and SalmonScape (WDFW 2022b) websites.

3.4.3.1 ESA-Listed Species and Critical Habitat

The assessment for ESA-listed species and critical habitats for this Project was performed based on data provided for the Project site. The following subsections describe ESA-listed species and critical habitats that may occur in the vicinity of the Study Area.

ESA-listed species and critical habitats under NMFS and USFWS jurisdiction in Western Washington are referenced on the agencies' websites. NMFS identifies ESA-listed species that occur or may occur within a broad geographic area, such as an evolutionarily significant unit or a distinct population segment, rather than a project-specific location (NMFS 2022). The USFWS identifies ESA-listed species that occur or may occur within a specific location where a project is proposed (USFWS 2021b).

3.4.3.2 Federally Listed Species That May Occur in the Study Area

The September 2022 status of federally listed species and critical habitats protected under the ESA that occur or may occur within the Study Area is presented in Table 1. As shown in Table 1, three ESA-listed bird species occur or may occur within the Study Area. One ESA-listed insect species is identified as potentially occurring within the Study Area. Four ESA-listed fish species are present in the nearby Puyallup River, and steelhead trout (*Oncorhynchus mykiss*), Chinook salmon (*Oncorhynchus tshawytscha*), bull trout (*Salvelinus confluentus*), and Dolly Varden (*S. malma*). All four have a designated critical habitat in the Puyallup River. However, these species do not occur or are very unlikely to occur in the Study Area based on the species' life history and habitat requirements. No ESA-listed plant or mammal species are identified as potentially occurring within the Study Area. Fish species listed in Table 1 are located within the Puyallup River but not in the agricultural ditch. These species would not be susceptible to impacts related to construction, as no in-water work is proposed, but they are relevant considering the Project is located within the Puyallup River floodplain.

Table 1
Federally Listed Species That May Occur in Study Area

Species	Status	Agency	Critical Habitat
Birds			
Marbled murrelet (*Brachyramphus marmoratus*)	Threatened	USFWS	Designated (does not include Study Area)
Streaked horned lark (*Eremophila alpestris strigata*)	Threatened	USFWS	Designated (does not include Study Area)
Yellow-billed cuckoo (*Cocczyus americanus*)	Threatened	USFWS	Designated (does not include Study Area)
Insects			
Monarch butterfly (*Danaus plexippus*)	Candidate	USFWS	Designated (does not include Study Area)
Fish			
Steelhead trout (*Oncorhynchus mykiss*)	Threatened	NMFS	Designated – Puyallup River
Chinook salmon (*Oncorhynchus tshawytscha*)	Threatened	NMFS	Designated – Puyallup River
Bull trout (*Salvelinus malma/S. confluentus*)	Threatened	USFWS	Designated – Puyallup River
Dolly Varden (*S. malma/S. confluentus*)	Threatened	USFWS	Designated – Puyallup River

Marbled murrelets are more commonly associated with marine habitat instead of the freshwater habitat in the Study Area. The urbanized and industrial areas within the Project site are unfavorable to marbled murrelets, streaked horned larks, and yellow-billed cuckoos.

3.5 Special Flood Hazard Areas

The Puyallup River flows approximately 1,200 feet south of the Study Area, south of North Levee Road East. The Study Area is located within the 100-year floodplain of the Puyallup River within FEMA Flood Zone AE (FEMA 1999). The base flood elevation (BFE) for the Puyallup River is 33 feet North American Vertical Datum of 1988 (NAVD88); however, the levee along North Levee Road East is not officially certified, meaning the floodplain is mapped as extending onto the Study Area. Per PMC 21.07, the floodplain within the Study Area is a special flood hazard area and a habitat assessment should be prepared by a qualified professional to evaluate the effects and/or indirect effects of the proposed development (during both construction and operation) on floodplain functions. Section 5 of this report documents that the proposed development will not result in impacts to any species listed as threatened or endangered under the ESA.

4 Wetland Delineation

Anchor QEA wetland scientists performed wetland delineation field work on March 11, 2022. One wetland was delineated off-site: Wetland A, a category III emergent scrub-shrub and forested depressional wetland located to the south of 19th Avenue Northwest. One artificial wetland was delineated on-site: Wetland B, an unrated emergent depressional wetland located on the eastern portion of parcel number 0420174075. Following our review of the Third-Party Report, we also identified four other off-site wetlands, with three located on the WSDOT owned properties to the east and one located to the west of Freeman Road. Once the results of the WSDOT SR 167 Extension CAR are provided, this report will be updated to include the off-site wetland's final ratings and associated wetland buffer widths. Figure 7 provides a preliminary depiction of the wetlands and how their anticipated buffers may extend onto the eastern side of the Study Area.

The following sections describe the methodology and results of the wetland delineation. Critical areas figures are attached to this CAR, including wetland delineation results in Figure 5. Site photos are included in Appendix B, wetland determination data forms and wetland rating forms are provided in Appendix C.

4.1 Methodology

This section describes the methodology used to perform the wetland delineation, including the review of existing information and field investigation procedures. These methods are consistent with current federal and state agency requirements, as well as local jurisdiction requirements, for performing wetland delineations and identifying protective wetland buffer widths.

Field work was conducted according to methods presented in the U.S. Army Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987); 2010 Regional Supplement (USACE 2010); and Field Indicators of Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils, Version 8.1, 2017 (USDA and NRCS 2016). Soil colors were classified by their numerical description as identified on a Munsell Soil Color Chart (Munsell 2000).

The U.S. Army Corps of Engineers defines wetlands as follows:

> Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. (Environmental Laboratory 1987)

The method for delineating wetlands is based on the presence of three parameters: hydrophytic vegetation, hydric soils, and wetland hydrology. Hydrophytic vegetation is "the macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanently or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present" (Environmental Laboratory 1987). Hydric soils are "formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (Environmental Laboratory 1987). Wetland hydrology "encompasses all hydrologic characteristics of areas that are periodically inundated or have soils saturated to the surface for a sufficient duration during the growing season" (Ecology 1997). Data collection methods for each of these parameters are described in the following subsections.

A total of 12 data plots were sampled and recorded. Vegetation, soils, and hydrology information were collected at each of the plots and recorded on field data sheets (Appendix C). Wetland boundaries were determined based upon plot data and visual observations of the wetland. The wetland location, wetland boundary, and data plot locations were flagged and recorded by Anchor QEA wetland scientists using a Trimble Geo7x GPS unit.

4.1.1 Vegetation

Plant species occurring in each plot were recorded on field data forms, with one data form per plot. Percent cover for each plant species was estimated in the plot, and dominant plant species were identified. At each plot, trees within a 30-foot radius, shrubs and saplings within a 15-foot radius, and herb and forb species within a 5-foot radius from the center of the plot were identified and recorded. Plant indicator status was determined using the National Wetland Plant List: 2016 Wetland Ratings (Lichvar et al. 2016), and a determination was made as to whether the vegetation in the plot was hydrophytic. To meet the hydrophytic parameter, more than 50% of the dominant species, with 20% or greater cover, must have an indicator of obligate wetland (OBL), facultative wetland (FACW), or facultative (FAC). Table 2 shows the definitions for each wetland indicator status category.

Table 2
Wetland Plant Indicator Status Definitions

Indicator Status	Description
Obligate Wetland (OBL)	Plant species occur almost always in wetlands (estimated probability greater than 99%) under natural conditions.
Facultative Wetland (FACW)	Plant species usually occur in wetlands (estimated probability 67% to 99%) but are occasionally found in non-wetlands.
Facultative (FAC)	Plant species are equally likely to occur in wetlands or non-wetlands (estimated probability 34% to 66%).
Facultative Upland (FACU)	Plant species usually occur in non-wetlands (estimated probability 67% to 99%) but are occasionally found in wetlands.
Obligate Upland (UPL)	Plant species occur almost always in non-wetlands (estimated probability greater than 99%) under natural conditions.

Source: Reed 1988

4.1.2 Soils

Soils were sampled in each plot and evaluated for hydric soil indicators. Soil pits were dug to a depth of 18 inches, unless a restrictive layer was present. Hydric soil indicators include low soil matrix chroma, gleying, and redoximorphic (redox) features. Redox features are spots of contrasting color that occur within the soil matrix (the predominant soil color). Gleyed soils are predominantly bluish, greenish, or grayish in color.

4.1.3 Hydrology

Wetland hydrology was evaluated at each plot to determine whether it "encompasses all hydrologic characteristics of areas that are periodically inundated or have soils saturated to the surface for a sufficient duration during the growing season" (Ecology 1997). Field observations of saturation, inundation, and other indicators of wetland hydrology, such as water-stained leaves and drainage patterns in wetlands, were recorded.

4.1.4 Wetland Community Types

Wetland community types are discussed according to the USFWS classification developed by Cowardin et al. (1979) for use in the National Wetlands Inventory (Cowardin system). This system, published in 1979 by a team of USFWS scientists led by L.M. Cowardin, bases the classification of wetlands on their physical characteristics, such as the general type of vegetation in the wetland (e.g., trees, shrubs, grass) and how much, and where, water is present in the wetland. The Cowardin system provides a classification for every known wetland type that occurs throughout the United States, and under this system a wetland can be classified as having one or more wetland community types. The community types found during this investigation included the following:

- **Palustrine emergent (PEM):** These wetlands have erect, rooted, herbaceous vegetation present for most of the growing season in most years.
- **Palustrine scrub-shrub (PSS):** These wetlands have 30% cover of woody vegetation that is less than 20 feet high.
- **Palustrine forested (PFO):** These wetlands have at least 30% cover of woody vegetation that is at least 20 feet high.

4.1.5 Wetland Ratings

Wetland ratings were determined using the most current version of the *Washington State Wetland Rating System for Western Washington: 2014 Update* (Washington rating system; Hruby 2014) and according to the City of Puyallup wetland rating criteria, as defined in the PMC. The Washington rating system was updated by Ecology as of January 1, 2015.

The system developed by Ecology is used to differentiate wetlands based on their sensitivity to disturbance, their significance in the watershed, their rarity, our ability to replace them, and the beneficial functions they provide to society. The Washington rating system requires the user to collect specific information about the wetland in a step-by-step process. Three major functions are analyzed: water quality improvement, hydrologic functions, and wildlife habitat. Ratings are based on a point system, where points are given if a wetland meets specific criteria related to the wetland's potential and opportunity to provide certain benefits.

Per the Washington rating system, wetlands are categorized according to the following criteria and associated point system where points are awarded to three functional value categories (water quality improvement, hydrologic functions, and habitat):

- **Category I wetlands** (23 or more points) represent a unique or rare wetland type, are more sensitive to disturbance, or are relatively undisturbed and contain ecological attributes that are impossible to replace within a human lifetime.
- **Category II wetlands** (20 to 22 points) are difficult, though not impossible, to replace and provide high levels of some functions.
- **Category III wetlands** (16 to 19 points) have moderate levels of functions. They have been disturbed in some ways and are often less diverse or more isolated from other natural resources in the landscape than category II wetlands.
- **Category IV wetlands** (less than 16 points) have the lowest levels of functions and are often heavily disturbed.

PMC classifies wetlands into four categories (categories I, II, III, and IV) based on the Washington rating system.

4.1.6 Wetlands Function Assessment

The functions of wetlands were rated according to the Washington rating system. Using this system, wetlands were rated based on points awarded to three categories of functions: water quality, hydrologic functions, and wildlife habitat. Detailed scoring, based on Washington wetland rating forms, is provided in Appendix C.

4.1.7 State Hydrogeomorphic Classification System

Scientists have come to understand that wetlands can perform functions in different ways. The way a wetland functions depends to a large degree on hydrologic and geomorphic conditions. To recognize these differences among wetlands, a way to group or classify them has been developed. This classification system, called the hydrogeomorphic (HGM) classification, groups wetlands into categories based on the geomorphic and hydrologic characteristics that control many functions.

The Washington rating system incorporates the HGM classification as part of the questionnaire for characterizing a wetland's functions. The Washington rating system uses only the highest grouping in the HGM classification: wetland class. Wetland classes are based on geomorphic settings, such as riverine, slope, lake fringe, or depressional. A classification key is provided within the rating form to help identify which of the following HGM classifications apply to the wetland: riverine, depressional, slope, lake fringe, tidal fringe, or flats.

4.2 Results

Anchor QEA wetland scientists delineated one wetland (Wetland A; off-site) and one artificial wetland (Wetland B; on-site) within the Study Area (Figure 7). These wetlands are summarized in Tables 3 and 4 and described in more detail in the following subsections. Site photographs showing these features are included in Appendix B. Wetland determination data forms are provided in Appendix C.

Table 3
Wetlands Delineated Within the Study Area

Wetland	Cowardin Class[1]	HGM Class	Category	Total Wetland Area	
				Square Feet	Acres
A	PEM1C, PSS1C PFO1C	Depressional	III	323,650	7.43
B	PEM1C	Depressional	Artificial	1,218	0.03

Notes:
1. PEM1C: palustrine, emergent, persistent, seasonally flooded; PSS1: palustrine, scrub-shrub, persistent, seasonally flooded: PFO1C: palustrine, forested, persistent, seasonally flooded

For the Washington rating system, a low, moderate, or high rating is based on three functions: improving water quality, hydrologic, and habitat. Within each of these three functions are three subfunction categories: site potential, landscape potential, and value. Each of these subfunction categories is rated as low, moderate, or high. Wetland functions and scores for Wetland A using the Washington rating system are shown in Table 5. The Washington wetland rating forms are provided in Appendix C.

Table 4
Summary of Scores for Wetland Functions and Values

Wetland and Function	Improving Water Quality	Hydrologic	Habitat	Total Functions Score[1]	Washington State Rating	Puyallup Rating
Wetland A						
Site Potential	Moderate	Moderate	Moderate	--	--	--
Landscape Potential	Moderate	High	Low	--	--	--
Value	Moderate	Moderate	Low	--	--	--
Score Based on Rating[1]	6	7	4	17	III	III

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Wetland and Function	Improving Water Quality	Hydrologic	Habitat	Total Functions Score[1]	Washington State Rating	Puyallup Rating
Wetland B						
Site Potential	NA	NA	NA	--	--	--
Landscape Potential	NA	NA	NA	--	--	--
Value	NA	NA	NA	--	--	--
Score Based on Rating[1]	-	-	-	-	-	-

Notes: Potential total score per function is 9, for a potential total score of 27. Wetland B rating is not applicable (NA), as it is an artificial wetland.

The following sections describe the wetlands identified during our field investigations and wetland delineation. The wetland is classified and rated according to the Cowardin system and the Washington rating system.

4.2.1 Wetland A

Wetland A is 7.43 acres (323,650 square feet) with PEM, PSS, and PFO vegetation classes and has a depressional HGM classification. The approximate wetland position is mapped on Pierce County's PublicGIS wetland inventory (Pierce County 2022). In March 2022, Anchor QEA ecologists provided an additional delineation along the northern and eastern boundaries and the current extent was confirmed (Figure 7).

4.2.1.1 Vegetation

Wetland A is dominated by forest vegetation species such as black cottonwood (*Populus trichocarpa*; FAC), red alder (*Alnus rubra*; FAC), and red osier dogwood (*cornus sericea*; FACW), interspersed with a few patches of Himalayan blackberry (*Rubus armeniacus*; FAC). Other species found along the eastern edge of the wetland include Sitka spruce (*Picea sitchensis*; FAC), osoberry (*Oemleria cerasiformis;* FACU), snowberry (*Symphoricarpos albus*; FACU), red current (*Ribes sanguineum*; FACU), salmonberry (*Rubus spectabilis*; FAC), and common ivy (*Hedera helix*; FACU).

Overall, the vegetation in Wetland A meets the dominance test hydrophytic vegetation indicator and satisfies the hydrophytic vegetation criteria of the 2010 Regional Supplement (USACE 2010).

4.2.1.2 Soils

Soils in Wetland A are mapped as Pilchuck fine sand, a soil type that is classified as hydric. The soils observed in Wetland A were generally dark at the surface, with a depleted matrix below and redoximorphic features increasing with depth. Upon inspection, the predominant textures were confirmed to be silt loam and sandy loam.

Overall, soil samples met the Depleted Below Dark Surface (A11) hydric soil indicator, satisfying the hydric soil criteria of the 2010 Regional Supplement.

4.2.1.3 Hydrology

Wetland hydrology was confirmed in Wetland A at two data points by a surface water (A1), high water table (A2), saturation (A3), inundation visible on aerial imagery (B7), sparsely vegetated concave surface (B8), and water-stained leaves (B9). The primary water regimes of Wetland A were determined to be permanently flooded, seasonally flooded, and saturated.

4.2.1.4 Boundary Determination

The eastern and northern wetland and upland boundaries of Wetland A were determined by an abrupt change in topography and the presence of hydric soils, wetland hydrology, and hydrophytic vegetation. The southern boundary was estimated from publicly available aerial imagery and the Pierce County GIS Wetlands Layer. The southern boundary was not delineated during the March 11, 2022, site visit.

4.2.1.5 Wetland Functions Scores and Rating

Wetland A is rated as a category III wetland, with a score of six for water quality functions, a score of seven for hydrologic functions, and a score of four for habitat functions. The ratings are discussed in more detail in the following sections, and the wetland rating form for Wetland A is provided in Appendix C. Wetland B was not rated as it is artificial and likely non-jurisdictional.

4.2.1.5.1 Water Quality Functions

Wetland A has moderate functions for improving water quality based on the Washington rating system for all three components: site potential, landscape potential, and value. Contributing factors to this function rating include that the wetland is in a depression with no surface water leaving it (no outlet), persistent not grazed plants covering more than 50% of the wetland, the absence of septic systems within 150 feet, and the presence of a 303(d)-listed aquatic resource within the subbasin.

4.2.1.5.2 Hydrologic Functions

Wetland A has moderate, high, and moderate hydrologic functions based on the Washington rating system for site potential, landscape potential, and value, respectively. Factors that contribute to this function include marks of ponding greater than 3 feet deep, intensive land uses within the subbasin, stormwater discharging directly into the wetland, and surface flooding problems in a subbasin further down-gradient from the wetland.

4.2.1.5.3 Habitat Functions

Wetland A has moderate, moderate, and low habitat functions based on the Washington rating system for site potential, landscape potential, and value, respectively. Factors that contribute to this function include: the presence of three Cowardin plant classes and three hydroperiods; large, downed woody debris; standing snags; stable steep banks of fine material; thin-stemmed persistent plants for amphibian habitat; adjacent high land use intensity; and the lack of nearby undisturbed habitat.

4.2.1.6 Puyallup Wetland Buffer Guidance

Required wetland buffers have been identified according to the current PMC. PMC identifies minimum protective buffer widths for category III wetlands based on the Ecology habitat rating score, per the Washington rating system, and land use intensity. Per PMC 21.06.930 2 (D), the minimum proposed buffer width for a category III wetland with a habitat score of 3 to 5 points and high land use intensity on the upland side of the buffer is 80 feet, measured from the wetland boundary as delineated in the field. Therefore, the proposed buffer width for Wetland A is 80 feet. However, any Wetland A buffer that may project onto the Study Area is interrupted by a roadway (19th Avenue Northwest) that lies between the wetland and the Study Area. The temporary impacts from the proposed sewer easement through the northern and eastern buffer are discussed in Section 5.

4.2.2 Wetland B

As discussed in Section 3.2.1, Wetland B is an artificial wetland and is not regulated.

4.2.3 Eastern WSDOT Right-of-Way

A small wetland, identified as Wetland 87, was delineated on the WSDOT right-of-way property by WSDOT consultants. It is located east of the ditch. The preliminary rating is a category III wetland with a low habitat score, which is based on field reconnaissance nearby the wetland from the west side of the ditch. Per PMC 21.06.930 2 (D), the minimum proposed buffer width for a category III wetland with a habitat score of 3 to 5 points and high land use intensity on the upland side of the buffer is 80 feet, measured from the wetland boundary as delineated in the field. This buffer does not extend onto the Study Area.

A larger wetland, identified as Wetland 85, was delineated on the WSDOT right-of-way property by WSDOT consultants. It is located east of the ditch and is in an active agricultural area. The preliminary rating is a category IV wetland with a low habitat score, based on field reconnaissance near the wetland from the west side of the ditch. Per PMC 21.06.930 2 (E), the minimum proposed buffer width for a category IV wetland with a high land use intensity on the upland side of the buffer is 50 feet, measured from the wetland boundary as delineated in the field. This buffer does not extend onto the Study Area.

5 Critical Areas Impact Assessment

This section provides a summary of potential impacts to wetlands and fish and wildlife habitat conservation areas.

Project construction activities will not occur in stream or regulated wetland areas. The Project will not have measurable short-term or long-term impacts on wildlife species. Noise associated with construction activities could result in avoidance behavior by some wildlife species, if they are present. However, the Study Area is an industrial, agricultural, and residential area that experiences ongoing human disturbance. Noise levels associated with operation of the Project site after construction are expected to be consistent with current ambient noise levels.

5.1 On-Site Wetlands and Buffers

A sewer line is proposed to be installed within the Wetland B buffer. This will result in a temporary impact to the buffer, which will be restored following construction. The easement is 40 feet wide and is located south of 19th Avenue Northwest, extending to the east on parcel 0420201114 for about 640 feet and south for about 310 feet until it meets the O'Reilly Auto Parts property (total easement area is 37,973 square feet). Temporary impacts will result from removal of black cottonwood, red alder, and red osier dogwood trees, along with removal of Himalayan blackberry and a few native shrubs. Large trees within the 40-foot easement will be avoided, to the extent feasible. The temporary impact area will be restored with installation of native shrubs, such as osoberry, snowberry, red current, and salmonberry, and a native grass seed mix.

Buffers for wetlands located around the Study Area do not extend onto the proposed development area. Therefore, no permanent impacts are anticipated for wetland buffers. This includes buffers for Wetlands 85 and 87 located in the WSDOT right-of-way and for the off-site wetland located east of Freeman Road.

5.2 On-Site Stream Buffer

The agricultural ditch may be classified as a class III stream, which would carry a 50-foot buffer, pending final determination from WDFW. A 50-foot buffer projected onto the Study Area results in approximately 1,540 square feet, with 1319 square feet on parcel 0420174075 and 221.10 square feet on parcel 0420205016. We estimate the maximum width of the on-site buffer to be approximately 29 feet. The proposed development has been reduced to avoid impacts to this stream buffer, as shown the Site Plan included in Appendix A.

5.3 Special Flood Hazard Areas Habitat Assessment

The Study Area is located within the 100-year floodplain of the Puyallup River and within a Pierce County designated special flood hazard area. As discussed in Section 3.5, the Puyallup River flows approximately 1,200 feet south of the Study Area, south of North Levee Road East. The proposed Project includes construction activities within the 100-year floodplain (Appendix A). The Project will be constructed within the footprint of current low-density residential lots and agricultural fields that experience ongoing human use and disturbance from automobiles, livestock, and agricultural activities.

The BFE is 33 feet NAVD88 in this area, and the two warehouse buildings will be elevated so that the finish floor is elevated approximately 2 to 3 feet above the BFE. This will place all electrical and other equipment at least 2 to 3 feet above the BFE as well. These design features will avoid or minimize potential impacts to the floodplain, reduce the potential for inundation during flood events, and meet City of Puyallup requirements. The orientation of the proposed warehouses will be situated in line with one another (the northern warehouse will be within the hydraulic shadow of the southern building to align with anticipated flood flows through the property when they occur). This design is intended to minimize potential impacts on floodwater velocity.

To construct the proposed structures, a net import of fill will be required within the floodplain and will be required to elevate the buildings and install structure foundations. A rock gallery (drywell with clean crushed rock and perforated distribution pipes) will be constructed below the building slabs. Each building will have between 2.5 feet and 3 feet depth of rock with 0.4 void ratio. The net import of fill material will have a localized impact on flood storage capacity. However, no net loss of storage capacity will occur due to the balance provided by the proposed stormwater facilities. Material removed from the floodplain will be located within the same floodplain cross section and perpendicular to the flow. These mitigation measures are anticipated to result in zero net fill and will not cause any rise to the BFE within the floodplain, consistent with PMC 21.07.

The federal habitat assessment guidelines require an analysis of other potential impacts to the floodplain environment. The following includes an analysis of habitat assessment elements per the minimum habitat assessment standards:

- **Project and action area description, maps, and site plans have been provided.** See Project Description and figures in Appendix A.
- **Methods of work are described.** See Project Description and figures in Appendix A.
- **Projects in the Protected Area are designed to inherently avoid detrimental impacts without mitigation.** The Project is located within the footprint of residential and agricultural fields that experience ongoing human use and disturbance. The Project is designed to avoid or minimize potential detrimental impacts through the orientation of the buildings relative to flood flows, the construction of rock galleries underlying the building slabs and stormwater facilities, and removal of soils from other properties within the floodplain.
- **Direct and indirect impacts.** Direct impacts include minor impacts to the floodplain from construction as described in this CAR. Long-term impacts include the presence of structures

within the floodplain in an area previously used for residences and agriculture. The long-term environmental benefits from the Project, including improved water quality from runoff, are anticipated to offset any potential short-term impacts from construction and operation of the facility. Indirect impacts from the Project may include improved downstream water quality in the Puyallup River and reductions in nutrient loads to the Puyallup River from runoff and during flood events.

- **Interrelated and interdependent activities.** All development impacts associated with this Project are described in this CAR. No other projects are known that would result in interrelated and interdependent activities.
- **Cumulative impacts.** Cumulative impacts are those that could result in the combination of effects from individual project actions occurring over time. If left unmitigated, the cumulative or incremental effects of these actions have the potential to result in significant environmental impacts. The Project is located within an area characterized by residences, agricultural fields and associated structures, and industrial buildings, such as warehouses. At the time of publication, there are no nearby projects that are anticipated to contribute to cumulative impacts at this time. However, it is anticipated that future projects in the area would be required to conduct a separate, project-specific environmental review, as appropriate. It is anticipated that mitigation measures implemented for each project would decrease the potential for cumulative adverse effects on the environment.
- **Other habitat assessment elements include the following:**
  1. **Water quantity and quality.** As described previously, the Project is anticipated to result in a net improvement to water quality from runoff and during flood events due to the construction of stormwater facilities. During construction, stormwater control measures will be implemented to avoid or minimize potential short-term construction impacts on water quality to be shown in a Stormwater Pollution Prevention Plan and Temporary Erosion and Soil Control Plan. A Stormwater Site Plan will also be prepared, describing the stormwater control best management practices (BMPs) incorporated into the Project to meet the requirements of the City of Puyallup stormwater regulations. The Project will have no impact on water quantity.
  2. **Flood velocities and volumes.** As described previously, the Project has been designed to accommodate flood velocities through orientation of the structures (with the north warehouse designed to be within the hydraulic shadow of south warehouse) and to align them with floodwaters. The Project will not create any rapid water runoff conditions and therefore will not impact flood flows downstream. The Project will have a negligible impact on flood volumes.
  3. **Flood storage capacity.** Earthwork cuts and fills will be balanced at the site to the extent possible. The construction of rock galleries with a 0.4 void ratio below the warehouses and storm water facilities will provide no net loss to flood storage capacity.

4. **Riparian vegetation.** The Project is located over 1,200 feet from the Puyallup River and associated riparian buffers. No riparian vegetation will be impacted by the Project.
5. **Measures to preserve habitat forming processes.** No in-water work is proposed, and no impacts to habitat forming processes will occur from the Project; therefore, no measures to preserve habitat forming processes are proposed.
6. **Refuge from higher velocity floodwaters is provided.** The presence of the structures within the floodplain may provide limited refuge from higher velocity floodwaters. No additional measures are proposed.
7. **Spawning substrate is provided or protected.** No in-water work or work in the vicinity of salmonid spawning habitat is proposed, and no impacts to spawning substrate will occur from the Project; therefore, no spawning substrate needs to be provided by the Project.
8. **No adverse effects from habitat isolation, bank armoring, channel straightening, construction effects (transport of sediment from the work area, noise, etc.), or direct effects.** No habitat isolation, bank armoring, or channel straightening is proposed as part of the Project. To avoid or minimize potential construction effects from the Project, stormwater control measures will be implemented to avoid or minimize potential construction impacts on water quality and will be shown in the Stormwater Pollution Prevention Plan and Temporary Erosion and Soil Control Plan. As described above, a Stormwater Site Plan will also be prepared describing the stormwater control BMPs incorporated into the Project to meet the requirements of the City of Puyallup stormwater regulations. Overall, the long-term environmental benefits from the Project, including improved water quality from runoff, are anticipated to offset any potential short-term impacts from construction and operation of the facility.

For the reasons stated above, the proposed project may effect, but is not likely to adversely affect listed fish NMFS species, as evaluated per the NMFS Biological Opinion for the NFIP (NMFS 2008), or listed USFWS species.

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6 References

City of Puyallup, 2022a. “Puyallup Municipal Code.” Accessed August 24, 2022. Available at: https://www.codepublishing.com/WA/Puyallup/.

City of Puyallup, 2022b. Inventory of Designated Puyallup Wetlands. City of Puyallup GIS Portal Wetland and Stream Maps. Accessed August 24, 2022. Available at: https://gis-portal-puyallup.opendata.arcgis.com/datasets/puyallup::wetlands/explore?location=47.184207%2C-122.289624%2C13.58.

Confluence Environmental Group, 2022. *Vector Development Company Freeman Road Logistics Warehouse: Third-Party Review of Critical Areas Report*. March 4, 2022.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe (Cowardin et al.), 1979. *Classification of Wetlands and Deepwater Habitats of the United States.* FWS/OBS-79/31. U.S. Fish and Wildlife Service. December 1979.

Ecology (Washington State Department of Ecology), 1997. *Washington State Wetland Identification and Delineation Manual.* Publication No. 96-94. 1997.

Ecology, 2022. “WRIA 10 Puyallup-White Watershed.” Water Resource Inventory Area Maps. Accessed August 24, 2022. Available at: https://ecology.wa.gov/Water-Shorelines/Water-supply/Water-availability/In-your-watershed/Puyallup-White.

Environmental Laboratory, 1987. *Corps of Engineers Wetland Delineation Manual.* Technical Report Y-87-1. U.S. Army Waterways Experiment Station. January 1987.

FEMA (Federal Emergency Management Agency), 1999. FEMA Flood Insurance Rate Map (FIRM). Community Panel Number 53053C0329E. Accessed September 15, 2022. Available at: https://msc.fema.gov/portal

Hruby, T., 2014. *Washington State Wetland Rating System for Western Washington: 2014 Update.* Washington State Department of Ecology. Publication No. 14-06-029. October 2014.

Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin, 2016. “The National Wetland Plant List: 2016 wetland ratings.” *Phytoneuron* 2016(30): 1–17.

Munsell (Munsell Color), 2000. *Munsell Soil Color Charts.* Grand Rapids, MI: Munsell Color.

NMFS (National Marine Fisheries Service), 2022. “Regions – West Coast.” Endangered Species Act status reviews and listing information. Accessed August 24, 2022. Available at: http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/salmon_and_steelhead.html.

NRCS (U.S. Department of Agriculture Natural Resources Conservation Service), 2022. "Web Soil Survey." Accessed August 24, 2022. Available at: http://websoilsurvey.nrcs.usda.gov/app.

Pierce County, 2022a. "GIS Map Applications." Pierce County PublicGIS Interactive Mapping Tool. Accessed August 24, 2022. Available at: https://www.piercecountywa.gov/2281/GIS-Map-Applications.

Pierce County, 2022b. "The Pierce County Stormwater Management and Site Development Manual" Pierce County Stormwater Management and Site Development Manual. Accessed August 24, 2022. Available at: https://www.piercecountywa.gov/DocumentCenter/View/106293/Stormwater-Management-and-Site-Development-Manual20210701.

USACE (U.S. Army Corps of Engineers), 2010. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region*. Version 2.0. J.S. Wakeley, R.W. Lichvar, and C.V. Noble (eds). ERDC/EL TR-10-3. Vicksburg, Mississippi: U.S. Army Engineer Research and Development Center.

USDA (U.S. Department of Agriculture), 2019a. Aerial image from USDA National Agriculture Imagery Program. Accessed October 2021. Available at: https://www.fsa.usda.gov/programs-and-services/aerial-photography/imagery-programs/naip-imagery/.

USDA, 2019b. "Web Soil Survey." Natural Resources Conservation Service Soil Data. Accessed August 24, 2022. Available at: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

USDA and NRCS, 2016. *Field Indicators of Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils*. Version 8.1, 2017.

USFWS (U.S. Fish and Wildlife Service), 2022a. "National Wetlands Inventory – Wetlands Mapper." Accessed August 24, 2022. Available at: https://www.fws.gov/wetlands/.

USFWS, 2022b. "IPaC Information for Planning and Consultation." Endangered Species Act Status Reviews and Listing Information. Accessed August 24, 2022. Available at: https://ecos.fws.gov/ipac/.

WDFW (Washington Department of Fish and Wildlife), 2022a. "Priority Habitats and Species: Maps." Accessed August 24, 2022. Available at: http://wdfw.wa.gov/mapping/phs/.

WDFW, 2022b. "SalmonScape." WDFW Mapping System. Accessed August 24, 2022. Available at: http://apps.wdfw.wa.gov/salmonscape/.

Figures

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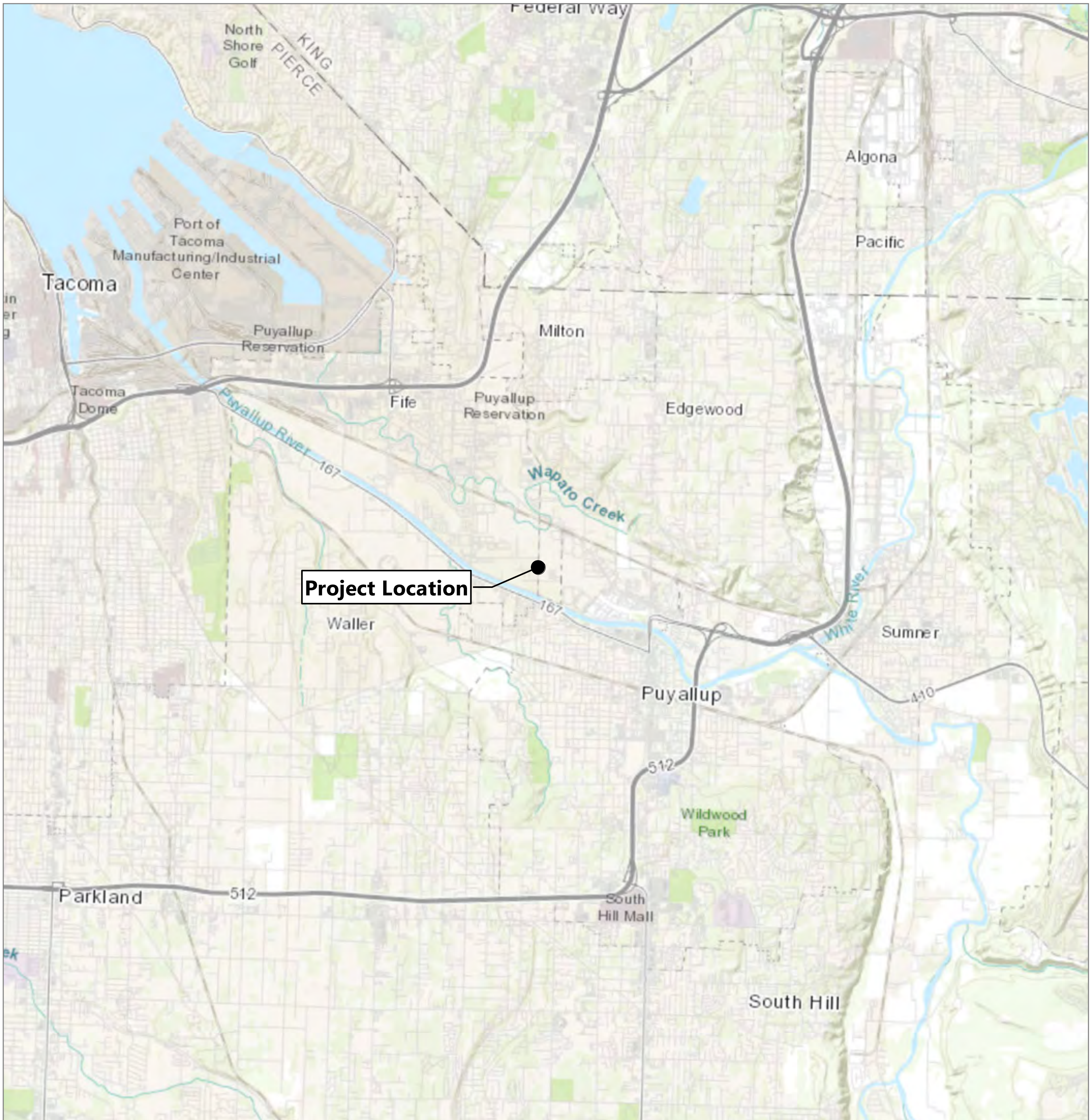

NOTES:
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

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Figure 1
Vicinity Map
Critical Area Report
Freeman Road Logistics

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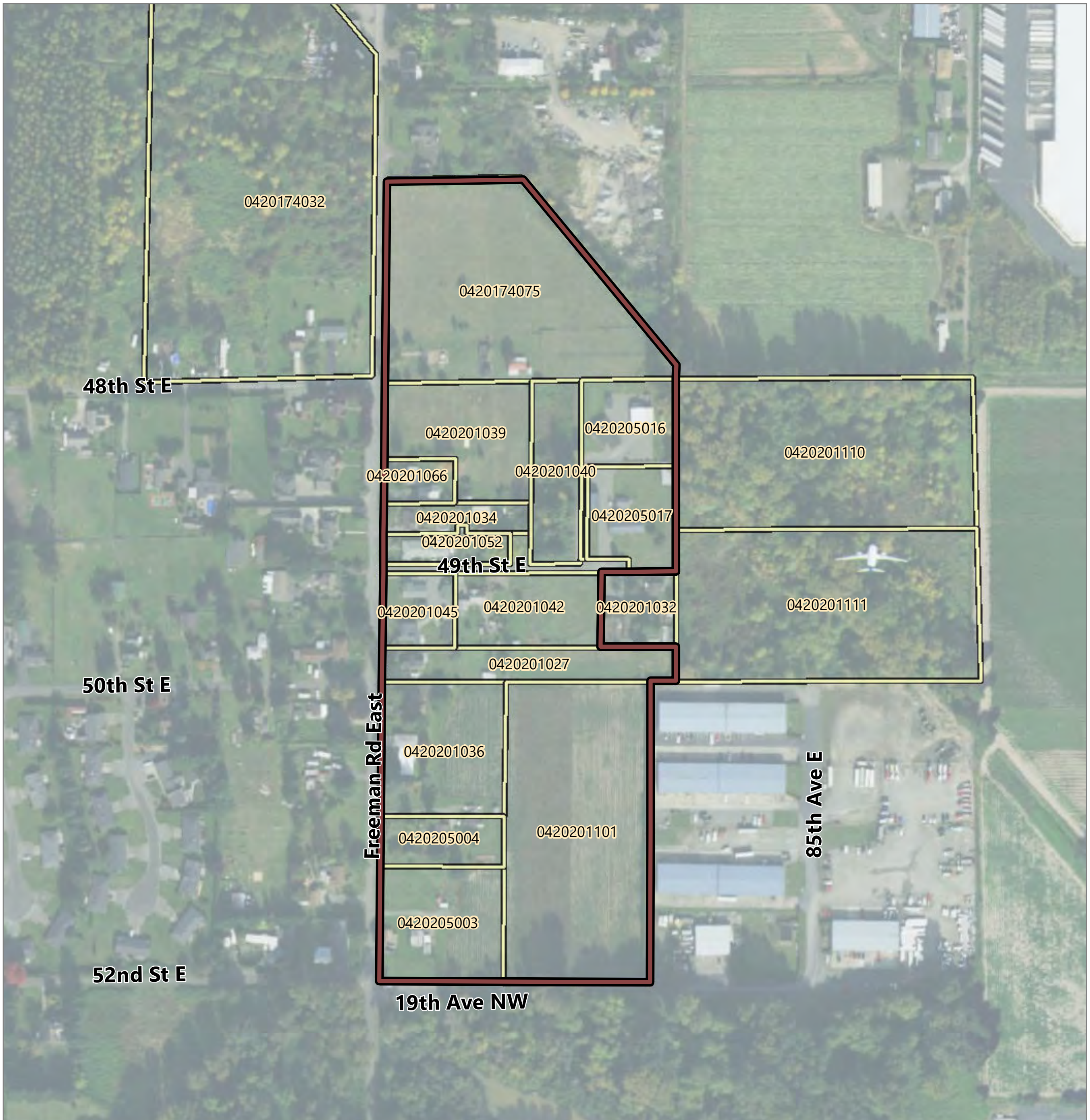

LEGEND:

Study Area

Parcel Boundary

NOTES:
1. Parcel boundaries acquried from Pierce County on October 14, 2012.
2. Aerial image is U.S. Department of Agriculture National Agriculture Imagery Program (USDA 2019a).

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Figure 2
Study Area and Existing Conditions
Critical Area Report
Freeman Road Logistics

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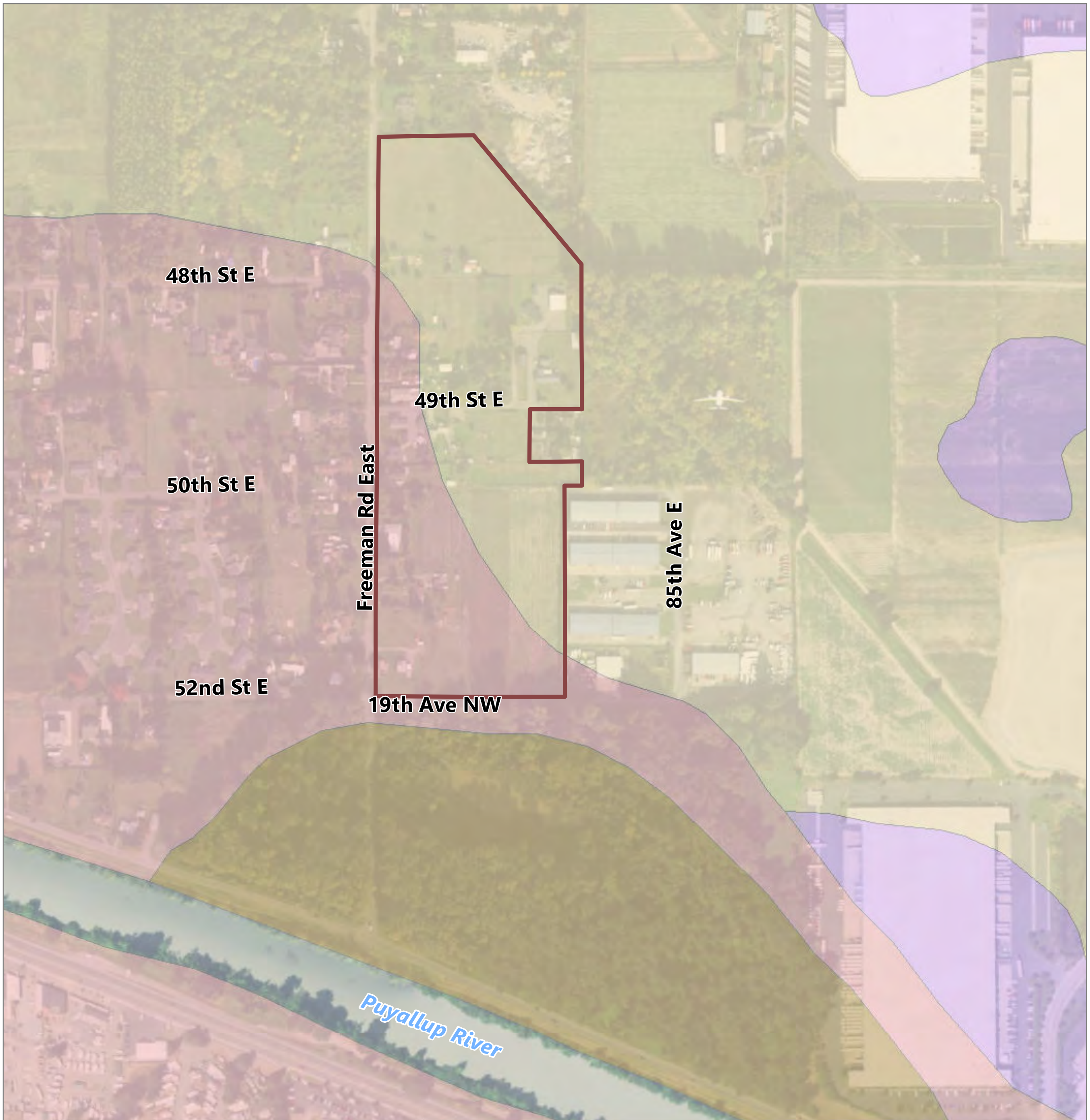

LEGEND:

Study Area

NRCS Soils

- Briscot loam
- Pilchuck fine sand
- Puyallup fine sandy loam
- Sultan silt loam

NOTES:

NRCS: Natural Resouces Conservation Service

1. Soil data acquired from USDA Natural Resouces Conservation Service SSURGO soil survey (USDA 2019b).
2. Aerial image is U.S. Department of Agriculture National Agriculture Imagery Program (USDA 2019).

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Figure 3

NRCS Soils Map

Critical Area Report

Freeman Road Logistics

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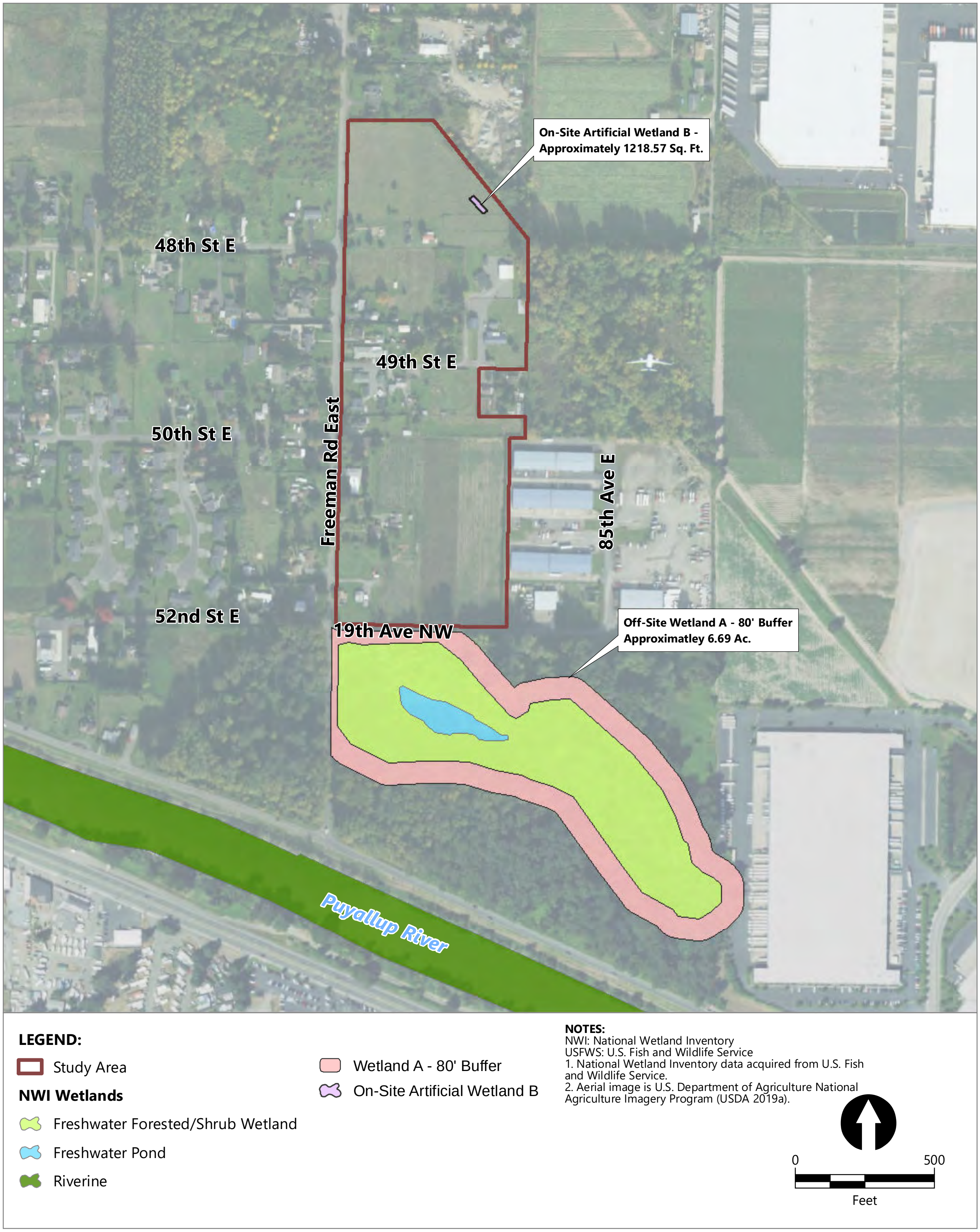

NOTES:
NWI: National Wetland Inventory
USFWS: U.S. Fish and Wildlife Service
1. National Wetland Inventory data acquired from U.S. Fish and Wildlife Service.
2. Aerial image is U.S. Department of Agriculture National Agriculture Imagery Program (USDA 2019a).

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Figure 4
USFWS National Wetlands Inventory Map
Critical Area Report
Freeman Road Logistics

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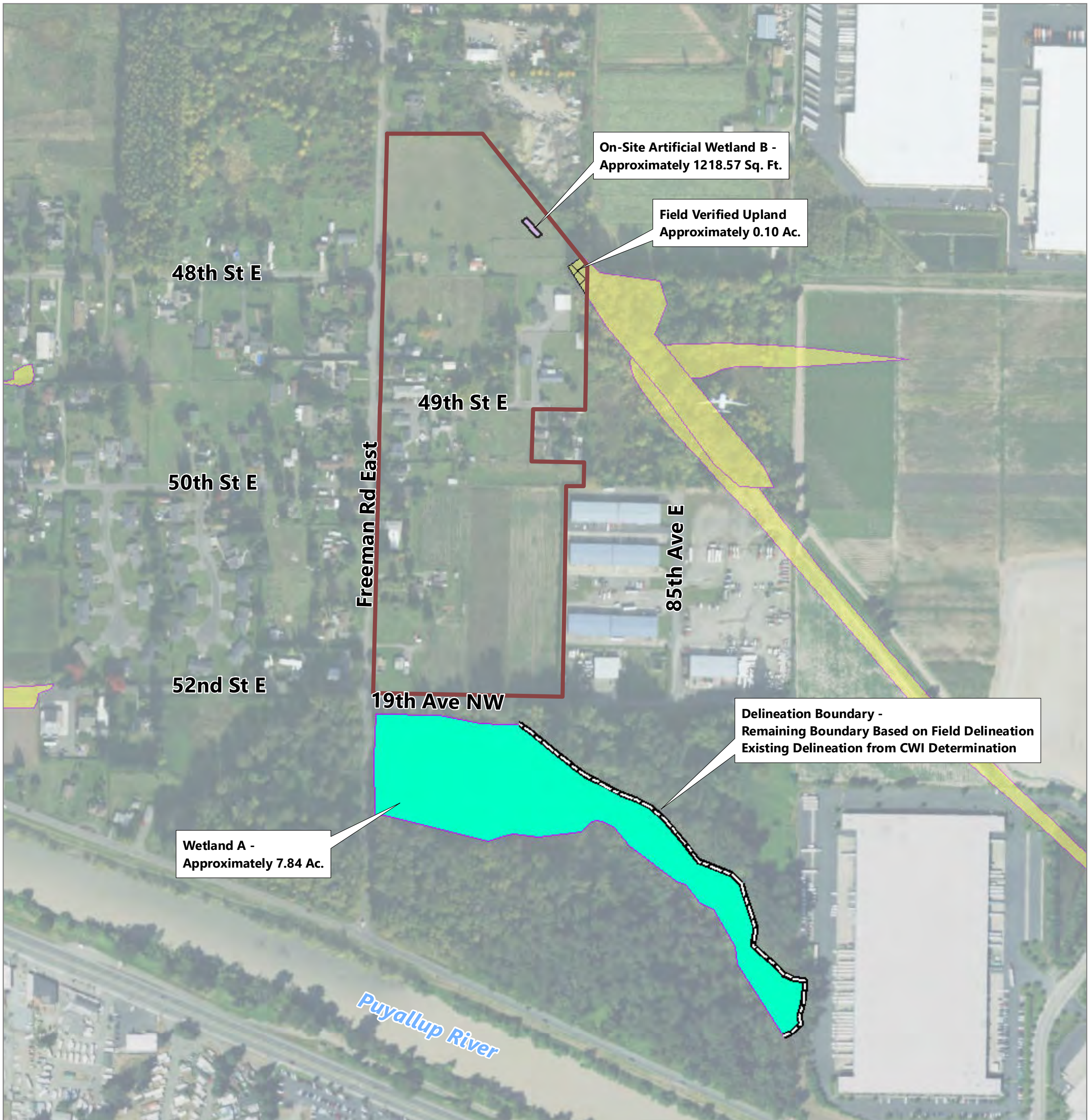

LEGEND:

- Study Area
- Field Delineation Line
- On-Site Artificial Wetland B

City of Puyallup Wetlands Inventory

- Field Verified
- Unverified
- Field Verified Upland

NOTES:
1. City of Puyallup Wetlands Inventory data acquired from City of Puyallup.
2. Aerial image is U.S. Department of Agriculture National Agriculture Imagery Program (USDA 2019).

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Figure 5
City of Puyallup Wetlands Inventory Map
Critical Area Report
Freeman Road Logistics

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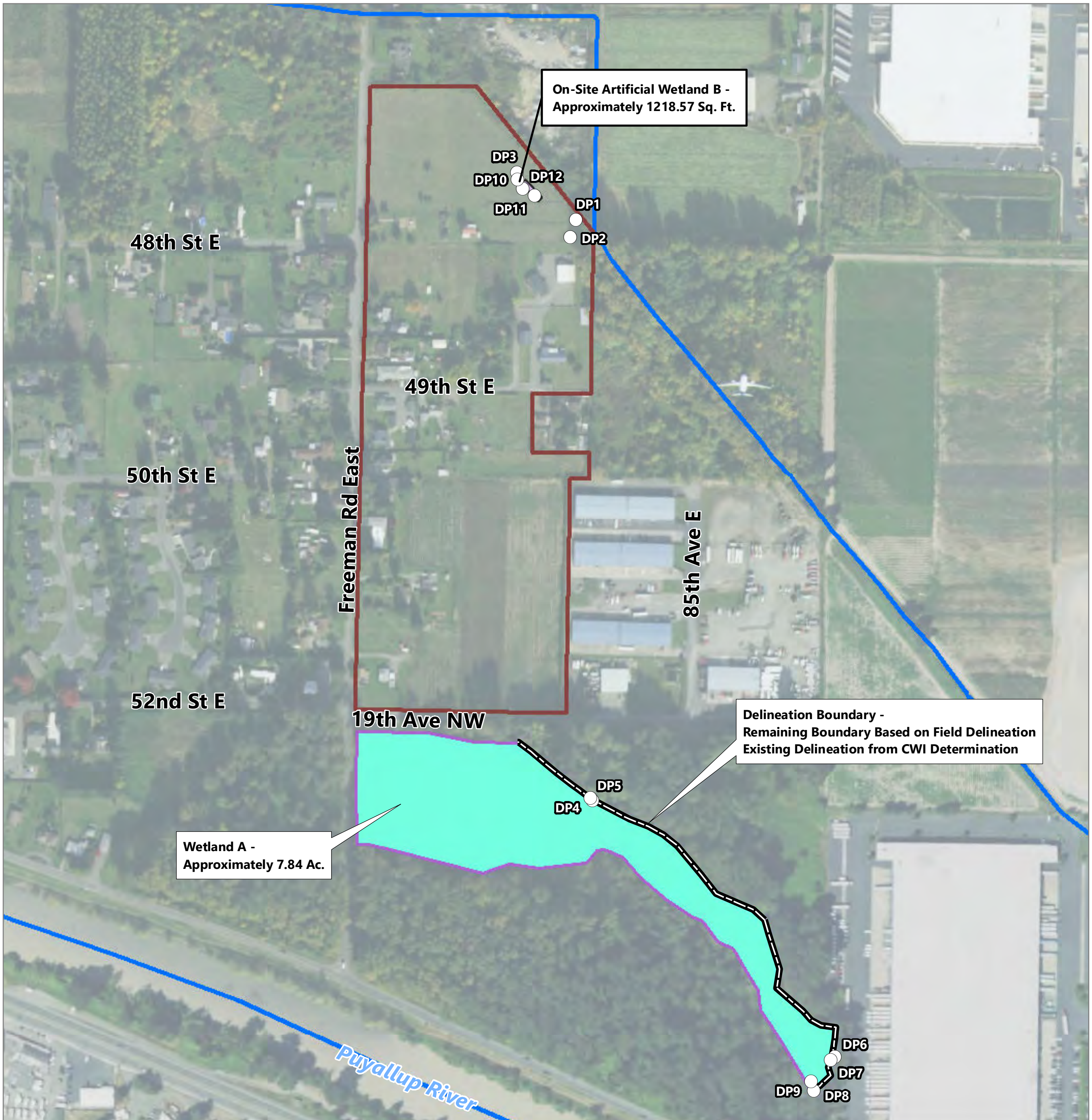

LEGEND:

- Study Area
- Wetland Test Plot Location
- Off-site Wetland
- On-Site Artificial Wetland B
- Stream (No fish observed)
- Field Delineation Line

NOTES:
DP: Data Plot
USDA: U.S. Department of Agriculture

SOURCES:
1. Stream data acquired from Pierce County.
2. Aerial image is USDA National Agriculture Imagery Program (USDA 2019).

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Figure 6
Critical Area Results
Critical Area Report
Freeman Road Logistics

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LEGEND:

- Category 3 Wetland
- Category 4 Wetland
- Category 3 - 50' Riparian Buffer
- Category 3 - 80' Wetland' Buffer
- Category 4 - 50' Wetland Buffer
- On-site Wetland
- Riparian Buffer On Site

NOTES:
USDA: U.S. Department of Agriculture

SOURCES:
1. Stream data acquired from Pierce County.
2. Aerial image is USDA National Agriculture Imagery Program (USDA 2021).

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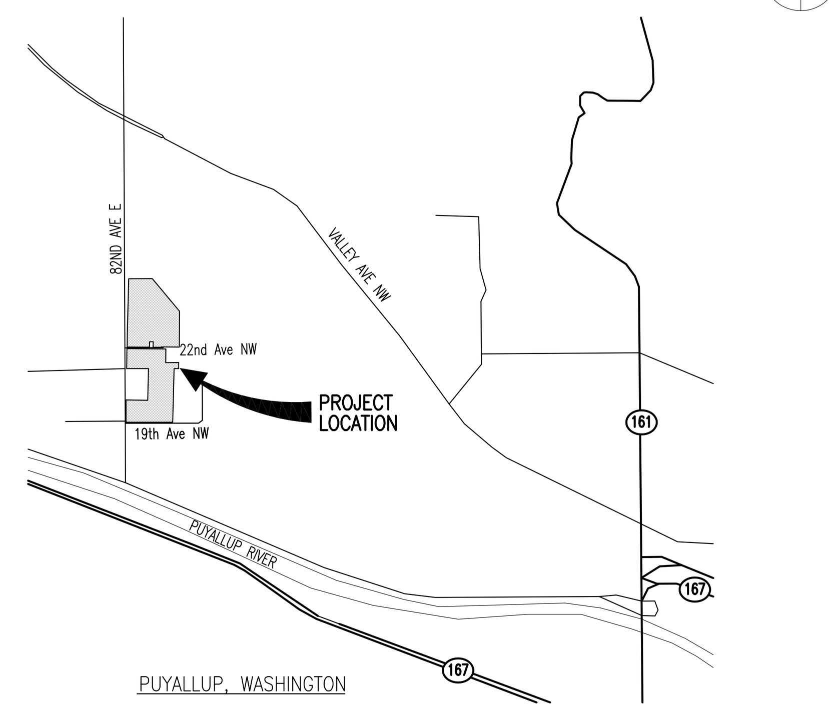
Figure 7
Off-Site WSDOT Parcels Critical Areas and Buffers
Critical Area Report
Freeman Road Logistics

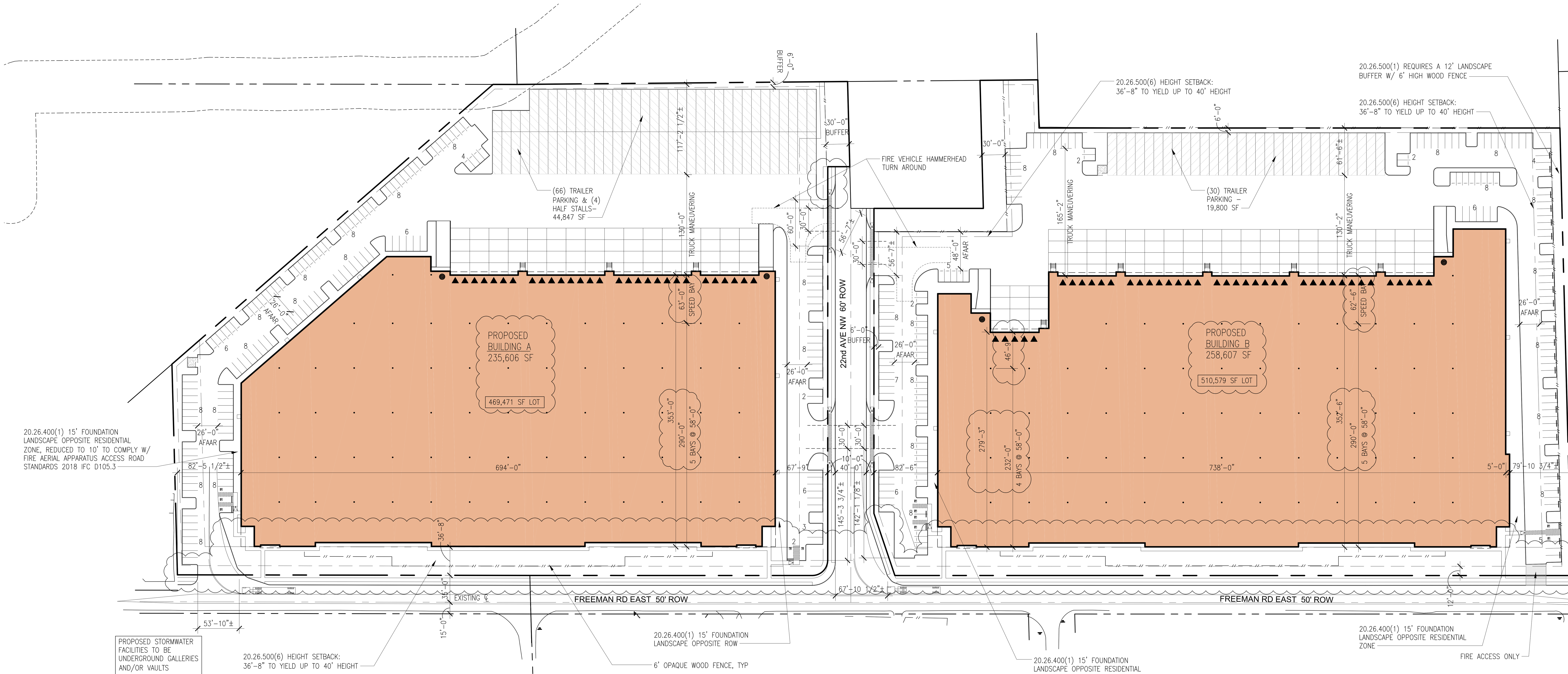
Appendix A
Plan Set

VICINITY MAP



PROJECT DATA

SITE AREA	980,050 SF	
BUILDING AREA	494,213 SF	
COVERAGE	50.4%	
BUILDING A PARKING REQUIRED	146.1	
10,000 SF OFFICE @ 1:300	33.3	
225,606 SF WHSE @ 1:2000	112.8	
PARKING PROVIDED		149
BUILDING B PARKING REQUIRED	157.6	
10,000 SF OFFICE @ 1:300	33.3	
248,607 SF WHSE @ 1:2000	124.3	
PARKING PROVIDED		159
▲ 9'x10' DOCK DOOR		69
● 12'x14' GRADE ACCESS DOOR		4



SITE PLAN
SCALE: 1" = 70'-0"

SYNTHESIS PLLC
THE FUSION OF ARCHITECTURE, DESIGN TECHNOLOGY & PEOPLE

12503 Bel-Red Road, Suite 100
Bellevue, WA 98005
p 425 646 1818 f 425 646 4141

VECTOR
Development Company
11411 NE 124th Street
Suite 190
Kirkland, WA 98034

REVISIONS

ISSUE NO.	DATE	ITEM
1	08 10 22	SEPA RESUBMITTAL
D	10 19 21	DESIGN REVIEW APPLICATION
C	09 15 21	PRELIMINARY BID
B	03 19 21	SEPA APPLICATION
A	01 05 21	PRE-APPLICATION

PROFESSIONAL STAMP

PROGRESS PRINTING
September 13, 2022

NOT FOR CONSTRUCTION

PROJECT INFORMATION

FREEMAN ROAD LOGISTICS
Puyallup, WA – 98371

SHEET INFORMATION

RELEASE FOR: SEPA RESUBMITTAL
TITLE: SITE PLAN

DESIGNED BY:
DRAWN BY:
REVIEWED BY:
APPROVED BY:
DATE: 01 05 21
SHEET NO: A1.1
PROJECT NO: 201401.13.031

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Appendix B
Study Area Photographs

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Appendix B
Study Area Photographs

Photograph 1
Parcels 0420174075 and 0420205016

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Photograph 2
Agricultural Ditch

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Photograph 3
Agricultural Ditch and Adjacent Agricultural Field

Photograph 4
Adjacent Agricultural Fields

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Photograph 5
View of DP1

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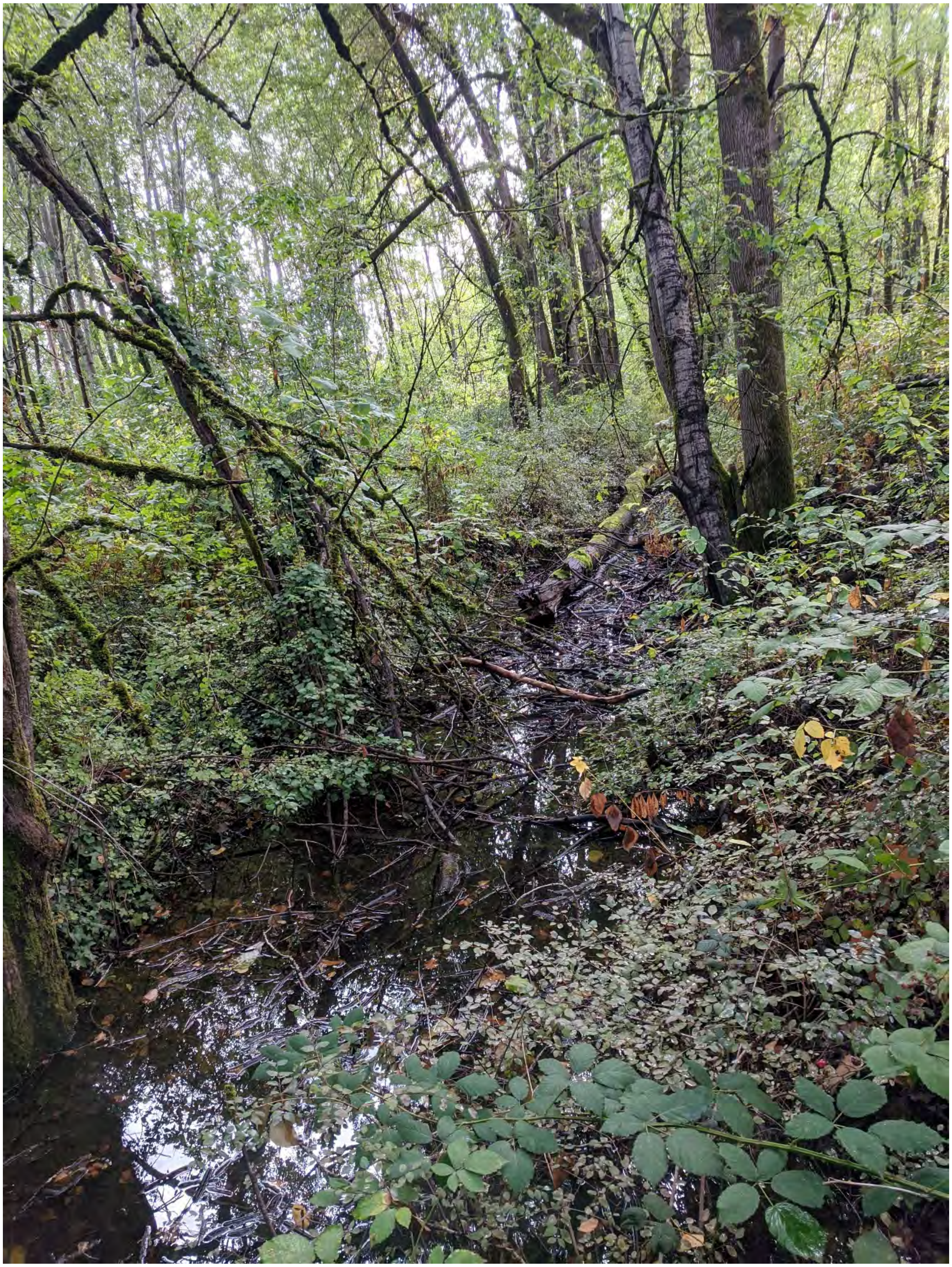
Photograph 6
Agricultural Ditch South



Photograph 7
East Edge of Parcel 0420205016

Photograph 8
Active Grazing in Parcel 0420174075

Photograph 9
Grazing in Parcel 0420174075

DRAFT

Photograph 10
Ditch

DRAFT

Photograph 11
Field Adjacent to DP2

Photograph 12
Landscape View of DP3

Photograph 13
View of DP2

Photograph 14
View of DP3

Photograph 15
Area Near DP3

Photograph 16
Wetlands Mapped South of 52nd Street East

Photograph 17
Wetlands Mapped South of 52nd Street East

Photograph 18
Vegetation in Wetlands Mapped South of 52nd Street East

DRAFT

Photograph 19
Wetland B on Parcel 0420174075 (March 11, 2022)

Photograph 20
Wetland B on Parcel 0420174075 (March 11, 2022)

Photograph 21
Wetland B on Parcel 0420174075 (March 11, 2022)

Appendix C
Wetland Forms

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Freeman Road Logistics City/County: Puyallup/Pierce County Sampling Date: 3/11/2022

Applicant/Owner: Vector Development Company State: WA Sampling Point: Wet A DP1 W

Investigator(s): C. Douglas, M. Curran Section, Township, Range: S17 & 20 R4E T20N

Landform (hillslope, terrace, etc.): Forested Local relief (concave, convex, none): concave Slope: 1-5

Subregion (LRR): Northwest Forests and Coast (LRR A) Lat: 47.12'33 Long: 122.19'03 Datum: NAD83

Soil Map Unit Name: Pilchuck fine sand NWI Classification: PFO, PSS, POW

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" Present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No
Hydric Soil Present?	Yes X	No
Wetland Hydrology Present?	Yes X	No

Is the Sampled Area within a Wetland? **Yes X No**

Remarks: Delineated northern and eastern boundary of large wetland system to identify potential buffer impacts for utility line construction

VEGETATION

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Indicator Status?
1. *Populus balsamifera ssp. Trichocarpa*	70	Yes	FAC
2.			
3.			
4.			
5.			
50%= 35 20%= 14 Total Cover:	70		
Sapling/Shrub Stratum (Plot size:)			
1. *Cornus sericea*	85	Yes	FACW
2. *Rubus armeniacus*	20	No	FAC
3. *Symphoricarpos albus*	20	No	FACU
4.			
5.			
50%= 62.5 20%= 25 Total Cover:	125		
Herb Stratum (Plot size:)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
50%= 0 20%= 0 Total Cover:	0		
Woody Vine Stratum (Plot size:)			
1.			
2.			
Total Cover:	0		
% Bare Ground in Herb Stratum 100	% Cover of Biotic Crust		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	**2**	(A)
Total Number of Dominant Species Across All Strata:	**2**	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	**100%**	(A/B)

Prevalence Index Worksheet:

Total % Cover of:			Multiply by:
OBL species	**0**	x1 =	**0**
FACW species	**85**	x2 =	**170**
FAC species	**90**	x3 =	**270**
FACU species	**20**	x4 =	**80**
UPL species	**0**	x5 =	**0**
Column Totals:	**195** (A)		**520** (B)

Prevalence Index = B/A = **2.7**

Hydrophytic Vegetation Indicators:

	1 - Rapid Test for Hydrophytic Vegetation
X	2 - Dominance Test is >50%
X	3 - Prevalence Index is ≤3.0[1]
	4 - Morphological Adaptation[1] (Provide supporting data in Remarks or on a separate sheet)
	5 - Wetland Non-Vascular Plants[1]
	Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes X No**

Remarks: 100% FAC vegetation

SOIL

Sampling Point: Wet A DP1 W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 3/1	100					SiL	
4-9	10YR 3/1	90	10YR 5/4	10	D	M	SL	
9-18	10YR 2/1	95	10YR 4/1	5	D	M	LS	w/gravel

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- x Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Muck Mineral (S1)
- ___ Sandy gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? **Yes** X **No** ___

Remarks: 1 chroma with redox

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum one required; check all that apply)

- x Surface Water (A1)
- x High Water Table (A2)
- x Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- x Inundation Visible on Aerial Imagery (B7)
- x Sparsely Vegetated Concave Surface (B8)
- x Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A and 4B**)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Plowed Soils (C6)
- ___ Stunted or Stressed Plants (D1) (**LRR A**)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- x Water-Stained Leaves (B9) (**MLRA 1, 2, 4A and 4B**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (**LRR A**)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes x	No ___	Depth (inches): 1 inch
Water table Present?	Yes x	No ___	Depth (inches): at surface
Saturation Present? (includes capillary fringe)	Yes x	No ___	Depth (inches): at surface

Wetland Hydrology Present? **Yes** X **No** ___

Describe Recorded Data (Unnamed Tributary gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Standing water >1 ft deep 10 ft from DP

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Freeman Road Logistics City/County: Puyallup/Pierce County Sampling Date: 3/11/2022
Applicant/Owner: Vector Development Company State: WA Sampling Point: Wet A DP2 Up
Investigator(s): C. Douglas, M. Curran Section, Township, Range: S17 & 20 R4E T20N
Landform (hillslope, terrace, etc.): Forested Local relief (concave, convex, none): concave Slope: 1-5
Subregion (LRR): Northwest Forests and Coast (LRR A) Lat: 47.12'33 Long: 122.19'03 Datum: NAD83
Soil Map Unit Name: Pilchuck fine sand NWI Classification: PFO, PSS, POW
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" Present? Yes x No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?		X
Hydric Soil Present?		X
Wetland Hydrology Present?	X	
Is the Sampled Area within a Wetland?		X

Remarks: Delineated northern and eastern boundary of large wetland system to identify potential buffer impacts for utility line construction

VEGETATION

	Absolute % Cover	Dominant Species?	Indicator Status?
Tree Stratum (Plot size: ____)			
1. *Populus balsamifera ssp. Trichocarpa*	80	Yes	FAC
2. *Picea sitchensis*	10	No	FAC
3.			
4.			
5.			
50%= 45 20%= 18 Total Cover:	90		
Sapling/Shrub Stratum (Plot size: ____)			
1. *Cornus sericea*	30	No	FACW
2. *Rubus armeniacus*	20	No	FAC
3. *Symphoricarpos albus*	90	Yes	FACU
4. *Ribes sanguineum*	20	No	FACU
5.			
50%= 80 20%= 32 Total Cover:	160		
Herb Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
50%= 0 20%= 0 Total Cover:	0		
Woody Vine Stratum (Plot size: ____)			
1. *Hedera helix*	20		FACU
2.			
Total Cover:	20		
% Bare Ground in Herb Stratum 100 % Cover of Biotic Crust ____			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: **1** (A)
Total Number of Dominant Species Across All Strata: **2** (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: **50%** (A/B)

Prevalence Index Worksheet:

Total % Cover of:			Multiply by:
OBL species	**0**	x1 =	**0**
FACW species	**30**	x2 =	**60**
FAC species	**110**	x3 =	**330**
FACU species	**110**	x4 =	**440**
UPL species	**0**	x5 =	**0**
Column Totals:	**250**	(A)	**830** (B)

Prevalence Index = B/A = **3.3**

Hydrophytic Vegetation Indicators:

____ 1 - Rapid Test for Hydrophytic Vegetation
____ 2 - Dominance Test is >50%
____ 3 - Prevalence Index is ≤3.0[1]
____ 4 - Morphological Adaptation[1] (Provide supporting data in Remarks or on a separate sheet)
____ 5 - Wetland Non-Vascular Plants[1]
____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks: 50% FAC vegetation

SOIL

Sampling Point: Wet A DP2 Up

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 3/2	100					SiL	w/gravel
8-18	10YR 4/2	100					SL	w/gravel

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Muck Mineral (S1)
___ Sandy gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ____ **No** X

Remarks: 2 chroma with no redox

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
x Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A and 4B**)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Plowed Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ____ No ____ Depth (inches): ______
Water table Present? Yes ____ No ____ Depth (inches): ______
Saturation Present? (includes capillary fringe) Yes x No ____ Depth (inches): 10 inches

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (Unnamed Tributary gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Saturation 10 inches deep, no other hydric indicators

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Freeman Road Logistics City/County: Puyallup/Pierce County Sampling Date: 3/11/2022
Applicant/Owner: Vector Development Company State: WA Sampling Point: Wet A DP3 W
Investigator(s): C. Douglas, M. Curran Section, Township, Range: S17 & 20 R4E T20N
Landform (hillslope, terrace, etc.): Forested Local relief (concave, convex, none): concave Slope: 1-5
Subregion (LRR): Northwest Forests and Coast (LRR A) Lat: 47.12'33 Long: 122.19'03 Datum: NAD83
Soil Map Unit Name: Pilchuck fine sand NWI Classification: PFO, PSS, POW
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks)
Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" Present? Yes x No ___
Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ___	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes X No ___	
Wetland Hydrology Present?	Yes X No ___	

Remarks: Delineated northern and eastern boundary of large wetland system to identify potential buffer impacts for utility line construction

VEGETATION

Tree Stratum (Plot size: ___)	Absolute % Cover	Dominant Species?	Indicator Status?
1. *Populus balsamifera ssp. Trichocarpa*	60	Yes	FAC
2.			
3.			
4.			
5.			
50%= 30 20%= 12 Total Cover:	60		
Sapling/Shrub Stratum (Plot size: ___)			
1. *Cornus sericea*	80	Yes	FACW
2. *Rubus armeniacus*	20	No	FAC
3. *Rubus spectabilis*	30	Yes	FAC
4.			
5.			
50%= 65 20%= 26 Total Cover:	130		
Herb Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
50%= 0 20%= 0 Total Cover:	0		
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
Total Cover:	0		
% Bare Ground in Herb Stratum 100 % Cover of Biotic Crust ___			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	**3**	(A)
Total Number of Dominant Species Across All Strata:	**3**	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	**100%**	(A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:
OBL species	**0**	x1 = **0**
FACW species	**80**	x2 = **160**
FAC species	**110**	x3 = **330**
FACU species	**0**	x4 = **0**
UPL species	**0**	x5 = **0**
Column Totals:	**190** (A)	**490** (B)

Prevalence Index = B/A = **2.6**

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
X 2 - Dominance Test is >50%
X 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptation[1] (Provide supporting data in Remarks or on a separate sheet)
___ 5 - Wetland Non-Vascular Plants[1]
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: 100% FAC vegetation

SOIL

Sampling Point: Wet A DP3 W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 3/1	100					SiL	
5-18	10YR 4/1	85	10YR 5/4	15	D	M	SiL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- x Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Muck Mineral (S1)
- ___ Sandy gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? **Yes** X **No** ___

Remarks: 1 chroma with redox

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum one required; check all that apply)

- ___ Surface Water (A1)
- x High Water Table (A2)
- x Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- x Inundation Visible on Aerial Imagery (B7)
- x Sparsely Vegetated Concave Surface (B8)
- x Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A and 4B**)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- x Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Plowed Soils (C6)
- ___ Stunted or Stressed Plants (D1) (**LRR A**)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- x Water-Stained Leaves (B9) (**MLRA 1, 2, 4A and 4B**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (**LRR A**)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ___	No x	Depth (inches):	___
Water table Present?	Yes x	No ___	Depth (inches):	at surface
Saturation Present? (includes capillary fringe)	Yes x	No ___	Depth (inches):	at surface

Wetland Hydrology Present? **Yes** X **No** ___

Describe Recorded Data (Unnamed Tributary gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Standing water >1 ft deep 3 ft from DP

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Freeman Road Logistics City/County: Puyallup/Pierce County Sampling Date: 3/11/2022
Applicant/Owner: Vector Development Company State: WA Sampling Point: Wet A DP4 Up
Investigator(s): C. Douglas, M. Curran Section, Township, Range: S17 & 20 R4E T20N
Landform (hillslope, terrace, etc.): Forested Local relief (concave, convex, none): concave Slope: 1-5
Subregion (LRR): Northwest Forests and Coast (LRR A) Lat: 47.12'33 Long: 122.19'03 Datum: NAD83
Soil Map Unit Name: Pilchuck fine sand NWI Classification: PFO, PSS, POW
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks)
Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" Present? Yes x No ___
Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?		X
Hydric Soil Present?		X
Wetland Hydrology Present?	X	
Is the Sampled Area within a Wetland?		X

Remarks: Delineated northern and eastern boundary of large wetland system to identify potential buffer impacts for utility line construction

VEGETATION

Tree Stratum (Plot size: ___)	Absolute % Cover	Dominant Species?	Indicator Status?
1. *Populus balsamifera ssp. Trichocarpa*	80	Yes	FAC
2. *Picea sitchensis*	10	No	FAC
3.			
4.			
5.			
50%= 45 20%= 18 Total Cover:	90		
Sapling/Shrub Stratum (Plot size: ___)			
1. *Cornus sericea*	30	No	FACW
2. *Rubus armeniacus*	20	No	FAC
3. *Symphoricarpos albus*	90	Yes	FACU
4. *Ribes sanguineum*	20	No	FACU
5.			
50%= 80 20%= 32 Total Cover:	160		
Herb Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
50%= 0 20%= 0 Total Cover:	0		
Woody Vine Stratum (Plot size: ___)			
1. *Hedera helix*	20		FACU
2.			
Total Cover:	20		
% Bare Ground in Herb Stratum 100 % Cover of Biotic Crust ___			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: **1** (A)
Total Number of Dominant Species Across All Strata: **2** (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: **50%** (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:
OBL species	**0**	x1 = **0**
FACW species	**30**	x2 = **60**
FAC species	**110**	x3 = **330**
FACU species	**110**	x4 = **440**
UPL species	**0**	x5 = **0**
Column Totals:	**250** (A)	**830** (B)

Prevalence Index = B/A = **3.3**

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptation[1] (Provide supporting data in Remarks or on a separate sheet)
___ 5 - Wetland Non-Vascular Plants[1]
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: 50% FAC vegetation

SOIL

Sampling Point: Wet A DP4 Up

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 3/2	100					SiL	w/gravel
8-18	10YR 4/2	100					SL	w/gravel

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Muck Mineral (S1)
___ Sandy gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):
Type: ______
Depth (inches): ______

Hydric Soil Present? **Yes** ____ **No** X

Remarks: 2 chroma with no redox

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
x Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A and 4B**)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Plowed Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ____ No ____ Depth (inches): ______
Water table Present? Yes ____ No ____ Depth (inches): ______
Saturation Present? (includes capillary fringe) Yes x No ____ Depth (inches): 10 inches

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (Unnamed Tributary gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Saturation 10 inches deep, no other hydric indicators

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Freeman Road Logistics — City/County: Puyallup/Pierce County — Sampling Date: 3/11/2022

Applicant/Owner: Vector Development Company — State: WA — Sampling Point: Wet A DP5 W

Investigator(s): C. Douglas, M. Curran — Section, Township, Range: S17 & 20 R4E T20N

Landform (hillslope, terrace, etc.): Forested — Local relief (concave, convex, none): concave — Slope: 1-5

Subregion (LRR): Northwest Forests and Coast (LRR A) — Lat: 47.12'33 — Long: 122.19'03 — Datum: NAD83

Soil Map Unit Name: Pilchuck fine sand — NWI Classification: PFO, PSS, POW

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" Present? Yes x No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?	X	
Hydric Soil Present?	X	
Wetland Hydrology Present?	X	

Is the Sampled Area within a Wetland? **Yes** X **No** ___

Remarks: Delineated northern and eastern boundary of large wetland system to identify potential buffer impacts for utility line construction

VEGETATION

	Absolute % Cover	Dominant Species?	Indicator Status?
Tree Stratum (Plot size: ___)			
1. *Populus balsamifera ssp. Trichocarpa*	70	Yes	FAC
2.			
3.			
4.			
5.			
50%= 35 20%= 14 Total Cover:	70		
Sapling/Shrub Stratum (Plot size: ___)			
1. *Cornus sericea*	85	Yes	FACW
2. *Rubus armeniacus*	20	No	FAC
3. *Symphoricarpos albus*	20	No	FACU
4.			
5.			
50%= 62.5 20%= 25 Total Cover:	125		
Herb Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
50%= 0 20%= 0 Total Cover:	0		
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
Total Cover:	0		

% Bare Ground in Herb Stratum **100** % Cover of Biotic Crust ___

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: **2** (A)

Total Number of Dominant Species Across All Strata: **2** (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: **100%** (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:
OBL species	**0**	x1 = **0**
FACW species	**85**	x2 = **170**
FAC species	**90**	x3 = **270**
FACU species	**20**	x4 = **80**
UPL species	**0**	x5 = **0**
Column Totals:	**195** (A)	**520** (B)

Prevalence Index = B/A = **2.7**

Hydrophytic Vegetation Indicators:

- ___ 1 - Rapid Test for Hydrophytic Vegetation
- **X** 2 - Dominance Test is >50%
- **X** 3 - Prevalence Index is ≤3.0[1]
- ___ 4 - Morphological Adaptation[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ 5 - Wetland Non-Vascular Plants[1]
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: 100% FAC vegetation

SOIL

Sampling Point: Wet A DP5 W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 3/1	100					SiL	
4-9	10YR 3/1	90	10YR 5/4	10	D	M	SL	
9-18	10YR 2/1	95	10YR 4/1	5	D	M	LS	w/gravel

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- x Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Muck Mineral (S1)
- ___ Sandy gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):
Type:
Depth (inches):

Hydric Soil Present? **Yes** X **No** ___

Remarks: 1 chroma with redox

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum one required; check all that apply)

- x Surface Water (A1)
- x High Water Table (A2)
- x Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- x Inundation Visible on Aerial Imagery (B7)
- x Sparsely Vegetated Concave Surface (B8)
- x Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A and 4B**)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Plowed Soils (C6)
- ___ Stunted or Stressed Plants (D1) (**LRR A**)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- x Water-Stained Leaves (B9) (**MLRA 1, 2, 4A and 4B**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (**LRR A**)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes x	No ___	Depth (inches):	1 inch
Water table Present?	Yes x	No ___	Depth (inches):	at surface
Saturation Present? (includes capillary fringe)	Yes x	No ___	Depth (inches):	at surface

Wetland Hydrology Present? **Yes** X **No** ___

Describe Recorded Data (Unnamed Tributary gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Standing water >1 ft deep 10 ft from DP

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Freeman Road Logistics	City/County: Puyallup/Pierce County		Sampling Date: 3/11/2022
Applicant/Owner: Vector Development Company		State: WA	Sampling Point: Wet A DP6 Up
Investigator(s): C. Douglas, M. Curran	Section, Township, Range: S17 & 20 R4E T20N		
Landform (hillslope, terrace, etc.): Forested	Local relief (concave, convex, none): concave		Slope: 1-5
Subregion (LRR): Northwest Forests and Coast (LRR A)	Lat: 47.12'33	Long: 122.19'03	Datum: NAD83
Soil Map Unit Name: Pilchuck fine sand		NWI Classification: PFO, PSS, POW	

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" Present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?	X	
Hydric Soil Present?		X
Wetland Hydrology Present?		X

Is the Sampled Area within a Wetland? Yes ____ No X

Remarks: Delineated northern and eastern boundary of large wetland system to identify potential buffer impacts for utility line construction

VEGETATION

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status?
1. *Alnus rubra*	10	No	FAC
2. *Populus balsamifera ssp. Trichocarpa*	60	Yes	FAC
3.			
4.			
5.			
50%= 35 20%= 14 Total Cover:	**70**		
Sapling/Shrub Stratum (Plot size: ____)			
1. *Oemleria cerasiformis*	30	Yes	FACU
2. *Rubus armeniacus*	70	Yes	FAC
3.			
4.			
5.			
50%= 50 20%= 20 Total Cover:	**100**		
Herb Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
50%= 0 20%= 0 Total Cover:	**0**		
Woody Vine Stratum (Plot size: ____)			
1. *Hedera helix*	30		FACU
2.			
Total Cover:	**30**		
% Bare Ground in Herb Stratum **100** % Cover of Biotic Crust ____			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: **2** (A)

Total Number of Dominant Species Across All Strata: **3** (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: **67%** (A/B)

Prevalence Index Worksheet:

Total % Cover of:			Multiply by:
OBL species	**0**	x1 =	**0**
FACW species	**0**	x2 =	**0**
FAC species	**140**	x3 =	**420**
FACU species	**30**	x4 =	**120**
UPL species	**0**	x5 =	**0**
Column Totals:	**170** (A)		**540** (B)

Prevalence Index = B/A = **3.2**

Hydrophytic Vegetation Indicators:

- ____ 1 - Rapid Test for Hydrophytic Vegetation
- X 2 - Dominance Test is >50%
- ____ 3 - Prevalence Index is ≤3.0[1]
- ____ 4 - Morphological Adaptation[1] (Provide supporting data in Remarks or on a separate sheet)
- ____ 5 - Wetland Non-Vascular Plants[1]
- ____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks: 67% FAC vegetation

SOIL

Sampling Point: Wet A DP6 Up

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features				Texture	Remarks
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-18	10YR 3/3	100					SiL	w/gravel

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Muck Mineral (S1)
___ Sandy gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):
Type: ___
Depth (inches): ___

Hydric Soil Present? **Yes** ___ **No** X

Remarks: 3 chroma with no redox

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A and 4B**)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Plowed Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No ___ Depth (inches): ___
Water table Present? Yes ___ No ___ Depth (inches): ___
Saturation Present? (includes capillary fringe) Yes ___ No ___ Depth (inches): ___

Wetland Hydrology Present? **Yes** ___ **No** X

Describe Recorded Data (Unnamed Tributary gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No hydric indicators

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Freeman Road Logistics City/County: Puyallup/Pierce County Sampling Date: 3/11/2022
Applicant/Owner: Vector Development Company State: WA Sampling Point: Wet A DP7 W
Investigator(s): C. Douglas, M. Curran Section, Township, Range: S17 & 20 R4E T20N
Landform (hillslope, terrace, etc.): Forested Local relief (concave, convex, none): concave Slope: 1-5
Subregion (LRR): Northwest Forests and Coast (LRR A) Lat: 47.12'33 Long: 122.19'03 Datum: NAD83
Soil Map Unit Name: Pilchuck fine sand NWI Classification: PFO, PSS, POW
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" Present? Yes x No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X No ____	**Is the Sampled Area within a Wetland?**	**Yes** X **No** ____
Hydric Soil Present?	Yes X No ____		
Wetland Hydrology Present?	Yes X No ____		

Remarks: Delineated northern and eastern boundary of large wetland system to identify potential buffer impacts for utility line construction

VEGETATION

	Absolute % Cover	Dominant Species?	Indicator Status?
Tree Stratum (Plot size: ____)			
1. *Populus balsamifera ssp. Trichocarpa*	60	Yes	FAC
2.			
3.			
4.			
5.			
50%= 30 20%= 12 Total Cover:	**60**		
Sapling/Shrub Stratum (Plot size: ____)			
1. *Cornus sericea*	80	Yes	FACW
2. *Rubus armeniacus*	20	No	FAC
3. *Rubus spectabilis*	30	Yes	FAC
4.			
5.			
50%= 65 20%= 26 Total Cover:	**130**		
Herb Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
50%= 0 20%= 0 Total Cover:	**0**		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
Total Cover:	**0**		
% Bare Ground in Herb Stratum **100** % Cover of Biotic Crust ____			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	**3**	(A)
Total Number of Dominant Species Across All Strata:	**3**	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	**100%**	(A/B)

Prevalence Index Worksheet:

Total % Cover of:			Multiply by:
OBL species	**0**	x1 =	**0**
FACW species	**80**	x2 =	**160**
FAC species	**110**	x3 =	**330**
FACU species	**0**	x4 =	**0**
UPL species	**0**	x5 =	**0**
Column Totals:	**190** (A)		**490** (B)

Prevalence Index = B/A = **2.6**

Hydrophytic Vegetation Indicators:

____ 1 - Rapid Test for Hydrophytic Vegetation
X 2 - Dominance Test is >50%
X 3 - Prevalence Index is ≤3.0[1]
____ 4 - Morphological Adaptation[1] (Provide supporting data in Remarks or on a separate sheet)
____ 5 - Wetland Non-Vascular Plants[1]
____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** X **No** ____

Remarks: 100% FAC vegetation

SOIL

Sampling Point: Wet A DP7 W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 3/1	100					SiL	
5-18	10YR 4/1	85	10YR 5/4	15	D	M	SiL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
_x_ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Muck Mineral (S1)
___ Sandy gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):
Type: ______
Depth (inches): ______

Hydric Soil Present? **Yes** _X_ **No** ___

Remarks: 1 chroma with redox

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum one required; check all that apply)

___ Surface Water (A1)
_x_ High Water Table (A2)
_x_ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
_x_ Inundation Visible on Aerial Imagery (B7)
_x_ Sparsely Vegetated Concave Surface (B8)
_x_ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A and 4B**)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
_x_ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Plowed Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

_x_ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present?	Yes ___	No _x_	Depth (inches): ___		
Water table Present?	Yes _x_	No ___	Depth (inches): at surface		
Saturation Present? (includes capillary fringe)	Yes _x_	No ___	Depth (inches): at surface	**Wetland Hydrology Present?**	**Yes** _X_ **No** ___

Describe Recorded Data (Unnamed Tributary gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Standing water >1 ft deep 3 ft from DP

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Freeman Road Logistics City/County: Puyallup/Pierce County Sampling Date: 3/11/2022
Applicant/Owner: Vector Development Company State: WA Sampling Point: Wet A DP8 Up
Investigator(s): C. Douglas, M. Curran Section, Township, Range: S17 & 20 R4E T20N
Landform (hillslope, terrace, etc.): Forested Local relief (concave, convex, none): concave Slope: 1-5
Subregion (LRR): Northwest Forests and Coast (LRR A) Lat: 47.12'33 Long: 122.19'03 Datum: NAD83
Soil Map Unit Name: Pilchuck fine sand NWI Classification: PFO, PSS, POW
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" Present? Yes x No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?		X
Hydric Soil Present?		X
Wetland Hydrology Present?		X

Is the Sampled Area within a Wetland? Yes ____ No X

Remarks: Delineated northern and eastern boundary of large wetland system to identify potential buffer impacts for utility line construction

VEGETATION

	Absolute % Cover	Dominant Species?	Indicator Status?
Tree Stratum (Plot size: ____)			
1. *Alnus rubra*	60	Yes	FAC
2. *Populus balsamifera ssp. Trichocarpa*	80	Yes	FAC
3.			
4.			
5.			
50%= 70 20%= 28 Total Cover:	**140**		
Sapling/Shrub Stratum (Plot size: ____)			
1. *Oemleria cerasiformis*	50	Yes	FACU
2. *Rubus armeniacus*	10	No	FAC
3. *Rubus spectabilis*	20	No	FAC
4. *Symphoricarpos albus*	70	Yes	FACU
5.			
50%= 75 20%= 30 Total Cover:	**150**		
Herb Stratum (Plot size: ____)			
1. *Polystichum munitum*	20	Yes	FACU
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
50%= 10 20%= 4 Total Cover:	**20**		
Woody Vine Stratum (Plot size: ____)			
1. *Hedera helix*	20		FACU
2.			
Total Cover:	**20**		
% Bare Ground in Herb Stratum **80** % Cover of Biotic Crust ____			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: **2** (A)
Total Number of Dominant Species Across All Strata: **5** (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: **40%** (A/B)

Prevalence Index Worksheet:

Total % Cover of:			Multiply by:
OBL species	**0**	x1 =	**0**
FACW species	**0**	x2 =	**0**
FAC species	**170**	x3 =	**510**
FACU species	**140**	x4 =	**560**
UPL species	**0**	x5 =	**0**
Column Totals:	**310** (A)		**1070** (B)

Prevalence Index = B/A = **3.5**

Hydrophytic Vegetation Indicators:

____ 1 - Rapid Test for Hydrophytic Vegetation
____ 2 - Dominance Test is >50%
____ 3 - Prevalence Index is ≤3.0[1]
____ 4 - Morphological Adaptation[1] (Provide supporting data in Remarks or on a separate sheet)
____ 5 - Wetland Non-Vascular Plants[1]
____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks: 40% FAC vegetation

SOIL

Sampling Point: Wet A DP8 Up

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 3/3	100					L	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Muck Mineral (S1)
___ Sandy gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? Yes ____ No X

Remarks: 3 chroma with no redox

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A and 4B**)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Plowed Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ____ No ____ Depth (inches): ____
Water table Present? Yes ____ No ____ Depth (inches): ____
Saturation Present? (includes capillary fringe) Yes ____ No ____ Depth (inches): ____

Wetland Hydrology Present? Yes ____ No X

Describe Recorded Data (Unnamed Tributary gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No hydric indicators

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Freeman Road Logistics City/County: Puyallup/Pierce County Sampling Date: 3/11/2022

Applicant/Owner: Vector Development Company State: WA Sampling Point: Wet A DP9 W

Investigator(s): C. Douglas, M. Curran Section, Township, Range: S17 & 20 R4E T20N

Landform (hillslope, terrace, etc.): Forested Local relief (concave, convex, none): concave Slope: 1-5

Subregion (LRR): Northwest Forests and Coast (LRR A) Lat: 47.12'33 Long: 122.19'03 Datum: NAD83

Soil Map Unit Name: Pilchuck fine sand NWI Classification: PFO, PSS, POW

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" Present? Yes x No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No ____

Hydric Soil Present? Yes X No ____

Wetland Hydrology Present? Yes X No ____

Is the Sampled Area within a Wetland? **Yes X No ____**

Remarks: Delineated northern and eastern boundary of large wetland system to identify potential buffer impacts for utility line construction

VEGETATION

	Absolute % Cover	Dominant Species?	Indicator Status?
Tree Stratum (Plot size: ____)			
1. *Alnus rubra*	70	Yes	FAC
2. *Populus balsamifera ssp. Trichocarpa*	20	Yes	FAC
3.			
4.			
5.			
50%= 45 20%= 18 Total Cover:	90		
Sapling/Shrub Stratum (Plot size: ____)			
1. *Cornus sericea*	70	Yes	FACW
2. *Rubus armeniacus*	20	No	FAC
3. *Rubus spectabilis*	20	No	FAC
4. *Ribes sanguineum*	5	No	FACU
5. *Symphoricarpos albus*	5	No	FACU
50%= 60 20%= 24 Total Cover:	120		
Herb Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
50%= 0 20%= 0 Total Cover:	0		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
Total Cover:	0		
% Bare Ground in Herb Stratum 100 % Cover of Biotic Crust ____			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: **3** (A)

Total Number of Dominant Species Across All Strata: **3** (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: **100%** (A/B)

Prevalence Index Worksheet:

Total % Cover of:			Multiply by:
OBL species	0	x1 =	0
FACW species	70	x2 =	140
FAC species	130	x3 =	390
FACU species	10	x4 =	40
UPL species	0	x5 =	0
Column Totals:	210	(A)	570 (B)

Prevalence Index = B/A = **2.7**

Hydrophytic Vegetation Indicators:

____ 1 - Rapid Test for Hydrophytic Vegetation

X 2 - Dominance Test is >50%

X 3 - Prevalence Index is ≤3.0[1]

____ 4 - Morphological Adaptation[1] (Provide supporting data in Remarks or on a separate sheet)

____ 5 - Wetland Non-Vascular Plants[1]

____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes X No ____**

Remarks: 100% FAC vegetation

SOIL

Sampling Point: Wet A DP9 W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 3/1	100					SiL	
4-18	10YR 4/1	80	10YR 5/4	20	D	M	SiL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
_x_ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Muck Mineral (S1)
___ Sandy gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):
Type: ______
Depth (inches): ______

Hydric Soil Present? **Yes** _X_ **No** ___

Remarks: 1 chroma with redox

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum one required; check all that apply)

_x_ Surface Water (A1)
_x_ High Water Table (A2)
_x_ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
_x_ Inundation Visible on Aerial Imagery (B7)
_x_ Sparsely Vegetated Concave Surface (B8)
_x_ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A and 4B**)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
_x_ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Plowed Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

_x_ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes _x_ No ___ Depth (inches): 1 inch
Water table Present? Yes _x_ No ___ Depth (inches): at surface
Saturation Present? (includes capillary fringe) Yes _x_ No ___ Depth (inches): at surface

Wetland Hydrology Present? **Yes** _X_ **No** ___

Describe Recorded Data (Unnamed Tributary gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Standing water >1 ft deep 2 ft from DP

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Freeman Road Logistics City/County: Puyallup/Pierce County Sampling Date: 3/11/2022
Applicant/Owner: Vector Development Company State: WA Sampling Point: Wet B DP10 Up
Investigator(s): C. Douglas, M. Curran Section, Township, Range: S17 R4E T20N
Landform (hillslope, terrace, etc.): Forested Local relief (concave, convex, none): concave Slope: 1-5
Subregion (LRR): Northwest Forests and Coast (LRR A) Lat: 47.12'33 Long: 122.19'03 Datum: NAD83
Soil Map Unit Name: Sultan silt loam NWI Classification: None
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" Present? Yes x No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?		X
Hydric Soil Present?		X
Wetland Hydrology Present?	X	
Is the Sampled Area within a Wetland?		X

Remarks: Confirming upland conditions in suspect area identified as SP 13 in Confluence Report

VEGETATION

	Absolute % Cover	Dominant Species?	Indicator Status?
Tree Stratum (Plot size: ____)			
1. *Populus balsamifera ssp. Trichocarpa*	70	Yes	FAC
2.			
3.			
4.			
5.			
50%= 35 20%= 14 Total Cover:	70		
Sapling/Shrub Stratum (Plot size: ____)			
1. *Oemleria cerasiformis*	20	Yes	FACU
2. *Symphoricarpos albus*	80	Yes	FACU
3.			
4.			
5.			
50%= 50 20%= 20 Total Cover:	100		
Herb Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
50%= 0 20%= 0 Total Cover:	0		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
Total Cover:	0		
% Bare Ground in Herb Stratum 100 % Cover of Biotic Crust ____			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: **1** (A)
Total Number of Dominant Species Across All Strata: **3** (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: **33%** (A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:
OBL species	**0**	x1 = **0**
FACW species	**0**	x2 = **0**
FAC species	**70**	x3 = **210**
FACU species	**100**	x4 = **400**
UPL species	**0**	x5 = **0**
Column Totals:	**170** (A)	**610** (B)

Prevalence Index = B/A = **3.6**

Hydrophytic Vegetation Indicators:

____ 1 - Rapid Test for Hydrophytic Vegetation
____ 2 - Dominance Test is >50%
____ 3 - Prevalence Index is ≤3.0[1]
____ 4 - Morphological Adaptation[1] (Provide supporting data in Remarks or on a separate sheet)
____ 5 - Wetland Non-Vascular Plants[1]
____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No X

Remarks: 33% FAC vegetation

SOIL

Sampling Point: Wet B DP10 Up

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 3/3	100					SL	gravel below 8 inches

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Muck Mineral (S1)
___ Sandy gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? **Yes** ____ **No** X

Remarks: 3 chroma with no redox

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum one required; check all that apply)

x Surface Water (A1)
x High Water Table (A2)
x Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A and 4B**)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Plowed Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes x No ___ Depth (inches): 6 inches
Water table Present? Yes x No ___ Depth (inches): at surface
Saturation Present? (includes capillary fringe) Yes x No ___ Depth (inches): at surface

Wetland Hydrology Present? **Yes** X **No** ____

Describe Recorded Data (Unnamed Tributary gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Standing water in depression area that appears to have been excavated

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Freeman Road Logistics City/County: Puyallup/Pierce County Sampling Date: 3/11/2022
Applicant/Owner: Vector Development Company State: WA Sampling Point: Wet B DP11 W
Investigator(s): C. Douglas, M. Curran Section, Township, Range: S17 R4E T20N
Landform (hillslope, terrace, etc.): Forested Local relief (concave, convex, none): concave Slope: 1-5
Subregion (LRR): Northwest Forests and Coast (LRR A) Lat: 47.12'33 Long: 122.19'03 Datum: NAD83
Soil Map Unit Name: Pilchuck fine sand NWI Classification: PFO, PSS, POW
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks)
Are Vegetation x , Soil x , or Hydrology ____ significantly disturbed? Are "Normal Circumstances" Present? Yes x No ____
Are Vegetation ____ , Soil ____ , or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes X No ____ Hydric Soil Present? Yes X No ____ Wetland Hydrology Present? Yes X No ____	**Is the Sampled Area within a Wetland?** **Yes** X **No** ____

Remarks: Suspect area identified as SP 12 in Confluence Report. Depression area within grass pasture, ground is cleared of vegetation, grass vegetation surrounds standing water.

VEGETATION

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status?
1.			
2.			
3.			
4.			
5.			
50%= 0 20%= 0 Total Cover:	0		
Sapling/Shrub Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
50%= 0 20%= 0 Total Cover:	0		
Herb Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
50%= 0 20%= 0 Total Cover:	0		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
Total Cover:	0		
% Bare Ground in Herb Stratum 100 % Cover of Biotic Crust ____			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	**0**	(A)
Total Number of Dominant Species Across All Strata:	**0**	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	**0%**	(A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:
OBL species	**0**	x1 = **0**
FACW species	**0**	x2 = **0**
FAC species	**0**	x3 = **0**
FACU species	**0**	x4 = **0**
UPL species	**0**	x5 = **0**
Column Totals:	**0** (A)	**0** (B)

Prevalence Index = B/A = **0.0**

Hydrophytic Vegetation Indicators:

____ 1 - Rapid Test for Hydrophytic Vegetation
____ 2 - Dominance Test is >50%
____ 3 - Prevalence Index is ≤3.0[1]
____ 4 - Morphological Adaptation[1] (Provide supporting data in Remarks or on a separate sheet)
____ 5 - Wetland Non-Vascular Plants[1]
____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** X **No** ____

Remarks: No vegetation in standing water depression within grass pasture

SOIL

Sampling Point: Wet B DP11 W

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 5/2	90	10YR 5/4	10	D	M	SiL	
8-18	10YR 5/1	70	7.5YR 4/4	30	D	M	SiL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Muck Mineral (S1)
___ Sandy gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
___ Loamy Gleyed Matrix (F2)
_X_ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ 2 cm Muck (A10) (**LRR B**)
___ Red Parent Material (TF2)
___ Very Shallow Dark Surface (TF12)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** _X_ **No** ___

Remarks: 1 and 2 chroma with redox

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum one required; check all that apply)

_x_ Surface Water (A1)
___ High Water Table (A2)
_x_ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A and 4B**)
___ Salt Crust (B11)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Plowed Soils (C6)
___ Stunted or Stressed Plants (D1) (**LRR A**)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A and 4B**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Saturation Visible on Aerial Imagery (C9)
___ Geomorphic Position (D2)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)
___ Raised Ant Mounds (D6) (**LRR A**)
___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes _x_ No ___ Depth (inches): 3 inches
Water table Present? Yes ___ No _x_ Depth (inches): ___
Saturation Present? (includes capillary fringe) Yes _x_ No ___ Depth (inches): at surface

Wetland Hydrology Present? **Yes** _X_ **No** ___

Describe Recorded Data (Unnamed Tributary gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Standing water a few inches deep in depression. No water table, surface water flowed into data plot hole.

WETLAND DETERMINATION DATA FORM – Western Mountains, Valleys and Coast Region

Project/Site: Freeman Road Logistics City/County: Puyallup/Pierce County Sampling Date: 3/11/2022
Applicant/Owner: Vector Development Company State: WA Sampling Point: Wet B DP12 Up
Investigator(s): C. Douglas, M. Curran Section, Township, Range: S17 R4E T20N
Landform (hillslope, terrace, etc.): Forested Local relief (concave, convex, none): concave Slope: 1-5
Subregion (LRR): Northwest Forests and Coast (LRR A) Lat: 47.12'33 Long: 122.19'03 Datum: NAD83
Soil Map Unit Name: Pilchuck fine sand NWI Classification: PFO, PSS, POW
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" Present? Yes x No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No
Hydric Soil Present?	Yes	No X
Wetland Hydrology Present?	Yes X	No

Is the Sampled Area within a Wetland? Yes ____ No X

Remarks: Suspect area identified as SP 12 in Confluence Report. Depression area within grass pasture, ground is cleared of vegetation, grass vegetation surrounds standing water

VEGETATION

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status?
1.			
2.			
3.			
4.			
5.			
50%= 0 20%= 0 Total Cover:	0		
Sapling/Shrub Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
50%= 0 20%= 0 Total Cover:	0		
Herb Stratum (Plot size: ____)			
1. *Agrostis capillaris*	30	Yes	FAC
2. *Festuca rubra*	70	Yes	FAC
3.			
4.			
5.			
6.			
7.			
8.			
9.			
50%= 50 20%= 20 Total Cover:	100		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
Total Cover:	0		
% Bare Ground in Herb Stratum 0 % Cover of Biotic Crust			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	2	(A)
Total Number of Dominant Species Across All Strata:	2	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	100%	(A/B)

Prevalence Index Worksheet:

Total % Cover of:		Multiply by:
OBL species	0	x1 = 0
FACW species	0	x2 = 0
FAC species	100	x3 = 300
FACU species	0	x4 = 0
UPL species	0	x5 = 0
Column Totals:	100 (A)	300 (B)

Prevalence Index = B/A = 3.0

Hydrophytic Vegetation Indicators:

____ 1 - Rapid Test for Hydrophytic Vegetation
X 2 - Dominance Test is >50%
X 3 - Prevalence Index is ≤3.0[1]
____ 4 - Morphological Adaptation[1] (Provide supporting data in Remarks or on a separate sheet)
____ 5 - Wetland Non-Vascular Plants[1]
____ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes X No ____

Remarks: 100% FAC vegetation, mowed grass pasture

SOIL

Sampling Point: Wet B DP12 Up

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 4/3	99	10YR 5/4	1	D	M	SiL	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Muck Mineral (S1)
- ___ Sandy gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1) (**except MLRA 1**)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Red Parent Material (TF2)
- ___ Very Shallow Dark Surface (TF12)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ___ **No** X

Remarks: 3 chroma with redox

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- x Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Water-Stained Leaves (B9) (**except MLRA 1, 2, 4A and 4B**)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Plowed Soils (C6)
- ___ Stunted or Stressed Plants (D1) (**LRR A**)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A and 4B**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6) (**LRR A**)
- ___ Frost-Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ___ No x Depth (inches): ___

Water table Present? Yes ___ No x Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes x No ___ Depth (inches): 14 inches

Wetland Hydrology Present? **Yes** X **No** ___

Describe Recorded Data (Unnamed Tributary gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: Saturation at 14 inches

Wetland name or number A

RATING SUMMARY – Western Washington

Name of wetland (or ID #): Wetland A Date of site visit: 3/11/22

Rated by C. Douglas Trained by Ecology? ☒ Yes ☐ No Date of training 2007

HGM Class used for rating Depressional Wetland has multiple HGM classes? ☐ Y ☒ N

NOTE: **Form is not complete without the figures requested** *(figures can be combined)*.
Source of base aerial photo/map ______________________________

OVERALL WETLAND CATEGORY III (based on functions ☒ or special characteristics ☐)

1. Category of wetland based on FUNCTIONS

_______ **Category I** – Total score = 23 - 27

_______ **Category II** – Total score = 20 - 22

x **Category III** – Total score = 16 - 19

_______ **Category IV** – Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
			Circle the appropriate ratings	
Site Potential	H **M** L	H **M** L	H **M** L	
Landscape Potential	H **M** L	**H** M L	H M **L**	
Value	H **M** L	H **M** L	H M **L**	**TOTAL**
Score Based on Ratings	6	7	4	**17**

Score for each function based on three ratings
(order of ratings is not important)

9 = H,H,H
8 = H,H,M
7 = H,H,L
7 = H,M,M
6 = H,M,L
6 = M,M,M
5 = H,L,L
5 = M,M,L
4 = M,L,L
3 = L,L,L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	CATEGORY
Estuarine	I II
Wetland of High Conservation Value	I
Bog	I
Mature Forest	I
Old Growth Forest	I
Coastal Lagoon	I II
Interdunal	I II III IV
None of the above	X

Wetland name or number A

Maps and figures required to answer questions correctly for Western Washington

Depressional Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	D 1.3, H 1.1, H 1.4	
Hydroperiods	D 1.4, H 1.2	
Location of outlet (*can be added to map of hydroperiods)*	D 1.1, D 4.1	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	D 2.2, D 5.2	
Map of the contributing basin	D 4.3, D 5.3	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	D 3.1, D 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	D 3.3	

Riverine Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Ponded depressions	R 1.1	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	R 2.4	
Plant cover of trees, shrubs, and herbaceous plants	R 1.2, R 4.2	
Width of unit vs. width of stream *(can be added to another figure)*	R 4.1	
Map of the contributing basin	R 2.2, R 2.3, R 5.2	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	R 3.1	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	R 3.2, R 3.3	

Lake Fringe Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	L 1.1, L 4.1, H 1.1, H 1.4	
Plant cover of trees, shrubs, and herbaceous plants	L 1.2	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	L 2.2	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	L 3.1, L 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	L 3.3	

Slope Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Plant cover of **dense** trees, shrubs, and herbaceous plants	S 1.3	
Plant cover of **dense, rigid** trees, shrubs, and herbaceous plants (*can be added to figure above)*	S 4.1	
Boundary of 150 ft buffer (can be added to another figure)	S 2.1, S 5.1	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	S 3.1, S 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	S 3.3	

Wetland name or number A

HGM Classification of Wetlands in Western Washington

For questions 1-7, the criteria described must apply to the entire unit being rated.

If the hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1-7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides except during floods?

(●) NO – go to 2 ( ) **YES** – the wetland class is **Tidal Fringe** – go to 1.1

1.1 Is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)?

( ) **NO – Saltwater Tidal Fringe (Estuarine)** ( ) **YES – Freshwater Tidal Fringe**

If your wetland can be classified as a Freshwater Tidal Fringe use the forms for ***Riverine*** *wetlands. If it is Saltwater Tidal Fringe it is an* ***Estuarine*** *wetland and is not scored. This method* ***cannot*** *be used to score functions for estuarine wetlands.*

2. The entire wetland unit is flat and precipitation is the only source (>90%) of water to it. Groundwater and surface water runoff are NOT sources of water to the unit.

(●) NO – go to 3 ( ) **YES** – The wetland class is **Flats**

If your wetland can be classified as a Flats wetland, use the form for ***Depressional*** *wetlands.*

3. Does the entire wetland unit **meet all** of the following criteria?
   - [ ] The vegetated part of the wetland is on the shores of a body of permanent open water (without any plants on the surface at any time of the year) at least 20 ac (8 ha) in size;
   - [ ] At least 30% of the open water area is deeper than 6.6 ft (2 m).

(●) NO – go to 4 ( ) **YES –** The wetland class is **Lake Fringe** (Lacustrine Fringe)

4. Does the entire wetland unit **meet all** of the following criteria?
   - [ ] The wetland is on a slope (*slope can be very gradual*),
   - [ ] The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks,
   - [ ] The water leaves the wetland **without being impounded**.

(●) NO – go to 5 ( ) **YES –** The wetland class is **Slope**

NOTE: Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3 ft diameter and less than 1 ft deep).

5. Does the entire wetland unit **meet all** of the following criteria?
   - [ ] The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river,
   - [ ] The overbank flooding occurs at least once every 2 years.

Wetland name or number A

- [x] NO – go to 6
- [ ] **YES** – The wetland class is **Riverine**

NOTE: The Riverine unit can contain depressions that are filled with water when the river is not flooding

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year? *This means that any outlet, if present, is higher than the interior of the wetland.*

- [ ] NO – go to 7
- [x] **YES** – The wetland class is **Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding? The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.

- [x] NO – go to 8
- [ ] **YES** – The wetland class is **Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a Depressional wetland has a zone of flooding along its sides. GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within the wetland unit being scored.

   NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the HGM class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM classes within the wetland unit being rated	HGM class to use in rating
Slope + Riverine	Riverine
Slope + Depressional	Depressional
Slope + Lake Fringe	Lake Fringe
Depressional + Riverine along stream within boundary of depression	Depressional
Depressional + Lake Fringe	Depressional
Riverine + Lake Fringe	Riverine
Salt Water Tidal Fringe and any other class of freshwater wetland	Treat as ESTUARINE

If you are still unable to determine which of the above criteria apply to your wetland, or if you have ***more than 2 HGM classes*** *within a wetland boundary, classify the wetland as Depressional for the rating.*

Wetland name or number A

DEPRESSIONAL AND FLATS WETLANDS **Water Quality Functions** - Indicators that the site functions to improve water quality	
D 1.0. Does the site have the potential to improve water quality?	
D 1.1. Characteristics of surface water outflows from the wetland: Wetland is a depression or flat depression (QUESTION 7 on key) with no surface water leaving it (no outlet). points = 3 Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet. points = 2 Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing points = 1 Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch. points = 1	3
D 1.2. The soil 2 in below the surface (or duff layer) is true clay or true organic *(use NRCS definitions).* Yes = 4 No = 0	0
D 1.3. Characteristics and distribution of persistent plants (Emergent, Scrub-shrub, and/or Forested Cowardin classes): Wetland has persistent, ungrazed, plants > 95% of area points = 5 Wetland has persistent, ungrazed, plants > ½ of area points = 3 Wetland has persistent, ungrazed plants > $^1/_{10}$ of area points = 1 Wetland has persistent, ungrazed plants < $^1/_{10}$ of area points = 0	3
D 1.4. Characteristics of seasonal ponding or inundation: *This is the area that is ponded for at least 2 months. See description in manual.* Area seasonally ponded is > ½ total area of wetland points = 4 Area seasonally ponded is > ¼ total area of wetland points = 2 Area seasonally ponded is < ¼ total area of wetland points = 0	2
Total for D 1 Add the points in the boxes above	**8**

Rating of Site Potential If score is: ☐ **12-16 = H** ☒ **6-11 = M** ☐ **0-5 = L** *Record the rating on the first page*

D 2.0. Does the landscape have the potential to support the water quality function of the site?	
D 2.1. Does the wetland unit receive stormwater discharges? Yes = 1 No = 0	1
D 2.2. Is > 10% of the area within 150 ft of the wetland in land uses that generate pollutants? Yes = 1 No = 0	1
D 2.3. Are there septic systems within 250 ft of the wetland? Yes = 1 No = 0	0
D 2.4. Are there other sources of pollutants coming into the wetland that are not listed in questions D 2.1-D 2.3? Source_______________ Yes = 1 No = 0	0
Total for D 2 Add the points in the boxes above	**2**

Rating of Landscape Potential If score is: ☐ **3 or 4 = H** ☒ **1 or 2 = M** ☐ **0 = L** *Record the rating on the first page*

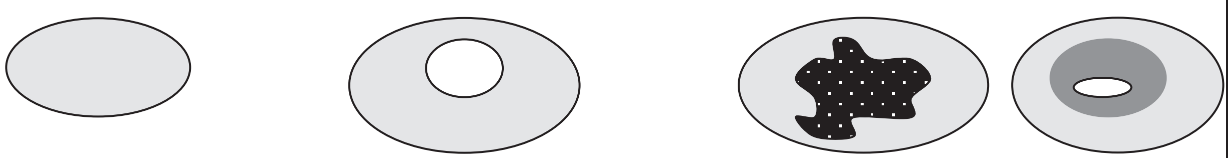
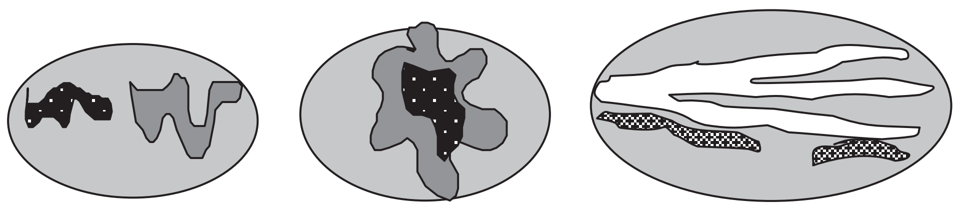
D 3.0. Is the water quality improvement provided by the site valuable to society?	
D 3.1. Does the wetland discharge directly (i.e., within 1 mi) to a stream, river, lake, or marine water that is on the 303(d) list? Yes = 1 No = 0	0
D 3.2. Is the wetland in a basin or sub-basin where an aquatic resource is on the 303(d) list? Yes = 1 No = 0	1
D 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality (*answer YES if there is a TMDL for the basin in which the unit is found*)? Yes = 2 No = 0	0
Total for D 3 Add the points in the boxes above	**1**

Rating of Value If score is: ☐ **2-4 = H** ☒ **1 = M** ☐ **0 = L** *Record the rating on the first page*

Wetland name or number A

DEPRESSIONAL AND FLATS WETLANDS **Hydrologic Functions** - Indicators that the site functions to reduce flooding and stream degradation	
D 4.0. Does the site have the potential to reduce flooding and erosion?	
D 4.1. Characteristics of surface water outflows from the wetland: Wetland is a depression or flat depression with no surface water leaving it (no outlet) points = 4 Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outletpoints = 2 Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch points = 1 Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing points = 0	4
D 4.2. Depth of storage during wet periods: *Estimate the height of ponding above the bottom of the outlet. For wetlands with no outlet, measure from the surface of permanent water or if dry, the deepest part.* Marks of ponding are 3 ft or more above the surface or bottom of outlet points = 7 Marks of ponding between 2 ft to < 3 ft from surface or bottom of outlet points = 5 Marks are at least 0.5 ft to < 2 ft from surface or bottom of outlet points = 3 The wetland is a "headwater" wetland points = 3 Wetland is flat but has small depressions on the surface that trap water points = 1 Marks of ponding less than 0.5 ft (6 in) points = 0	7
D 4.3. Contribution of the wetland to storage in the watershed: *Estimate the ratio of the area of upstream basin contributing surface water to the wetland to the area of the wetland unit itself.* The area of the basin is less than 10 times the area of the unit points = 5 The area of the basin is 10 to 100 times the area of the unit points = 3 The area of the basin is more than 100 times the area of the unit points = 0 Entire wetland is in the Flats class points = 5	0
Total for D 4 Add the points in the boxes above	**11**
Rating of Site Potential If score is: ☐ **12-16 = H** ☒ **6-11 = M** ☐ **0-5 = L** *Record the rating on the first page*	
D 5.0. Does the landscape have the potential to support hydrologic functions of the site?	
D 5.1. Does the wetland receive stormwater discharges? Yes = 1 No = 0	1
D 5.2. Is >10% of the area within 150 ft of the wetland in land uses that generate excess runoff? Yes = 1 No = 0	1
D 5.3. Is more than 25% of the contributing basin of the wetland covered with intensive human land uses (residential at >1 residence/ac, urban, commercial, agriculture, etc.)? Yes = 1 No = 0	1
Total for D 5 Add the points in the boxes above	**3**
Rating of Landscape Potential If score is: ☒ **3 = H** ☐ **1 or 2 = M** ☐ **0 = L** *Record the rating on the first page*	
D 6.0. Are the hydrologic functions provided by the site valuable to society?	
D 6.1. The unit is in a landscape that has flooding problems. *Choose the description that best matches conditions around the wetland unit being rated. Do not add points. Choose the highest score if more than one condition is met.* The wetland captures surface water that would otherwise flow down-gradient into areas where flooding has damaged human or natural resources (e.g., houses or salmon redds): • Flooding occurs in a sub-basin that is immediately down-gradient of unit. points = 2 • Surface flooding problems are in a sub-basin farther down-gradient. points = 1 Flooding from groundwater is an issue in the sub-basin. points = 1 The existing or potential outflow from the wetland is so constrained by human or natural conditions that the water stored by the wetland cannot reach areas that flood. *Explain why* _____________ points = 0 There are no problems with flooding downstream of the wetland. points = 0	1
D 6.2. Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan? Yes = 2 No = 0	0
Total for D 6 Add the points in the boxes above	**1**
Rating of Value If score is: ☐ **2-4 = H** ☒ **1 = M** ☐ **0 = L** *Record the rating on the first page*	

Wetland name or number A

These questions apply to wetlands of all HGM classes. **HABITAT FUNCTIONS** - Indicators that site functions to provide important habitat	
H 1.0. Does the site have the potential to provide habitat?	
H 1.1. Structure of plant community: *Indicators are Cowardin classes and strata within the Forested class.* Check the Cowardin plant classes in the wetland. *Up to 10 patches may be combined for each class to meet the threshold of ¼ ac or more than 10% of the unit if it is smaller than 2.5 ac. Add the number of structures checked.* ____Aquatic bed — 4 structures or more: points = 4 __X__Emergent — 3 structures: points = 2 __X__Scrub-shrub (areas where shrubs have > 30% cover) — 2 structures: points = 1 __X__Forested (areas where trees have > 30% cover) — 1 structure: points = 0 *If the unit has a Forested class, check if:* ____The Forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the Forested polygon	2
H 1.2. Hydroperiods Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or ¼ ac to count (*see text for descriptions of hydroperiods*). __X__Permanently flooded or inundated — 4 or more types present: points = 3 __X__Seasonally flooded or inundated — 3 types present: points = 2 ____Occasionally flooded or inundated — 2 types present: points = 1 __X__Saturated only — 1 type present: points = 0 ____Permanently flowing stream or river in, or adjacent to, the wetland ____Seasonally flowing stream in, or adjacent to, the wetland ____**Lake Fringe wetland** — **2 points** ____**Freshwater tidal wetland** — **2 points**	2
H 1.3. Richness of plant species Count the number of plant species in the wetland that cover at least 10 ft^2. *Different patches of the same species can be combined to meet the size threshold and you do not have to name the species.* ***Do not include Eurasian milfoil, reed canarygrass, purple loosestrife, Canadian thistle*** If you counted: > 19 species — points = 2 5 - 19 species — points = 1 < 5 species — points = 0	1
H 1.4. Interspersion of habitats Decide from the diagrams below whether interspersion among Cowardin plants classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, moderate, low, or none. *If you have four or more plant classes or three classes and open water, the rating is always high.*  **None** = 0 points — **Low** = 1 point — **Moderate** = 2 points  All three diagrams in this row are **HIGH** = 3points	2

H 1.5. Special habitat features: Check the habitat features that are present in the wetland. *The number of checks is the number of points.* _X_Large, downed, woody debris within the wetland (> 4 in diameter and 6 ft long). _X_Standing snags (dbh > 4 in) within the wetland ____Undercut banks are present for at least 6.6 ft (2 m) **and/or** overhanging plants extends at least 3.3 ft (1 m) over a stream (or ditch) in, or contiguous with the wetland, for at least 33 ft (10 m) _X_Stable steep banks of fine material that might be used by beaver or muskrat for denning (> 30 degree slope) OR signs of recent beaver activity are present *(cut shrubs or trees that have not yet weathered where wood is exposed)* _X_At least ¼ ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated *(structures for egg-laying by amphibians)* ____Invasive plants cover less than 25% of the wetland area in every stratum of plants (*see H 1.1 for list of strata*)	4
Total for H 1 — Add the points in the boxes above	**11**

Rating of Site Potential If score is: ☐ **15-18 = H** ☒ **7-14 = M** ☐ **0-6 = L** *Record the rating on the first page*

H 2.0. Does the landscape have the potential to support the habitat functions of the site?

H 2.1. Accessible habitat (include *only habitat that directly abuts wetland unit*). *Calculate:* % undisturbed habitat _5_ **+** [(% moderate and low intensity land uses)/2] _0_ **=** _5_% If total accessible habitat is: > $^{1}/_{3}$ (33.3%) of 1 km Polygon — points = 3 20-33% of 1 km Polygon — points = 2 10-19% of 1 km Polygon — points = 1 < 10% of 1 km Polygon — points = 0	0
H 2.2. Undisturbed habitat in 1 km Polygon around the wetland. *Calculate:* % undisturbed habitat _10_ **+** [(% moderate and low intensity land uses)/2] _10_ **=** _20_% Undisturbed habitat > 50% of Polygon — points = 3 Undisturbed habitat 10-50% and in 1-3 patches — points = 2 Undisturbed habitat 10-50% and > 3 patches — points = 1 Undisturbed habitat < 10% of 1 km Polygon — points = 0	1
H 2.3. Land use intensity in 1 km Polygon: If > 50% of 1 km Polygon is high intensity land use — points = (- 2) ≤ 50% of 1 km Polygon is high intensity — points = 0	-2
Total for H 2 — Add the points in the boxes above	**-1**

Rating of Landscape Potential If score is: ☐ **4-6 = H** ☐ **1-3 = M** ☒ **< 1 = L** *Record the rating on the first page*

H 3.0. Is the habitat provided by the site valuable to society?

H 3.1. Does the site provide habitat for species valued in laws, regulations, or policies? *Choose only the highest score that applies to the wetland being rated.* Site meets ANY of the following criteria: — points = 2 — It has 3 or more priority habitats within 100 m (see next page) — It provides habitat for Threatened or Endangered species (any plant or animal on the state or federal lists) — It is mapped as a location for an individual WDFW priority species — It is a Wetland of High Conservation Value as determined by the Department of Natural Resources — It has been categorized as an important habitat site in a local or regional comprehensive plan, in a Shoreline Master Plan, or in a watershed plan Site has 1 or 2 priority habitats (listed on next page) within 100 m — points = 1 Site does not meet any of the criteria above — points = 0	**0**

Rating of Value If score is: ☐ **2 = H** ☐ **1 = M** ☒ **0 = L** *Record the rating on the first page*

Wetland name or number A

WDFW Priority Habitats

Priority habitats listed by WDFW (see complete descriptions of WDFW priority habitats, and the counties in which they can be found, in: Washington Department of Fish and Wildlife. 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp. http://wdfw.wa.gov/publications/00165/wdfw00165.pdf or access the list from here: http://wdfw.wa.gov/conservation/phs/list/)

Count how many of the following priority habitats are within 330 ft (100 m) of the wetland unit: ***NOTE:*** *This question is independent of the land use between the wetland unit and the priority habitat.*

— **Aspen Stands:** Pure or mixed stands of aspen greater than 1 ac (0.4 ha).

— **Biodiversity Areas and Corridors**: Areas of habitat that are relatively important to various species of native fish and wildlife (*full descriptions in WDFW PHS report*).

— **Herbaceous Balds:** Variable size patches of grass and forbs on shallow soils over bedrock.

— **Old-growth/Mature forests:** Old-growth west of Cascade crest – Stands of at least 2 tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) > 32 in (81 cm) dbh or > 200 years of age. Mature forests – Stands with average diameters exceeding 21 in (53 cm) dbh; crown cover may be less than 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80-200 years old west of the Cascade crest.

— **Oregon White Oak:** Woodland stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important (*full descriptions in WDFW PHS report p. 158 – see web link above*).

— **Riparian**: The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other.

— **Westside Prairies:** Herbaceous, non-forested plant communities that can either take the form of a dry prairie or a wet prairie (*full descriptions in WDFW PHS report p. 161 – see web link above*).

— **Instream:** The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources.

— **Nearshore**: Relatively undisturbed nearshore habitats. These include Coastal Nearshore, Open Coast Nearshore, and Puget Sound Nearshore. (*full descriptions of habitats and the definition of relatively undisturbed are in WDFW report – see web link on previous page).*

— **Caves:** A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human.

— **Cliffs:** Greater than 25 ft (7.6 m) high and occurring below 5000 ft elevation.

— **Talus:** Homogenous areas of rock rubble ranging in average size 0.5 - 6.5 ft (0.15 - 2.0 m), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.

x **Snags and Logs:** Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 20 in (51 cm) in western Washington and are > 6.5 ft (2 m) in height. Priority logs are > 12 in (30 cm) in diameter at the largest end, and > 20 ft (6 m) long.

Note: All vegetated wetlands are by definition a priority habitat but are not included in this list because they are addressed elsewhere.

Wetland name or number A

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

Wetland Type *Check off any criteria that apply to the wetland. Circle the category when the appropriate criteria are met.*	**Category**
SC 1.0. Estuarine wetlands Does the wetland meet the following criteria for Estuarine wetlands? — The dominant water regime is tidal, — Vegetated, and — With a salinity greater than 0.5 ppt ◯Yes –Go to **SC 1.1** ◉No= **Not an estuarine wetland**	
SC 1.1. Is the wetland within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151? ◯Yes = **Category I** ◯No - Go to **SC 1.2**	◯**Cat. I**
SC 1.2. Is the wetland unit at least 1 ac in size and meets at least two of the following three conditions? — The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing, and has less than 10% cover of non-native plant species. (If non-native species are *Spartina*, see page 25) — At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. — The wetland has at least two of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands. ◯Yes = **Category I** ◯No = **Category II**	◯**Cat. I** ◯**Cat. II**
SC 2.0. Wetlands of High Conservation Value (WHCV) SC 2.1. Has the WA Department of Natural Resources updated their website to include the list of Wetlands of High Conservation Value? ◯Yes **–** Go to **SC 2.2** ◯No **–** Go to **SC 2.3** SC 2.2. Is the wetland listed on the WDNR database as a Wetland of High Conservation Value? ◯Yes **= Category I** ◉No **= Not a WHCV** SC 2.3. Is the wetland in a Section/Township/Range that contains a Natural Heritage wetland? http://www1.dnr.wa.gov/nhp/refdesk/datasearch/wnhpwetlands.pdf ◯Yes **– Contact WNHP/WDNR and go to SC 2.4** ◯No **= Not a WHCV** SC 2.4. Has WDNR identified the wetland within the S/T/R as a Wetland of High Conservation Value and listed it on their website? ◯Yes **= Category I** ◯No **= Not a WHCV**	◯**Cat. I**
SC 3.0. Bogs Does the wetland (or any part of the unit) meet both the criteria for soils and vegetation in bogs? *Use the key below.* ***If you answer YES you will still need to rate the wetland based on its functions.*** SC 3.1. Does an area within the wetland unit have organic soil horizons, either peats or mucks, that compose 16 in or more of the first 32 in of the soil profile? ◯Yes – Go to **SC 3.3** ◯No – Go to **SC 3.2** SC 3.2. Does an area within the wetland unit have organic soils, either peats or mucks, that are less than 16 in deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond? ◯Yes – Go to **SC 3.3** ◯No = **Is not a bog** SC 3.3. Does an area with peats or mucks have more than 70% cover of mosses at ground level, AND at least a 30% cover of plant species listed in Table 4? ◯Yes = **Is a Category I bog** ◯No – Go to **SC 3.4** **NOTE:** If you are uncertain about the extent of mosses in the understory, you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16 in deep. If the pH is less than 5.0 and the plant species in Table 4 are present, the wetland is a bog. SC 3.4. Is an area with peats or mucks forested (> 30% cover) with Sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann spruce, or western white pine, AND any of the species (or combination of species) listed in Table 4 provide more than 30% of the cover under the canopy? ◯Yes = **Is a Category I bog** ◉No = **Is not a bog**	◯**Cat. I**

SC 4.0. Forested Wetlands Does the wetland have at least 1 contiguous acre of forest that meets one of these criteria for the WA Department of Fish and Wildlife's forests as priority habitats? ***If you answer YES you will still need to rate the wetland based on its functions.*** — **Old-growth forests** (west of Cascade crest): Stands of at least two tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) that are at least 200 years of age OR have a diameter at breast height (dbh) of 32 in (81 cm) or more. — **Mature forests** (west of the Cascade Crest): Stands where the largest trees are 80- 200 years old OR the species that make up the canopy have an average diameter (dbh) exceeding 21 in (53 cm). ○ Yes = **Category I** ◉ No **= Not a forested wetland for this section**	○ **Cat. I**
SC 5.0. Wetlands in Coastal Lagoons Does the wetland meet all of the following criteria of a wetland in a coastal lagoon? — The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or, less frequently, rocks — The lagoon in which the wetland is located contains ponded water that is saline or brackish (> 0.5 ppt) during most of the year in at least a portion of the lagoon *(needs to be measured near the bottom)* ○ Yes – Go to **SC 5.1** ◉ No = **Not a wetland in a coastal lagoon** SC 5.1. Does the wetland meet all of the following three conditions? — The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of aggressive, opportunistic plant species (see list of species on p. 100). — At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. — The wetland is larger than $^{1}/_{10}$ ac (4350 ft^2) ○ Yes = **Category I** ◉ No = **Category II**	○ **Cat. I** ○ **Cat. II**
SC 6.0. Interdunal Wetlands Is the wetland west of the 1889 line (also called the Western Boundary of Upland Ownership or WBUO)? ***If you answer yes you will still need to rate the wetland based on its habitat functions.*** In practical terms that means the following geographic areas: — Long Beach Peninsula: Lands west of SR 103 — Grayland-Westport: Lands west of SR 105 — Ocean Shores-Copalis: Lands west of SR 115 and SR 109 ○ Yes – Go to **SC 6.1** ◉ No = **not an interdunal wetland for rating** SC 6.1. Is the wetland 1 ac or larger and scores an 8 or 9 for the habitat functions on the form (rates H,H,H or H,H,M for the three aspects of function)? ○ Yes = **Category I** ○ No – Go to **SC 6.2** SC 6.2. Is the wetland 1 ac or larger, or is it in a mosaic of wetlands that is 1 ac or larger? ○ Yes = **Category II** ○ No – Go to **SC 6.3** SC 6.3. Is the unit between 0.1 and 1 ac, or is it in a mosaic of wetlands that is between 0.1 and 1 ac? ○ Yes = **Category III** ○ No = **Category IV**	○ **Cat I** ○ **Cat. II** ○ **Cat. III** ○ **Cat. IV**
Category of wetland based on Special Characteristics If you answered No for all types, enter "Not Applicable" on Summary Form	NA

Wetland name or number B

RATING SUMMARY – Western Washington

Name of wetland (or ID #): Wetland B Date of site visit: 3/11/22

Rated by C. Douglas Trained by Ecology? ☒ Yes ☐ No Date of training 2007

HGM Class used for rating Depressional Wetland has multiple HGM classes? ☐ Y ☒ N

NOTE: Form is not complete without the figures requested *(figures can be combined)*.

Source of base aerial photo/map ________________

OVERALL WETLAND CATEGORY IV (based on functions ☒ or special characteristics ☐)

1. Category of wetland based on FUNCTIONS

_____ **Category I** – Total score = 23 - 27

_____ **Category II** – Total score = 20 - 22

_____ **Category III** – Total score = 16 - 19

x **Category IV** – Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
			Circle the appropriate ratings	
Site Potential	H **M** L	H M **L**	H M **L**	
Landscape Potential	H **M** L	H **M** L	H M **L**	
Value	H **M** L	H M **L**	H M **L**	**TOTAL**
Score Based on Ratings	7	4	3	**14**

Score for each function based on three ratings
(order of ratings is not important)

9 = H,H,H
8 = H,H,M
7 = H,H,L
7 = H,M,M
6 = H,M,L
6 = M,M,M
5 = H,L,L
5 = M,M,L
4 = M,L,L
3 = L,L,L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	CATEGORY
Estuarine	I II
Wetland of High Conservation Value	I
Bog	I
Mature Forest	I
Old Growth Forest	I
Coastal Lagoon	I II
Interdunal	I II III IV
None of the above	X

Maps and figures required to answer questions correctly for Western Washington

Depressional Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	D 1.3, H 1.1, H 1.4	
Hydroperiods	D 1.4, H 1.2	
Location of outlet (*can be added to map of hydroperiods)*	D 1.1, D 4.1	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	D 2.2, D 5.2	
Map of the contributing basin	D 4.3, D 5.3	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	D 3.1, D 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	D 3.3	

Riverine Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Ponded depressions	R 1.1	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	R 2.4	
Plant cover of trees, shrubs, and herbaceous plants	R 1.2, R 4.2	
Width of unit vs. width of stream *(can be added to another figure)*	R 4.1	
Map of the contributing basin	R 2.2, R 2.3, R 5.2	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	R 3.1	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	R 3.2, R 3.3	

Lake Fringe Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	L 1.1, L 4.1, H 1.1, H 1.4	
Plant cover of trees, shrubs, and herbaceous plants	L 1.2	
Boundary of area within 150 ft of the wetland *(can be added to another figure)*	L 2.2	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	L 3.1, L 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	L 3.3	

Slope Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Plant cover of **dense** trees, shrubs, and herbaceous plants	S 1.3	
Plant cover of **dense, rigid** trees, shrubs, and herbaceous plants (*can be added to figure above)*	S 4.1	
Boundary of 150 ft buffer (can be added to another figure)	S 2.1, S 5.1	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	S 3.1, S 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	S 3.3	

HGM Classification of Wetlands in Western Washington

For questions 1-7, the criteria described must apply to the entire unit being rated.

If the hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1-7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides except during floods?

(●) NO – go to 2 ( ) **YES** – the wetland class is **Tidal Fringe** – go to 1.1

1.1 Is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)?

( ) **NO – Saltwater Tidal Fringe (Estuarine)** ( ) **YES – Freshwater Tidal Fringe**

*If your wetland can be classified as a Freshwater Tidal Fringe use the forms for **Riverine** wetlands. If it is Saltwater Tidal Fringe it is an **Estuarine** wetland and is not scored. This method **cannot** be used to score functions for estuarine wetlands.*

2. The entire wetland unit is flat and precipitation is the only source (>90%) of water to it. Groundwater and surface water runoff are NOT sources of water to the unit.

(●) NO – go to 3 ( ) **YES** – The wetland class is **Flats**

*If your wetland can be classified as a Flats wetland, use the form for **Depressional** wetlands.*

3. Does the entire wetland unit **meet all** of the following criteria?
   - [ ] The vegetated part of the wetland is on the shores of a body of permanent open water (without any plants on the surface at any time of the year) at least 20 ac (8 ha) in size;
   - [ ] At least 30% of the open water area is deeper than 6.6 ft (2 m).

(●) NO – go to 4 ( ) **YES –** The wetland class is **Lake Fringe** (Lacustrine Fringe)

4. Does the entire wetland unit **meet all** of the following criteria?
   - [ ] The wetland is on a slope (*slope can be very gradual*),
   - [ ] The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks,
   - [ ] The water leaves the wetland **without being impounded**.

(●) NO – go to 5 ( ) **YES –** The wetland class is **Slope**

NOTE: Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3 ft diameter and less than 1 ft deep).

5. Does the entire wetland unit **meet all** of the following criteria?
   - [ ] The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river,
   - [ ] The overbank flooding occurs at least once every 2 years.

Wetland name or number B

◉ NO – go to 6 ○ **YES** – The wetland class is **Riverine**

NOTE: The Riverine unit can contain depressions that are filled with water when the river is not flooding

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year? *This means that any outlet, if present, is higher than the interior of the wetland.*

○ NO – go to 7 ◉ **YES** – The wetland class is **Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding? The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.

◉ NO – go to 8 ○ **YES** – The wetland class is **Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a Depressional wetland has a zone of flooding along its sides. GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within the wetland unit being scored.

   NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the HGM class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM classes within the wetland unit being rated	HGM class to use in rating
Slope + Riverine	Riverine
Slope + Depressional	Depressional
Slope + Lake Fringe	Lake Fringe
Depressional + Riverine along stream within boundary of depression	Depressional
Depressional + Lake Fringe	Depressional
Riverine + Lake Fringe	Riverine
Salt Water Tidal Fringe and any other class of freshwater wetland	Treat as ESTUARINE

If you are still unable to determine which of the above criteria apply to your wetland, or if you have ***more than 2 HGM classes*** *within a wetland boundary, classify the wetland as Depressional for the rating.*

Wetland name or number B

DEPRESSIONAL AND FLATS WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality

D 1.0. Does the site have the potential to improve water quality?	
D 1.1. Characteristics of surface water outflows from the wetland: Wetland is a depression or flat depression (QUESTION 7 on key) with no surface water leaving it (no outlet). points = 3 Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet. points = 2 Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing points = 1 Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch. points = 1	3
D 1.2. The soil 2 in below the surface (or duff layer) is true clay or true organic *(use NRCS definitions)*. Yes = 4 No = 0	0
D 1.3. Characteristics and distribution of persistent plants (Emergent, Scrub-shrub, and/or Forested Cowardin classes): Wetland has persistent, ungrazed, plants > 95% of area points = 5 Wetland has persistent, ungrazed, plants > ½ of area points = 3 Wetland has persistent, ungrazed plants > $^{1}/_{10}$ of area points = 1 Wetland has persistent, ungrazed plants < $^{1}/_{10}$ of area points = 0	0
D 1.4. Characteristics of seasonal ponding or inundation: *This is the area that is ponded for at least 2 months. See description in manual.* Area seasonally ponded is > ½ total area of wetland points = 4 Area seasonally ponded is > ¼ total area of wetland points = 2 Area seasonally ponded is < ¼ total area of wetland points = 0	4
Total for D 1 Add the points in the boxes above	**7**

Rating of Site Potential If score is: ☐ **12-16 = H** ☒ **6-11 = M** ☐ **0-5 = L** *Record the rating on the first page*

D 2.0. Does the landscape have the potential to support the water quality function of the site?	
D 2.1. Does the wetland unit receive stormwater discharges? Yes = 1 No = 0	0
D 2.2. Is > 10% of the area within 150 ft of the wetland in land uses that generate pollutants? Yes = 1 No = 0	1
D 2.3. Are there septic systems within 250 ft of the wetland? Yes = 1 No = 0	0
D 2.4. Are there other sources of pollutants coming into the wetland that are not listed in questions D 2.1-D 2.3? Source_______________ Yes = 1 No = 0	0
Total for D 2 Add the points in the boxes above	**1**

Rating of Landscape Potential If score is: ☐ **3 or 4 = H** ☒ **1 or 2 = M** ☐ **0 = L** *Record the rating on the first page*

D 3.0. Is the water quality improvement provided by the site valuable to society?	
D 3.1. Does the wetland discharge directly (i.e., within 1 mi) to a stream, river, lake, or marine water that is on the 303(d) list? Yes = 1 No = 0	0
D 3.2. Is the wetland in a basin or sub-basin where an aquatic resource is on the 303(d) list? Yes = 1 No = 0	1
D 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality (*answer YES if there is a TMDL for the basin in which the unit is found*)? Yes = 2 No = 0	0
Total for D 3 Add the points in the boxes above	**1**

Rating of Value If score is: ☐ **2-4 = H** ☒ **1 = M** ☐ **0 = L** *Record the rating on the first page*

DEPRESSIONAL AND FLATS WETLANDS

Hydrologic Functions - Indicators that the site functions to reduce flooding and stream degradation

D 4.0. Does the site have the potential to reduce flooding and erosion?	
D 4.1. Characteristics of surface water outflows from the wetland: Wetland is a depression or flat depression with no surface water leaving it (no outlet) points = 4 Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outletpoints = 2 Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch points = 1 Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing points = 0	4
D 4.2. Depth of storage during wet periods: *Estimate the height of ponding above the bottom of the outlet. For wetlands with no outlet, measure from the surface of permanent water or if dry, the deepest part.* Marks of ponding are 3 ft or more above the surface or bottom of outlet points = 7 Marks of ponding between 2 ft to < 3 ft from surface or bottom of outlet points = 5 Marks are at least 0.5 ft to < 2 ft from surface or bottom of outlet points = 3 The wetland is a "headwater" wetland points = 3 Wetland is flat but has small depressions on the surface that trap water points = 1 Marks of ponding less than 0.5 ft (6 in) points = 0	0
D 4.3. Contribution of the wetland to storage in the watershed: *Estimate the ratio of the area of upstream basin contributing surface water to the wetland to the area of the wetland unit itself.* The area of the basin is less than 10 times the area of the unit points = 5 The area of the basin is 10 to 100 times the area of the unit points = 3 The area of the basin is more than 100 times the area of the unit points = 0 Entire wetland is in the Flats class points = 5	0
Total for D 4 Add the points in the boxes above	**4**

Rating of Site Potential If score is: ☐ **12-16 = H** ☐ **6-11 = M** ☒ **0-5 = L** *Record the rating on the first page*

D 5.0. Does the landscape have the potential to support hydrologic functions of the site?	
D 5.1. Does the wetland receive stormwater discharges? Yes = 1 No = 0	0
D 5.2. Is >10% of the area within 150 ft of the wetland in land uses that generate excess runoff? Yes = 1 No = 0	0
D 5.3. Is more than 25% of the contributing basin of the wetland covered with intensive human land uses (residential at >1 residence/ac, urban, commercial, agriculture, etc.)? Yes = 1 No = 0	1
Total for D 5 Add the points in the boxes above	**1**

Rating of Landscape Potential If score is: ☐ **3 = H** ☒ **1 or 2 = M** ☐ **0 = L** *Record the rating on the first page*

D 6.0. Are the hydrologic functions provided by the site valuable to society?	
D 6.1. The unit is in a landscape that has flooding problems. *Choose the description that best matches conditions around the wetland unit being rated. Do not add points. Choose the highest score if more than one condition is met.* The wetland captures surface water that would otherwise flow down-gradient into areas where flooding has damaged human or natural resources (e.g., houses or salmon redds): • Flooding occurs in a sub-basin that is immediately down-gradient of unit. points = 2 • Surface flooding problems are in a sub-basin farther down-gradient. points = 1 Flooding from groundwater is an issue in the sub-basin. points = 1 The existing or potential outflow from the wetland is so constrained by human or natural conditions that the water stored by the wetland cannot reach areas that flood. *Explain why* ______________ points = 0 There are no problems with flooding downstream of the wetland. points = 0	0
D 6.2. Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan? Yes = 2 No = 0	0
Total for D 6 Add the points in the boxes above	**0**

Rating of Value If score is: ☐ **2-4 = H** ☐ **1 = M** ☒ **0 = L** *Record the rating on the first page*

Wetland name or number B

These questions apply to wetlands of all HGM classes.

HABITAT FUNCTIONS - Indicators that site functions to provide important habitat

H 1.0. Does the site have the potential to provide habitat?

H 1.1. Structure of plant community: *Indicators are Cowardin classes and strata within the Forested class.* Check the Cowardin plant classes in the wetland. *Up to 10 patches may be combined for each class to meet the threshold of ¼ ac or more than 10% of the unit if it is smaller than 2.5 ac. Add the number of structures checked.*

____Aquatic bed	4 structures or more: points = 4
____Emergent	3 structures: points = 2
____Scrub-shrub (areas where shrubs have > 30% cover)	2 structures: points = 1
____Forested (areas where trees have > 30% cover)	1 structure: points = 0

If the unit has a Forested class, check if:

____The Forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the Forested polygon

Score: 0

H 1.2. Hydroperiods

Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or ¼ ac to count (*see text for descriptions of hydroperiods*).

____Permanently flooded or inundated	4 or more types present: points = 3
____Seasonally flooded or inundated	3 types present: points = 2
____Occasionally flooded or inundated	2 types present: points = 1
____Saturated only	1 type present: points = 0
____Permanently flowing stream or river in, or adjacent to, the wetland	
____Seasonally flowing stream in, or adjacent to, the wetland	
____**Lake Fringe wetland**	**2 points**
____**Freshwater tidal wetland**	**2 points**

Score: 1

H 1.3. Richness of plant species

Count the number of plant species in the wetland that cover at least 10 ft^2.

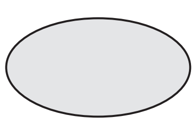
Different patches of the same species can be combined to meet the size threshold and you do not have to name the species. ***Do not include Eurasian milfoil, reed canarygrass, purple loosestrife, Canadian thistle***

If you counted: > 19 species	points = 2
5 - 19 species	points = 1
< 5 species	points = 0

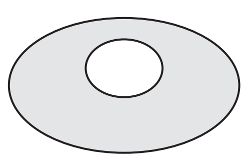
Score: 0

H 1.4. Interspersion of habitats

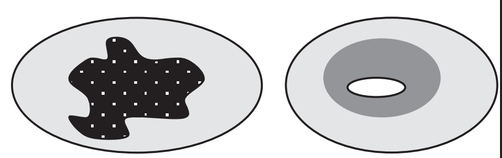
Decide from the diagrams below whether interspersion among Cowardin plants classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, moderate, low, or none. *If you have four or more plant classes or three classes and open water, the rating is always high.*



None = 0 points

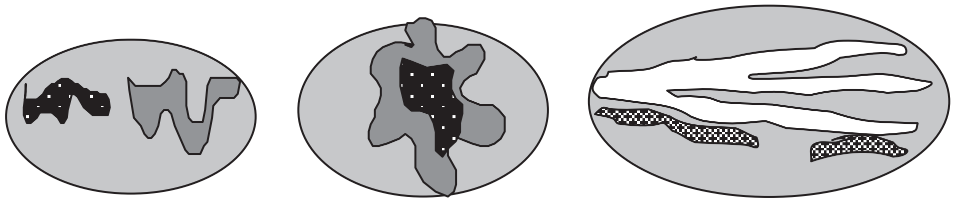


Low = 1 point



Moderate = 2 points

All three diagrams in this row are **HIGH** = 3points



Score: 0

Wetland name or number B

H 1.5. Special habitat features: Check the habitat features that are present in the wetland. *The number of checks is the number of points.* ____Large, downed, woody debris within the wetland (> 4 in diameter and 6 ft long). ____Standing snags (dbh > 4 in) within the wetland ____Undercut banks are present for at least 6.6 ft (2 m) **and/or** overhanging plants extends at least 3.3 ft (1 m) over a stream (or ditch) in, or contiguous with the wetland, for at least 33 ft (10 m) ____Stable steep banks of fine material that might be used by beaver or muskrat for denning (> 30 degree slope) OR signs of recent beaver activity are present *(cut shrubs or trees that have not yet weathered where wood is exposed)* ____At least ¼ ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated *(structures for egg-laying by amphibians)* ____Invasive plants cover less than 25% of the wetland area in every stratum of plants (*see H 1.1 for list of strata*)	0
Total for H 1 — Add the points in the boxes above	**1**

Rating of Site Potential If score is: ☐ **15-18 = H** ☐ **7-14 = M** ☒ **0-6 = L** *Record the rating on the first page*

H 2.0. Does the landscape have the potential to support the habitat functions of the site?	
H 2.1. Accessible habitat (include *only habitat that directly abuts wetland unit*). *Calculate:* % undisturbed habitat 0 + [(% moderate and low intensity land uses)/2] 0 = 0 % If total accessible habitat is: > $^{1}/_{3}$ (33.3%) of 1 km Polygon — points = 3 20-33% of 1 km Polygon — points = 2 10-19% of 1 km Polygon — points = 1 < 10% of 1 km Polygon — points = 0	0
H 2.2. Undisturbed habitat in 1 km Polygon around the wetland. *Calculate:* % undisturbed habitat 10 + [(% moderate and low intensity land uses)/2] 10 = 20 % Undisturbed habitat > 50% of Polygon — points = 3 Undisturbed habitat 10-50% and in 1-3 patches — points = 2 Undisturbed habitat 10-50% and > 3 patches — points = 1 Undisturbed habitat < 10% of 1 km Polygon — points = 0	1
H 2.3. Land use intensity in 1 km Polygon: If > 50% of 1 km Polygon is high intensity land use — points = (- 2) ≤ 50% of 1 km Polygon is high intensity — points = 0	-2
Total for H 2 — Add the points in the boxes above	**-1**

Rating of Landscape Potential If score is: ☐ **4-6 = H** ☐ **1-3 = M** ☒ **< 1 = L** *Record the rating on the first page*

H 3.0. Is the habitat provided by the site valuable to society?	
H 3.1. Does the site provide habitat for species valued in laws, regulations, or policies? *Choose only the highest score that applies to the wetland being rated.* Site meets ANY of the following criteria: — points = 2 — It has 3 or more priority habitats within 100 m (see next page) — It provides habitat for Threatened or Endangered species (any plant or animal on the state or federal lists) — It is mapped as a location for an individual WDFW priority species — It is a Wetland of High Conservation Value as determined by the Department of Natural Resources — It has been categorized as an important habitat site in a local or regional comprehensive plan, in a Shoreline Master Plan, or in a watershed plan Site has 1 or 2 priority habitats (listed on next page) within 100 m — points = 1 Site does not meet any of the criteria above — points = 0	**0**

Rating of Value If score is: ☐ **2 = H** ☐ **1 = M** ☒ **0 = L** *Record the rating on the first page*

Wetland name or number B

WDFW Priority Habitats

Priority habitats listed by WDFW (see complete descriptions of WDFW priority habitats, and the counties in which they can be found, in: Washington Department of Fish and Wildlife. 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp. http://wdfw.wa.gov/publications/00165/wdfw00165.pdf or access the list from here: http://wdfw.wa.gov/conservation/phs/list/)

Count how many of the following priority habitats are within 330 ft (100 m) of the wetland unit: ***NOTE:*** *This question is independent of the land use between the wetland unit and the priority habitat.*

— **Aspen Stands:** Pure or mixed stands of aspen greater than 1 ac (0.4 ha).

— **Biodiversity Areas and Corridors**: Areas of habitat that are relatively important to various species of native fish and wildlife (*full descriptions in WDFW PHS report*).

— **Herbaceous Balds:** Variable size patches of grass and forbs on shallow soils over bedrock.

— **Old-growth/Mature forests:** Old-growth west of Cascade crest – Stands of at least 2 tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) > 32 in (81 cm) dbh or > 200 years of age. Mature forests – Stands with average diameters exceeding 21 in (53 cm) dbh; crown cover may be less than 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80-200 years old west of the Cascade crest.

— **Oregon White Oak:** Woodland stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important (*full descriptions in WDFW PHS report p. 158 – see web link above*).

— **Riparian**: The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other.

— **Westside Prairies:** Herbaceous, non-forested plant communities that can either take the form of a dry prairie or a wet prairie (*full descriptions in WDFW PHS report p. 161 – see web link above*).

— **Instream:** The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources.

— **Nearshore**: Relatively undisturbed nearshore habitats. These include Coastal Nearshore, Open Coast Nearshore, and Puget Sound Nearshore. (*full descriptions of habitats and the definition of relatively undisturbed are in WDFW report – see web link on previous page).*

— **Caves:** A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human.

— **Cliffs:** Greater than 25 ft (7.6 m) high and occurring below 5000 ft elevation.

— **Talus:** Homogenous areas of rock rubble ranging in average size 0.5 - 6.5 ft (0.15 - 2.0 m), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.

— **Snags and Logs:** Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 20 in (51 cm) in western Washington and are > 6.5 ft (2 m) in height. Priority logs are > 12 in (30 cm) in diameter at the largest end, and > 20 ft (6 m) long.

Note: All vegetated wetlands are by definition a priority habitat but are not included in this list because they are addressed elsewhere.

Wetland name or number B

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

Wetland Type *Check off any criteria that apply to the wetland. Circle the category when the appropriate criteria are met.*	**Category**
SC 1.0. Estuarine wetlands Does the wetland meet the following criteria for Estuarine wetlands? — The dominant water regime is tidal, — Vegetated, and — With a salinity greater than 0.5 ppt ◯Yes –Go to **SC 1.1** ◉No= **Not an estuarine wetland**	
SC 1.1. Is the wetland within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151? ◯Yes = **Category I** ◯No - Go to **SC 1.2**	◯**Cat. I**
SC 1.2. Is the wetland unit at least 1 ac in size and meets at least two of the following three conditions? — The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing, and has less than 10% cover of non-native plant species. (If non-native species are *Spartina*, see page 25) — At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. — The wetland has at least two of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands. ◯Yes = **Category I** ◯No = **Category II**	◯**Cat. I** ◯**Cat. II**
SC 2.0. Wetlands of High Conservation Value (WHCV) SC 2.1. Has the WA Department of Natural Resources updated their website to include the list of Wetlands of High Conservation Value? ◯Yes **–** Go to **SC 2.2** ◯No **–** Go to **SC 2.3** SC 2.2. Is the wetland listed on the WDNR database as a Wetland of High Conservation Value? ◯Yes **= Category I** ◉No **= Not a WHCV** SC 2.3. Is the wetland in a Section/Township/Range that contains a Natural Heritage wetland? http://www1.dnr.wa.gov/nhp/refdesk/datasearch/wnhpwetlands.pdf ◯Yes **– Contact WNHP/WDNR and go to SC 2.4** ◯No **= Not a WHCV** SC 2.4. Has WDNR identified the wetland within the S/T/R as a Wetland of High Conservation Value and listed it on their website? ◯Yes **= Category I** ◯No **= Not a WHCV**	◯**Cat. I**
SC 3.0. Bogs Does the wetland (or any part of the unit) meet both the criteria for soils and vegetation in bogs? *Use the key below.* ***If you answer YES you will still need to rate the wetland based on its functions.*** SC 3.1. Does an area within the wetland unit have organic soil horizons, either peats or mucks, that compose 16 in or more of the first 32 in of the soil profile? ◯Yes – Go to **SC 3.3** ◯No – Go to **SC 3.2** SC 3.2. Does an area within the wetland unit have organic soils, either peats or mucks, that are less than 16 in deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond? ◯Yes – Go to **SC 3.3** ◯No = **Is not a bog** SC 3.3. Does an area with peats or mucks have more than 70% cover of mosses at ground level, AND at least a 30% cover of plant species listed in Table 4? ◯Yes = **Is a Category I bog** ◯No – Go to **SC 3.4** **NOTE:** If you are uncertain about the extent of mosses in the understory, you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16 in deep. If the pH is less than 5.0 and the plant species in Table 4 are present, the wetland is a bog. SC 3.4. Is an area with peats or mucks forested (> 30% cover) with Sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann spruce, or western white pine, AND any of the species (or combination of species) listed in Table 4 provide more than 30% of the cover under the canopy? ◯Yes = **Is a Category I bog** ◉No **= Is not a bog**	◯**Cat. I**

Wetland name or number B

SC 4.0. Forested Wetlands	
Does the wetland have at least 1 contiguous acre of forest that meets one of these criteria for the WA Department of Fish and Wildlife's forests as priority habitats? ***If you answer YES you will still need to rate the wetland based on its functions.*** — **Old-growth forests** (west of Cascade crest): Stands of at least two tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) that are at least 200 years of age OR have a diameter at breast height (dbh) of 32 in (81 cm) or more. — **Mature forests** (west of the Cascade Crest): Stands where the largest trees are 80- 200 years old OR the species that make up the canopy have an average diameter (dbh) exceeding 21 in (53 cm). ○ Yes = **Category I** ◉ No = **Not a forested wetland for this section**	○ **Cat. I**
SC 5.0. Wetlands in Coastal Lagoons Does the wetland meet all of the following criteria of a wetland in a coastal lagoon? — The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or, less frequently, rocks — The lagoon in which the wetland is located contains ponded water that is saline or brackish (> 0.5 ppt) during most of the year in at least a portion of the lagoon *(needs to be measured near the bottom)* ○ Yes – Go to **SC 5.1** ◉ No = **Not a wetland in a coastal lagoon** SC 5.1. Does the wetland meet all of the following three conditions? — The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of aggressive, opportunistic plant species (see list of species on p. 100). — At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. — The wetland is larger than $^{1}/_{10}$ ac (4350 ft^2) ○ Yes = **Category I** ○ No = **Category II**	○ **Cat. I** ○ **Cat. II**
SC 6.0. Interdunal Wetlands Is the wetland west of the 1889 line (also called the Western Boundary of Upland Ownership or WBUO)? ***If you answer yes you will still need to rate the wetland based on its habitat functions.*** In practical terms that means the following geographic areas: — Long Beach Peninsula: Lands west of SR 103 — Grayland-Westport: Lands west of SR 105 — Ocean Shores-Copalis: Lands west of SR 115 and SR 109 ○ Yes – Go to **SC 6.1** ◉ No = **not an interdunal wetland for rating** SC 6.1. Is the wetland 1 ac or larger and scores an 8 or 9 for the habitat functions on the form (rates H,H,H or H,H,M for the three aspects of function)? ○ Yes = **Category I** ○ No – Go to **SC 6.2** SC 6.2. Is the wetland 1 ac or larger, or is it in a mosaic of wetlands that is 1 ac or larger? ○ Yes = **Category II** ○ No – Go to **SC 6.3** SC 6.3. Is the unit between 0.1 and 1 ac, or is it in a mosaic of wetlands that is between 0.1 and 1 ac? ○ Yes = **Category III** ○ No = **Category IV**	○ **Cat I** ○ **Cat. II** ○ **Cat. III** ○ **Cat. IV**
Category of wetland based on Special Characteristics If you answered No for all types, enter "Not Applicable" on Summary Form	NA

Appendix D
Owner Letter

March 30, 2022

Re: Sessler Parcel 0420174075
NE Corner Ponding

Tyler,

Thank you for calling to discuss the water ponding you found on the property we sold to you in November. I'm happy to provide you with a history of this parcel as it relates to storm water and farming activities.

My wife and I have owned this property for over 20 years at the time of selling it in November 2021. During that time, there were two old barns on the property as it was used as an animal farm. At no point in our ownership period was there standing water on the property.

We had torn down the shed structures since a rise in homeless and transient activity started to plague the Freeman Road area. In addition to this work, we had begun to relocate soil from the northeast corner of the property (adjacent to the WSDOT shared property line) to the location of the sheds, with the intent of raising the elevation in the footprint of the sheds. While excavating soil from the northeast, we noticed groundwater seeping up, which led us to stop using material from that location.

We left the source for the soil relocation bare and flat, which resulted in slightly lower elevation than surrounding areas. At no point during our 20+ year ownership was there ponding on-site or even puddles forming during heavy rain events. We knew we had to keep the property relatively dry due to recurring farming activities throughout our ownership.

Sincerely,

Jon Sessler

Tab 7.0

7.0 OTHER PERMITS

7.0 OTHER PERMITS

Other permits for this project site include:

- NPDES General Permit from the Department of Ecology
- Site Development Permit from the City of Puyallup
- Grade and Fill Permit from the City of Puyallup
- Right of Way Permits from the City of Puyallup and Fife

Tab 8.0

8.0 CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN

A complete Construction Stormwater Pollution Prevention Plan will be included during future construction submittals.

Tab 9.0

9.0 OPERATIONS AND MAINTENANCE MANUAL

9.0 OPERATION AND MAINTENANCE MANUAL

See below for operation and maintenance requirements for flow control facilities, water quality facilities, and conveyance systems from the DOE SWMM. This section shall be updated as needed to reflect all chosen BMPs.

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NO. 3 – DETENTION TANKS AND VAULTS

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash and debris	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Tank or Vault Storage Area	Trash and debris	Any trash and debris accumulated in vault or tank (includes floatables and non-floatables).	No trash or debris in vault.
	Sediment accumulation	Accumulated sediment depth exceeds 10% of the diameter of the storage area for ½ length of storage vault or any point depth exceeds 15% of diameter. Example: 72-inch storage tank would require cleaning when sediment reaches depth of 7 inches for more than ½ length of tank.	All sediment removed from storage area.
Tank Structure	Plugged air vent	Any blockage of the vent.	Tank or vault freely vents.
	Tank bent out of shape	Any part of tank/pipe is bent out of shape more than 10% of its design shape.	Tank repaired or replaced to design.
	Gaps between sections, damaged joints or cracks or tears in wall	A gap wider than ½-inch at the joint of any tank sections or any evidence of soil particles entering the tank at a joint or through a wall.	No water or soil entering tank through joints or walls.
Vault Structure	Damage to wall, frame, bottom, and/or top slab	Cracks wider than ½-inch, any evidence of soil entering the structure through cracks or qualified inspection personnel determines that the vault is not structurally sound.	Vault is sealed and structurally sound.
Inlet/Outlet Pipes	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.
	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.

NO. 3 – DETENTION TANKS AND VAULTS

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Access Manhole	Cover/lid not in place	Cover/lid is missing or only partially in place. **Any open manhole requires immediate maintenance.**	Manhole access covered.
	Locking mechanism not working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to remove	One maintenance person cannot remove cover/lid after applying 80 lbs of lift.	Cover/lid can be removed and reinstalled by one maintenance person.
	Ladder rungs unsafe	Missing rungs, misalignment, rust, or cracks.	Ladder meets design standards. Allows maintenance person safe access.
Large access doors/plate	Damaged or difficult to open	Large access doors or plates cannot be opened/removed using normal equipment.	Replace or repair access door so it can opened as designed.
	Gaps, doesn't cover completely	Large access doors not flat and/or access opening not completely covered.	Doors close flat; covers access opening completely.
	Lifting Rings missing, rusted	Lifting rings not capable of lifting weight of door or plate.	Lifting rings sufficient to lift or remove door or plate.

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NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Structure	Sediment	Sediment exceeds 60% of the depth from the bottom of the catch basin to the invert of the lowest pipe into or out of the catch basin or is within 6 inches of the invert of the lowest pipe into or out of the catch basin.	Sump of catch basin contains no sediment.
	Trash and debris	Trash or debris of more than ½ cubic foot which is located immediately in front of the catch basin opening or is blocking capacity of the catch basin by more than 10%.	No Trash or debris blocking or potentially blocking entrance to catch basin.
		Trash or debris in the catch basin that exceeds $^1/_3$ the depth from the bottom of basin to invert the lowest pipe into or out of the basin.	No trash or debris in the catch basin.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within catch basin.
		Deposits of garbage exceeding 1 cubic foot in volume.	No condition present which would attract or support the breeding of insects or rodents.
	Damage to frame and/or top slab	Corner of frame extends more than ¾ inch past curb face into the street (If applicable).	Frame is even with curb.
		Top slab has holes larger than 2 square inches or cracks wider than ¼ inch.	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than ¾ inch of the frame from the top slab.	Frame is sitting flush on top slab.
	Cracks in walls or bottom	Cracks wider than ½ inch and longer than 3 feet, any evidence of soil particles entering catch basin through cracks, or maintenance person judges that catch basin is unsound.	Catch basin is sealed and is structurally sound.
		Cracks wider than ½ inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	No cracks more than $^1/_4$ inch wide at the joint of inlet/outlet pipe.
	Settlement/ misalignment	Catch basin has settled more than 1 inch or has rotated more than 2 inches out of alignment.	Basin replaced or repaired to design standards.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the catch basin at the joint of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of inlet/outlet pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
Inlet/Outlet Pipe	Sediment accumulation	Sediment filling 20% or more of the pipe.	Inlet/outlet pipes clear of sediment.
	Trash and debris	Trash and debris accumulated in inlet/outlet pipes (includes floatables and non-floatables).	No trash or debris in pipes.

	Damaged	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering at the joints of the inlet/outlet pipes.	No cracks more than ¼-inch wide at the joint of the inlet/outlet pipe.

NO. 5 – CATCH BASINS AND MANHOLES

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Metal Grates (Catch Basins)	Unsafe grate opening	Grate with opening wider than $^{7}/_{8}$ inch.	Grate opening meets design standards.
	Trash and debris	Trash and debris that is blocking more than 20% of grate surface.	Grate free of trash and debris. footnote to guidelines for disposal
	Damaged or missing	Grate missing or broken member(s) of the grate. **Any open structure requires urgent maintenance**.	Grate is in place and meets design standards.
Manhole Cover/Lid	Cover/lid not in place	Cover/lid is missing or only partially in place. **Any open structure requires urgent maintenance**.	Cover/lid protects opening to structure.
	Locking mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts cannot be seated. Self-locking cover/lid does not work.	Mechanism opens with proper tools.
	Cover/lid difficult to Remove	One maintenance person cannot remove cover/lid after applying 80 lbs. of lift.	Cover/lid can be removed and reinstalled by one maintenance person.

-

NO. 6 – CONVEYANCE PIPES AND DITCHES

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Pipes	Sediment & debris accumulation	Accumulated sediment or debris that exceeds 20% of the diameter of the pipe.	Water flows freely through pipes.
	Vegetation/roots	Vegetation/roots that reduce free movement of water through pipes.	Water flows freely through pipes.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damage to protective coating or corrosion	Protective coating is damaged; rust or corrosion is weakening the structural integrity of any part of pipe.	Pipe repaired or replaced.
	Damaged	Any dent that decreases the cross section area of pipe by more than 20% or is determined to have weakened structural integrity of the pipe.	Pipe repaired or replaced.
Ditches	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet of ditch and slopes.	Trash and debris cleared from ditches.
	Sediment accumulation	Accumulated sediment that exceeds 20% of the design depth.	Ditch cleaned/flushed of all sediment and debris so that it matches design.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Vegetation	Vegetation that reduces free movement of water through ditches.	Water flows freely through ditches.
	Erosion damage to slopes	Any erosion observed on a ditch slope.	Slopes are not eroding.
	Rock lining out of place or missing (If Applicable)	One layer or less of rock exists above native soil area 5 square feet or more, any exposed native soil.	Replace rocks to design standards.

-

NO. 8 – ENERGY DISSIPATERS

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed.
Site	Trash and debris	Trash and/or debris accumulation.	Dissipater clear of trash and/or debris.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
Rock Pad	Missing or moved Rock	Only one layer of rock exists above native soil in area five square feet or larger or any exposure of native soil.	Rock pad prevents erosion.
Dispersion Trench	Pipe plugged with sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not discharging water properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow" of water along trench).	Water discharges from feature by sheet flow.
	Perforations plugged.	Over 1/4 of perforations in pipe are plugged with debris or sediment.	Perforations freely discharge flow.
	Water flows out top of "distributor" catch basin.	Water flows out of distributor catch basin during any storm less than the design storm.	No flow discharges from distributor catch basin.
	Receiving area over-saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Gabions	Damaged mesh	Mesh of gabion broken, twisted or deformed so structure is weakened or rock may fall out.	Mesh is intact, no rock missing.
	Corrosion	Gabion mesh shows corrosion through more than ¼ of its gage.	All gabion mesh capable of containing rock and retaining designed form.
	Collapsed or deformed baskets	Gabion basket shape deformed due to any cause.	All gabion baskets intact, structure stands as designed.
	Missing rock	Any rock missing that could cause gabion to loose structural integrity.	No rock missing.
Manhole/Chamber	Worn or damaged post, baffles or side of chamber	Structure dissipating flow deteriorates to ½ or original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure is in no danger of failing.
	Damage to wall, frame, bottom, and/or top slab	Cracks wider than ½-inch or any evidence of soil entering the structure through cracks, or maintenance inspection personnel determines that the structure is not structurally sound.	Manhole/chamber is sealed and structurally sound.
	Damaged pipe joints	Cracks wider than ½-inch at the joint of the inlet/outlet pipes or any evidence of soil entering the structure at the joint of the inlet/outlet pipes.	No soil or water enters and no water discharges at the joint of inlet/outlet pipes.

NO. 9 – FENCING

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Erosion or holes under fence	Erosion or holes more than 4 inches high and 12-18 inches wide permitting access through an opening under a fence.	No access under the fence.
Wood Posts, Boards and Cross Members	Missing or damaged parts	Missing or broken boards, post out of plumb by more than 6 inches or cross members broken	No gaps on fence due to missing or broken boards, post plumb to within 1½ inches, cross members sound.
	Weakened by rotting or insects	Any part showing structural deterioration due to rotting or insect damage	All parts of fence are structurally sound.
	Damaged or failed post foundation	Concrete or metal attachments deteriorated or unable to support posts.	Post foundation capable of supporting posts even in strong wind.
Metal Posts, Rails and Fabric	Damaged parts	Post out of plumb more than 6 inches.	Post plumb to within 1½ inches.
		Top rails bent more than 6 inches.	Top rail free of bends greater than 1 inch.
		Any part of fence (including post, top rails, and fabric) more than 1 foot out of design alignment.	Fence is aligned and meets design standards.
		Missing or loose tension wire.	Tension wire in place and holding fabric.
	Deteriorated paint or protective coating	Part or parts that have a rusting or scaling condition that has affected structural adequacy.	Structurally adequate posts or parts with a uniform protective coating.
	Openings in fabric	Openings in fabric are such that an 8-inch diameter ball could fit through.	Fabric mesh openings within 50% of grid size.

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NO. 10 – GATES/BOLLARDS/ACCESS BARRIERS

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Chain Link Fencing Gate	Damaged or missing members	Missing gate.	Gates in place.
		Broken or missing hinges such that gate cannot be easily opened and closed by a maintenance person.	Hinges intact and lubed. Gate is working freely.
		Gate is out of plumb more than 6 inches and more than 1 foot out of design alignment.	Gate is aligned and vertical.
		Missing stretcher bar, stretcher bands, and ties.	Stretcher bar, bands, and ties in place.
	Locking mechanism does not lock gate	Locking device missing, no-functioning or does not link to all parts.	Locking mechanism prevents opening of gate.
	Openings in fabric	Openings in fabric are such that an 8-inch diameter ball could fit through.	Fabric mesh openings within 50% of grid size.
Bar Gate	Damaged or missing cross bar	Cross bar does not swing open or closed, is missing or is bent to where it does not prevent vehicle access.	Cross bar swings fully open and closed and prevents vehicle access.
	Locking mechanism does not lock gate	Locking device missing, no-functioning or does not link to all parts.	Locking mechanism prevents opening of gate.
	Support post damaged	Support post does not hold cross bar up.	Cross bar held up preventing vehicle access into facility.
Bollards	Damaged or missing	Bollard broken, missing, does not fit into support hole or hinge broken or missing.	No access for motorized vehicles to get into facility.
	Does not lock	Locking assembly or lock missing or cannot be attached to lock bollard in place.	No access for motorized vehicles to get into facility.
Boulders	Dislodged	Boulders not located to prevent motorized vehicle access.	No access for motorized vehicles to get into facility.
	Circumvented	Motorized vehicles going around or between boulders.	No access for motorized vehicles to get into facility.

NO. 11 – GROUNDS (LANDSCAPING)

Maintenance Component	Defect or Problem	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash or litter	Any trash and debris which exceed 1 cubic foot per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size office garbage can). In general, there should be no visual evidence of dumping.	Trash and debris cleared from site.
	Noxious weeds	Any noxious or nuisance vegetation which may constitute a hazard to County personnel or the public.	Noxious and nuisance vegetation removed according to applicable regulations. No danger of noxious vegetation where County personnel or the public might normally be.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Grass/groundcover	Grass or groundcover exceeds 18 inches in height.	Grass or groundcover mowed to a height no greater than 6 inches.
Trees and Shrubs	Hazard	Any tree or limb of a tree identified as having a potential to fall and cause property damage or threaten human life. **A hazard tree identified by a qualified arborist must be removed as soon as possible.**	No hazard trees in facility.
	Damaged	Limbs or parts of trees or shrubs that are split or broken which affect more than 25% of the total foliage of the tree or shrub.	Trees and shrubs with less than 5% of total foliage with split or broken limbs.
		Trees or shrubs that have been blown down or knocked over.	No blown down vegetation or knocked over vegetation. Trees or shrubs free of injury.
		Trees or shrubs which are not adequately supported or are leaning over, causing exposure of the roots.	Tree or shrub in place and adequately supported; dead or diseased trees removed.

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NO. 12 – ACCESS ROADS

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Site	Trash and debris	Trash and debris exceeds 1 cubic foot per 1,000 square feet (i.e., trash and debris would fill up one standards size garbage can).	Roadway drivable by maintenance vehicles.
		Debris which could damage vehicle tires or prohibit use of road.	Roadway drivable by maintenance vehicles.
	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Blocked roadway	Any obstruction which reduces clearance above road surface to less than 14 feet.	Roadway overhead clear to 14 feet high.
		Any obstruction restricting the access to a 10- to 12 foot width for a distance of more than 12 feet or any point restricting access to less than a 10 foot width.	At least 12-foot of width on access road.
Road Surface	Erosion, settlement, potholes, soft spots, ruts	Any surface defect which hinders or prevents maintenance access.	Road drivable by maintenance vehicles.
	Vegetation on road surface	Trees or other vegetation prevent access to facility by maintenance vehicles.	Maintenance vehicles can access facility.
Shoulders and Ditches	Erosion	Erosion within 1 foot of the roadway more than 8 inches wide and 6 inches deep.	Shoulder free of erosion and matching the surrounding road.
	Weeds and brush	Weeds and brush exceed 18 inches in height or hinder maintenance access.	Weeds and brush cut to 2 inches in height or cleared in such a way as to allow maintenance access.
Modular Grid Pavement	Contaminants and pollution	Any evidence of contaminants or pollution such as oil, gasoline, concrete slurries or paint.	Materials removed and disposed of according to applicable regulations. Source control BMPs implemented if appropriate. No contaminants present other than a surface oil film.
	Damaged or missing	Access surface compacted because of broken on missing modular block.	Access road surface restored so road infiltrates.

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en Installation and operating instructions

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Table of contents

1 General information

1.1 About these instructions

These installation and operating instructions are an integral part of the product. Read these instructions before commencing work and keep them in an accessible place at all times. Strict adherence to these instructions is a precondition for the intended use and correct operation of the product. All information and markings on the product must be observed.

The language of the original operating instructions is German. All other languages of these instructions are translations of the original operating instructions.

1.2 Copyright

These installation and operating instructions have been copyrighted by the manufacturer. Contents of any kind may not be reproduced or distributed, or used for purposes of competition and shared with others.

1.3 Subject to change

The manufacturer reserves the right to make technical modifications to the device or individual components. The illustrations used may differ from the original and are intended as an example representation of the device.

1.4 Warranty

The specifications in the current “General Terms and Conditions” apply to the warranty and the warranty period. These can be found at www.wilo.com/legal

Any deviations must be contractually agreed and shall then be given priority.

Claim to warranty

If the following points are complied with, the manufacturer is obligated to rectify every qualitative or constructive flaw:
- The defects are reported in writing to the manufacturer within the warranty period.
- Application according to intended use.
- All monitoring devices are connected and tested before commissioning.

Exclusion from liability

Exclusion from liability excludes all liability for personal injury, material damage or financial losses. This exclusion ensues as soon as one of the following applies:
- Inadequate configuration due to inadequate or incorrect instructions by the operator or the client
- Non-compliance with installation and operating instructions
- Improper use
- Incorrect storage or transport
- Incorrect installation or dismantling
- Insufficient maintenance
- Unauthorised repairs
- Inadequate construction site
- Chemical, electrical or electro-chemical influences
- Wear

2 Safety

This chapter contains basic information for the individual phases of the life cycle. Failure to observe this information carries the following risks:
- Injury to persons from electrical, mechanical and bacteriological factors as well as electromagnetic fields
- Environmental damage from discharge of hazardous substances
- Property damage
- Failure of important functions of the product

Failure to observe the information contained herein will result in the loss of claims for damages.

The instructions and safety instructions in the other chapters must also be observed!

2.1 Identification of safety instructions

These installation and operating instructions set out safety instructions for preventing personal injury and damage to property. These safety instructions are shown differently:
- Safety instructions relating to personal injury start with a signal word, are **preceded by a corresponding symbol** and are shaded in grey.

DANGER

Type and source of the danger!

Consequences of the danger and instructions for avoidance.

→ Safety instructions relating to property damage start with a signal word and are displayed **without** a symbol.

CAUTION

Type and source of the danger!

Consequences or information.

Signal words

→ **DANGER!**
Failure to observe the safety instructions will result in serious injuries or death!

→ **WARNING!**
Failure to follow the instructions can lead to (serious) injuries!

→ **CAUTION!**
Failure to follow the instructions can lead to property damage and a possible total loss.

→ **NOTICE!**
Useful information on handling the product

Markups

✓ Prerequisite

1. Work step/list

   ⇒ Notice/instructions

▶ Result

Symbols

These instructions use the following symbols:

Danger of electric voltage

Danger of bacterial infection

Danger of explosion

Danger – explosive atmosphere

General warning symbols

Warning of cutting injuries

Warning of hot surfaces

Warning of high pressure

Warning of suspended loads

Personal protective equipment: Wear a safety helmet

Personal protective equipment: Wear foot protection

Personal protective equipment: Wear hand protection

Personal protective equipment: Wear mouth protection

Personal protective equipment: Wear safety goggles

Autonomous work prohibited! A second person must be present.

Useful information

2.2 Personnel qualifications

Personnel must:
- → Be instructed about locally applicable regulations governing accident prevention.
- → Have read and understood the installation and operating instructions.

Personnel must have the following qualifications.
- → Electrical work: A qualified electrician must carry out the electrical work.
- → Installation/dismantling: The technician must be trained in the use of the necessary tools and fixation materials for the relevant construction site.
- → Maintenance tasks: The technician must be familiar with the use of operating fluids and their disposal. In addition, the technician must have basic knowledge of mechanical engineering.

Definition of "qualified electrician"

A qualified electrician is a person with appropriate technical education, knowledge and experience who can identify **and** prevent electrical hazards.

2.3 Electrical work

- → Electrical work must be carried out by a qualified electrician.
- → Before commencing work, disconnect the product from the mains and safeguard it from being switched on again.
- → Observe applicable local regulations when connecting to the mains power supply.
- → Adhere to the requirements of the local energy supply company.
- → Train personnel in connecting electrics.
- → Instruct personnel in options for switching off the device.
- → Comply with the technical specifications contained in these installation and operating instructions and on the rating plate.
- → Earth the device.
- → Observe regulations for connection to the electrical switching system.
- → Comply with the specifications on electro-magnetic compatibility when using electronic start-up controllers (e.g. soft starter or frequency converter). If required, take into account special measures (e.g. shielded cables, filters etc.).
- → Replace defective connection cables. Contact customer service.

2.4 Monitoring devices

The following monitoring devices must be provided on-site:

Circuit breaker

The size and switching characteristics of the circuit breakers must conform to the rated current of the connected product. Observe local regulations.

Motor protection switch

Make provision for an on-site motor protection switch for devices without a plug! The minimum requirement is a thermal relay/motor protection switch with temperature compensation, differential triggering and anti-reactivation device in accordance with the local regulations. In case of sensitive mains, make provision for the installation on-site of other protective equipment (e.g. overvoltage, undervoltage or phase failure relay, etc.).

Residual-current device (RCD)

Comply with the regulations of the local energy supply company! The use of a residual-current device is recommended.
If persons come into contact with the device and conductive fluids, secure the connection **with** a residual-current device (RCD).

2.5 Use in fluids hazardous to health

There is a danger of bacterial infection when using the device in fluids hazardous to health! Thoroughly clean and disinfect the device after dismantling and prior to further use. The operator must ensure the following:

→ The following protective equipment is provided and worn when cleaning the device:
  – Closed safety goggles
  – Breathing mask
  – Protective gloves
→ All persons are informed about the fluid, the associated danger and its correct handling!

2.6 Transport

→ The following protective equipment must be worn:
  – Safety shoes
  – Safety helmet (when using lifting equipment)
→ Always hold the handle to transport the device. Never pull the power supply cable!
→ Only use legally specified and approved lifting gear.
→ Select the lifting gear based on the existing conditions (weather, attachment point, load, etc.).
→ Always attach the lifting gear to the attachment points (handle or lifting eyelet).
→ The stability of the lifting equipment must be ensured during operation.
→ When using lifting equipment, a second person must be present to coordinate the procedure if required (e.g. if the operator's field of vision is blocked).
→ Persons are not permitted to stand beneath suspended loads. Do **not** carry suspended loads over workplaces where people are present.

2.7 Installing/dismantling

→ Wear the following protective equipment:
  – Safety shoes
  – Safety gloves for protection against cuts
  – Safety helmet (when using lifting equipment)
→ Locally applicable laws and regulations for work safety and accident prevention must be complied with.
→ Disconnect the device from the mains and secure it against being switched on again without authorisation.
→ All rotating parts must be at a standstill.
→ Provide adequate aeration in closed rooms.
→ When working in chambers and closed spaces, a second person must be present for safety reasons.
→ Take immediate countermeasures if there is a build-up of toxic or suffocating gases!
→ Clean the device thoroughly. Disinfect devices that are used in fluids hazardous to health!
→ Make sure that there is no risk of explosion when carrying out any type of welding work or work with electrical devices.

2.8 During operation

→ Wear the following protective equipment:
  – Safety shoes
  – Ear protection (in accordance with the notice of the work regulations)
→ Work area of the device is not a recreational area. No persons are allowed in the work area during operation.
→ The operator must immediately report any faults or irregularities to their line manager.
→ If safety-endangering defects occur, the operator must immediately deactivate the device:

- – Malfunction of the safety and monitoring device
- – Damage to the housing parts
- – Damage to the electrical equipment
- → Never reach into the suction port. The rotating parts can crush and sever limbs.
- → If the motor emerges during operation, the motor housing can heat up to above 40 °C (104 °F).
- → Open all gate valves in the piping on the suction and pressure side.
- → Ensure minimum water submersion through dry-running protection.
- → Under normal operating conditions, the sound pressure level of the device is below 85 dB(A). However, the actual sound-pressure level depends on several factors:
  - – Installation depth
  - – Installation
  - – Fixation of accessories and pipe
  - – Duty point
  - – Immersion depth
- → If the device is operated under normal operating conditions, the operator must measure the sound pressure. Ear protection must be worn for sound pressure levels of 85 dB(A) and above and this must be noted in the work regulations!

2.9 Maintenance tasks

- → Wear the following protective equipment:
  - – Closed safety goggles
  - – Safety shoes
  - – Safety gloves for protection against cuts
- → Always carry out maintenance tasks outside the operating space/installation site.
- → Only carry out maintenance tasks mentioned in these installation and operating instructions.
- → Only original parts from the manufacturer may be used for maintenance and repairs. Use of parts other than the original parts releases the manufacturer from any liability.
- → Collect any leakage of fluid and operating fluid immediately and dispose of it according to the locally applicable guidelines.
- → Store tools at the designated locations.
- → After completing work, reattach all safety and monitoring devices and check that they function properly.

Changing operating fluid

In case of a defect, a pressure **of several bar can build up** in the motor! This pressure escapes when the screw plugs are **opened**. If screw plugs are opened without due caution, they can be ejected at high speed! To avoid injuries, observe the following instructions:

- → Adhere to the prescribed sequence of work steps.
- → Unscrew the screw plugs slowly, but never unscrew them completely. As soon as the pressure escapes (audible whistling or hissing of air), stop turning the screw plug any further.
  WARNING! Hot operating fluids can also spray out when the pressure is escaping. This can result in scalding! To avoid injuries, allow the motor to cool down to the ambient temperature before carrying out any work!
- → When the pressure has completely dissipated, fully unscrew the screw plug.

2.10 Operating fluid

In the sealing chamber, the motor is filled with white oil. Operating fluid must be replaced during regular maintenance work and disposed off according to the local guidelines.

2.11 Operator responsibilities

- → Installation and operating instructions must be in a language which the personnel can understand.
- → Make sure that the personnel is relevantly trained for the specified work.
- → Provide the necessary protective equipment and make sure that the personnel wears it.
- → Safety and information signs mounted on the device must be always legible.
- → Train the personnel pertaining to the functioning of the system.
- → Eliminate risk from electrical current.
- → Equip hazardous components inside the system with an on-site guard.
- → Identify and cordon off the work area.
- → To ensure safe working practice, define the responsibilities of the employees.

Children and persons younger than 16 years or with reduced physical, sensory or mental capacities or limited experience are prohibited from handling the product! A technician must supervise persons younger than 18 years!

3 Application/use

3.1 Intended use

Submersible pumps are suitable for pumping:
- Sewage containing faeces
- Wastewater (with small amounts of sand and gravel)
- Process sewage
- Fluids with dry matter up to max. 8 %

3.2 Improper use

DANGER

Explosion due to pumping of explosive fluids!
Pumping of highly flammable and explosive fluids (gasoline, kerosene, etc.) in pure form is strictly prohibited. There is a risk of fatal injury due to explosion! The pumps are not designed for these fluids.

DANGER

Danger due to fluids hazardous to health!
If the pump is used in fluids hazardous to health, decontaminate the pump after dismantling and before carrying out any other work! There is a risk of fatal injury! Observe the specifications in the work regulations! The operator must make sure that the personnel have received and read the work regulations!

The submersible pumps must **not be used** for pumping:
- Drinking water
- Fluids containing hard components (such as stones, wood, metal, etc.)
- Fluids containing large quantities of abrasive contents (e.g. sand, gavel)

Intended use also includes compliance with this manual. Any other use is regarded as non-compliant with the intended use.

4 Product description

4.1 Design

Submersible sewage pump as submersible monobloc unit for continuous duty in wet well and dry well installation.

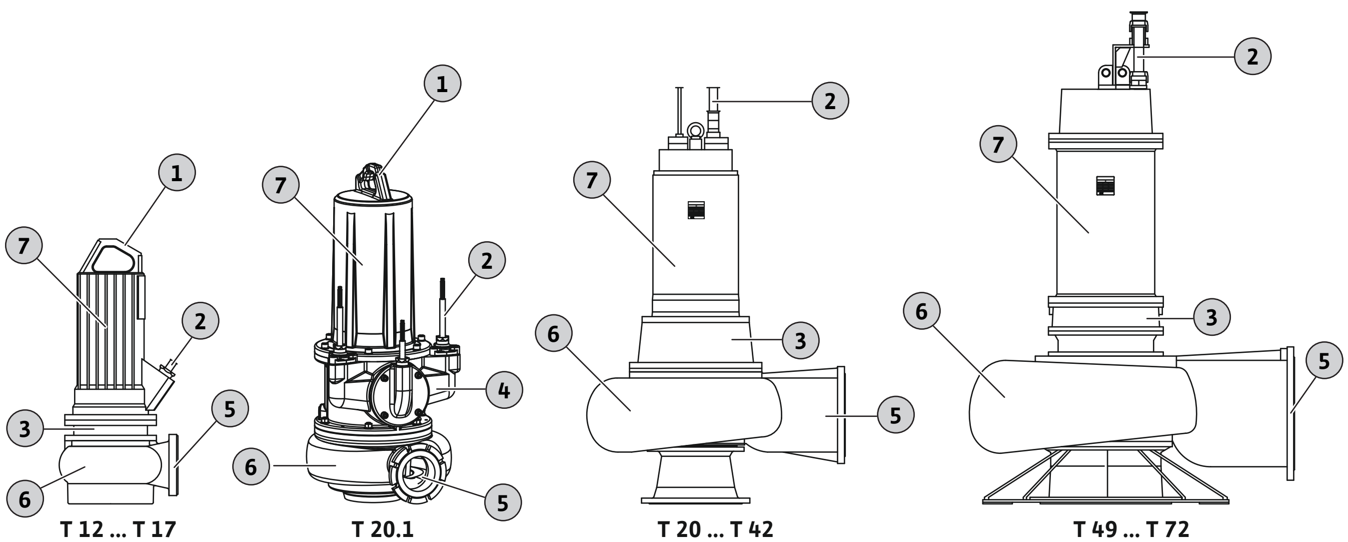

Fig. 1: Overview

1	Handle
2	Connection cable

3	Seal housing
4	Bearing housing
5	Pressure port
6	Hydraulics housing
7	Motor

4.1.1 Hydraulics

Centrifugal hydraulics with different impeller shapes, horizontal flange connection on the pressure side, inspection cover as well as casing and impeller wear rings.
The hydraulics are **not** self-priming, in other words, the fluid must flow in either automatically or with supply pressure.

Impeller shapes

The individual impeller shapes depend on the size of the hydraulics and not every impeller shape is available for every hydraulic system. The following is an overview of the different impeller shapes:
- → Vortex impeller
- → Single-channel impeller
- → Two-channel impeller
- → Three-channel impeller
- → Four-channel impeller
- → SOLID impeller, closed or half open

Inspection cover (depending on the hydraulics)

Additional opening on the hydraulics housing. This opening is used to remove clogging in the hydraulics.

Casing and impeller wear rings (depending on the hydraulics)

The suction port and impeller are subjected to the most stress when pumping. In the case of channel impellers, the gap between the impeller and the suction port is an important factor for a constant efficiency. The larger the gap between the impeller and the suction port, the higher the losses in the delivery rate. The efficiency decreases and the danger of clogging increases. In order to ensure long and efficient operation of the hydraulics, an impeller wear ring and/or casing wear ring is installed depending on the impeller and the hydraulics.
- → Impeller wear ring
  The impeller wear ring is attached to the channel impellers and protects the incoming flow edge of the impeller.
- → Casing wear ring
  The casing wear ring is installed in the suction port of the hydraulics and protects the incoming flow edge in the centrifugal chamber.

The two components can be replaced easily when worn.

4.1.2 Motor

The system is driven by surface-cooled motors in three-phase current version. The motor is cooled by the fluid around it. The waste heat is transferred directly to the fluid or the ambient air via the motor housing. The motor may emerge during operation. Operation is possible in dry well installation depending on the motor power.

The motors are provided with different fittings depending on the motor size:
- → Roller bearing: permanently lubricated and maintenance-free or regular re-greasing
- → Condensate (condensation water) in motor: can be drained off

Overview of motor fittings

	T 12 ... T 20	T 20.1	T 24 ... T 42	T 49, T 56	T 50, T 50.1, T 57.1, T 63.1	T 63.2, T 72
Leakage chamber for condensate (condensation water)*	–	–	•	•	•	•
Roller bearing: permanently lubricated	•	•	•	•	–	–

	T 12 … T 20	T 20.1	T 24 … T 42	T 49, T 56	T 50, T 50.1, T 57.1, T 63.1	T 63.2, T 72
Roller bearing: regular re-greasing	–	–	–	–	•	•

• = standard-equipped , – = not available

* **NOTICE! In the case of Ex-rated motors, the condensation water cannot be drained off from all motors. Depending on the motor, the drainage screw would be placed in a spark-proof area!**

The connection cable is longitudinally watertight and has bare cable ends.

4.1.3 Seal

Different methods are used for the seal to the fluid and the motor compartment:
- Version “H”: rotary shaft seal on the motor side, mechanical seal on the fluid side
- Version “G”: two separate mechanical seals
- Version “K”: two mechanical seals in a block seal cartridge made of stainless steel

Leakage from the seal is caught in the sealing chamber or leakage chamber:
- The sealing chamber accommodates any possible leakage of the seal on the fluid side.
- The leakage chamber accommodates any possible leakage of the seal on the motor side.
  In the case of motors without an additional leakage chamber, the leakage from the seal on the motor side is taken up in the motor.

Overview of gasket and leakage chamber

	T 12 … T 20	T 20.1	T 24 … T 42	T 49, T 56	T 50, T 50.1, T 57.1, T 63.1	T 63.2, T 72
Sealing chamber	•	•	•	•	•	•
Leakage chamber	–	•	–	–	•	•

• = standard-equipped , – = not available

The sealing chamber between the mechanical seals is filled with medical white oil. The leakage chamber is empty.

4.1.4 Material

The following materials are used in the standard version:
- Pump housing: EN-GJL-250 (ASTM A48 Class 35/40B)
- Impeller: EN-GJL-250 (ASTM A48 Class 35/40B)
- Motor housing: EN-GJL-250 (ASTM A48 Class 35/40B)
- Seal on the motor side:
  - “H” = NBR (nitrile)
  - “G” = carbon/ceramic or SiC/SiC
  - “K” = SiC/SiC
- Seal on the fluid side: SiC/SiC
- Seal, static: NBR (nitrile)

The precise details of the materials are shown in the respective configuration.

4.2 Monitoring devices

Overview of monitoring devices

	T 12 ... T 17	T 20	T 20.1	T 24 ... T 42	T 49, T 56	T 50, T 50.1, T 57.1, T 63.1	T 63.2, T 72
Internal monitoring devices							
Motor compartment	•	•	–	–	–	–	–
Terminal room/motor compartment	–	–	•	•	•	•	•
Motor winding	•	•	•	•	•	•	•
Motor bearings	–	o	o	o	o	o	o
Sealing chamber	•	–	–	–	–	•	•
Leakage chamber	–	–	•	–	–	•	•
Vibration sensor	–	–	–	o	o	o	o
External monitoring devices							
Sealing chamber	o	o	o	o	o	o	o

• = standard-equipped , – = not available, o = optional

All the monitoring devices fitted must always be connected!

Monitoring of motor compartment

The motor compartment monitoring protects the motor winding from short-circuits. The moisture is measured by an electrode.

Monitoring the terminal room and motor compartment

The terminal room and motor compartment monitoring protects the motor terminals and winding from short-circuits. An electrode in both the terminal room and the motor compartment measures the moisture content.

Monitoring of motor winding

The thermal motor monitoring protects the motor winding from overheating. Temperature limiting with bimetallic strip is fitted as standard.

As an option, the temperature can also be measured with a PTC sensor. The thermal motor monitoring can also be designed as temperature control. This allows the measurement of two temperatures. When the low temperature is reached, an automatic reactivation can be initiated after cooling the motor. When the high temperature is reached, the unit must deactivate with reactivation lock.

Internal monitoring of sealing chamber

This sealing chamber is equipped with an internal pencil electrode. The electrode registers fluid ingress through the mechanical seal on the fluid side. An alarm or deactivation of the pump can therefore take place by pump control.

External monitoring of the sealing chamber

The sealing chamber can be equipped with an external pencil electrode. The electrode registers fluid ingress through the mechanical seal on the fluid side. An alarm or deactivation of the pump can therefore take place by pump control.

Leakage chamber monitoring

The leakage chamber is equipped with a float switch. The float switch registers fluid ingress through the mechanical seal on the motor side. An alarm or deactivation of the pump can therefore take place by pump control.

Monitoring of motor bearing

The thermal monitoring of the motor bearing protects the roller bearings against overheating. Pt100 sensors are used for temperature measurement.

Monitoring of vibration occurring due to operation

The pump can be equipped with a vibration sensor. The vibration sensor registers the vibration that occurs during operation. An alarm or deactivation of the pump must be effected via the pump control depending on the differing limit values.

NOTICE! The limit values are set on-site during commissioning and recorded in the commissioning log!

4.3 Operating modes

Operating mode S1: Continuous duty

The pump can operate continuously at the rated load without exceeding the permissible temperature.

Operating mode: Non-immersed operation

The “non-immersed operation” operating mode describes the possibility of the motor emerging during the drainage pumping sequence. This allows a further lowering of the water level as far as the upper edge of the hydraulics.

	T 12 ... T 17	T 20	T 20.1	T 24 ... T 42	T 49, T 56	T 50, T 50.1 T 57.1, T 63.1	T 63.2, T 72
Non-immersed operation allowed	Yes	No	Yes	Yes	No	Yes	No

Observe the following points during non-immersed operation:

→ Operating mode “non-immersed” indicated
The motor emerging in “non-immersed” operating mode is permissible.

→ Operating mode: “non-immersed” **not** indicated
If the motor is fitted with a temperature controller (2-circuit temperature monitoring), emergence of the motor is permitted. Automatic reactivation can be initiated after the motor has cooled down using the low temperature. The unit is forced to deactivate with reactivation lock once the high-temperature has been reached.
CAUTION! To protect the motor winding from overheating, the motor must be equipped with a temperature controller! If only one temperature limiter is installed, the motor must not emerge during operation.

→ Max. fluid and ambient temperature: The maximum ambient temperature corresponds to the maximum fluid temperature shown on the rating plate.
CAUTION! The following applies to motor T 12: During non-immersed operation, the fluid temperature and ambient temperature must not exceed 30 °C!

4.4 Operation with frequency converter

Operation on the frequency converter is permitted. Refer to the appendix for the relevant requirements!

4.5 Operation in an explosive atmosphere

Overview of standard motors

	T 12	T 13	T 17	T 17.2	T 20	T 20.1	T 24	T 30	T 34	T 42	T 49	T 50	T 50.1	T 56	T 63.1/T 63.2	T 72
ATEX approval	o	o	o	o	o	o	o	o	o	o	–	–	o	o	o	–
FM approval	o	o	o	o	o	o	o	o	o	o	o	–	o	o	o	–
CSA-Ex approval	o	o	o	o	o	–	o	o	o	–	–	–	–	–	–	–

Key
– = not available/possible, o = optional, • = as standard

Overview of IE3 motors (derived from IEC 60034)

	T 17 ...-E3	T 17.2 ...-E3	T 20.1 ...-E3	T 24 ...-E3	T 30 ...-E3	T 34 ...-E3	T 42 ...-E3	T 50.1 ...-E3	T 57.1 ...-E3	T 63.1 ...-E3	T 63.2 ...-E3
ATEX approval	o	o	o	o	o	o	o	o	o	o	o
FM approval	–	–	–	–	–	–	–	–	–	–	–
CSA-Ex approval	–	–	–	–	–	–	–	–	–	–	–

Key
– = not available/possible, o = optional, • = as standard

For use in explosive atmospheres, the pump must be marked as follows on the rating plate:
→ “Ex” symbol of the corresponding approval
→ Ex classification

For the relevant requirements, refer to the explosion protection chapter in the appendix of these installation and operating instructions!

ATEX approval

The pumps are suitable for operation in potentially explosive atmospheres:
→ Device group: II
→ Category: 2, zone 1 and zone 2
These pumps must not be used in zone 0!

FM approval

The pumps are suitable for operation in potentially explosive atmospheres:
→ Protection class: Explosionproof
→ Category: Class I, Division 1
Notice: If the cabling is carried out according to Division 1, installation in Class I, Division 2 is also permitted.

CSA-Ex-rating according to division (Motor T 12, T 13, T 17, T 17.2, T 20, T 34)

The pumps are suitable for operation in potentially explosive atmospheres:
→ Protection class: Explosion-proof
→ Category: Class 1Division 1

CSA-Ex-rating according to zone (Motor T 24, T 30)

The pumps are suitable for operation in potentially explosive atmospheres:
→ Device group: II
→ Category: 2, zone 1 and zone 2
These pumps must not be used in zone 0!

4.6 Rating plate

The following is an overview of the abbreviations and associated data on the rating plate:

Rating plate designation	Value
P-Typ	Pump type
M-Typ	Motor type
S/N	Serial number
Art.-No.	Article number
MFY	Date of manufacture*
Q_N	Volume flow duty point
Q_{max}	Max. volume flow
H_N	Delivery head duty point

Rating plate designation	Value
H_{max}	Max. delivery head
H_{min}	Min. delivery head
n	Speed
T	Max. fluid temperature
IP	Protection class
I	Rated current
I_{ST}	Starting current
I_{SF}	Rated current at service factor
P_1	Power consumption
P_2	Rated power
U	Rated voltage
f	Frequency
Cos φ	Motor efficiency
SF	Service factor
OT_S	Operating mode: immersed
OT_E	Operating mode: non-immersed
AT	Starting mode
IM_{org}	Impeller diameter: original
IM_{korr}	Impeller diameter: corrected

*The date of manufacture is stated in accordance with ISO 8601: JJJJWww
- → JJJJ = year
- → W = abbreviation for week
- → ww = calendar week

4.7 Type key

Examples: Wilo-EMU FA 15.52-245E + T 17.2-4/24HEx-E3 Wilo-Rexa SUPRA-V10-736A + T 17.2-4/24HEx-E3 Wilo-Rexa SOLID-Q10-345A + T 17.2-4/24HEx-E3	
Hydraulics type key "EMU FA"	
FA	Sewage pump
15	x10 = nominal diameter of pressure connection
52	Internal performance coefficient
245	Original impeller diameter (only for standard variants, omitted for configured pumps)
D	Impeller shape: W = vortex impeller E = single-channel impeller Z = two-channel impeller D = three-channel impeller V = four-channel impeller T = closed two-channel impeller G = half-open single-channel impeller
Hydraulics type key "Rexa SUPRA"	
SUPRA	Sewage pump
V	Impeller shape: V = vortex impeller C = single-channel impeller M = multi-channel impeller
10	x10 = nominal diameter of pressure connection
73	Internal performance coefficient
6	Characteristic curve number

Examples: Wilo-EMU FA 15.52-245E + T 17.2-4/24HEx-E3 Wilo-Rexa SUPRA-V10-736A + T 17.2-4/24HEx-E3 Wilo-Rexa SOLID-Q10-345A + T 17.2-4/24HEx-E3	
A	Material version: A = standard version B = corrosion protection 1 D = abrasion protection 1 X = special configuration
Hydraulics type key "Rexa SOLID"	
SOLID	Sewage pump with SOLID impeller
Q	Impeller shape: T = closed two-channel impeller G = semi-open single-channel impeller Q = half-open two-channel impeller
10	x10 = nominal diameter of pressure connection
34	Internal performance coefficient
5	Characteristic curve number
A	Material version: A = standard version B = corrosion protection 1 D = abrasion protection 1 X = special configuration
Motor type key	
T	Surface-cooled motor
17	Size
2	Configuration version
4	Number of poles
24	Package length in cm
H	Seal version
Ex	Ex-rated
E3	IE-efficiency class (derived from IEC 60034-30)

4.8 Scope of delivery

Standard pump
- → Pump with bare cable end
- → Installation and operating instructions

Configured pumps
- → Pump with bare cable end
- → Cable length as per customer request
- → Mounted accessories, e.g. external pencil electrode, pump support foot, etc.
- → Installation and operating instructions

4.9 Accessories

- → Suspension unit
- → Pump support foot
- → Special versions with Ceram coatings or special materials
- → External pencil electrode for sealing chamber control
- → Level control devices
- → Fixation accessories and chains
- → Switchgear, relays and plugs

5 Transportation and storage

5.1 Delivery

After receiving the shipment, this must be checked immediately for defects (damage, completeness). Defects must be noted on the freight documentation! Furthermore, defects must be notified to the transport company or the manufacturer immediately on the day of receipt of shipment. Subsequently notified defects can no longer be asserted.

5.2 Transport

WARNING

Standing under suspended loads!

Never allow anyone to stand under suspended loads! Danger of (serious) injuries caused by falling parts. Loads may not be carried over work places where people are present!

WARNING

Head and foot injuries due to a lack of protective equipment!

Danger of (serious) injuries during work. Wear the following protective equipment:

- Safety shoes
- Safety helmet must be worn if lifting equipment are used!

NOTICE

Use only properly functioning lifting equipment!

Use only properly functioning lifting equipment to lift and lower the pump. Ensure that the pump does not become jammed during lifting and lowering. Do **not** exceed the maximum bearing capacity of the lifting equipment! Check that lifting equipment is functioning properly before use!

Only remove the outer packaging at the place of utilisation to ensure that the pump is not damaged during transport. Use tear-proof plastic sacks of sufficient size to package used pumps for transport in a leak-proof manner.

The following points must also be observed:

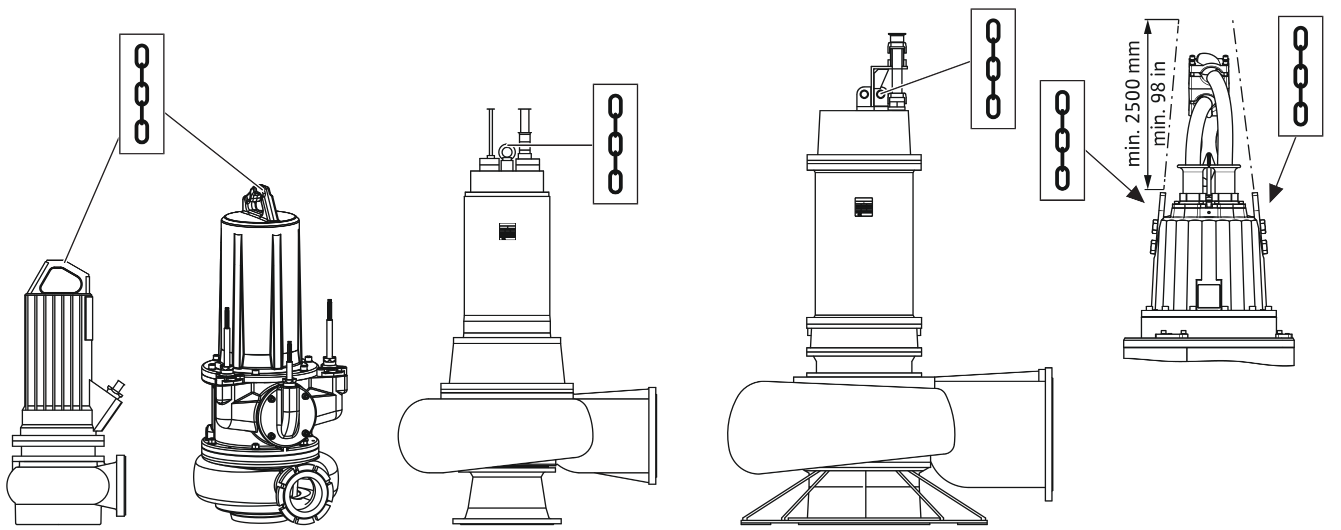

Fig. 2: Attachment points

- → Adhere to the applicable national safety regulations.
- → Use legally specified and approved lifting gear.
- → Select the lifting gear based on the existing conditions (weather, attachment point, load, etc.).
- → Only attach the lifting gear to the attachment point. Fix with a shackle.
- → Use lifting equipment with sufficient bearing capacity.
- → The stability of the lifting equipment must be ensured during operation.
- → When using lifting equipment, a second person must be present to coordinate the procedure if required (e.g. if the operator's field of vision is blocked).

5.3 Storage

DANGER

Danger due to fluids hazardous to health!

If the pump is used in fluids hazardous to health, decontaminate the pump after dismantling and before carrying out any other work! There is a risk of fatal injury! Observe the specifications in the work regulations! The operator must make sure that the personnel have received and read the work regulations!

WARNING

Sharp edges on the impeller and suction port!

Sharp edges can form on the impeller and suction port. There is danger of limbs being severed! Protective gloves must be worn to protect from cuts.

CAUTION

Total damage due to moisture ingress

Moisture ingress in the power supply cable damages the power supply cable and the pump! Never immerse the end of the power supply cable in a fluid and firmly seal it during storage.

Newly supplied pumps can be stored for one year. Contact customer service to store the pump for more than one year.

The following must be observed for storage:

- Place the pump upright (vertical) on a firm bearing surface and **secure it against slipping and falling over!**
- The max. storage temperature is -15 °C to +60 °C (5 °F to 140 °F) at a max. relative humidity of 90 %, non-condensing. Frost-proof storage at a temperature of 5 °C to 25 °C (41 °F to 77 °F) with relative humidity of 40 % to 50 % is recommended.
- Do not store the pump in rooms in which welding work is carried out. The resulting gases or radiation can corrode the elastomer parts and coatings.
- Seal the suction and pressure connection tightly.
- Protect power supply cables against kinking and damage.
- Protect the pump from direct sunlight and heat. Extreme heat can cause damage to the impellers and the coating!
- Impellers must be turned by 180 ° at regular intervals (3 – 6 months). This prevents locking of the bearings and renews the lubrication film of the mechanical seal. **WARNING! There is a risk of injury due to sharp edges on the impeller and suction port!**
- Elastomer parts and the coating are subject to natural brittleness. Contact customer service if the pump must be stored for more than 6 months.

After storage, remove any dust and oil from the pump and check the coating for damage. Repair damaged coatings before further use.

6 Installation and electrical connection

6.1 Personnel qualifications

- Electrical work: A qualified electrician must carry out the electrical work.
- Installation/dismantling: The technician must be trained in the use of the necessary tools and fixation materials for the relevant construction site.

6.2 Installation types

- Vertical stationary wet well installation
- Vertical portable wet well installation
- Vertical stationary dry well installation

The installation types are dependent on the motor type:

Motor type	Stationary wet	Portable wet	Stationary dry
T 12 ... T 17	•	•	•
T 20.1	•	•	•

Motor type	Stationary wet	Portable wet	Stationary dry
T 20 ... T 24	•	o	o
T 30 ... T 34	•	–	o
T 42 ... T 72	•	–	–

Key: – = not possible, o = possible on order by order basis, • = possible

The following installation types are **not** permitted:
→ Horizontal installation

6.3 Operator responsibilities

→ Observe locally applicable accident prevention and safety regulations of trade associations.
→ Observe all regulations for working with heavy loads and under suspended loads.
→ Provide protective equipment and ensure that the protective equipment is worn by personnel.
→ Observe local sewage technology regulations for the operation of sewage systems.
→ Avoid pressure surges!
Pressure surges can occur in long pressure pipes with steep terrain. These pressure surges can lead to the destruction of the pump!
→ Ensure the cooling time of the motor depending on the operating conditions and the size of the pump chamber.
→ Structural components and foundations must be of sufficient stability in order to allow the device to be fixed securely and functionally. The operator is responsible for the provision and suitability of the structural component/foundation!
→ Check that the available consulting documents (installation plans, design of the operating space, inflow conditions) are complete and correct.

6.4 Installation

DANGER

Risk of fatal injury due to dangerous lone working practices!

Work in chambers and narrow rooms as well as work involving risk of falling are dangerous work. Such work may not be carried out autonomously! A second person must be present for safety reasons.

WARNING

Hand and foot injuries due to lack of protective equipment!

Danger of (serious) injuries during work. Wear the following protective equipment:

- Safety gloves for protection against cuts
- Safety shoes
- Safety helmet must be worn if lifting equipment are used!

NOTICE

Use only properly functioning lifting equipment!

Use only properly functioning lifting equipment to lift and lower the pump. Ensure that the pump does not become jammed during lifting and lowering. Do **not** exceed the maximum bearing capacity of the lifting equipment! Check that lifting equipment is functioning properly before use!

→ Prepare operating space/installation location as follows:
  – Clean, free of coarse solids
  – Dry well
  – Frost-free
  – Decontaminated
→ Take immediate countermeasures if there is a build-up of toxic or suffocating gases!
→ Attach the lifting gear to the attachment point using a shackle. Only use lifting gear which has been technically approved.

- Use lifting gear for lifting, lowering and transporting the pump. Never pull the pump by the power supply cable!
- It must be possible to attach lifting equipment safely. The storage place and the operating space/installation site must be accessible with the lifting equipment. The set-down location must have a solid bearing surface.
- The routed power supply cables must allow safe operation. Check whether the cable cross-section and the cable length are sufficient for the selected installation type.
- The corresponding IP class must be observed when using switchgear. Install the switchgear overflow-proof and outside potentially explosive areas!
- Avoid air intake into the fluid, use baffles or deflector plates for the inlet. Air which has entered the system can collect in the pipe system and lead to impermissible operating conditions. Air pockets must be removed via ventilation systems!
- A dry run of the pump is prohibited! Avoid air pockets in the hydraulics housing or in the pipe system. Ensure the water level never falls below the minimum. The installation of a dry-running protection is recommended!

6.4.1 Indications for double pump operation

If several pumps are used in an operating space, minimum distances between the pumps and the wall must be complied with. Here there is a difference in the distances depending on the type of system: Alternating operation or parallel operation.

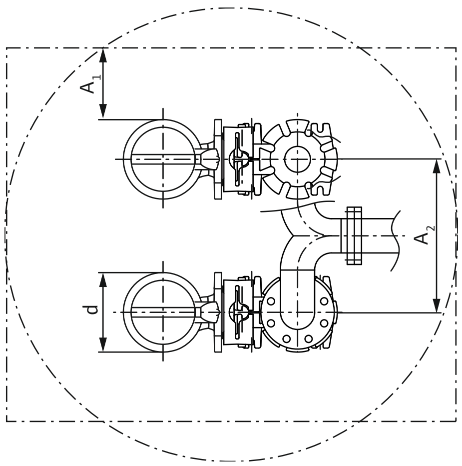

Fig. 3: Minimum distances

d	Diameter hydraulics housing
A_1	Minimum distance from the wall: - alternating operation: min. 0.3 × d - parallel operation: min. 1 × d
A_2	Distance to pressure pipes - alternating operation: min. 1.5 × d - parallel operation: min. 2 × d

6.4.2 Unloading pumps delivered in horizontal position

To prevent excessive tension and bending forces being applied to the pump, the pumps can, depending on their size and weight, be laid out horizontally for delivery. Delivery is on specially designed transport frames. Please observe the following work steps when unloading the pump.

NOTICE

Use only properly functioning lifting equipment!

Use only properly functioning lifting equipment to lift and lower the pump. Ensure that the pump does not become jammed during lifting and lowering. Do **not** exceed the maximum bearing capacity of the lifting equipment! Check that lifting equipment is functioning properly before use!

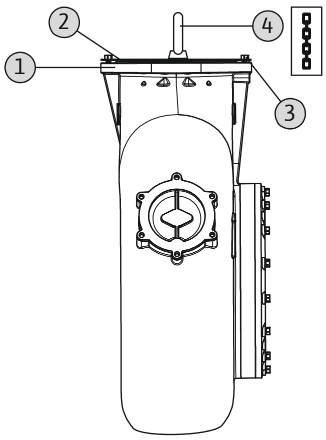

Fig. 4: Attachment point installation

Install the supplied attachment point (provided by the customer) on the pressure port.

1	Pressure connection
2	Load bar
3	Fixation load bar/pressure connection
4	Attachment point for angular loading up to 90 °

✓ Load bar with the corresponding bearing capacity for fixation of the attachment point

✓ Attachment point for angular loading up to 90 ° (e.g. "Theipa" type)

✓ Fixation material for the load bar

1. Place the load bar onto the pressure connection and attach it using two holes that are **opposite** each other.
2. Fix the attachment point to the load bar.

► Attachment point installed, pump prepared for attaching.

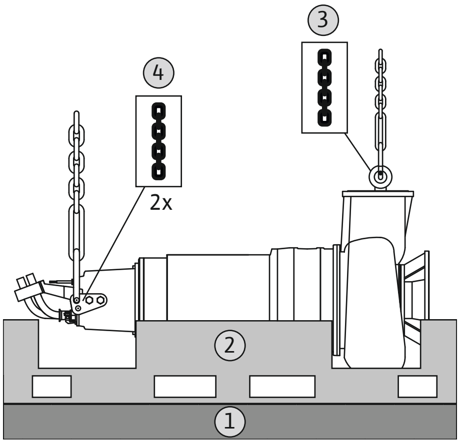

Fig. 5: Unload pump: prepare

Preparatory tasks

1	Bearing surface
2	Transport frame
3	Attachment point hydraulics
4	Attachment point motor

✓ The transport frame lies horizontally on a firm bearing surface.

✓ 2x lifting equipment with sufficient bearing capacity are provided.

✓ A sufficient number of approved items of lifting gear are provided.

1. Attach 1st lifting equipment to the hydraulics attachment point.
2. Attach 2nd lifting equipment to the motor attachment points.

► Pump ready for lifting and aligning.

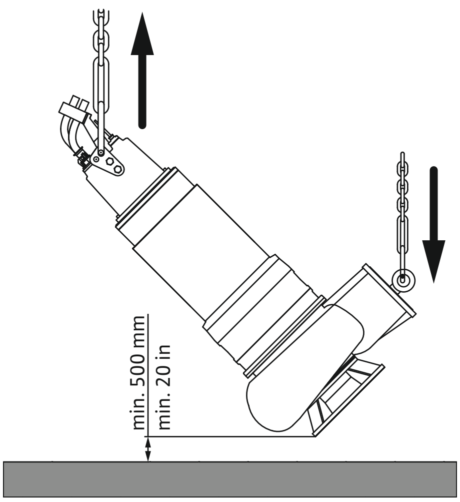

Fig. 6: Unload pump: turn

Lift and align the pump

✓ Preparatory tasks completed.

✓ Weather conditions permit unloading.

1. Slowly lift the pump using both items of lifting equipment. **CAUTION! Make sure that the pump remains horizontal!**
2. Remove transport frame.
3. Use the two items of lifting equipment to slowly move the pump into the vertical position. **CAUTION! Make sure that the housing parts do not touch the ground. The high point loads damage the housing parts.**
4. Once the pump is set upright, loosen the lifting gear at the hydraulics.

► The pump is aligned and ready to be set down.

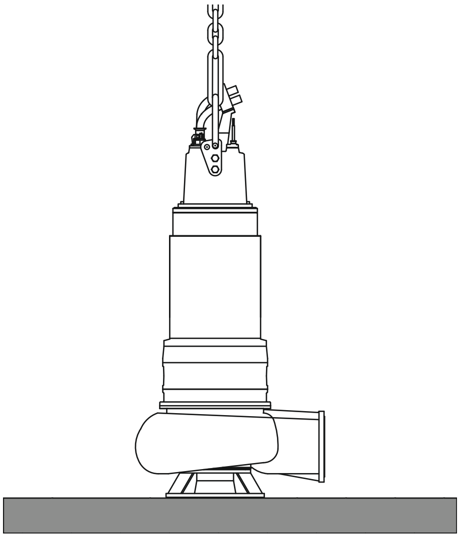

Fig. 7: Unload pump: set down

Set down pump

- ✓ The pump is aligned vertically (plumb).
- ✓ Lifting gear removed at the hydraulics.

1. Lower the pump slowly and set it down carefully.
   CAUTION! If the pump is set down too quickly, the hydraulics housing on the suction port can be damaged. Set the pump down slowly on the suction port! NOTICE! If the pump cannot be placed level on the suction port, use appropriate adjustment plates.

► The pump is ready for installation.

WARNING! If the pump is placed in temporary storage and the lifting equipment dismantled, secure the pump against falling over and slipping!

6.4.3 Maintenance tasks

After a storage period of more than 6 months, carry out the following maintenance tasks before installation:

→ Rotate the impeller.
→ Check the oil in the sealing chamber.

6.4.3.1 Rotate impeller

WARNING

Sharp edges on the impeller and suction port!

Sharp edges can form on the impeller and suction port. There is danger of limbs being severed! Protective gloves must be worn to protect from cuts.

Small pumps (T 12 ... T 20.1)

- ✓ The pump is **not** connected to the mains!
- ✓ Protective equipment must be put on!

1. Place the pump on a firm surface in a horizontal position. **WARNING! Risk of hands being crushed. Make sure that the pump cannot fall over or slip!**
2. Reach into the hydraulics housing carefully from below and slowly and turn the impeller.

Large pumps (T 24 ... T 63.2)

- ✓ The pump is **not** connected to the mains!
- ✓ Protective equipment must be put on!

1. Place the pump upright on a firm surface. **WARNING! Risk of hands being crushed. Make sure that the pump cannot fall over or slip!**
2. Carefully and slowly reach into the hydraulics housing through the pressure port and rotate the impeller.

6.4.3.2 Check oil in the sealing chamber

Motor T 12, T 13, T 17, T 17.2

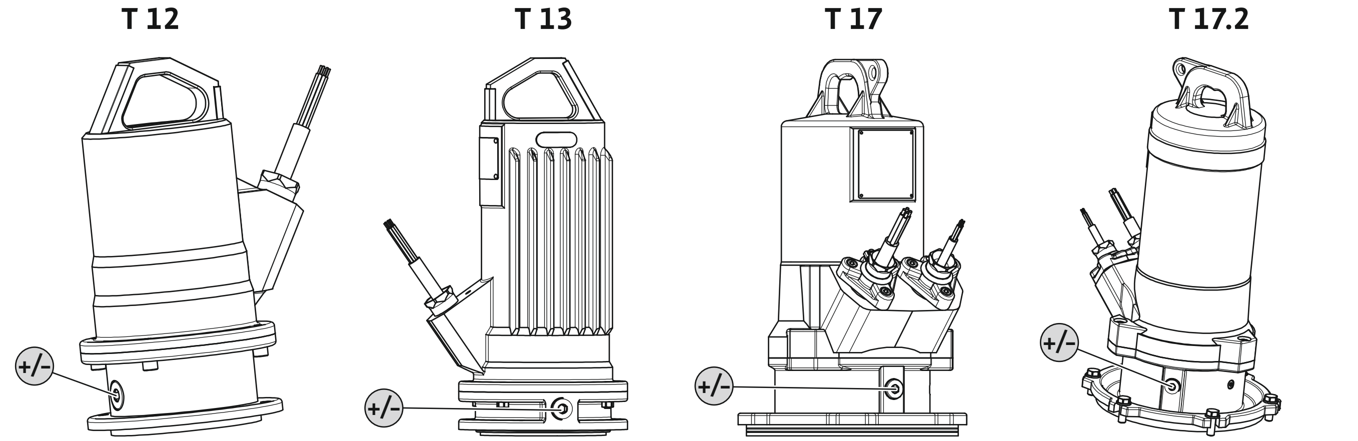

Fig. 8: Sealing chamber: Check oil

+/-	Fill/drain the oil in the sealing chamber

✓ Pump is **not** installed.

✓ Pump is **not** connected to the mains.

✓ Protective equipment has been put on!

1. Place the pump horizontally on a firm surface. The screw plug points upwards. **WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!**
2. Unscrew the screw plug.
3. Place a suitable tank to collect the operating fluid.
4. Drain the operating fluid: Rotate the pump until the opening points downwards.
5. Check the operating fluid:
   - ⇒ If the operating fluid is clear, reuse operating fluid.
   - ⇒ If the operating fluid is contaminated (black), fill with new operating fluid. Dispose of operating fluid in accordance with the local regulations!
   - ⇒ Notify customer service if an operating fluid contains metal chips!
6. Pour in operating fluid: Rotate the pump until the opening points upwards. Fill-in the operating fluid into the opening.
   - ⇒ Comply with the specifications for operating fluid locations and quantity! When recycling the operating fluid, check the quantity and if required adjust it!
7. Clean the screw plug, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft lb)!**

Motors T 20, T 20.1, T 24

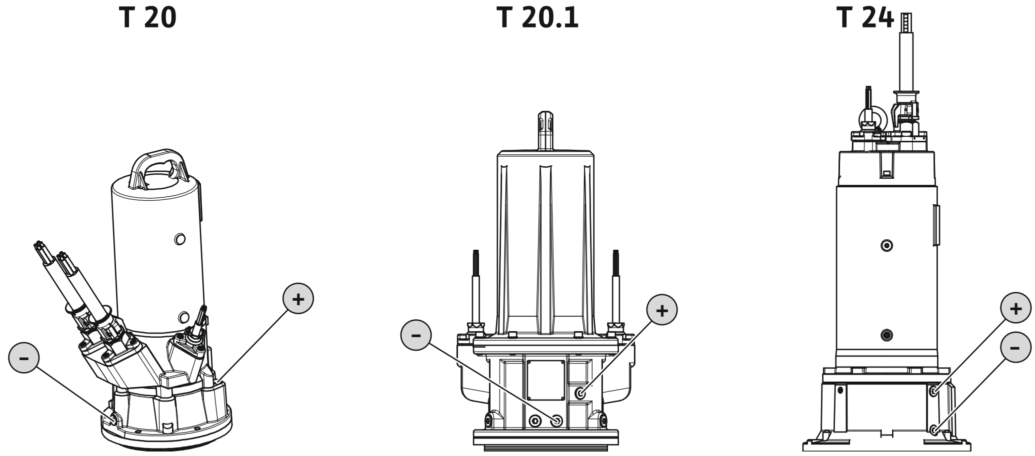

Fig. 9: Sealing chamber: Check oil

+	Add the oil to the sealing chamber
–	Drain the oil in the sealing chamber

✓ Pump is **not** installed.

✓ Pump is **not** connected to the mains.

✓ Protective equipment has been put on!

1. Place the pump upright on a firm surface.**WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!**
2. Place a suitable tank to collect the operating fluid.
3. Unscrew the screw plug **(+)**.
4. Unscrew screw plug **(–)** and drain the operating fluid. If a shut-off ball cock is installed on the outlet opening, open the shut-off ball cock.
5. Check the operating fluid:
   - ⇒ If the operating fluid is clear, reuse operating fluid.
   - ⇒ If the operating fluid is contaminated (black), fill with new operating fluid. Dispose of operating fluid in accordance with the local regulations!
   - ⇒ Notify customer service if the operating fluid contains swarf!
6. If a shut-off ball cock is installed on the outlet opening, close the shut-off ball cock.
7. Clean the screw plug **(–)**, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**
8. Pour the new operating fluid in through the hole for the screw plug **(+)**.
   - ⇒ Comply with the specifications for operating fluid type and quantity! When recycling the operating fluid, check the quantity and if required adjust it!
9. Clean the screw plug **(+)**, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**

Motors T 30, T 34, T 42, T 49, T 50.1, T 56, T 57, T 63.x, T 72

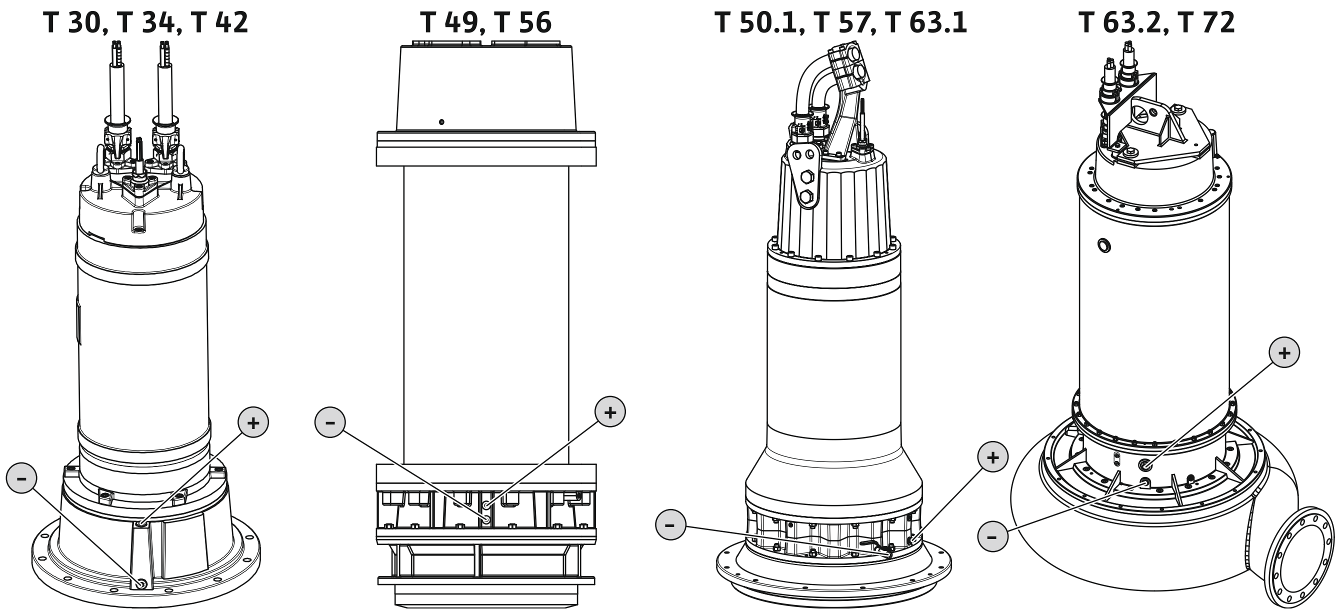

Fig. 10: Sealing chamber: Check oil

+	Add the oil to the sealing chamber
–	Drain the oil in the sealing chamber

✓ Pump is **not** installed.

✓ Pump is **not** connected to the mains.

✓ Protective equipment has been put on!

1. Place the pump upright on a firm surface.**WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!**
2. Place a suitable tank to collect the operating fluid.
3. Unscrew the screw plug **(+)**.
4. Unscrew screw plug **(-)** and drain the operating fluid. If a shut-off ball cock is installed on the outlet opening, open the shut-off ball cock.
5. Check the operating fluid:
   - ⇒ If the operating fluid is clear, reuse operating fluid.
   - ⇒ If the operating fluid is contaminated (black), fill with new operating fluid. Dispose of operating fluid in accordance with the local regulations!
   - ⇒ Notify customer service if the operating fluid contains swarf!
6. If a shut-off ball cock is installed on the outlet opening, close the shut-off ball cock.
7. Clean the screw plug **(-)**, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**
8. Pour the new operating fluid in through the hole for the screw plug **(+)**.
   - ⇒ Comply with the specifications for operating fluid type and quantity! When recycling the operating fluid, check the quantity and if required adjust it!
9. Clean the screw plug **(+)**, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**

6.4.4 Stationary wet well installation

NOTICE

Pumping problems due to water level being too low

If the fluid is lowered too much, separation of the volume flow may occur. Furthermore, air cushions may form in the hydraulic system, resulting in undesirable behaviour during operation. The minimum permissible water level must reach the upper edge of the hydraulics housing!

The pump is installed in the fluid for the wet well installation. For this, a suspension unit must be installed in the chamber. On the pressure side, the on-site pipe system is connected to the suspension unit and on the suction side to the pump. The connected pipe system must be self-supporting. The suspension unit must **not** support the pipe system!

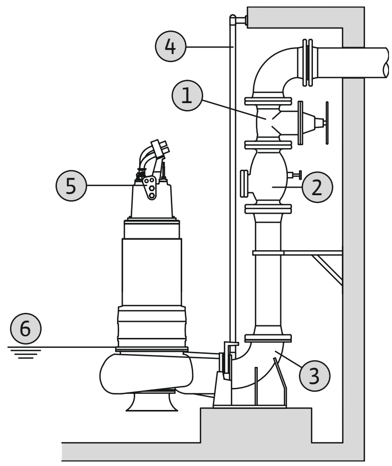

Fig. 11: Wet well installation, stationary

Work steps

1	Gate valve
2	Non-return valve
3	Suspension unit
4	Guide pipes (provided by the customer)
5	Attachment point for the lifting equipment
6	Minimum water level

- ✓ Operating space/installation location is prepared for the installation.
- ✓ Suspension unit and pipe system were installed.
- ✓ Pump is prepared for operation on the suspension unit.

1. Use a shackle to attach the lifting equipment to the attachment point of the pump.
2. Lift the pump, swivel it above the chamber opening and slowly lower the guide claw onto the guide pipe.
3. Lower the pump until it sets on the suspension unit and is connected automatically. **CAUTION! Hold the power supply cables slightly taut when lowering the pump!**
4. Loosen the lifting equipment from the lifting gear and secure it at the chamber outlet against falling.
5. Have the power supply cables routed into the chamber by a qualified electrician and route it outside properly from the chamber.

▶ The pump is installed, the qualified electrician can make the electrical connection.

6.4.5 Portable wet well installation

WARNING

Risk of burns from hot surfaces!

Motor housing can become hot during operation. It may cause burns. Allow the pump to cool down at ambient temperature after switching it off!

WARNING

Separation of pressure hose!

Separation or movement of the pressure hose can lead to (serious) injuries. Securely attach the pressure hose to the outlet! Prevent buckling of the pressure hose.

NOTICE

Pumping problems due to water level being too low

If the fluid is lowered too much, separation of the volume flow may occur. Furthermore, air cushions may form in the hydraulic system, resulting in undesirable behaviour during operation. The minimum permissible water level must reach the upper edge of the hydraulics housing!

For portable installation, the pump must be equipped with a pump support foot. The pump support foot ensures minimum ground clearance in the suction area and enables secure footing if placed on a solid bearing surface. In this installation type, the pump can be installed anywhere in the operating space/installation site. A hard base must be used at the installation location to prevent sinking in case of soft bearing surfaces. A pressure hose is connected on the pressure side. If operated for longer periods of time, fix the pump firmly to the floor. This prevents vibration and ensures quiet and low-wearing running.

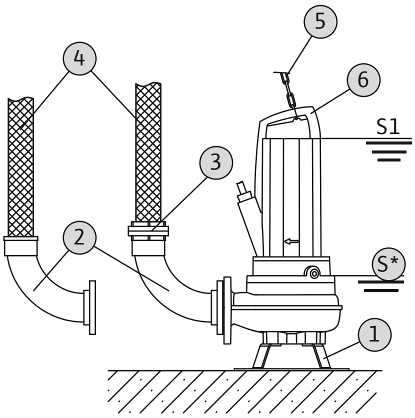

Fig. 12: Wet well installation, portable

Work steps

1	Pump support foot
2	Pipe elbow with hose connection or Storz pipe coupling
3	Storz hose coupling
4	Pressure hose
5	Lifting equipment
6	Attachment point
S*	Non-immersed operating mode: Observe information on the rating plate!

✓ Pump support foot mounted.

✓ Pressure connection prepared: Pipe elbow with hose connection or pipe elbow with Storz coupling mounted.

1. Use a shackle to attach the lifting equipment to the attachment point of the pump.
2. Lift the pump and lower it at the intended location (chamber, pit).
3. Place the pump on a solid bearing surface. **CAUTION! Sinking must be prevented!**
4. Lay the pressure hose and fasten it to a certain point (e.g. drainage). **DANGER! Separation or movement of the pressure hose can lead to (serious) injuries! Securely attach the pressure hose to the outlet.**
5. Lay the power supply cable properly. **CAUTION! Do not damage the power supply cable!**

▶ The pump is installed, the qualified electrician can make the electrical connection.

6.4.6 Stationary dry well installation

NOTICE

Pumping problems due to water level being too low

If the fluid is lowered too much, separation of the volume flow may occur. Furthermore, air cushions may form in the hydraulic system, resulting in undesirable behaviour during operation. The minimum permissible water level must reach the upper edge of the hydraulics housing!

In dry well installation, the operating space is divided into the collecting space and the machine room. In the collecting space, the fluid flows and is collected; the pump technology is installed in the machine room. The pump is installed in the machine room and connected to the pipe system on the suction and pressure side. Observe the following points for installation:

→ The suction- and pressure-side pipe system must be self-supporting. The pump must not support the pipe system.
→ Connect the pump to the pipe system ensuring that it is free of stress and vibrations. The use of elastic connection pieces (compensators) is recommended.
→ The pump is not self-priming, in other words, the fluid must flow in either automatically or with supply pressure. The minimum level in the collecting space must be at the same height as the upper edge of the hydraulics housing!
→ Max. ambient temperature: 40 °C (104 °F)

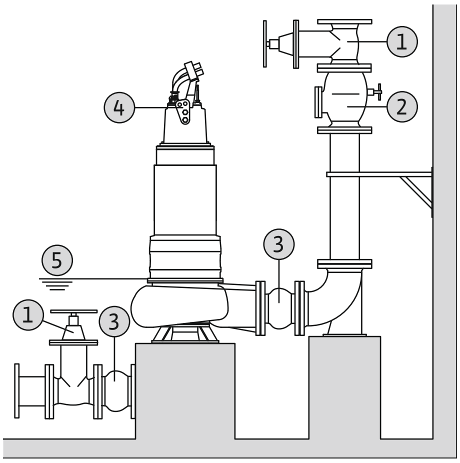

Fig. 13: Dry well installation

Work steps

1	Gate valve
2	Non-return valve
3	Compensator
4	Attachment point for the lifting equipment
5	Minimum water level in collecting space

✓ Machine room/installation location is prepared for the installation.

✓ Pipe system has been properly installed and is self-supporting.

1. Use a shackle to attach the lifting equipment to the attachment point of the pump.
2. Lift the pump and position it in the machine room.**CAUTION! Hold the power supply cables slightly taut when positioning the pump!**
3. Fasten pump to the foundation properly.
4. Connect pump to the pipe system. **NOTICE! Ensure the connection is free of stress and vibrations. If required, use plastic connection pieces (compensators).**
5. Loosen the lifting gear from the pump.
6. Have the power supply cables installed in the machine room by a qualified electrician.

► The pump is installed, the qualified electrician can make the electrical connection.

6.4.7 Level control

DANGER

Risk of explosion due to incorrect installation!

If the level control is installed within a potentially explosive area, the signal transmitter must be connected via an Ex cut-off relay or a Zener barrier. There is a risk of explosion if connected incorrectly! Connection must be carried out by a qualified electrician.

With a level control device, the current fill levels are determined and the pump is switched on and off automatically depending on the fill levels. Fill levels are recorded by using different sensor types (float switches, pressure and ultrasound measurements or electrodes). The following must be observed when using a level control device:

→ Float switches can move freely!
→ The water level must **not fall below** the minimum permissible!
→ The maximum switching frequency **must not be exceeded**!
→ If the fill levels fluctuate strongly, a level control with two measuring points is recommended. This makes it possible to achieve larger differential gaps.

6.4.8 Dry-running protection

Dry-running protection must prevent the pump from operating without fluid and air from entering the hydraulics. The minimum permissible fill level must be determined with the help of a signal transmitter. Once the specified limit value is reached, the pump must be deactivated with an appropriate signal. Dry-running protection can expand the available level controls by an additional measuring point or function as an independent switch-off device. Depending on the system security, the pump can be restarted automatically or manually. Installation of dry-running protection is recommended for optimum operational reliability.

6.5 Electrical connection

DANGER

Risk of death due to electrocution!

Improper conduct when carrying out electrical work can lead to death due to electric shock! Electrical work must be carried out by a qualified electrician in accordance with the locally applicable regulations.

DANGER

Risk of explosion due to incorrect connection!

- Always connect the pump to an electrical outlet outside the explosive area. If the connection must be made within the explosive area, then connection must be carried out in an Ex-rated housing (ignition protection class DIN EN 60079-0)! Non-observance may lead to fatal injury due to explosion!
- Connect the potential compensator to the earth terminal indicated. The earth terminal is installed in the area of the power supply cable. A cable cross-section in accordance with the locally applicable regulations must be used for the potential compensator.
- Connection must always be carried out by a qualified electrician.
- For the electrical connection, also note the additional information in the chapter on potentially explosive areas found in the appendix of these installation and operating instructions!

→ The mains connection must match the specifications on the rating plate.
→ Power supply on mains side for three-phase current motors with clockwise rotating field.
→ Lay the connection cable in accordance with the locally applicable regulations and connect it according to the wire assignment.
→ Connect the monitoring devices and check their function.
→ Earth the device properly in accordance with applicable local regulations.

6.5.1 Fuse on mains side

Circuit breaker

The size and switching characteristics of the circuit breakers must conform to the rated current of the connected product. Observe local regulations.

Motor protection switch

Make provision for an on-site motor protection switch for devices without a plug! The minimum requirement is a thermal relay/motor protection switch with temperature compensation, differential triggering and anti-reactivation device in accordance with the local regulations. In case of sensitive mains, make provision for the installation on-site of other protective equipment (e.g. overvoltage, undervoltage or phase failure relay, etc.).

Residual-current device (RCD)

Comply with the regulations of the local energy supply company! The use of a residual-current device is recommended.
If persons come into contact with the device and conductive fluids, secure the connection **with** a residual-current device (RCD).

6.5.2 Maintenance tasks

Carry out the following maintenance tasks prior to installation:
→ Check the insulation resistance of the motor winding.
→ Test the resistance of the temperature sensor.
→ Test the resistance of the pencil electrode (optionally available).

If the measured values differ from the specifications:
→ Moisture may have penetrated into the motor or the connection cable.
→ The monitoring device may be defective.

Contact customer service in the event of a fault.

6.5.2.1 Checking the insulation resistance of the motor winding

Use an insulation tester to measure the insulation resistance (measuring voltage = 1000 V). Observe the following values:
→ At the time of initial commissioning: Insulation resistance may not be less than 20 MΩ.
→ For further measurements: Value must be greater than 2 MΩ.

6.5.2.2 Test the resistor of the temperature sensor

Measure the resistor of the temperature sensors with an ohmmeter. The following measured values must be complied with:
→ **Bimetallic strip**: Measured value = 0 ohms (continuity).

→ **PTC sensor** (PTC thermistor): Measured value depends on the number of sensors installed. A PTC sensor has a cold resistance range of 20 to 100 ohms.
  – With **three** sensors in series, the measured value range is from 60 to 300 ohms.
  – With **four** sensors in series, the measured value range is from 80 to 400 ohms.

→ **Pt100 sensor**: Pt100 sensors have a resistance value of 100 ohms at 0 °C (32 °F). Between 0 °C (32 °F) and 100 °C (212 °F), the resistance increases by 0.385 ohms per 1 °C (1.8 °F) increase.
At an ambient temperature of 20 °C (68 °F), the resistance is 107.7 ohms.

6.5.2.3 Testing the resistor of the external electrode for sealing chamber control

Measure the resistor of the electrode with an ohmmeter. The measured value must approach “infinity”. For values ≤ 30 kOhm, if there is water in the oil – change the oil!

6.5.3 Three-phase motor connection

The three-phase current version is supplied with bare cable ends. Connection to the mains is established by connecting the power supply cables in the switchgear. Refer to the attached connection diagram for more precise details regarding the connection. **Electrical connection must always be carried out by a qualified electrician!**

NOTICE! The individual wires are designated according to the connection diagram. Do not cut the wires! There is no additional assignment between the wiring diagram and connection diagram.

Wiring diagram of the power connections for direct activation	
U, V, W	Mains connection
PE (green-yellow)	Earth

Wiring diagram of the power connections for star-delta starting	
U1, V1, W2	Mains connection (start of winding)
U2, V2, W2	Mains connection (end of winding)
PE (green-yellow)	Earth

6.5.4 Monitoring equipment connection

Refer to the enclosed connection diagram for details regarding the connection and installation of the monitoring devices. **Electrical connection must always be carried out by a qualified electrician!**

NOTICE! The individual wires are designated according to the connection diagram. Do not cut the wires! There is no additional assignment between the wiring diagram and connection diagram.

EX

DANGER

Risk of explosion due to incorrect connection!

If the monitoring devices are not connected correctly, there is a risk of fatal injury due to explosion in potentially explosive areas! Connection must always be carried out by a qualified electrician. If used in potentially explosive areas:

- Connect the thermal motor monitoring via an evaluation relay!
- Deactivation by the temperature limiter must be conducted with reactivation lock! It must only be possible to restart the unit when the unlock key has been actuated by hand!
- Connect the external electrode (e.g. sealing chamber control) via an evaluation relay with an intrinsically safe circuit!
- Note the additional information in the chapter on potentially explosive areas found in the appendix of these installation and operating instructions!

Overview of monitoring devices

	T 12 ... T 17	T 20	T 20.1	T 24 ... T 42	T 49, T 56	T 50, T 50.1, T 57.1, T 63.1	T 63.2, T 72
Internal monitoring devices							
Motor compartment	•	•	–	–	–	–	–
Terminal room/motor compartment	–	–	•	•	•	•	•
Motor winding	•	•	•	•	•	•	•
Motor bearings	–	o	o	o	o	o	o
Sealing chamber	•	–	–	–	–	•	•
Leakage chamber	–	–	•	–	–	•	•
Vibration sensor	–	–	–	o	o	o	o
External monitoring devices							
Sealing chamber	o	o	o	o	o	o	o

• = standard-equipped , – = not available, o = optional

All the monitoring devices fitted must always be connected!

6.5.4.1 Monitoring of motor compartment

Connect the electrodes via an evaluation relay. Relay “NIV 101/A” is recommended for this. The threshold is 30 kOhm.

Wiring diagram	
DK	Electrode connection

The system must be deactivated when the threshold is reached!

6.5.4.2 Monitoring of terminal room/motor compartment

Connect the electrodes via an evaluation relay. Relay “NIV 101/A” is recommended for this. The threshold is 30 kOhm.

Wiring diagram	
DK	Electrode connection

The system must be deactivated when the threshold is reached!

6.5.4.3 Terminal room, motor compartment and sealing chamber monitoring

Connect the electrodes via an evaluation relay. Relay “NIV 101/A” is recommended for this. The threshold is 30 kOhm.

Wiring diagram	
DK	Electrode connection

The system must be deactivated when the threshold is reached!

6.5.4.4 Monitoring of motor winding

With bimetallic strips

Directly connect bimetallic strips to the switchgear or via an evaluation relay.
Connection values: max. 250 V (AC), 2.5 A, cos φ = 1

Wiring diagram for bimetallic strip	
Temperature limiter	
20, 21	Bimetallic strip connection
Temperature controller and limiter	
21	High temperature connection
20	Centre terminal
22	Low temperature connection

With PTC sensor

Connect the PTC sensor via an evaluation relay. Relay “CM-MSS” is recommended for this. The threshold has been preset.

PTC sensor wiring diagram	
Temperature limiter	
10, 11	PTC sensor connection
Temperature controller and limiter	
11	High temperature connection
10	Centre terminal
12	Low temperature connection

Triggering status for temperature controller and limiter

Depending on the version of the thermal motor monitoring, the following triggering status must occur when the threshold value is reached:

- Temperature limiter (1 temperature circuit):
  The system must be deactivated when the threshold is reached.
- Temperature controller and limiter (2 temperature circuits):
  When the threshold for the low temperature is reached, the motor can deactivate with automatic reactivation. When the threshold for the high temperature limit is reached, the motor must deactivate with manual reactivation.

Note the additional information in the section on potentially explosive areas in the appendix!

6.5.4.5 Leakage chamber monitoring

The float switch is equipped with a potential-free normally closed contact. The switching capacity can be found in the supplied connection diagram.

Wiring diagram	
K20, K21	Float switch connection

When the float switch is activated, a warning must be issued or deactivation must take place.

6.5.4.6 Monitoring of motor bearing

Connect the Pt100 sensor via an evaluation relay. Relay “DGW 2.01G” is recommended for this. The threshold is 100 °C (212 °F).

Wiring diagram	
T1, T2	Pt100 sensor connection

When the threshold is reached, deactivation must take place!

6.5.4.7 Monitoring of vibration occurring due to operation

Connect the vibration sensor via a suitable evaluation relay. For more precise details on connection of the vibration sensor, see the installation and operating instructions of the evaluation relay.

The limit values must be set during commissioning and recorded in the commissioning log. When the threshold is reached, deactivation must take place!

6.5.4.8 Sealing chamber monitoring (external electrode)

Connect the external electrode via an evaluation relay. Relay “NIV 101/A” is recommended for this. The threshold is 30 kOhm.

Once the threshold is reached, a warning must be output or the unit must be switched off.

CAUTION

Connection of the sealing chamber control

If on reaching the threshold, there is only a warning, the pump could be irreparably damaged by the water ingress. Deactivation of the pump is always recommended!

Note the additional information in the chapter on potentially explosive areas found in the appendix!

6.5.5 Motor protection adjustment

Motor protection must be set depending on the selected activation type.

6.5.5.1 Direct activation

At full load, set the motor protection switch to the rated current (see rating plate). At partial load, it is recommended to set the motor protection switch 5 % above the current measured at the duty point.

6.5.5.2 Star-delta activation

The motor protection setting depends on the installation:
- Motor protection installed in the motor line: Set the motor protection to 0.58 x the rated current.
- Motor protection installed in the mains supply cable: Set the motor protection to the rated current.

The maximum start-up time in star connection is 3 seconds.

6.5.5.3 Soft starter

At full load, set the motor protection switch to the rated current (see rating plate). At partial load, it is recommended to set the motor protection switch 5 % above the current measured at the duty point. The following points must also be observed:
- Power consumption must always be below the rated current.
- Complete starting and stopping within 30 s.
- To avoid power dissipation, bypass the electronic starter (soft start) once normal operation is reached.

6.5.6 Operation with frequency converter

Operation on the frequency converter is permitted. Refer to the appendix for the relevant requirements!

7 Commissioning

WARNING

Foot injuries due to a lack of protective equipment!

Danger of (serious) injuries during work. Wear safety shoes!

7.1 Personnel qualifications

- Electrical work: A qualified electrician must carry out the electrical work.
- Operation/control: Operating personnel must be instructed in the functioning of the complete system.

7.2 Operator responsibilities

- Providing installation and operating instructions by the pump or at a place specially reserved for it.
- Making the installation and operating instructions available in the language of the personnel.
- Making sure that the installation and operating instructions are read and understood by all personnel.
- All safety devices and emergency cut-outs on the system-side must be active and checked to ensure that they work properly.
- The pump is suitable for use under the specified operating conditions.

7.3 Direction of rotation check (for three-phase current motors only)

The pump is factory-checked and adjusted to the correct direction of rotation for a clockwise rotating field. Connection is made in accordance with the specifications in chapter “Electrical connection”.

Direction of rotation check

A qualified electrician checks the rotating field at the mains connection with a rotating field-test device. For the correct direction of rotation, a clockwise rotating field must be available at the mains connection. The pump is **not** approved for operation with a counter-clockwise rotating field! **CAUTION! If the direction of rotation is checked with a test run, comply with the ambient and operating conditions!**

Incorrect direction of rotation

If the direction of rotation is incorrect, change the connection as follows:
- Swap two phases for motors with direct starting.

→ Swap the connections of two windings (e.g. U1/V1 and U2/V2) for star-delta activation motors.

7.4 Operation in an explosive atmosphere

DANGER

Risk of explosion due to flying sparks in the hydraulics!

During operation the hydraulics must be flooded (completely filled with the fluid). If the volume flow is interrupted or the hydraulics emerges, air cushions can form in the hydraulics. If this happens, there is a risk of explosion, e.g. flying sparks due to static charge! Dry-running protection must ensure that the pump is deactivated at the appropriate level.

Overview of standard motors

	T 12	T 13	T 17	T 17.2	T 20	T 20.1	T 24	T 30	T 34	T 42	T 49	T 50	T 50.1	T 56	T 63.1/T 63.2	T 72
ATEX approval	o	o	o	o	o	o	o	o	o	o	–	–	o	o	o	–
FM approval	o	o	o	o	o	o	o	o	o	o	o	–	o	o	o	–
CSA-Ex approval	o	o	o	o	o	–	o	o	o	–	–	–	–	–	–	–

Key

– = not available/possible, o = optional, • = as standard

Overview of IE3 motors (derived from IEC 60034)

	T 17 ...-E3	T 17.2 ...-E3	T 20.1 ...-E3	T 24 ...-E3	T 30 ...-E3	T 34 ...-E3	T 42 ...-E3	T 50.1 ...-E3	T 57.1 ...-E3	T 63.1 ...-E3	T 63.2 ...-E3
ATEX approval	o	o	o	o	o	o	o	o	o	o	o
FM approval	–	–	–	–	–	–	–	–	–	–	–
CSA-Ex approval	–	–	–	–	–	–	–	–	–	–	–

Key

– = not available/possible, o = optional, • = as standard

For use in explosive atmospheres, the pump must be marked as follows on the rating plate:

→ "Ex" symbol of the corresponding approval
→ Ex classification

For the relevant requirements, refer to the explosion protection chapter in the appendix of these installation and operating instructions!

ATEX approval

The pumps are suitable for operation in potentially explosive atmospheres:

→ Device group: II
→ Category: 2, zone 1 and zone 2
These pumps must not be used in zone 0!

FM approval

The pumps are suitable for operation in potentially explosive atmospheres:

→ Protection class: Explosionproof
→ Category: Class I, Division 1

Notice: If the cabling is carried out according to Division 1, installation in Class I, Division 2 is also permitted.

CSA-Ex-rating according to division (Motor T 12, T 13, T 17, T 17.2, T 20, T 34)

The pumps are suitable for operation in potentially explosive atmospheres:
- Protection class: Explosion-proof
- Category: Class 1Division 1

CSA-Ex-rating according to zone (Motor T 24, T 30)

The pumps are suitable for operation in potentially explosive atmospheres:
- Device group: II
- Category: 2, zone 1 and zone 2
  These pumps must not be used in zone 0!

7.5 Before switching on

Check the following prior to activation:
- Check whether the device has been installed properly and in accordance with the locally applicable regulations:
  - Has the pump been earthed?
  - Layout of power supply cable tested?
  - Electrical connection made properly?
  - Mechanical components attached correctly?
- Check level control:
  - Float switches can move freely?
  - Switching level tested (pump on, pump off, minimum water level)?
  - Additional dry-running protection installed?
- Test operating conditions:
  - Min./max. temperature of the fluid tested?
  - Max. immersion depth tested?
  - Operating mode defined depending on the minimum water level?
  - Maximum switching frequency adhered to?
- Check installation location/operating space:
  - Pipe system on the pressure side free of deposits?
  - Inlet or pump sump cleaned or free of deposits?
  - All gate valves open?
  - Minimum water level defined and monitored?
    The hydraulics housing must be filled completely with the fluid and there must be no air cushions in the hydraulics. **NOTICE! Provide suitable venting devices if there is a risk of air cushions being formed in the system!**

7.6 Switching on and off

During the start process, the rated current is temporarily exceeded. During operation, the rated current may no longer be exceeded. **CAUTION! If the pump does not start, switch off the pump immediately. Remove the fault before reactivating the pump!**

Place pumps which are installed as portable pumps on a firm surface so they are level. If pumps have fallen over, place them upright again before activating them. Securely attach the pump with screws in case of difficult surfaces.

Pumps with free cable end

The pump must be switched on and off using a separate operating point (on/off switch, switchgear) provided by the customer.

Pump with attached plug
- Three-phase current version: After inserting the plug into the socket, the pump is ready for operation. The pump is switched on and off with the ON/OFF switch.

Pump with attached float switch and plug
- Three-phase current version: After inserting the plug into the socket, the pump is ready for operation. The pump is controlled via two switches on the plug:
  - MANUAL/AUTO: Determines if the pump is switched on and off directly (MANUAL) or depending on the fill level (AUTO).
  - ON/OFF: Switch pump on and off.

7.7 During operation

DANGER

Risk of explosion due to overpressure in the hydraulics!

If the gate valves on the suction and pressure sides are closed during operation, the fluid in the hydraulics housing is heated up by the pumping movement. This heating creates a pressure of several bars in the hydraulics. The pressure can result in the pump exploding! Make sure that all gate valves are open during operation. Open closed gate valves immediately!

WARNING

Amputation of limbs due to rotating components!

No persons must be present in the work area of the pump! There is risk of (serious) injuries due to rotating components! No persons must be present in the work area of the pump during start-up or operation.

WARNING

Risk of burns from hot surfaces!

Motor housing can become hot during operation. It may cause burns. Allow the pump to cool down at ambient temperature after switching it off!

NOTICE

Pumping problems due to water level being too low

If the fluid is lowered too much, separation of the volume flow may occur. Furthermore, air cushions may form in the hydraulic system, resulting in undesirable behaviour during operation. The minimum permissible water level must reach the upper edge of the hydraulics housing!

When operating the pump, observe the locally applicable regulations on the following topics:

- Workplace safety
- Accident prevention
- Handling electrical machines

Strictly comply with the personnel responsibilities specified by the operator. All personnel are responsible for ensuring compliance with responsibilities and regulations!

Due to their design, centrifugal pumps have rotating parts that are easily accessible. Depending on operating conditions, sharp edges can develop on these parts. **WARNING! This can lead to cuts and limbs may be severed!** Check the following points at regular intervals:

Motors T 12, T 13, T 17, T 17.2, T 20, T 20.1, T 24, T 30, T 34, T 42

- Operating voltage (+/-10 % of the rated voltage)
- Frequency (+/-2 % of the rated frequency)
- Power consumption between individual phases (max. 5 %)
- Voltage difference between the individual phases (max. 1 %)
- Max. switching frequency
- Minimum water submersion depending on the operating mode
- Inlet: no air intake
- Level control device/dry-running protection: Switching points
- Quiet/low-vibration running
- All gate valves open

Motors T 49, T 50.1, T 56, T 57, T 63.x, T 72

- Operating voltage (+/- 5 % of the rated voltage)
- Frequency (+/- 2 % of the rated frequency)
- Current consumption between individual phases (max. 5 %)
- Voltage difference between the individual phases (max. 1 %)
- Max. switching frequency
- Minimum water submersion depending on the operating mode

- Inlet: no air intake.
- Level control device/dry-running protection: Switching points
- Quiet/low-vibration running
- All gate valves open

Operation in the limit range

The pump can briefly be operated in the limit range (max. 15 min/day). During operation in the limit range, expect relatively large deviations from the operating data. **NOTICE! Continuous duty in the limit range is prohibited! The pump is exposed to high wear and there is a greater risk of failure!**

The following parameters apply during operation in the limit range:
- Operating voltage (+/-10 % of the rated voltage)
- Frequency (+3/-5 % of the rated frequency)
- Power consumption between individual phases (max. 6 %)
- Voltage difference between the individual phases (max. 2 %)

8 Shut-down/dismantling

8.1 Personnel qualifications

- Operation/control: Operating personnel must be instructed in the functioning of the complete system.
- Electrical work: A qualified electrician must carry out the electrical work.
- Installation/dismantling: The technician must be trained in the use of the necessary tools and fixation materials for the relevant construction site.

8.2 Operator responsibilities

- Locally applicable accident prevention and safety regulations of trade associations.
- Observe regulations for working with heavy loads and under suspended loads.
- Provide the necessary protective equipment and make sure that the personnel wears it.
- Provide adequate aeration in closed rooms.
- Take immediate countermeasures if there is a build-up of toxic or suffocating gases!

8.3 Shut-down

The pump is deactivated during decommissioning, but remains installed. This ensures that the pump is always ready for operation.

✓ To protect the pump from frost and ice, always immerse the pump completely in the fluid.

✓ The temperature of the fluid must always be above +3 °C (+37 °F).

1. Switch off the pump at the operating point.
2. Secure the operating point against being switched on again by unauthorised persons (e.g. lock main switch).

► The pump is out of operation and can now be dismantled.

If the pump remains installed after decommissioning, observe the following:
- Ensure that the prerequisites for decommissioning are maintained for the complete period of decommissioning. If these prerequisites cannot be guaranteed, dismantle the pump after decommissioning!
- For an extended period of decommissioning, carry out a 5-minute function test at regular intervals (monthly to quarterly). **CAUTION! A function test may only be carried out under the applicable operating conditions. A dry run is not permitted! Non-compliance can result in irreparable damage!**

8.4 Removal

DANGER

Danger due to fluids hazardous to health!

If the pump is used in fluids hazardous to health, decontaminate the pump after dismantling and before carrying out any other work! There is a risk of fatal injury! Observe the specifications in the work regulations! The operator must make sure that the personnel have received and read the work regulations!

DANGER

Risk of death due to electrocution!

Improper conduct when carrying out electrical work can lead to death due to electric shock! Electrical work must be carried out by a qualified electrician in accordance with the locally applicable regulations.

DANGER

Risk of fatal injury due to dangerous lone working practices!

Work in chambers and narrow rooms as well as work involving risk of falling are dangerous work. Such work may not be carried out autonomously! A second person must be present for safety reasons.

WARNING

Risk of burns from hot surfaces!

Motor housing can become hot during operation. It may cause burns. Allow the pump to cool down at ambient temperature after switching it off!

NOTICE

Use only properly functioning lifting equipment!

Use only properly functioning lifting equipment to lift and lower the pump. Ensure that the pump does not become jammed during lifting and lowering. Do **not** exceed the maximum bearing capacity of the lifting equipment! Check that lifting equipment is functioning properly before use!

8.4.1 Stationary wet well installation

✓ Pump is decommissioned.

✓ Gate valves on the inlet and pressure side closed.

1. Disconnect the pump from the mains.
2. Attach the lifting equipment to the attachment point. **CAUTION! Never pull on the power supply cable! This damages the power supply cable!**
3. Slowly raise the pump and lift above the guide pipes from the operating space. **CAUTION! The power supply cable can be damaged while lifting! Hold the power supply cable slightly taut when lifting!**
4. Clean the pump thoroughly (see point “Cleaning and disinfecting”). **DANGER! Disinfect the pump when used in fluids hazardous to health!**

8.4.2 Portable wet well installation

✓ Pump is taken out of operation.

1. Disconnect the pump from the mains.
2. Roll up the power supply cable and place it over the motor housing. **CAUTION! Never pull on the power supply cable! This damages the power supply cable!**
3. Loosen the pressure pipe from the pressure port.
4. Attach the lifting equipment to the attachment point.
5. Lift the pump from the operating space. **CAUTION! The power supply cable may be squeezed and damaged when setting the pump down! Pay attention to the power supply cable when setting the pump down!**
6. Clean the pump thoroughly (see point “Cleaning and disinfecting”). **DANGER! Disinfect the pump when used in fluids hazardous to health!**

8.4.3 Stationary dry well installation

✓ Pump is taken out of operation.

✓ Gate valves on the inlet and pressure side closed.

1. Disconnect the pump from the mains.

2. Roll up the power supply cable and attach to the motor.**CAUTION! Do not damage the power supply cable when attaching! Look out for crushing and cable breakage.**
3. Loosen the pipe system form the suction and discharge port. **DANGER! Fluids hazardous to health! Residues from the pumped fluid may still be present in the piping and hydraulics! Place collector tank, immediately wipe up drips and dispose of fluids properly.**
4. Attach the lifting equipment to the attachment point.
5. Loosen the pump from the foundation.
6. Lift the pump slowly out of the pipework and place on a suitable set-down location. **CAUTION! The power supply cable may be squeezed and damaged when setting the pump down! Pay attention to the power supply cable when setting the pump down!**
7. Clean pump thoroughly (see point “Cleaning and disinfecting”). **DANGER! Disinfect the pump when used in fluids hazardous to health!**

8.4.4 Clean and disinfect

DANGER

Danger due to fluids hazardous to health!

Danger to life if the pump is used in fluids hazardous to health! Decontaminate the pump before carrying out any further work! Wear the following protective equipment while performing cleaning tasks:

- Closed safety goggles
- Breathing mask
- Protective gloves

⇒ The equipment listed here is the minimum requirement, observe the specifications of the work regulations! The operator must make sure that the personnel have received and read the work regulations!

✓ Pump is dismantled.

✓ Contaminated cleaning water is disposed of in the sewer in accordance with local regulations.

✓ A disinfectant is provided for contaminated pumps.

1. Attach the lifting equipment to the attachment point of the pump.
2. Lift the pump approximately 30 cm (10 in) above the ground.
3. Spray the pump with clear water from top to bottom. **NOTICE! An appropriate disinfectant must be used for contaminated pumps! Strictly observe the manufacturer’s specifications concerning use!**
4. To clean the impeller and the pump interior, guide the water jet inside via the pressure port.
5. Flush all dirt residue onto the floor of the channel.
6. Allow the pump to dry out.

9 Maintenance and repair

DANGER

Danger due to fluids hazardous to health!

If the pump is used in fluids hazardous to health, decontaminate the pump after dismantling and before carrying out any other work! There is a risk of fatal injury! Observe the specifications in the work regulations! The operator must make sure that the personnel have received and read the work regulations!

NOTICE

Use only properly functioning lifting equipment!

Use only properly functioning lifting equipment to lift and lower the pump. Ensure that the pump does not become jammed during lifting and lowering. Do **not** exceed the maximum bearing capacity of the lifting equipment! Check that lifting equipment is functioning properly before use!

- Always carry out maintenance tasks in a clean location with good lighting. It must be possible to position the pump safely and secure it.
- Only carry out maintenance tasks mentioned in these installation and operating instructions.
- Wear the following protective equipment while performing maintenance tasks:
  - Safety goggles
  - Safety shoes
  - Safety gloves

9.1 Personnel qualifications

- Electrical work: A qualified electrician must carry out the electrical work.
- Maintenance tasks: The technician must be familiar with the use of operating fluids and their disposal. In addition, the technician must have basic knowledge of mechanical engineering.

9.2 Operator responsibilities

- Provide the necessary protective equipment and make sure that the personnel wears it.
- Collect operating fluids in suitable tanks and dispose of properly.
- Dispose of protective clothing used in accordance with regulations.
- Use only original parts of the manufacturer. Use of parts other than the original parts releases the manufacturer from any liability.
- Collect any leakage of fluid and operating fluid immediately and dispose of it according to the locally applicable guidelines.
- Provide the tools required.
- If flammable solvents and cleaning agents are used, open flames, naked lights and smoking are prohibited.

9.3 Labelling of the screw plugs

M	Motor compartment screw plugs
D	Sealing chamber screw plugs
K	Cooling system screw plugs
L	Leakage chamber screw plug
S	Condensation water chamber screw plug
F	Grease nipple screw plug

9.4 Operating fluid

9.4.1 Oil types

Medicinal white oil is filled into the sealing chamber ex-factory. The following oil types are recommended when changing the oil:

- Aral Autin PL*
- Shell ONDINA 919
- Esso MARCOL 52* or 82*
- BP WHITEMORE WOM 14*
- Texaco Pharmaceutical 30* or 40*

All oil types marked with “*” are approved for use with foods in accordance with “USDA-H1”.

9.4.2 Grease

Use the following greases:

- Esso Unirex N3
- Tripol Molub-Alloy-Food Proof 823 FM (with **“USDA-H1” approval**)

9.4.3 Filling quantities

Refer to the supplied configuration for the filling quantities.

9.5 Maintenance intervals

To ensure reliable operation, maintenance tasks must be carried out regularly. Depending on the real ambient temperatures, maintenance intervals different from those mentioned in the contract can be defined! If strong vibrations occur during operation, the pump and the installation must be checked regardless of the defined maintenance intervals.

9.5.1 Maintenance intervals for normal conditions

8000 operating hours or after 2 years at the latest

	Visual inspection of the connection cable	Visual inspection of accessories	Visual inspection of the coating and housing for wear	Function test of monitoring devices	Sealing chamber oil change*	Draining the leakage chamber	Grease lower roller bearings	Grease upper roller bearings	Drain condensation water
T 12	•	•	•	•	•	–	–	–	–
T 13	•	•	•	•	•	–	–	–	–
T 17	•	•	•	•	•	–	–	–	–
T 17.2	•	•	•	•	•	–	–	–	–
T 20	•	•	•	•	•	–	–	–	–
T 20.1	•	•	•	•	•	•	–	–	–
T 24	•	•	•	•	•	–	–	–	•
T 30	•	•	•	•	•	–	–	–	•
T 34	•	•	•	•	•	–	–	–	•
T 42	•	•	•	•	•	–	–	–	•
T 49	•	•	•	•	•	–	–	–	•
T 50.1	•	•	•	•	•	•	•	–	•
T 56	•	•	•	•	•	–	–	–	•
T 57	•	•	•	•	•	•	•	–	•
T 63.1	•	•	•	•	•	•	•	–	•
T 63.2	•	•	•	•	•	•	•	–	•
T 72	•	•	•	•	•	•	•	•	•

• = Carry out maintenance measures, – = do **not** carry out maintenance measures

***NOTICE! If a sealing chamber control is installed, the oil is changed according to the indicator!**

15000 operating hours or after 10 years at the latest
→ General overhaul

9.5.2 Maintenance intervals for harsh conditions

Under harsh operating conditions, specified maintenance intervals must be shortened if required. Harsh operating conditions include:
→ Fluids with long-fibre components
→ Turbulent inlet (e.g. due to air intake, cavitation)
→ Strongly corroding or abrasive fluids
→ Heavily gas generating fluids
→ Operation at an unfavourable duty point
→ Pressure surges

When using pumps under hard conditions, it is recommended to sign a maintenance contract. Contact customer service.

9.6 Maintenance measures

WARNING

Sharp edges on the impeller and suction port!

Sharp edges can form on the impeller and suction port. There is danger of limbs being severed! Protective gloves must be worn to protect from cuts.

WARNING

Hand, foot or eye injuries due to the absence of protective equipment!

Danger of (serious) injuries during work. Wear the following protective equipment:

- Safety gloves for protection against cuts
- Safety shoes
- Closed safety goggles

The following pre-requisites must be fulfilled prior to starting maintenance measures:
→ Pump cooled down to the ambient temperature.
→ Pump cleaned thoroughly and disinfected (if required).

9.6.1 Visual inspection of the connection cable

Check connection cable for:
→ Bubbles
→ Cracks
→ Scratches
→ Abrasion
→ Pinch points

If damage is identified on the connection cable, decommission the pump immediately! Have the connection cable replaced by Wilo customer service. Only operate the pump up again once the damage has been properly remedied!

CAUTION! Water may penetrate into the pump due to the damaged connection cable! Water ingress leads to total failure of the pump.

9.6.2 Visual inspection of accessories

Accessories must be checked for:
→ Correct fixation
→ Smooth function
→ Signs of wear, e.g. cracks caused by frequencies

Any defects detected must be repaired immediately or the accessories must be replaced.

9.6.3 Visual inspection of coatings and housing for wear

The coatings and housing parts must not show any signs of damage. If there are defects, the following must be observed:
→ If the coating is damaged, it must be restored.
→ Contact customer service if housing parts have worn out!

9.6.4 Function test of the monitoring device

The mixer must be cooled down to ambient temperature to test resistances!

9.6.4.1 Test the resistor of the internal electrodes for motor compartment monitoring

Measure the resistor of the electrode with an ohmmeter. The measured value must approach “infinity”. For values ≤ 30 kOhm, there is water in the motor compartment. **Contact customer service!**

9.6.4.2 Test the resistor for the internal electrodes for terminal room/motor compartment monitoring

The internal electrodes are switched in parallel. During testing, all the electrodes are thus measured together.

Measure the resistor of the electrodes with an ohmmeter. The measured value must approach “infinity”. At values ≤ 30 kOhm, there is water in the terminal room or motor compartment. **Contact customer service!**

9.6.4.3 Test the resistor of the internal electrodes for monitoring the terminal room, motor compartment and sealing chamber

The internal electrodes are switched in parallel. During testing, all the electrodes are thus measured together.

Measure the resistor of the electrodes with an ohmmeter. The measured value must approach “infinity”. At values ≤ 30 kOhm, there is water in the terminal room, motor compartment or sealing chamber. Change the oil in the sealing chamber and measure again.

NOTICE! If the value is still ≤ 30 kOhm, contact customer service!

9.6.4.4 Test the resistor of the temperature sensor

Measure the resistor of the temperature sensors with an ohmmeter. The following measured values must be complied with:
→ **Bimetallic strip**: Measured value = 0 ohms (continuity).

- → **PTC sensor** (PTC thermistor): Measured value depends on the number of sensors installed. A PTC sensor has a cold resistance range of 20 to 100 ohms.
  - With **three** sensors in series, the measured value range is from 60 to 300 ohms.
  - With **four** sensors in series, the measured value range is from 80 to 400 ohms.
- → **Pt100 sensor**: Pt100 sensors have a resistance value of 100 ohms at 0 °C (32 °F). Between 0 °C (32 °F) and 100 °C (212 °F), the resistance increases by 0.385 ohms per 1 °C (1.8 °F) increase.
  At an ambient temperature of 20 °C (68 °F), the resistance is 107.7 ohms.

9.6.4.5 Testing the resistor of the external electrode for sealing chamber control

Measure the resistor of the electrode with an ohmmeter. The measured value must approach “infinity”. For values ≤ 30 kOhm, if there is water in the oil – change the oil!

9.6.5 Oil change in sealing chamber

WARNING

Operating fluid under high pressure!

A pressure of **several bar can build up** in the motor! This pressure escapes when the screw plugs are **opened**. If screw plugs are opened without due caution, they can be ejected at high speed! To avoid injuries, observe the following instructions:

- Adhere to the prescribed sequence of work steps.
- Unscrew the screw plugs slowly, but never unscrew them completely. As soon as the pressure escapes (audible whistling or hissing of air), stop turning the screw plug any further!
- When the pressure has completely dissipated, fully unscrew the screw plugs.
- Wear closed safety goggles.

WARNING

Scalding from hot operating fluids!

Hot operating fluids can also spray out when pressure is released. This can result in scalding! To avoid injuries, the following instructions must be observed:

- Allow the motor to cool down to the ambient temperature before opening the screw plugs.
- Wear closed safety goggles or face protection and gloves.

Motor T 12, T 13, T 17, T 17.2

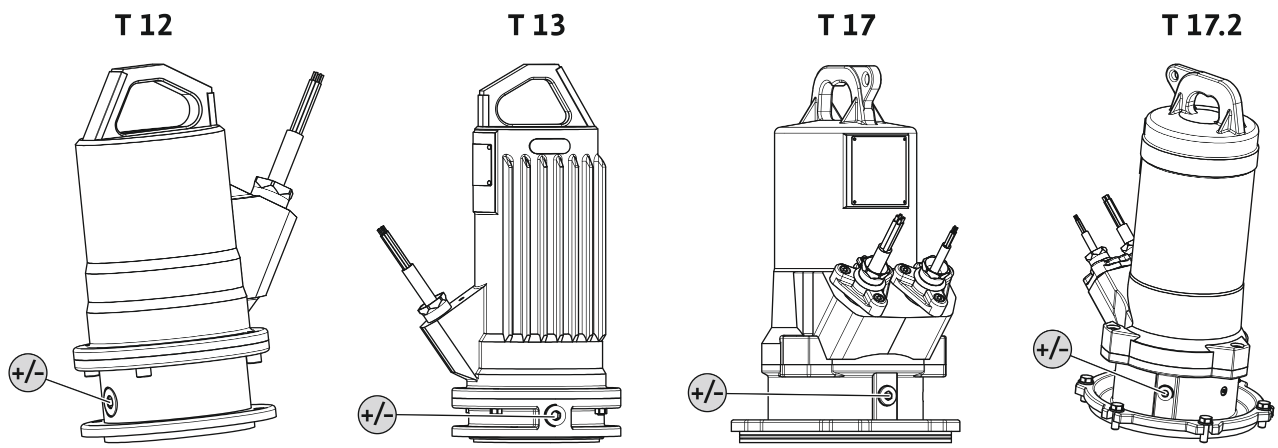

Fig. 14: Sealing chamber: Oil change

+/-	Fill/drain the oil in the sealing chamber

✓ Protective equipment has been put on!

✓ Pump has been dismantled and cleaned (decontaminated if required).

1. Position the pump horizontally on a firm surface. The screw plug points upwards.
   WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!

2. Unscrew the screw plug slowly, but do not unscrew it completely. **WARNING! Overpressure in the motor! Stop turning the screw plug further if hissing or whistling is audible! Wait until the pressure has completely dissipated.**
3. After the pressure has dissipated, fully unscrew the screw plug.
4. Place a suitable tank to collect the operating fluid.
5. Drain the operating fluid: Rotate the pump until the opening points downwards.
6. Check the operating fluid: Notify customer service if an operating fluid contains metal chips!
7. Pour in operating fluid: Rotate the pump until the opening points upwards. Fill-in the operating fluid into the opening.
   ⇒ Comply with the specifications for operating fluid locations and quantity!
8. Clean the screw plug, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft lb)!**

Motors T 20, T 20.1, T 24

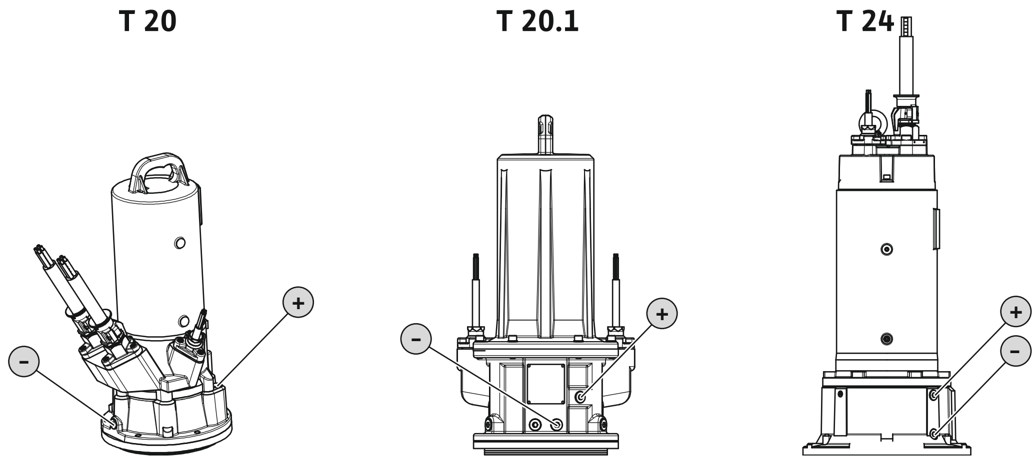

Fig. 15: Sealing chamber: Oil change

+	Add the oil to the sealing chamber
–	Drain the oil in the sealing chamber

✓ Protective equipment has been put on!

✓ Pump has been dismantled and cleaned (decontaminated if required).

1. Place the pump upright on a firm surface.**WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!**
2. Place a suitable tank to collect the operating fluid.
3. Unscrew the screw plug **(+)** slowly, but do not unscrew it completely. **WARNING! Overpressure in the motor! Stop turning the screw plug further if hissing or whistling is audible! Wait until the pressure has completely dissipated.**
4. After the pressure has dissipated, fully unscrew the screw plug **(+)**.
5. Unscrew screw plug **(–)** and drain the operating fluid. If a shut-off ball cock is installed on the outlet opening, open the shut-off ball cock.
6. Check the operating fluid: Notify customer service if the operating fluid contains swarf!
7. If a shut-off ball cock is installed on the outlet opening, close the shut-off ball cock.
8. Clean the screw plug **(–)**, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**
9. Pour the new operating fluid in through the hole of the screw plug **(+)**.
   ⇒ Comply with the specifications for operating fluid type and quantity!
10. Clean the screw plug **(+)**, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**

Motors T 30, T 34, T 42, T 49, T 50.1, T 56, T 57, T 63.x, T 72

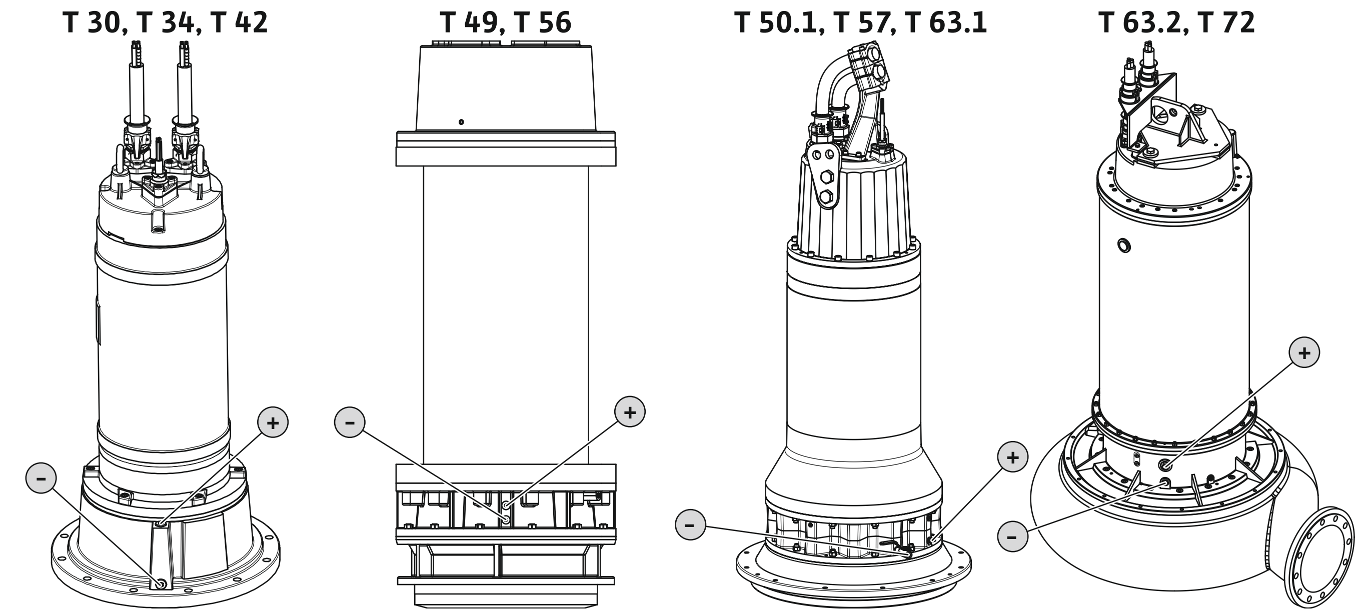

Fig. 16: Sealing chamber: Oil change

+	Add the oil to the sealing chamber
–	Drain the oil in the sealing chamber

✓ Protective equipment has been put on!

✓ Pump has been dismantled and cleaned (decontaminated if required).

1. Place the pump upright on a firm surface.**WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!**
2. Place a suitable tank to collect the operating fluid.
3. Unscrew the screw plug **(+)** slowly, but do not unscrew it completely. **WARN-ING! Overpressure in the motor! Stop turning the screw plug further if hissing or whistling is audible! Wait until the pressure has completely dissipated.**
4. After the pressure has dissipated, fully unscrew the screw plug **(+)**.
5. Unscrew screw plug **(–)** and drain the operating fluid. If a shut-off ball cock is in-stalled on the outlet opening, open the shut-off ball cock.
6. Check the operating fluid: Notify customer service if the operating fluid contains swarf!
7. If a shut-off ball cock is installed on the outlet opening, close the shut-off ball cock.
8. Clean the screw plug **(–)**, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**
9. Pour the new operating fluid in through the hole of the screw plug **(+)**.
   ⇒ Comply with the specifications for operating fluid type and quantity!
10. Clean the screw plug **(+)**, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**

9.6.6 Drain the leakage chamber

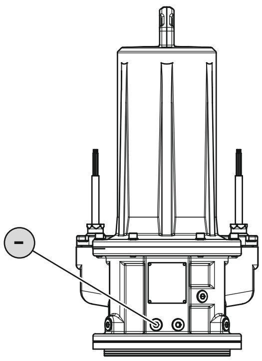

Fig. 17: Drain the leakage chamber: T 20.1

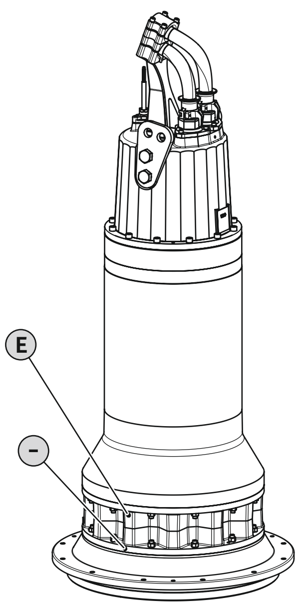

Fig. 18: Drain the leakage chamber: T 50.1, T 57, T 63.1

Motors T 20.1

–	Drain off the leakage

- ✓ Protective equipment has been put on!
- ✓ Pump has been dismantled and cleaned (decontaminated if required).

1. Place the pump upright on a firm surface.**WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!**
2. Place a suitable tank to collect the operating fluid.
3. Unscrew the screw plug slowly **(–)** but do not unscrew it completely. **WARN-ING! Overpressure in the motor! Stop turning the screw plug further if hissing or whistling is audible! Wait until the pressure has completely dissipated.**
4. After the pressure has dissipated, fully unscrew the screw plug **(–)** and drain the operating fluid.
5. Clean the screw plug **(–)**, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**

Motors T 50.1, T 57, T 63.1

E	Venting
–	Drain off the leakage

- ✓ Protective equipment has been put on!
- ✓ Pump has been dismantled and cleaned (decontaminated if required).

1. Place the pump upright on a firm surface.**WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!**
2. Place a suitable tank to collect the operating fluid.
3. Unscrew the screw plug **(E)** slowly, but do not unscrew it completely. **WARN-ING! Overpressure in the motor! Stop turning the screw plug further if hissing or whistling is audible! Wait until the pressure has completely dissipated.**
4. After the pressure has dissipated, fully unscrew the screw plug **(E)**.
5. Unscrew screw plug **(–)** and drain the operating fluid.
6. Clean screw plug **(E) and (–)**, replace the seal ring and screw it back in. **Max. tight-ening torque: 8 Nm (5.9 ft·lb)!**

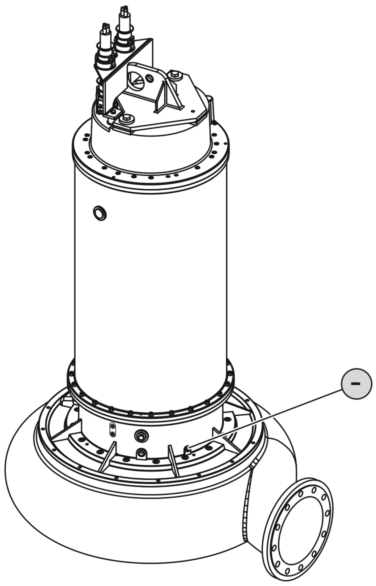

Fig. 19: Drain the leakage chamber: T 63.2, T 72

Motor T 63.2, T 72

–	Drain off the leakage

✓ Protective equipment has been put on!

✓ Pump has been dismantled and cleaned (decontaminated if required).

1. Place the pump upright on a firm surface.**WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!**
2. Place a suitable tank to collect the operating fluid.
3. Unscrew the screw plug slowly **(–)** but do not unscrew it completely. **WARN-ING! Overpressure in the motor! Stop turning the screw plug further if hissing or whistling is audible! Wait until the pressure has completely dissipated.**
4. After the pressure has dissipated, fully unscrew the screw plug **(–)** and drain the operating fluid.
5. Clean the screw plug **(–)**, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**

9.6.7 Greasing roller bearings

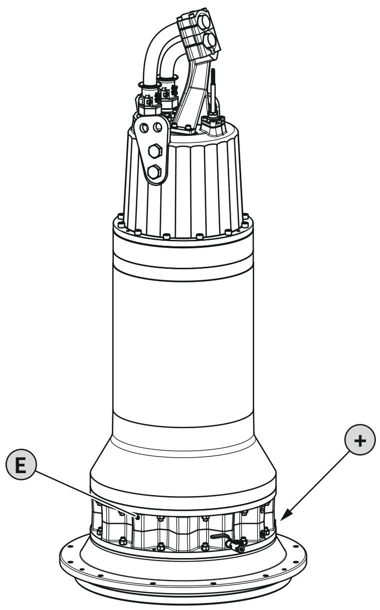

Fig. 20: Greasing roller bearings: T 50.1, T 57, T 63.1

Motors T 50.1, T 57, T 63.1

E	Venting
+	Grease nipple for greasing (grease quantity: 200 g/7 oz)

✓ Protective equipment has been put on!

✓ Pump has been dismantled and cleaned (decontaminated if required).

1. Place the pump upright on a firm surface.**WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!**
2. Unscrew the screw plug **(E)** slowly, but do not unscrew it completely. **WARN-ING! Overpressure in the motor! Stop turning the screw plug further if hissing or whistling is audible! Wait until the pressure has completely dissipated.**
3. After the pressure has dissipated, fully unscrew the screw plug **(E)**.
4. Unscrew the screw plug **(+)**. The grease nipple for lubricating the bearings is loc-ated behind the screw plug.
5. Use a grease gun to inject the new grease into the grease nipple.
6. Clean screw plug **(E) and (+)**, replace the seal ring and screw it back in. **Max. tight-ening torque: 8 Nm (5.9 ft·lb)!**

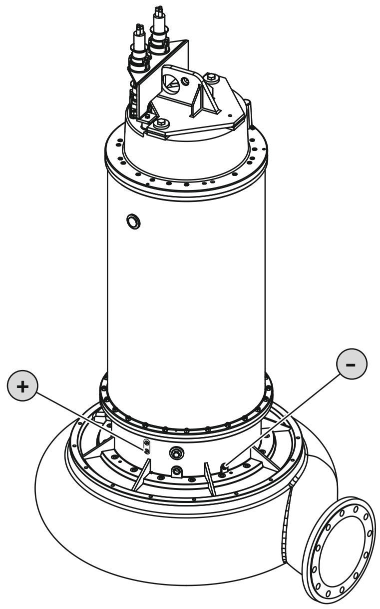

Fig. 21: Greasing roller bearings: T 63.2

Motor T 63.2

–	Leakage chamber screw plug (venting)
+	Grease nipple for greasing (grease quantity: 200 g/7 oz)

✓ Protective equipment must be put on!

✓ Pump has been dismantled and cleaned (decontaminated if required).

1. Place the pump on a firm surface in a vertical position. **WARNING! Risk of hands being crushed. Make sure that the pump can not fall over or slip!**
2. Unscrew the leakage chamber screw plug **(–)** slowly and do not unscrew it completely. **WARNING! Overpressure in the motor! Stop turning the screw plug further if hissing or whistling is audible! Wait until the pressure has completely dissipated.**
3. After the pressure has dissipated, fully unscrew the leakage chamber **(–)** screw plug.
4. Unscrew the screw plug **(+)**. The grease nipple for lubricating the bearings is located behind the screw plug.
5. Use a grease gun to inject the new grease into the grease nipple.
6. Clean screw plugs **(–) and (+)**, fit with new seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**

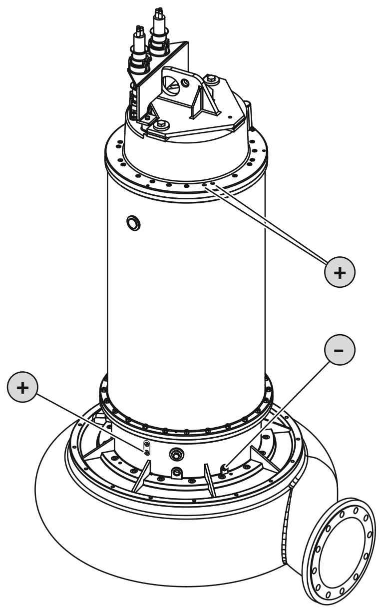

Fig. 22: Greasing roller bearings: T 72

Motor T 72

–	Leakage chamber screw plug (venting)
+	Grease nipple for greasing Grease quantity **lower** bearing: 160 g/6 oz Grease quantity **upper** bearing: 20 g/0.7 oz

✓ Protective equipment must be put on!

✓ Pump has been dismantled and cleaned (decontaminated if required).

1. Place the pump on a firm surface in a vertical position. **WARNING! Risk of hands being crushed. Make sure that the pump can not fall over or slip!**
2. Unscrew the leakage chamber screw plug **(–)** slowly and do not unscrew it completely. **WARNING! Overpressure in the motor! Stop turning the screw plug further if hissing or whistling is audible! Wait until the pressure has completely dissipated.**
3. After the pressure has dissipated, fully unscrew the leakage chamber **(–)** screw plug.
4. Unscrew the screw plug **(+)**. The grease nipple for lubricating the bearings is located behind the screw plug.
5. Use a grease gun to inject the new grease into the grease nipple.
6. Clean screw plugs **(–) and (+)**, fit with new seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**

9.6.8 Draining condensation water

Motors T 24, T 30, T 34, T 42, T 49, T 56

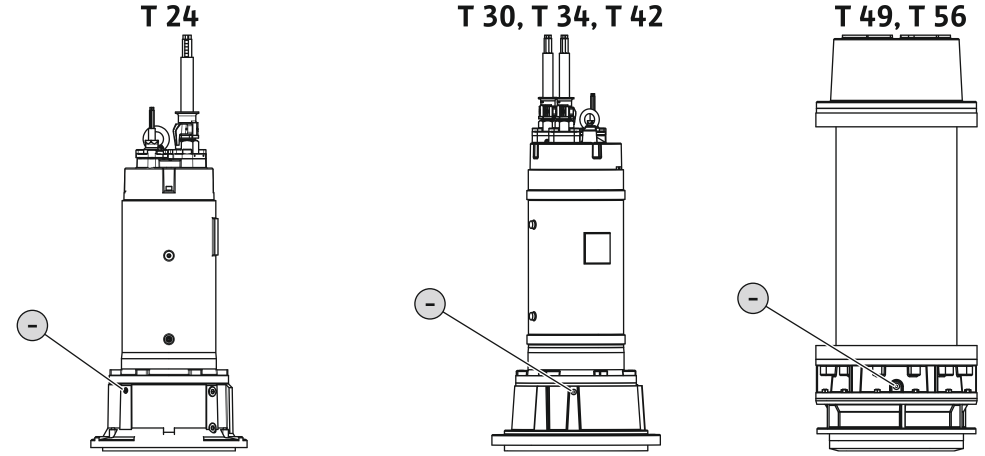

Fig. 23: Drain condensation water: T 24, T 30, T 34, T 42, T 49, T 56

–	Draining condensation water

Motors T 50.1, T 57, T 63.1

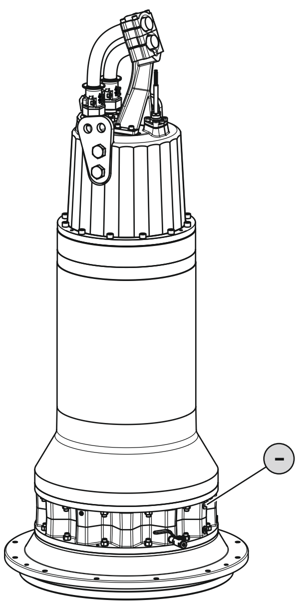

Fig. 24: Drain condensation water: T 50.1, T 57, T 63.1

–	Draining condensation water

✓ Protective equipment has been put on!

✓ Pump has been dismantled and cleaned (decontaminated if required).

1. Place the pump upright on a firm surface.**WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!**
2. Place a suitable tank to collect the operating fluid.
3. Unscrew the screw plug slowly **(–)** but do not unscrew it completely. **WARNING! Overpressure in the motor! Stop turning the screw plug further if hissing or whistling is audible! Wait until the pressure has completely dissipated.**
4. After the pressure has dissipated, fully unscrew the screw plug **(–)** and drain the operating fluid.
5. Clean the screw plug **(–)**, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**

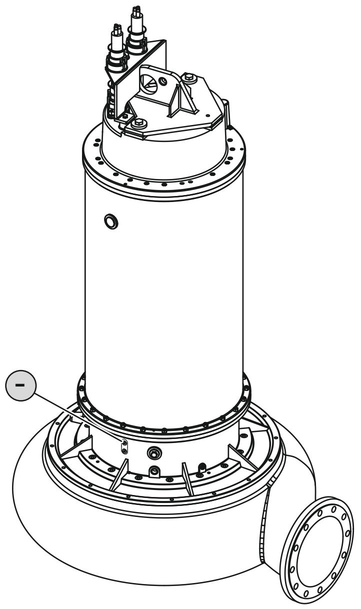

Fig. 25: Drain condensation water: T 63.2, T 72

Motor T 63.2, T 72

–	Drain condensation water

✓ Protective equipment has been put on!

✓ Pump has been dismantled and cleaned (decontaminated if required).

1. Place the pump upright on a firm surface.**WARNING! Risk of hands being crushed. Ensure that the pump cannot fall over or slip away!**
2. Place a suitable tank to collect the operating fluid.
3. Unscrew the screw plug slowly **(–)** but do not unscrew it completely. **WARNING! Overpressure in the motor! Stop turning the screw plug further if hissing or whistling is audible! Wait until the pressure has completely dissipated.**
4. After the pressure has dissipated, fully unscrew the screw plug **(–)** and drain the operating fluid.
5. Clean the screw plug **(–)**, replace the seal ring and screw it back in. **Max. tightening torque: 8 Nm (5.9 ft·lb)!**

9.7 Repairs

WARNING

Sharp edges on the impeller and suction port!

Sharp edges can form on the impeller and suction port. There is danger of limbs being severed! Protective gloves must be worn to protect from cuts.

WARNING

Hand, foot or eye injuries due to the absence of protective equipment!

Danger of (serious) injuries during work. Wear the following protective equipment:

- Safety gloves for protection against cuts
- Safety shoes
- Closed safety goggles

The following preconditions must be met prior to starting repair work:
→ Pump cooled down to the ambient temperature.
→ Pump is switched voltage-free and secured against being activated inadvertently.
→ Pump cleaned thoroughly and disinfected (if required).

For repair work the following generally applies:
→ Wipe up spillage quantities of fluid and operating fluid immediately!
→ Always replace O-rings, gaskets and screw locking devices!
→ Observe the tightening torques in the appendix!
→ Never use force when carrying out this work!

9.7.1 Instructions on using screw locking devices

A screw locking device can be used on the screws. Screw locking is done at the factory using two different methods:
→ Thread-locking fluid
→ Mechanical screw locking device

Always re-apply the screw locking device!

Thread-locking fluid

Medium-strength thread-locking fluid (e.g. Loctite 243) is used for the liquid screw locking compound. This threadlocker can be loosened with increased force. If the thread-locking fluid cannot be loosened, then the compound must be heated to approx. 300 °C (572 °F). Clean the components thoroughly after dismantling.

Mechanical screw locking device

The mechanical screw locking device consists of two Nord-Lock wedge lock washers. The screw connection is secured by the clamping force. The Nord-Lock screw locking device must only be used on bolts with strength class 10.9 which have been coated with Geomet. **The use of stainless screws is prohibited!**

9.7.2 Which repair work may be carried out

→ Changing the hydraulics housing.
→ SOLID G- and Q impeller: Readjusting the suction port.

9.7.3 Changing the hydraulics housing

DANGER

Dismantling the impeller is prohibited!

Depending on the impeller diameter, the impeller must be removed for dismantling the hydraulics housing on some pumps. Before carrying out any work, check whether dismantling the impeller is necessary. If yes, notify customer service! The dismantling of the impeller must be carried out by customer service or an authorized specialist workshop.

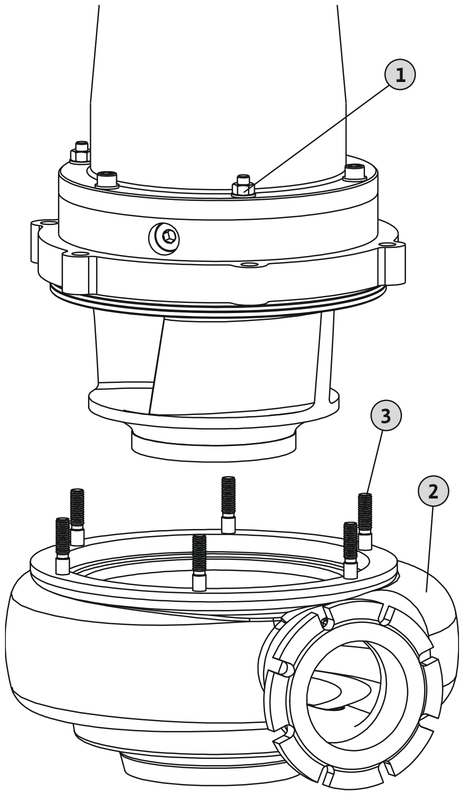

Fig. 26: Changing the hydraulics housing

1	Hexagon nuts for fixation of the motor/hydraulics
2	Hydraulics housing
3	Threaded bolt

✓ Lifting equipment with sufficient bearing capacity is present.

✓ Protective equipment has been put on.

✓ New hydraulics housing is ready.

✓ Impeller **must not** be dismantled!

1. Attach lifting equipment with suitable lifting gear to the attachment point of the pump.
2. Place the pump upright.
   CAUTION! If the pump is placed down too quickly, the hydraulics housing at the suction port can be damaged. Place the pump down slowly on the suction port! NOTICE! If the pump cannot be placed level on the suction port, use appropriate adjustment plates. In order for the motor to be lifted without any problem, the pump must be vertical.
3. Mark the motor/hydraulics position on the housing.
4. Loosen and remove hexagon nuts on the hydraulics housing.
5. Slowly lift the motor and pull it off the threaded bolts.
   CAUTION! Lift the motor vertically and do not tilt! The threaded bolts will be damaged if tilted!
6. Swivel the motor over the new hydraulics housing.
7. Slowly drain the motor. Make sure that the motor/hydraulic markings match and the threaded bolts screw exactly into the holes.
8. Screw hexagon nuts and connect the motor to the hydraulics firmly. **NOTICE! Observe the tightening torques in the appendix!**

► Hydraulics housing changed. Pump can be reinstalled.

WARNING! If the pump is placed in temporary storage and the lifting equipment dismantled, secure the pump against falling over and slipping!

9.7.4 SOLID G- and Q impeller: Readjusting the suction port

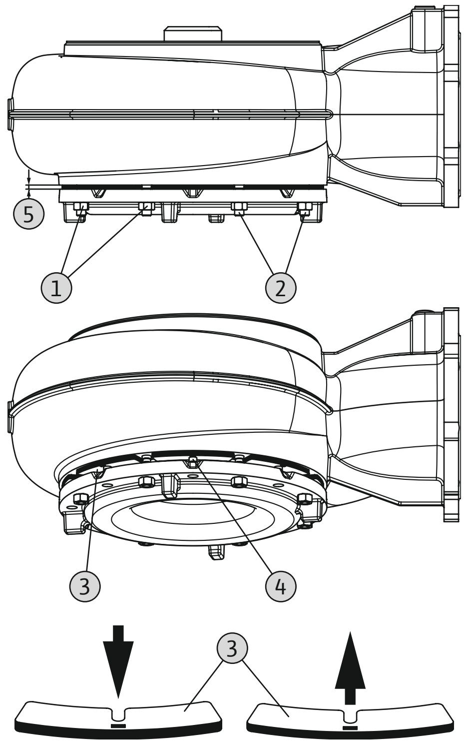

Fig. 27: SOLID G: Readjusting the gap

1	Hexagon nut for suction port attachment
2	Threaded bolt
3	Laminated core
4	Laminated core fastening screw
5	Gap between suction port and hydraulics housing

✓ Lifting equipment with sufficient bearing capacity is present.

✓ Protective equipment has been put on.

1. Attach lifting equipment with suitable lifting gear to the attachment point of the pump.
2. Lift the pump so that the pump is approx. 50 cm (20 in) above the ground.
3. Loosen the hexagon nuts for fixation of the suction port. Unscrew the hexagon nut until the hexagon nut is flush with the threaded bolt.
   WARNING! Risk of crushing fingers! The suction port can stick on the hydraulics housing due to encrustations and slide down suddenly. Loosen the nuts only in a crosswise manner and grasp them from the bottom. Wear protective gloves!
4. Suction port is on the hexagon nuts. If the suction port sticks to the hydraulics housing, carefully loosen the suction port with a wedge!
5. Clean the sliding surface and the screwed-on laminated cores and disinfect (if necessary).
6. Loosen the screws from the laminated cores and remove the individual laminated cores.
7. Slowly re-tighten the three hexagon nuts crosswise until the suction port is in contact with the impeller. **CAUTION! Only tighten the hexagon nuts by hand! If the hexagon nuts are excessively tightened, the impeller and the motor bearings may get damaged!**
8. Measure the gap between the suction port and hydraulics housing.
9. Adjust the laminated cores according to the measured dimensions and add another metal sheet.
10. Unscrew the three hexagon nuts again until the hexagon nuts are flush with the threaded bolt.
11. Reinsert the laminated cores and screw into place.
12. Tighten the hexagon nuts crosswise until the suction port is flush with the laminated cores.
13. Firmly tighten the hexagon nuts crosswise. **Observe the tightening torques in the appendix!**
14. Reach into the suction port from below and turn the impeller. When the gap is correctly set, the impeller can be rotated. If the gap is too small, the impeller is difficult to rotate. Repeat setting. **WARNING! Danger of amputation of limbs! Sharp edges can form on the suction port and impeller. Wear safety gloves to protect against cuts!**

► Suction port correctly set. Pump can be reinstalled.

10 Faults, causes and remedies

DANGER

Danger due to fluids hazardous to health!

Danger of death in case of pumps with fluids hazardous to health! Wear the following protective equipment while performing the work:

- Closed safety goggles
- Breathing mask
- Protective gloves
  - ⇒ The equipment listed here is the minimum requirement, observe the specifications of the work regulations! The operator must make sure that the personnel have received and read the work regulations!

DANGER

Risk of death due to electrocution!

Improper conduct when carrying out electrical work can lead to death due to electric shock! Electrical work must be carried out by a qualified electrician in accordance with the locally applicable regulations.

DANGER

Risk of fatal injury due to dangerous lone working practices!

Work in chambers and narrow rooms as well as work involving risk of falling are dangerous work. Such work may not be carried out autonomously! A second person must be present for safety reasons.

WARNING

No persons are allowed to be present inside the working area of the pump!

Persons may suffer (serious) injuries while the pump is in operation! No persons may therefore be present inside the working area. If persons must enter the working area of the pump, the pump must be decommissioned and secured against being switched on again without authorisation.

WARNING

Sharp edges on the impeller and suction port!

Sharp edges can form on the impeller and suction port. There is danger of limbs being severed! Protective gloves must be worn to protect from cuts.

Fault: Pump does not start

1. Electricity supply interrupted or short-circuit/earth fault in the cable or motor winding.
   - ⇒ Have the connection and motor checked by a qualified electrician and replace if necessary.
2. Tripping of fuses, of the motor protection switch or the monitoring device
   - ⇒ Have the connection and the monitoring device checked by a qualified electrician and change it if necessary.
   - ⇒ Have the motor protection switches and fuses installed and adjusted according to the technical specifications by a qualified electrician and reset monitoring device.
   - ⇒ Check the impeller to make sure that it runs smoothly, clean the hydraulics if necessary.
3. The sealing chamber control (optional) has interrupted the electric circuit (connection-related)

⇒ See “Fault: Mechanical seal leakage, sealing chamber control reports a fault and switches the pump off”.

Fault: Pump starts up, motor protection trips after short period

1. Motor protection switch set incorrectly.
   ⇒ Have the adjustment of the trigger checked and corrected by a qualified electrician.
2. Increased power consumption due to major voltage drop.
   ⇒ Have the voltage of individual phases checked by a qualified electrician. Contact the electricity distribution network.
3. There are only two phases at the connection.
   ⇒ Have the connection checked and corrected by a qualified electrician.
4. Excessive differences in voltage between the phases.
   ⇒ Have the voltage of individual phases checked by a qualified electrician. Contact the electricity distribution network.
5. Incorrect direction of rotation.
   ⇒ Have the connection corrected by a qualified electrician.
6. Increased power consumption through jammed hydraulics.
   ⇒ Clean the hydraulics and check the inlet.
7. The density of the fluid is too high.
   ⇒ Contact customer service.

Fault: Pump runs, there is no volume flow

1. There is no fluid.
   ⇒ Check the inlet, open all gate valves.
2. Inlet clogged.
   ⇒ Check the inlet and remove clogging.
3. Hydraulics jammed.
   ⇒ Clean the hydraulics.
4. Pipe system on the pressure side or pressure hose clogged.
   ⇒ Remove clogging and replace the damaged components if necessary.
5. Intermittent operation.
   ⇒ Check the switching system.

Fault: Pump starts, duty point is not reached

1. Inlet clogged.
   ⇒ Check the inlet and remove clogging.
2. Slide valves on the pressure side closed.
   ⇒ Open all gate valves completely.
3. Hydraulics jammed.
   ⇒ Clean the hydraulics.
4. Incorrect direction of rotation.
   ⇒ Have the connection corrected by a qualified electrician.
5. Air cushion in the pipe system.
   ⇒ Vent the pipe system.
   ⇒ If air cushions occur frequently: Locate and prevent the air intake, if required install ventilation systems at specified locations.
6. Pump pumping against excessive pressure.
   ⇒ Open all gate valves on the pressure side completely.
   ⇒ Check the impeller shape, use other impeller shapes if required. Contact customer service.
7. Signs of wear on the hydraulics.

   ⇒ Have the components (impeller, suction port, pump housing) checked and replaced by customer service.
8. Pipe system on the pressure side or pressure hose clogged.
   ⇒ Remove clogging and replace the damaged components if necessary.
9. Strongly gassing fluid.
   ⇒ Contact customer service.
10. There are only two phases at the connection.
   ⇒ Have the connection checked and corrected by a qualified electrician.
11. Excessive decrease in the fill level during operation.
   ⇒ Check supply/capacity of the system.
   ⇒ Have the switching points of the level control checked and adjusted if necessary.

Fault: The pump does not run smoothly and is noisy

1. Improper duty point.
   ⇒ Check the pump configuration and the duty point, contact customer service.
2. Hydraulics jammed.
   ⇒ Clean the hydraulics.
3. Strongly gassing fluid.
   ⇒ Contact customer service.
4. There are only two phases at the connection.
   ⇒ Have the connection checked and corrected by a qualified electrician.
5. Incorrect direction of rotation.
   ⇒ Have the connection corrected by a qualified electrician.
6. Signs of wear on the hydraulics.
   ⇒ Have the components (impeller, suction port, pump housing) checked and replaced by customer service.
7. Motor bearings have worn.
   ⇒ Inform customer service; send the pump back to the factory for overhauling.
8. Pump is installed under tension.
   ⇒ Check installation, install rubber compensators if necessary.

Fault: Sealing chamber control reports fault or switches the pump off

1. Condensation water build-up due to extended storage or high temperature fluctuations.
   ⇒ Operate the pump for a short period (max. 5 min.) without pencil electrode.
2. Increased leakage when running in new mechanical seals.
   ⇒ Change the oil.
3. Pencil electrode cable is defective.
   ⇒ Replace the pencil electrode.
4. Mechanical seal is defective.
   ⇒ Inform customer service.

Further steps for troubleshooting

If the points listed here do not rectify the fault, contact customer service. Customer service can assist in the following ways:
→ Telephone or written support.
→ On-site support.
→ Inspection and repair at the factory.

Costs may be incurred if you request customer services! Please contact customer services for more information.

11 Spare parts

Spare parts are ordered via customer service. To avoid return queries and incorrect orders, the serial or article number must always be supplied. **Subject to change without prior notice!**

12 Disposal

12.1 Oils and lubricants

Operating fluid must be collected in suitable tanks and disposed of in accordance with the locally applicable guidelines. Wipe up drips immediately!

12.2 Protective clothing

Used protective clothing must be disposed off in accordance with the locally applicable guidelines.

12.3 Information on the collection of used electrical and electronic products

Proper disposal and appropriate recycling of this product prevents damage to the environment and danger to your personal health.

NOTICE

Disposal in domestic waste is forbidden!

In the European Union, this symbol can appear on the product, the packaging or the accompanying documentation. It means that the electrical and electronic products in question must not be disposed of along with domestic waste.

To ensure proper handling, recycling and disposal of the used products in question, please note the following points:

- → Only hand over these products at designated, certified collecting points.
- → Observe the locally applicable regulations!

Please consult your local municipality, the nearest waste disposal site, or the dealer who sold the product to you for information on proper disposal. Further recycling information at www.wilo-recycling.com.

13 Appendix

13.1 Tightening torques

Rust-free screws A2/A4			
Threaded	Tightening torque		
	Nm	kp m	ft·lb
M5	5.5	0.56	4
M6	7.5	0.76	5.5
M8	18.5	1.89	13.5
M10	37	3.77	27.5
M12	57	5.81	42
M16	135	13.77	100
M20	230	23.45	170
M24	285	29.06	210
M27	415	42.31	306
M30	565	57.61	417

Geomet-coated screws (strength 10.9) with Nord-Lock washer			
Threaded	Tightening torque		
	Nm	kp m	ft·lb
M5	9.2	0.94	6.8
M6	15	1.53	11
M8	36.8	3.75	27.1
M10	73.6	7.51	54.3
M12	126.5	12.90	93.3

Geomet-coated screws (strength 10.9) with Nord-Lock washer			
Threaded	Tightening torque		
	Nm	kp m	ft·lb
M16	155	15.81	114.3
M20	265	27.02	195.5

13.2 Operation with frequency converter

The motor in series design (confirming to IEC 60034-17) can be operated with a frequency converter. Contact customer service if the rated voltage is over 415 V/50 Hz or 480 V/60 Hz. Because of the additional heating caused by harmonics, the rated power of the motor must be around 10 % more than the power requirement of the pump. For frequency converters with a low-harmonic output, it may be possible to reduce the 10 % power reserve. A reduction of the harmonic waves is achieved with output filters. The frequency converter and filter must be compatible.

The configuration of the frequency converter depends on the rated motor current. Care must be taken to ensure that the pump operates without jerking or vibration, especially in the lower speed range. Otherwise, the mechanical seals can leak or be damaged. The flow rate in the pipe must also be observed. If the flow rate is too low, the greater the risk is of solids depositing in the pump and piping. A minimum flow rate of 0.7 m/s (2.3 ft/s) with a pumping pressure of 0.4 bar (6 psi) is recommended.

It is important that the pump operates across the entire control range without vibrations, resonance, oscillation or excessive noise. Increased motor noise caused by the harmonics of the power supply is normal.

During parameterisation of the frequency converter, observe the setting of the quadratic pump curve (U/f curve) for pumps and fans! The U/f curve ensures that the output voltage at frequencies less than the rated frequency (50 Hz or 60 Hz) is adjusted to the power requirement of the pump. Newer frequency converters feature an automatic power optimisation function – this automation achieves the same effect. For the frequency converter setting, refer to its installation and operating instructions.

Faults with the motor monitoring may occur on motors operated with a frequency converter depending on the type used and installation conditions present. The following measures can help to reduce or avoid these faults:
- → Keeping within the limit values stated in IEC 60034-25 for overvoltages and rise speed. Output filters may need to be installed.
- → Vary the pulse frequency of the frequency converter.
- → In the event of a fault on the internal sealing chamber control, use the external double-rod electrode.

The following construction measures can also help to reduce or prevent faults:
- → Separate power supply cables for the main and control cable (depending on the motor size).
- → When laying, ensure there is adequate clearance between the main and control cable.
- → Using shielded power supply cables.

Summary
- → Continuous duty up to rated frequency (50 Hz or 60 Hz), observing the minimum flow velocity.
- → Observe additional measures with regard to EMC regulations (choice of frequency converter, using filters, etc.).
- → Never exceed the rated current or rated speed of the motor.
- → It must be possible to connect the motor's own temperature monitoring (bimetallic strip or PTC sensor).

13.3 Ex rating

This section contains further information on the operation of the pump in an explosive atmosphere. All personnel must read this section. **This section applies only to Ex-rated pumps!**

13.3.1 Identification of Ex-rated pumps

For use in explosive atmospheres, the pump must be marked as follows on the rating plate:
- → "Ex" symbol of the corresponding approval
- → Ex classification

→ Certification number (depending on the approval)
The certification number, if required by the approval, is printed on the rating plate.

13.3.2 Protection class

The motor's design version corresponds to the following protection classes:
→ Flameproof enclosure (ATEX)
→ Explosionproof (FM)
→ Flameproof enclosures (CSA-EX)

In order to limit the surface temperature, the motor must be equipped with at least one temperature limiter (1-circuit temperature monitoring). It may also be equipped with a temperature controller (2-circuit temperature monitoring).

13.3.3 Intended use

DANGER
Explosion due to pumping of explosive fluids!
Pumping of highly flammable and explosive fluids (gasoline, kerosene, etc.) in pure form is strictly prohibited. There is a risk of fatal injury due to explosion! The pumps are not designed for these fluids.

ATEX approval

The pumps are suitable for operation in potentially explosive atmospheres:
→ Device group: II
→ Category: 2, zone 1 and zone 2
These pumps must not be used in zone 0!

FM approval

The pumps are suitable for operation in potentially explosive atmospheres:
→ Protection class: Explosionproof
→ Category: Class I, Division 1
Notice: If the cabling is carried out according to Division 1, installation in Class I, Division 2 is also permitted.

CSA-Ex-rating according to division (Motor T 12, T 13, T 17, T 17.2, T 20, T 34)

The pumps are suitable for operation in potentially explosive atmospheres:
→ Protection class: Explosion-proof
→ Category: Class 1Division 1

CSA-Ex-rating according to zone (Motor T 24, T 30)

The pumps are suitable for operation in potentially explosive atmospheres:
→ Device group: II
→ Category: 2, zone 1 and zone 2
These pumps must not be used in zone 0!

13.3.4 Electrical connection

DANGER
Risk of death due to electrocution!
Improper conduct when carrying out electrical work can lead to death due to electric shock! Electrical work must be carried out by a qualified electrician in accordance with the locally applicable regulations.

→ Always connect the pump to an electrical outlet outside the explosive area. If the connection must be made within the explosive area, then the connection must be carried out in an Ex-rated housing (ignition protection class according to DIN EN 60079-0)! Non-observance may lead to fatal injury due to explosion! Connection must always be carried out by a qualified electrician.
→ All monitoring devices outside the "spark-proof areas" must be connected via an intrinsically safe circuit (e.g. Ex-i relay XR-4...).

Motors T 12, T 13, T 17, T 17.2, T 20, T 20.1, T 24, T 30, T 34, T 42
→ The voltage tolerance may not be higher than max. ±10 %.

Motors T 49, T 50.1, T 56, T 57, T 63.x, T 72

→ The voltage tolerance may not be higher than max. ±5 %.

Overview of monitoring devices

	T 12 ... T 17	T 20	T 20.1	T 24 ... T 42	T 49, T 56	T 50, T 50.1, T 57.1, T 63.1	T 63.2, T 72
Internal monitoring devices							
Motor compartment	•	–	–	–	–	–	–
Terminal room/motor compartment	–	–	•	•	•	•	•
Motor winding	•	•	•	•	•	•	•
Motor bearings	–	o	o	o	o	o	o
Sealing chamber	–	–	–	–	–	•	•
Leakage chamber	–	–	•	–	–	•	•
Vibration sensor	–	–	–	o	o	o	o
External monitoring devices							
Sealing chamber	o	o	o	o	o	o	o

• = standard-equipped , – = not available, o = optional

All the monitoring devices fitted must always be connected!

13.3.4.1 Monitoring of motor compartment

The connection is made as described in the “Electrical connection” section.

13.3.4.2 Monitoring of terminal room/motor compartment

The connection is made as described in the “Electrical connection” section.

13.3.4.3 Terminal room, motor compartment and sealing chamber monitoring

The connection is made as described in the “Electrical connection” section.

13.3.4.4 Monitoring of motor winding

DANGER

Risk of explosion due to overheating of the motor!

If the temperature limiter is connected incorrectly, there is a risk of explosion due to overheating of the motor! Always connect the temperature limiter to a manual reactivation lock. This means that a “release button” must be manually activated!

The motor is equipped with a temperature limit (1-circuit temperature monitoring). As an option, the motor can be fitted with a temperature control and limit function (2-circuit temperature monitoring).

Depending on the version of the thermal motor monitoring, the following triggering status must occur when the threshold value is reached:

→ Temperature limiter (1 temperature circuit):
When the threshold is reached, deactivation **with reactivation lock** must take place!

→ Temperature controller and limiter (2 temperature circuits):
When the threshold for the low temperature is reached, the motor can deactivate with automatic reactivation. When the threshold for the high temperature is reached, the motor must deactivate **with reactivation lock**!

CAUTION! Motor damage due to overheating! In the event of automatic reactivation, comply with the specifications for the maximum switching frequency and switching break!

Connection of the thermal motor monitoring

→ Connect the bimetallic strip via an evaluation relay. Relay “CM-MSS” is recommended for this. The threshold is preset.

Connection values: max. 250 V(AC), 2.5 A, cos φ = 1

- Connect the PTC sensor via an evaluation relay. Relay “CM-MSS” is recommended for this. The threshold is preset.

13.3.4.5 Leakage chamber monitoring

Connect the float switch using an evaluation relay! Relay “CM-MSS” is recommended for this. The threshold is already pre-set.

13.3.4.6 Monitoring of motor bearing

The connection is made as described in the “Electrical connection” section.

13.3.4.7 Sealing chamber monitoring (external electrode)

- Connect the external pencil electrode via an Ex-rated evaluation relay! Relay “XR-4…” is recommended for this.
  The threshold is 30 kOhm.
- The connection must be made using an intrinsically safe circuit!

13.3.4.8 Frequency converter operation

- Type of converter: Pulse-width modulation
- Continuous duty: 30 Hz up to rated frequency (50 Hz or 60 Hz). Comply with the minimum flow velocity!
- Min. switching frequency: 4 kHz
- Max. overvoltages on the terminal board: 1350 V
- Output current on the frequency converter: max. 1.5 times rated current
- Max. overload time: 60 s
- Torque applications: quadratic pump curve
  Speed/torque curves required are available on request!
- Observe additional measures with regard to EMC regulations (choice of frequency converter, filters, etc.).
- Never exceed the rated current or rated speed of the motor.
- It must be possible to connect the motor’s own temperature monitoring (bimetallic strip or PTC sensor).
- If the temperature class is marked as T4/T3, temperature class T3 applies.

13.3.5 Commissioning

DANGER

Risk of explosion when using non Ex-rated pumps!

Pumps without Ex rating may not be used in potentially explosive areas! There is a risk of fatal injury due to explosion! Only use pumps which have the appropriate Ex labelling on the rating plate within potentially explosive areas.

DANGER

Risk of explosion due to flying sparks in the hydraulics!

During operation the hydraulics must be flooded (completely filled with the fluid). If the volume flow is interrupted or the hydraulics emerges, air cushions can form in the hydraulics. If this happens, there is a risk of explosion, e.g. flying sparks due to static charge! Dry-running protection must ensure that the pump is deactivated at the appropriate level.

DANGER

There is a risk of explosion if dry-running protection is connected incorrectly!

If the pump is operated within an explosive atmosphere, the dry-running protection must have a separate signal transmitter (redundant protection of the level control). Pump deactivation must be performed with a manual reactivation lock!

- The operator is responsible for defining the potentially explosive area.
- Only pumps with corresponding Ex rating may be used within a potentially explosive area.
- Pumps with Ex rating must be labelled on the rating plate.
- Do not exceed the **maximum fluid temperature**!
- Dry running of the pump must be prevented! Ensure on-site (dry-running protection) that emerging of the hydraulics is prevented.
  According to DIN EN 50495, a safety device with SIL level 1 and hardware fault tolerance 0 must be provided for category 2.

13.3.6 Maintenance and repair

- Carry out maintenance tasks according to the regulations.
- Only carry out maintenance tasks mentioned in these installation and operating instructions.
- The spark-proof gaps may **only** be repaired according to the manufacturer's design specifications. It is **not** permitted to carry out repairs according to the values in tables 1 and 2 of DIN EN 60079-1.
- Only use screw plugs as stipulated by the manufacturer, that at least correspond to a strength class of 600 N/mm² (38.85 long tons-force/inch²).

13.3.6.1 Repair of housing coating

The paint layer can become electrostatically charged in case of thicker coats.**DANGER! Risk of explosion! In explosive atmospheres, a discharge can cause an explosion!**

If the housing coating has to be repaired, the maximum coat thickness is 2 mm (0.08 in)!

13.3.6.2 Changing the mechanical seal

Changing the seal on the fluid and motor side is strictly prohibited!

13.3.6.3 Replacing the connection cable

Changing the connection cable is strictly prohibited!

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