PUYALLUP AOB (EZRA) DEVELOPMENT
PUYALLUP, WASHINGTION

PRELIMINARY DRAINAGE DESIGN AND EROSION CONTROL REPORT

City of Puyallup Project No. No. P-21-0141-Puyallup AOB

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Reviewing Agency:

City of Puyallup
Project No. No. P-21-0141-Puyallup AOB

August 25, 2022

PROJECT ENGINEERS CERTIFICATION STATEMENT

"I hereby certify that this Drainage Control Plan for the Puyallup AOB Development has been prepared by me or under my supervision and meets minimum standards of the City of Puyallup and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me."

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1.0 PROPOSED PROJECT DESCRIPTION

This report includes the necessary information for the City of Puyallup to evaluate the proposed Puyallup AOB Development (Project) for compliance with the stormwater requirements of the Department of Ecology Stormwater Management Manual for Western Washington, which has been adopted by the City of Puyallup and the Washington State Department of Ecology Phase II Western Washington Municipal Stormwater Permit. In addition to this report, Site Development Drawings, a soils report and design calculations are attached. A Stormwater Site Management Plan, a Construction Stormwater Pollution Prevention Plan (SWPPP) and a Level IV Tree, Soil, and Native Vegetation Protection and Replacement Plan will be attached to a post-construction version of this report and/or the final Operations and Maintenance Manual for the facility.

The project is located:
Address: 330 2rd St. NW
Parcel Number: 5745001371
Zoning: PUY
Abbreviated Legal description: Section 28 Township 20 Range 04 Quarter 41 Meekers 1ST & 2ND: Meekers 1ST & 2ND NE OF SE 28-20-04E Parcel `A` OF DBLR 96-09-27-0520 DESC AS ALL OF B 23, B 26, L 1 THRU 5 B 25 TOG/W 20 FT Wide E-W Alley Between B 26, 25 & 23 VAC PER ORD 1301 EXC FOLL DESC

The project involves the construction of a four-story apartment building on a 48,145 square foot (1.11 acre) parcel. Currently, these plans are being submitted as part of the initial plat permitting process and final development plans for the parcel have not been realized, just assumed.

The planned build out shows 10 trees with none of the trees behind the sidewalk on W Pioneer Ave shown as being retained.[Preliminary Drainage Report, Page 7 of 124]

The existing site is used as a parking lot and is paved. There are several buried utilities onsite and landscaping is limited to several planters with small trees located on islands within the parking lot. Storm runoff drains overland until it is collected at several storm drainage inlets in the curb and alleys around the parcel, as well as at storm drains on the parcel. The buffer strips between the sidewalk and the street are also vegetated and have some trees. Approximately 1300 square feet of sidewalk currently exists along the 3rd St SW frontage on the east side of the property. Approximately 350 square feet of sidewalk currently exists along the W Pioneer Ave frontage on the north side of the property. There are approximately 10 trees along the north frontage (Pioneer St) of the property. These trees will be removed. There are also approximately 10 trees along the east frontage (3rd St SW). These trees will be protected throughout site construction. The proposed development will consist of a multifamily building with approximately 79 to 93 residential units within three (3) levels developed over ground level structured and surface parking.

Storm runoff from the development will drain into the Puyallup stormwater system along 3rd St SW. It will then flow south until it intersects with the storm sewer main along 4th Av SW. Storm water will then flow west and join the storm sewer at W Pioneer Ave. Stormwater will then flow north and discharge to the Puyallup and may also, depending on the flow rate, flow west and discharge to Clarks Creek. A map of the Puyallup stormwater system is attached as Figure 1-1.

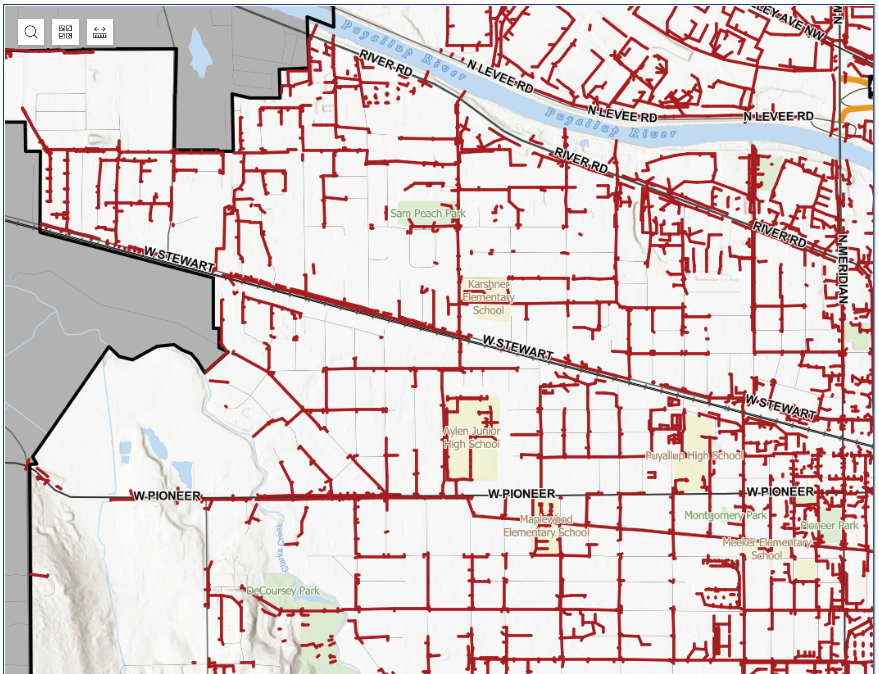
Clarify number of units. Should this say 'or'? [Preliminary Drainage Report, Page 7 of 124]

FIGURE 1-1. PUYALLUP STORMWATER SYSTEM

City of Puyallup Public Data Viewer

Data layers

- Utilities
  - Hydrants
  - Storm Water
    - Control Structures
    - Inlets
    - Manholes
    - Outfalls
    - Channels
    - Culverts
    - Pipes
    - Facilities
    - Stormwater Drainage Basins
  - Sanitary Sewer
- Transportation
- Recreation
- Environment
- Zoning
- Parcels



Esri, NASA, NGA, USGS, FEMA | William Keller - GIS Coordinator | Staff from the following departments worked on this project: City of Puyallup Public Works & Pierce County ... Powered by Esri

Legend

Utilities

Storm Water

Pipes

The existing site has already been substantially developed (greater than 35% hard surface coverage). As a result, this site is being redeveloped as part of this project.

The lots will be served by:

City of Puyallup	Water and Sanitary Sewer
Puget Sound Energy	Electricity
Century Link and Comcast	Telecommunications
D.M Disposal	Refuse and Recycling

City of Puyallup does not have a Refuse and Recycling Authority. [Preliminary Drainage Report, Page 9 of 124]

TABLE 1-1. EXISTING FACILITY AREAS

Surface Type	**Area (sqft)**	**Percentage of Site**
Asphalt Pavement	44,811	93%
Rooftops	0	0%
Sidewalks	0	0%
Landscaping	3,334	7%
Total Parcel	**48,145**	**100%**
Pollution Generating Surfaces	44,811	93%

TABLE 1-2. PROPOSED FACILITY AREAS

Surface Type	**Area (sqft)**	**Percentage of Site**
Asphalt Pavement	350	0.7%
Rooftops	40,385	83.9%
Sidewalks	2,266	4.7%
Landscaping	5,144	10.7%
Total Parcel	**48,145**	**100%**
Pollution Generating Surfaces	345	0.7%
New Hard Surface	2,616	5.4%
Comparative PGHS	-44,466	-99%

Figure 1-2 is a Site Plan for the project. As described in this document, on-site stormwater management will include water quality BMPs in accordance with the SMMWW. These BMPs will include the following:

- Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Chapter 5 of Volume V for lawn and landscaped areas,

1.1 APPLICABLE MINIMUM REQUIREMENTS

Section I-3 of Volume I of the 2019 Stormwater Management Manual for Western Washington (SMMWW) describes the Minimum requirements for stormwater management. Minimum requirements #1-9 will be triggered with the development of this parcel, because it is expected that more than 5,000 square-feet of new hard surfaces will be created if the rooftop is included. Figures I-3.1, I-3.2 and I-3.3 from the Department of Ecology Stormwater Management Manual for Western Washington are included in Appendix E. The following describes how the Minimum requirements have been addressed through the preparation and implementation of this Drainage Control Plan.

1.1.1 Minimum Requirement #1 – Preparation of Drainage Control Plans

This document includes the Drainage Control Plan requirements described in Chapter 3 of Volume I of the SMMWW.

1.1.2 Minimum Requirement #2 – Construction Stormwater Pollution Prevention Plan (SWPPP)

A Construction Stormwater Pollution Prevention Plan (SWPPP) will be prepared prior to construction.

1.1.3 Minimum Requirement # 3 – Source Pollution Control

A project-specific Pollution Source Control Program consistent with the provisions in the SMMWW Volume IV shall be prepared and provided for the site with the required stormwater maintenance agreement, which will be recorded prior to final project approval.

Specific Best Management Practices (BMPs) will be used to control pollution during construction, in accordance with the SWPPP.

1.1.4 Minimum Requirement #4 - Preservation of Natural Drainage Systems and Outfalls

There are no natural drainage systems or outfalls located on the subject property. The project site will discharge to the City of Puyallup MS4. That MS4 system discharges to Clarks Creek west of the project site and to the Puyallup River northwest of the project site. Currently, the existing site is paved and has no onsite treatment or detention facilities. Development of this site will reduce peak storm discharges and improve stormwater treatment for runoff from the site prior to its outfall into the Puyallup River and into Clarks Creek.

1.1.5 Minimum Requirement #5 – On-Site Stormwater Management

Since this project triggers minimum requirements #1-#9, is not flow control exempt, and is less than 5 acres; the project shall either use the LID BMPs from List #2 types of surfaces in List #2 or use the Flow Control BMP(s) designed to achieve the LID Performance Standard, in addition to applying BMP T5.13 Post-Construction Soil Quality and Depth. The On-Site Stormwater BMPs provided in List #2 and the feasibility of each from this project are discussed below:

1.1.5.1 Lawn and Landscape Areas

All disturbed and/or new lawn and landscape areas will meet the requirements of Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Chapter 5 of Volume V.

1.1.5.2 Roof Areas

Downspouts from the building roof will convey roof runoff to the City of Puyallup stormwater system. Prior to discharge, on-site stormwater management and flow control is required; therefore, the BMP(s) controlling rooftop runoff listed in List #2 were reviewed to determine if they were feasible. The BMPs included in List #2 are Full Dispersion (BMP T5.30) or Downspout Full Infiltration (BMP T5.10A), Bioretention BMPs (BMP T7.30), Downspout Dispersion Systems (BMP T5.10B), and Perforated Stub-out Connections (BMP T5.10C).

Based on the information and recommendations contained in the geotechnical report for the Site, these BMP(s) were found to not be feasible for the following reasons:

- Full Dispersion (BMP T5.30) is not feasible for this project since there is not an area on the site suitable for dispersion.
- Downspout Full Infiltration (BMP T5.10A) is not feasible for this project since the soils on the site are not suitable for infiltration. See geotechnical report (Appendix A), groundwater level monitoring and preliminary infiltration feasibility evaluation (Appendix B) and supplemental geotechnical report (Appendix C).
- Bioretention BMPs (BMP T7.30) are not feasible since a minimum vertical separation of 3 foot to the seasonal high-water table and impervious layer cannot be achieved below a bioretention or rain garden that would serve a drainage area that is exceeds 5,000 sq. ft. of pollution-generating impervious surface, includes more than 10,000 sq. ft of impervious surface and cannot be reasonably broken down into smaller amounts due to the limited available site area. The groundwater level monitoring and preliminary infiltration feasibility evaluation (Appendix B) describes the seasonal high groundwater table.
- Downspout Dispersion Systems (BMP T5.10B) is not feasible for this project since there is not an area on the site suitable for dispersion.
- Perforated Stub-Out Connections (BMP T5.10C) may be feasible in some areas of the site; however, due to the seasonal high-water table, minimal infiltration rates at the site, and limited space not occupied by a building, perforated stub-out connections are not recommended, as they will increase the groundwater table, which could impact structure settlement. The groundwater level monitoring and preliminary infiltration feasibility evaluation (Appendix B) and supplemental geotechnical report (Appendix C) provide additional information on percolation testing and the seasonal fluctuation in the depth to groundwater.

The BMPs listed in List #2 are not feasible or have the potential to impact the development of the site. As a result, the runoff from the site will remain undetained, per an agreement between the developer and the City of Puyallup.

1.1.5.3 Other Hard Surfaces:

Runoff from driveways and sidewalks will be routed to a Type 1 catch basins that currently exist, discharging to the storm sewer. BMP(s) controlling runoff from hard surfaces, listed in List #2, were reviewed to determine if they were feasible. The BMPs included in List #2 are Full Dispersion (BMP T5.30), Permeable Pavement (BMP T5.15), Bioretention BMPs (BMP T7.30), and Sheet Flow Dispersion (BMP T5.12) or Concentrated Flow Dispersion (BMP T5.11).

Based on the information and recommendations contained in the geotechnical report for the Site, these BMP(s) were found to not be feasible for the following reasons:

- Full Dispersion (BMP T5.30) is not feasible because a suitable dispersion area is not present on the site. 65% of the development site cannot be protected in a forest or native condition.
- Permeable Pavement (BMP T5.15) is only feasible if the material underlying the lowest level of base course is greater than 1 foot above the seasonally high groundwater elevation and is permeable enough to permit infiltration. Boring B-2 shows a high seasonal groundwater depth of 3.5 feet below existing ground. Therefore, the total thickness of permeable pavement could not exceed 2.5 feet if the existing ground remains at is current elevation. While this is a sufficient depth to allow for permeable pavement, the field infiltration testing performed at the approximate location of boring B-2 yielded an infiltration rate of approximately 0.5 in/hr (120 min/in). The geotechnical report describes the infiltration potential for the site as “low”. This infiltration rate is not sufficiently permeable to allow for permeable pavement. Therefore, Permeable Pavement (BMP T5.15) is not feasible. See the groundwater level monitoring and preliminary infiltration feasibility evaluation (Appendix B) and supplemental geotechnical report (Appendix C) for more information.
- Bioretention BMPs (BMP T7.30) are not feasible since a minimum vertical separation of 3 foot to the seasonal high-water table and impervious layer cannot be achieved below a bioretention or rain garden that would serve a

drainage area that exceeds 5,000 sq. ft. of pollution-generating impervious surface, includes more than 10,000 sq. ft of impervious surface and cannot be reasonably broken down into smaller amounts due to the limited available site area. The groundwater level monitoring and preliminary infiltration feasibility evaluation (Appendix B) describes the seasonal high groundwater table.

- Sheet Flow Dispersion (BMP T5.12) or Concentrated Flow Dispersion (BMP T5.11) are not feasible. Due to the small parcel size and density requirements, vegetated flow paths of the appropriate length are already being utilized for downspout dispersion for rooftop drainage and are not available for flow dispersion from other hard surfaces.

The BMPs listed in List #2 are not feasible or have the potential to impact the development of the site. As a result, the runoff from the site will remain undetained, per an agreement between the developer and the City of Puyallup.

1.1.6 Minimum Requirement #6 – Runoff Treatment

Pollution generating hard surfaces (PGHS), such as driveways, that are tributary to the stormwater system are proposed to cover approximately 350 square-feet; which is less than the 5,000 square foot maximum for pollution generating hard surfaces (PGHS); therefore, the project is exempt the site from MR #6.

Runoff treatment inside the parking garage will require an Oil Control BMP and will be routed to the sanitary sewer, per building code.

Phosphorous treatment is not required since the Puyallup River and Clarks Creek are not reported under section 305(b) of the Clean water act as not supporting beneficial uses due to phosphorous and neither stream is listed under section 319(a) of the Clean Water Act due to nutrients.

Enhanced treatment BMPs are not required for this project, since the project is a multifamily residential project sites that discharges directly through a municipal separate storm system to a water listed in Appendix III-A of the SMMWW. The receiving water for the City of Puyallup MS4 is the Puyallup River downstream from its confluence with the Carbon River.

1.1.7 Minimum Requirement #7 – Flow Control

The project will create more than 10,000 square-feet of effective impervious area replacing existing impervious area; therefore, flow control is required per the SMMWW. However, per an agreement between the developer and the City of Puyallup, this Minimum Requirement will be waived as part of this project. The site's pre-project and post-project hydrology has been reviewed using methods described in the SMMWW and using the WWHM.

The pre-project runoff peak flow rates will not be exceeded by the post-project runoff peak flow rates. This is being achieved by a reduction in overall impervious area.

Stormwater runoff from the driveways, sidewalks, and rooftops that cannot be dispersed and will be conveyed to the existing Puyallup stormwater system.

Stormwater Modeling Input/Assumptions:

- The site shall be graded so that stormwater runoff from public sidewalk and landscape areas within the public right-of-way shall report to the public stormwater system. This is similar to the existing condition. Stormwater runoff from private property shall be managed on the private property.
- All disturbed and/or new lawn and landscape areas will meet the requirements of Post-Construction Soil Quality and Depth in accordance with BMP T5.13 in Chapter 5 of Volume V and were entered into the Hydraulic Model (WWHM) as pasture.
- The pre-developed condition was assumed to be Type C forested area. The existing land cover for much of the site is paved parking. Existing soils are estimated to by Type C as a result of infiltration testing performed on the site, which determined that they had low hydraulic conductivities.

1.1.8 Minimum Requirement #8 – Wetland Protection

This minimum requirements is not applicable, as there are no known wetlands located on-site or within the immediate vicinity of the project.

1.1.9 Minimum Requirement #9 – Operation and Maintenance

Improvements, including stormwater outfalls, stormwater manholes, sanitary sewer manholes, etc., within the right-of-way will be maintained by the City of Puyallup. The SWPPP and storm drainage O&M as-builts will be prepared and recorded prior to final project approval.

FIGURE 1-2. SITE LAYOUT

VICINITY MAP

CODE ANALYSIS

ASSESSOR PARCEL NUMBER	5745001371
STREET ADDRESS	330 3RD STREET SW, PUYALLUP, WA 98371
COUNTY	PIERCE COUNTY
STATE	WASHINGTON
AUTHORITY HAVING JURISDICTION	CITY OF PUYALLUP
LEGAL DESCRIPTION	Section 28 Township 20 Range 04 Quarter 41 MEEKERS 1ST & 2ND: MEEKERS 1ST & 2ND NE OF SE 28-20-04E PARCEL "A" OF DBLR 96-09-27-0520 DESC AS ALL OF B 23, B 26, L 1 THRU 5 B 25 TOG/W 20 FT WIDE E-W ALLEY BETWEEN B 26, 25 & 23 VAC PER ORD 1301 EXC FOLL DESC PROP BEG AT NW OF SD B 26 TH S ALG W LI SD B 26 & B 25 300.83 FT TO SW COR OF L 5 B 25 TH E 110.13 FT TO SE COR SD L 5 TH N ALG E LI SD L 5 3.15 FT TO EXIST FENCE LI TH ALG SD FENCE LI S 88 DEG 20 MIN 49 SEC E 10.24 FT TH N 00 DEG 51 MIN 52 SEC E 132.90 FT TH S 89 DEG 03 MIN 38 SEC E 8.61 FT TH N 00 DEG 51 MIN 28 SEC E 165 FT TO N LI OF SD B 26 TH N 89 DEG 04 MIN 43 SEC W 129 FT TO POB EASE OF RECORD APPROX 48,336 SQ FT OUT OF 137-0 & 136-0 SEG I-0393 JU 12/11/96JU
TOTAL LOT AREA	48,145 SF (1.11 acres)
PRESENT USE *PROPOSED USE* *PROPOSED NUMBER OF UNITS*	BUSINESS SERVICES (SURFACE PARKING LOT) MIXED USE RETAIL AND MULTI-FAMILY RESIDENTIAL 83 UNITS, SEE UNIT COUNTS ON PAGE 8
CURRENT ZONING	CENTRAL BUSINESS DISTRICT CORE (CBD-CORE) // bordering CBD @ west, PF @ north, and RM-CORE @ SW
MAX. ALLOWABLE BUILDING HEIGHT *PROPOSED BUILDING HEIGHT*	40'; 50' WITH ADDITIONAL HEIGHT BONUS 45' WITH 1 STORY HEIGHT BONUS ACHIEVED (STRUCTURED PARKING)
MIN. HEIGHT @ GROUND FLOOR *PROPOSED GROUND FLOOR HEIGHT*	14'-0" AFF (PER PMC 20.30.0302 AND EXISTING EASEMENT) 15'-0" AFF (TO ALLOW FOR 14'-0" CLEAR EASEMENT THROUGH SITE)
MAX. FLOOR AREA RATIO (F.A.R.) *PROPOSED F.A.R. PROVIDED*	2.75 1.93 FAR [92,831 SF (BUILDING) / 48,145 SF (LOT)] SEE SQUARE FOOTAGE TABULATIONS DETERMINING F.A.R. ON PAGE 8
PARKING STALLS REQUIRED *PROPOSED STALLS PROVIDED*	83 (1 PARKING SPACE PER DWELLING UNIT) + 20 SENIOR CENTER STALLS (PER CITY CONTRACT AGREEMENT) 103 STALLS REQUIRED 89 STALLS PROVIDED ON-SITE + 26 ANGLED STALLS PROVIDED ALONG 3RD STREET SW 115 STALLS PROVIDED OVERALL
REQUIRED PLAZA SIZE (3% OF SITE) *PROPOSED PLAZA SIZE*	1,444 SF PLAZA REQUIRED [48,145 SF (LOT SIZE) X 0.03] 1,445 SF PLAZA AT NORTHEAST CORNER AND ALONG NORTH FACADE

SITE PLAN GENERAL NOTES

GENERAL NOTES BY NUMBER

REFER TO CIVIL DRAWINGS FOR SITE CONSTRUCTION INFORMATION, INCLUDING BUT NOT LIMITED TO THE FOLLOWING:

- SITE GEOMETRY AND DIMENSIONAL CONTROL INCLUDING FINISH ELEVATIONS
- SITE UTILITIES
- SITE GRADING AND DRAINAGE
- ASPHALT/CONCRETE PAVING DETAILS
- PAVING MARKERS
- CONCRETE SIDEWALK, CURB, GUTTER, & TREE PIT DETAILS
- PARKING BUMPERS
- TRAFFIC SIGNAGE
- PAVING STRIPING AND CURB MARKINGS
- TYPICAL HANDICAP SIGNAGE/SPACES

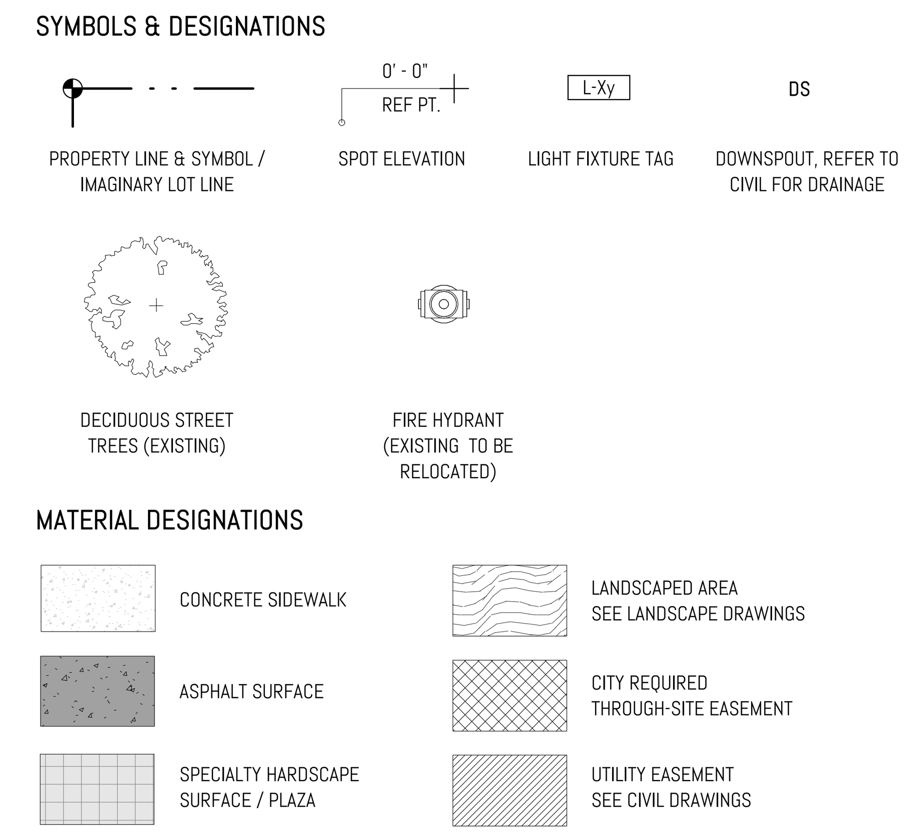
REFER TO ELECTRICAL DRAWINGS FOR SITE INFORMATION INCLUDING, BUT NOT LIMITED TO THE FOLLOWING:

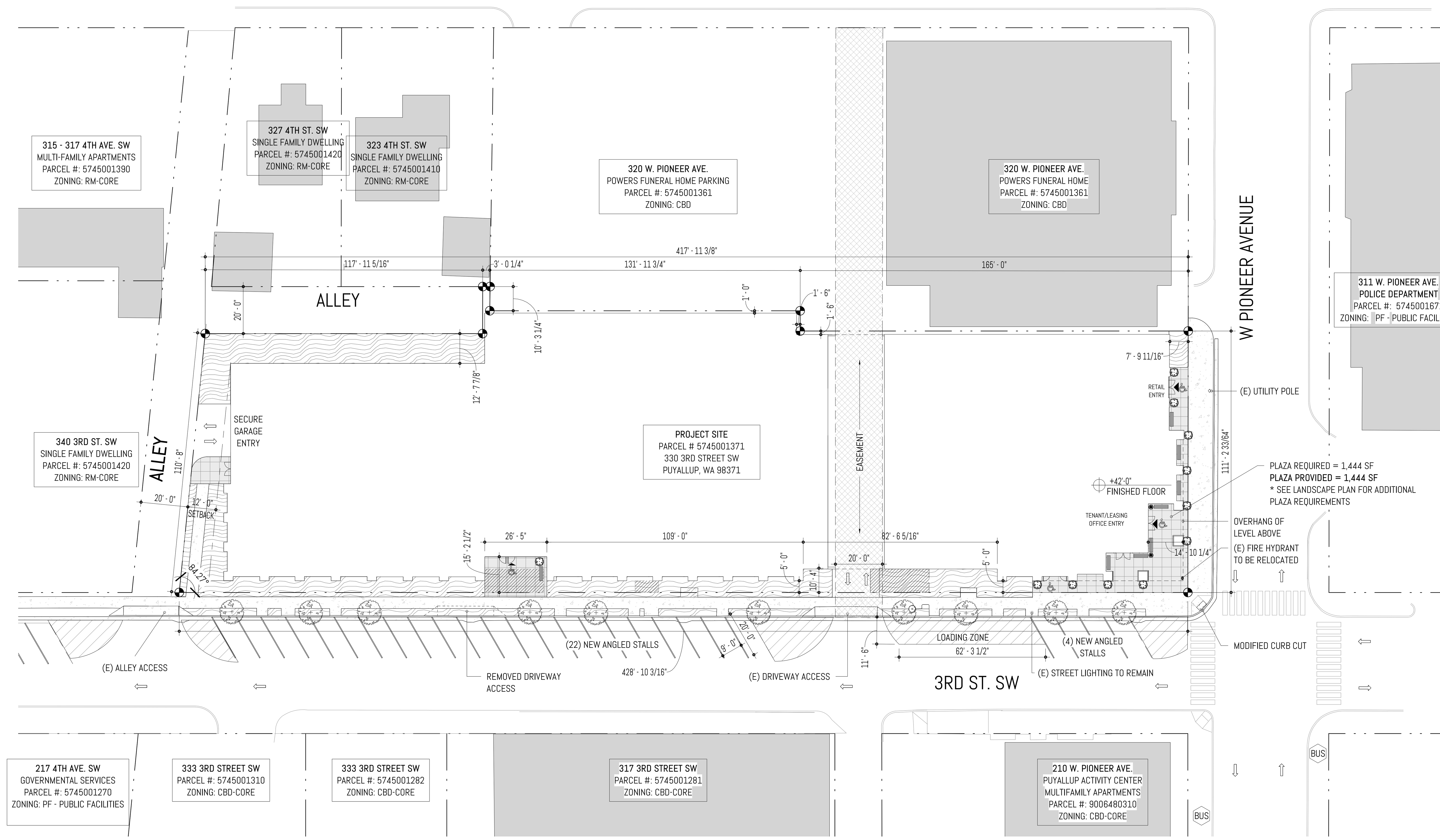
- SITE LIGHT STANDARD LOCATIONS AND SIZES
- ELECTRICAL SLEEVING LOCATIONS AND SIZES
- TELEPHONE AND CABLE TV PULL BOX LOCATIONS
- ELECTRICAL MANHOLE LOCATIONS AND DETAILS
- PULL BOX LOCATIONS AND SIZES FOR VARIOUS SITE LIGHTING ELEMENTS
- EXTERIOR BUILDING ILLUMINATION AND UTILITY COORDINATION

REFER TO CIVIL, LANDSCAPE AND ARCHITECTURAL FOR SITE SIGNAGE INFORMATION.

1. CONTRACTOR SHALL MAINTAIN ACCESS FOR EMERGENCY ENTRANCES AND SHALL NOT BLOCK ACCESS TO DRIVES.
2. SITE WORK AND STAGING THAT AFFECT THE AREAS ADJACENT TO ACCESSIBLE ENTRIES TO OTHER NEIGHBORING BUILDINGS WILL REQUIRE A WRITTEN COORDINATION PLAN SUBMITTED TO AND APPROVED BY THE OWNER.
3. CONTRACTOR SHALL INFORM THE OWNER PRIOR TO ANY SITE DEMOLITION AND SHALL SCHEDULE SUCH DEMOLITION AS NOT TO INTERFERE WITH THE OWNER'S OPERATIONS.

SITE PLAN GRAPHIC LEGEND





A1 OVERALL SITE PLAN
SCALE: 1" = 30'-0" @ FULL SCALE
0' 15' 30' 60' 90'

PROJECT NORTH   TRUE NORTH

FERGUSON
ARCHITECTURE
1916 Jefferson Avenue Tacoma, WA 98402
p 253.248.6060 www.fergusonarch.com

THE EZRA - MULTIFAMILY BUILDING
330 3RD ST. SW, PUYALLUP, WA 98371

MARK	ISSUED TO	ISSUED BY	DATE

PROJECT NO: 056-01-21
PRINCIPAL-IN-CHARGE: BF
PROJECT ARCHITECT: ND
DRAWN BY: ND

PROJECT STATUS: SCHEMATIC DESIGN

SHEET TITLE: SITE PLAN

SHEET NO. G-100

2.0 EXISTING CONDITIONS DESCRIPTION

The vacant lot is relatively flat, situated at an existing ground elevation of approximately 41 feet[1] and is currently an asphalt paved surface. Previous development on the parcel included several buildings which are no longer present. Trees currently exist north, east, and within the parcel. These trees are present along the road frontages for E Pioneer Ave. and 3rd St. SW as well as in parking lot islands. The parcel is adjacent to Powers Funeral Home, across the street from the Police Department and other residential housing. The Pioneer Street Right of Way frontage on the north side of the parcel and the 3rd St. SW frontage on the east side of the parcel have existing curb, gutter and sidewalks that are in good condition. The parcel is bounded by an alley on the south side and other privately owned parcels on the west side. The existing site conditions are shown on Figure 2-1.

Currently, the site is approximately flat. The site is graded to drain to existing storm drainage inlets along 3rd St. SW, in the alley on the south side of the parcel and within the parcel itself. There are no existing water bodies, or channels on the parcel. Stormwater runoff from the parcel enters the existing stormwater system on 3rd ST SW and is conveyed to a stormwater outfall on the Puyallup River and if flows are large enough, also to a stormwater outfall on Clarks Creek. The site is not listed as a wellhead protection area. The site is not an area of groundwater concern. The site is not located within a flood zone. The site is within the Puyallup River watershed and within two sub-basins, the Clarks Creek Basin and the Puyallup River South sub-basin. The property is within an aquifer recharge area. There are no known historical drainage problems related to flooding or erosion at the site. The property is in close proximity to a listed leaky underground storage tank on the east side of 3rd ST SW. There are no known leaky underground storage tanks on the site. It is not located nearby any closed or active landfills.

The parent soil type, according to the Natural Resource Conservation Service Web Soil Survey as Puyallup fine sandy loam. The on-site geotechnical investigation, however describes the top 2-5 feet of soil as fill consisting of loose, moist, silty sand (SM) and sandy silt (ML) and loose sand with varying amounts of silt (SP and SP-SM) within the upper 20 feet before becoming predominantly medium dense to dense sand with varying amounts of silt See the geotechnical soils report for more information on existing soil conditions (Appendix A).

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[1] North American Vertical Datum of 1988.

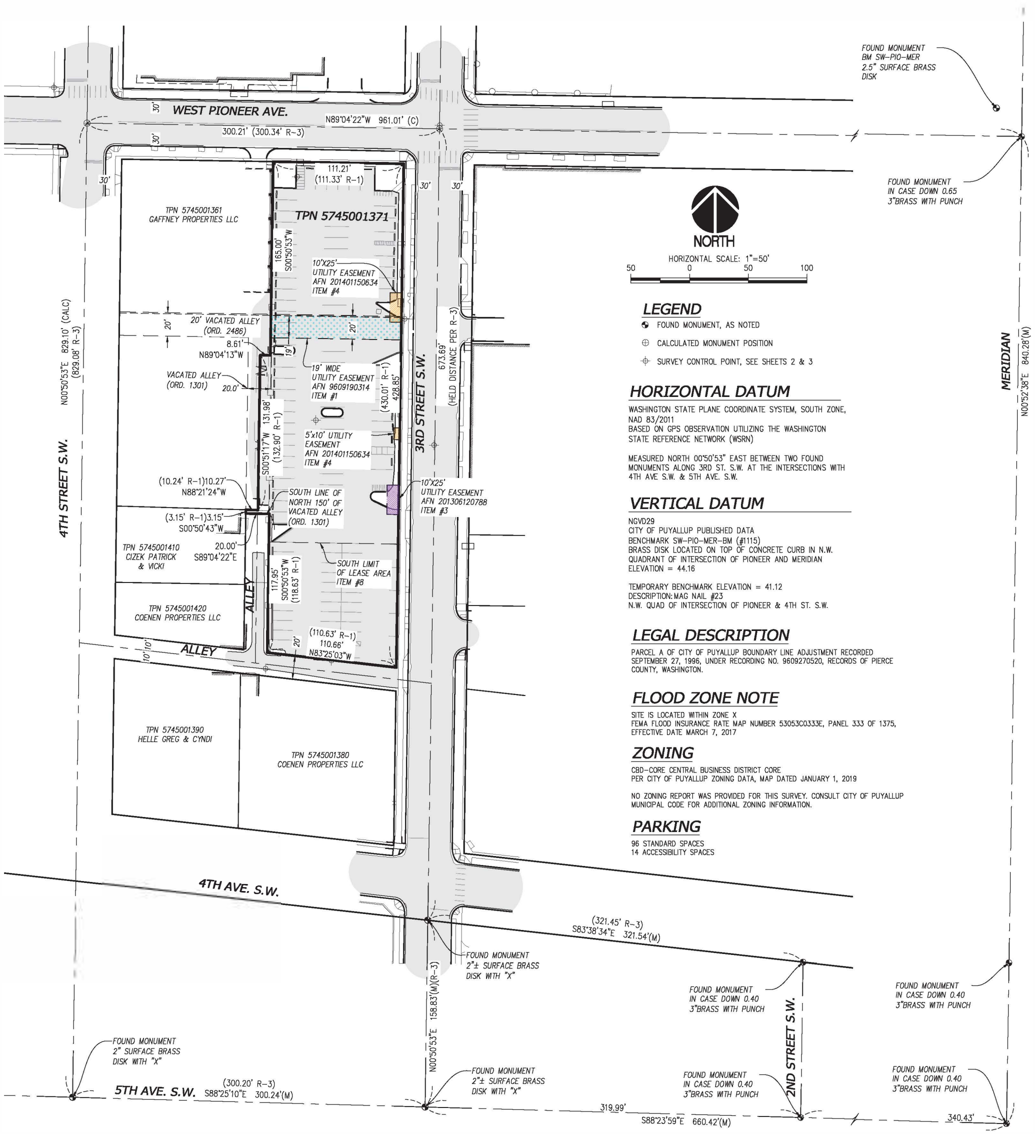
Permeability is low and ranges from 3 and 120 minutes/inch (0.5-21 inches per hour). Available infiltration capacity is low. A seasonal high-water table of approximately 3.5-5 feet below ground surface from December to March (Appendix B).

There are approximately 20 trees surrounding the north and east sides of the property as well as several on islands within the existing parking lot.

FIGURE 2-1. EXISTING SITE CONDITIONS

BOUNDARY & TOPOGRAPHIC SURVEY

A PORTION OF THE N.E. 1/4 OF THE S.E. 1/4 OF SECTION 28, TOWNSHIP 20 NORTH, RANGE 4 EAST, W.M., CITY OF PUYALLUP, PIERCE COUNTY, WASHINGTON



NORTH

HORIZONTAL SCALE: 1"=50'

50 0 50 100

LEGEND

- FOUND MONUMENT, AS NOTED
- CALCULATED MONUMENT POSITION
- SURVEY CONTROL POINT, SEE SHEETS 2 & 3

HORIZONTAL DATUM

WASHINGTON STATE PLANE COORDINATE SYSTEM, SOUTH ZONE, NAD 83/2011
BASED ON GPS OBSERVATION UTILIZING THE WASHINGTON STATE REFERENCE NETWORK (WSRN)

MEASURED NORTH 00°50'53" EAST BETWEEN TWO FOUND MONUMENTS ALONG 3RD ST. S.W. AT THE INTERSECTIONS WITH 4TH AVE S.W. & 5TH AVE. S.W.

VERTICAL DATUM

NGVD29
CITY OF PUYALLUP PUBLISHED DATA
BENCHMARK SW-PIO-MER-BM (#1115)
BRASS DISK LOCATED ON TOP OF CONCRETE CURB IN N.W. QUADRANT OF INTERSECTION OF PIONEER AND MERIDIAN
ELEVATION = 44.16

TEMPORARY BENCHMARK ELEVATION = 41.12
DESCRIPTION: MAG NAIL #23
N.W. QUAD OF INTERSECTION OF PIONEER & 4TH ST. S.W.

LEGAL DESCRIPTION

PARCEL A OF CITY OF PUYALLUP BOUNDARY LINE ADJUSTMENT RECORDED SEPTEMBER 27, 1996, UNDER RECORDING NO. 9609270520, RECORDS OF PIERCE COUNTY, WASHINGTON.

FLOOD ZONE NOTE

SITE IS LOCATED WITHIN ZONE X
FEMA FLOOD INSURANCE RATE MAP NUMBER 53053C0333E, PANEL 333 OF 1375, EFFECTIVE DATE MARCH 7, 2017

ZONING

CBD-CORE CENTRAL BUSINESS DISTRICT CORE
PER CITY OF PUYALLUP ZONING DATA, MAP DATED JANUARY 1, 2019

NO ZONING REPORT WAS PROVIDED FOR THIS SURVEY. CONSULT CITY OF PUYALLUP MUNICIPAL CODE FOR ADDITIONAL ZONING INFORMATION.

PARKING

96 STANDARD SPACES
14 ACCESSIBILITY SPACES

SCHEDULE B EXCEPTIONS

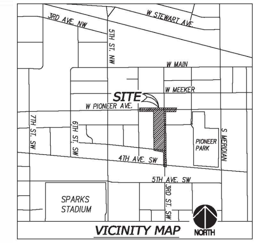
(PER CHICAGO TITLE COMPANY COMMITMENT NUMBER 202688-TC, UPDATED 2ND, DATED 10-27-2021)

* NOT A SURVEY MATTER, DESCRIPTION PROVIDED AS A COURTESY
** CONTENT/DATA WITHIN INSTRUMENT IS INSUFFICIENT TO DETERMINE EXACT LOCATION
*** INSTRUMENT IS BLANKET IN NATURE OR AFFECTS ENTIRE PROPERTY

EXCEPTION NUMBER	AFN	DESCRIPTION
1	9609190314	19' WIDE UTILITIES EASEMENT LOCATED ACROSS THE APPROXIMATE CENTER OF THE SUBJECT PARCEL WITHIN THE VACATED ALLEY, GRANTED TO US WEST COMMUNICATIONS, PLOTTED HEREON
2	9609270520	CITY OF PUYALLUP BOUNDARY LINE ADJUSTMENT NO. 96-84-009; BASIS OF THE LEGAL DESCRIPTION FOR THE SUBJECT PARCEL
3	201306120788	10'X25' ELECTRICAL & TELECOMMUNICATIONS EASEMENT LOCATED ON EAST SIDE OF SUBJECT PROPERTY, GRANTED TO QWEST CORP., PLOTTED HEREON
4	201401150634	ELECTRICAL EASEMENTS GRANTED TO PUGET SOUND ENERGY FOR ELECTRICAL AND COMMUNICATIONS; LOCATED ON EAST SIDE OF SUBJECT PROPERTY, PLOTTED HEREON
5	N/A	TITLE NOTE ABOUT TAX EXEMPTION STATUS, NOT A SURVEY MATTER
6	N/A	TITLE NOTE ABOUT SPECIAL TAXES, NOT A SURVEY MATTER
7	N/A	TITLE NOTE ABOUT OPEN MORTGAGES OR DEEDS OF TRUST, NOT A SURVEY MATTER
8	8803170279	EXTENSION OF LEASE FOR MONTH TO MONTH TENANCY GRANTED TO PUYALLUP IGA (TRADEWELL); UNRECORDED LEASE DATED APRIL 28, 1983 IS REFERENCED WITHIN THE INSTRUMENT AND NOT INCLUDED; SOUTH LIMITS OF LEASE AREA DEPICTED HEREON
9	N/A	NOT A SURVEY MATTER

REFERENCES

1. CITY OF PUYALLUP BOUNDARY LINE ADJUSTMENT NO.96-84-009, AFN 9609270520
2. CITY OF PUYALLUP BOUNDARY LINE ADJUSTMENT NO.96-84-011, AFN 9612200086
3. RECORD OF SURVEY (PARAMETRIX INC.), AFN 9703250076
4. RECORD OF SURVEY (SADLER BARNARD), AFN 201803085004
5. RECORD OF SURVEY (SITTS & HILL), AFN 200412305002
6. PLAT OF MEEKER'S 2ND ADDITION TO PUYALLUP W.T., V.2, P.93
7. PIERCE COUNTY ASSESSOR QUARTER SECTION MAP S.E. 1/4 28-T20N-R4E
8. CHICAGO TITLE 2ND COMMITMENT NO.202688-TC, DATED 10-27-2021



VICINITY MAP

SITE DATA

TAX PARCEL NO. 5745001371
ADDRESS: 330 - 3RD ST. S.W PUYALLUP
LAND AREA: 48,145± S.F.; 1.11± ACRES

NOTES

1. EQUIPMENT USED: TOPCON QS AND/OR CARLSON CR2+ ROBOTIC TOTAL STATION AND TOPCON GR3 RTK/GPS
2. THIS SURVEY WAS PERFORMED BY FIELD TRAVERSE WITH THE FINAL RESULTS MEETING OR EXCEEDING THE CURRENT TRAVERSE AND RELATIVE POSITIONAL ACCURACY STANDARDS CONTAINED IN W.A.C. 332-130-085 AND W.A.C. 332-130-090. THE RELATIVE POSITIONAL ACCURACY OF THE POSITIONS LOCATED HEREON MEETS OR EXCEEDS 2 CM (0.07 FT.) PLUS 50 PARTS PER MILLION BETWEEN ANY TWO TESTED POSITIONS. ALL MEASUREMENTS WERE MADE WITH A TOPCON QS ROBOTIC TOTAL STATION IN ACCORDANCE WITH THE EQUIPMENT MANUFACTURER'S SPECIFICATIONS
3. IN ACCORDANCE WITH THE REVISED CODE OF WASHINGTON (R.C.W.) 58.09 AND THE WASHINGTON ADMINISTRATIVE CODE (W.A.C.) 332-130, THIS SURVEY MAY DEPICT OCCUPATIONAL INDICATORS THAT DIFFER FROM THE DEEDED LOT LINES. THESE INDICATORS, IF AT ALL PRESENT, MAY REPRESENT A POTENTIAL FOR CLAIMS OF UNWRITTEN TITLE. THIS SURVEY DOES NOT PURPORT TO RESOLVE SUCH ITEMS.
4. FIELD WORK PERFORMED IN NOVEMBER 2021, UNDER SITTS & HILL JOB NUMBER 19508
5. UTILITIES AS SHOWN HEREON ARE BASED ON FIELD SURVEY OBSERVATION OF UTILITY LOCATE SERVICES PERFORMED BY MT. VIEW LOCATING INC. IN NOVEMBER 2021 FOR THIS SURVEY. THIS HAS BEEN SUPPLEMENTED BY RECORD INFORMATION PROVIDED BY CITY OF PUYALLUP GIS DATA. RECORD UTILITY LINES SHOWN HEREON ARE DEPICTED WITH A DASHED LINETYPE AS SHOWN IN THE LEGEND. UTILITIES OTHER THAN SHOWN MAY EXIST ON THE SITE. THE SURVEYOR DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED. THE SURVEYOR DOES CERTIFY THAT THEY ARE SHOWN AS ACCURATELY AS POSSIBLE FROM FIELD SURVEY AND PAINTED UTILITY LOCATE LINES. COLLECTION AND DEPICTION OF EXISTING SUBSURFACE UTILITY DATA IS CONSISTENT WITH QUALITY LEVEL B OF THE ASCE STANDARD GUIDELINES 38-02.
6. SITTS & HILL ENGINEERS, INC. HAS RELIED UPON TITLE INFORMATION NOTED IN COMMITMENT FOR TITLE INSURANCE PREPARED BY CHICAGO TITLE INSURANCE COMPANY OF WASHINGTON, 2ND COMMITMENT NUMBER 202688-TC, DATED 10-27-2021. IN PREPARATION OF THIS ALTA/NSPS LAND TITLE SURVEY, SITTS AND HILL ENGINEERS, INC. HAS CONDUCTED NO INDEPENDENT TITLE SEARCH NOR IS SITTS AND HILL ENGINEERS, INC. AWARE OF ANY TITLE ISSUES AFFECTING THE SURVEYED PROPERTY OTHER THAN THOSE SHOWN ON THE MAP AND/OR DISCLOSED BY SAID TITLE COMPANY'S ORDER. SITTS & HILL ENGINEERS, INC. HAS RELIED WHOLLY ON SAID TITLE COMPANY'S REPORT AND THEREFORE QUALIFIES THE MAP'S ACCURACY AND COMPLETENESS TO THAT EXTENT.
7. THIS SURVEY COMPLIES WITH W.A.C. 332-130-145. THE CONTOURS DEPICTED HEREON ARE BASED ON DATA FROM DIRECT FIELD MEASUREMENTS. SPOT ELEVATIONS ARE BASED ON DIRECT FIELD MEASUREMENTS AND ARE DEPICTED FOR REFERENCE. THE PURPOSE OF THIS TOPOGRAPHIC MAP IS TO SERVE AS A BASE MAP FOR CONTEMPLATED SITE IMPROVEMENTS AND DESIGN.

LEGAL DESCRIPTION

PARCEL A OF CITY OF PUYALLUP BOUNDARY LINE ADJUSTMENT RECORDED SEPTEMBER 27, 1996, UNDER RECORDING NO. 9609270520, RECORDS OF PIERCE COUNTY, WASHINGTON.

FLOOD ZONE NOTE

SITE IS LOCATED WITHIN ZONE X
FEMA FLOOD INSURANCE RATE MAP NUMBER 53053C0333E, PANEL 333 OF 1375, EFFECTIVE DATE MARCH 7, 2017

ZONING

CBD-CORE CENTRAL BUSINESS DISTRICT CORE
PER CITY OF PUYALLUP ZONING DATA, MAP DATED JANUARY 1, 2019

NO ZONING REPORT WAS PROVIDED FOR THIS SURVEY. CONSULT CITY OF PUYALLUP MUNICIPAL CODE FOR ADDITIONAL ZONING INFORMATION.

PARKING

96 STANDARD SPACES
14 ACCESSIBILITY SPACES

REVISIONS

APPROVALS: DESIGNED STT/GC/DMS; DRAWN MAM; CHECKED ---; DATE 12-23-2021; SCALE AS NOTED

SEAL: PRELIMINARY

PREPARED BY: sitts&hill
CIVIL | STRUCTURAL | SURVEY
4815 CENTER STREET | TACOMA, WA 98409
PHONE: (253) 474-9449 | FAX: (253) 474-0153
http://www.sittshill.com/

PREPARED FOR: PUYALLUP AOB DEVELOPMENT, LLC
5020 MAIN STREET, SUITE H
TACOMA, WA 98407
ATTN: MATT CYR

PROJECT: 303 - 3RD ST. S.W.
PUYALLUP, WA

SHEET TITLE: BOUNDARY AND TOPOGRAPHIC SURVEY

SHEET NO. 1 OF 3

PROJECT NO. 19508

3.0 INFILTRATION RATES/SOILS REPORTS

As mentioned above, the site consists of fill, silty sand and sandy silt materials. A groundwater level monitoring and preliminary infiltration feasibility evaluation (Appendix B) and a supplemental geotechnical report (Appendix C) were prepared by Aspect Consulting. These documents were written following site visits and investigations. Test pits and bore holes encountered revealed relatively uniform subsurface conditions that differed from the mapped stratigraphy within the site vicinity. Explorations encountered between 2 and 5 feet of fill consisting of loose, moist, silty sand and sandy silt. The fill was underlain by alluvium consisting of interbedded very soft to medium stiff silt with sand and loose sand with varying amount of silt within the upper 20 feet before becoming predominantly medium dense to dense sand with varying amounts of silt that extended to the maximum depth of the borings (approximately 80 feet below the ground surface). A test pit was excavated on May 11, 2021 and used to determine the percolation rates associated with the underlying soils.

Groundwater was observed and monitored between December, 2020 and May 2021. A seasonal maximum groundwater elevation of approximately 3.5 feet below ground surface was observed during these observations. It is expected that groundwater will vary between 3.5 and 7 feet below ground surface across the site. Aspect Consulting anticipates fluctuations in the local groundwater levels will occur in response to precipitation, precipitation patterns, off-site construction activities, and site utilization.

Based on Aspect Consulting’s site reconnaissance and subsurface explorations, it is their opinion that the infiltration of stormwater runoff generated onsite by the proposed residential development is not feasible for this project.

4.0 WELLS AND SEPTIC SYSTEMS

There are no wells and septic systems that are known to exist on the site or on adjacent property within the setback distance for stormwater retention/detention facilities. If wells or septic systems are found during construction, they will need to be shown on the as-builts and properly abandoned. The proper abandonment of wells is regulated by state law (WAC 173-160), Pierce County Environmental Health Department regulates drinking water and irrigation wells while the State Department of Ecology regulates resource protection wells. If a well is found on the site has not been properly sealed, the applicant will be responsible for contacting Pierce County Environmental Health and the appropriate procedure shall be followed for sealing any well. Proof of proper abandonment (e.g., copies of the well log and invoice from a firm qualified to perform such work) shall be supplied to the Pierce County Environmental Health or Ecology per its requirements.

5.0 FUEL TANKS

No above ground fuel tanks are present on the parcel and there are no underground fuel tanks known to exist on the parcel. If any fuel tanks are found during construction, the Pierce County Environmental Health Department and the City of Puyallup will be notified and the location of the fuel tanks will be shown in the construction as-built drawings. If fuel tanks need to be abandoned or removed, the Pierce County Environmental Health Department and the City of Puyallup will be contacted for specific instructions.

6.0 SUBBASIN DESCRIPTION

The Site is located in the Puyallup watershed and more specifically both the Clarks Creek basin and the Puyallup River South basin.

Clarks Creek drains a small urban watershed that includes portions of the cities Puyallup and Unincorporated Pierce County. The creek originates in the City of Puyallup, at an elevation of approximately 350 feet, and flows generally north to its confluence with the Puyallup River.

The Puyallup River drains a large urban, suburban and forested area of approximately 950 square miles. The Puyallup River south basin is located in the City of Puyallup and collects stormwater north of 4th Ave. SW, west of highway 512, east of 21st ST NW and south of the Puyallup River. It drains an urban area.

Currently, the existing site is paved and varies in slope and direction across the site. The site drains at slopes between 1 and 2% towards storm drain inlets. The lot is perched above surrounding roadways and there is no upstream drainage area that runs onto the site.

Weir box is located at 15th St SW. [Preliminary Drainage Report, Page 25 of 124]

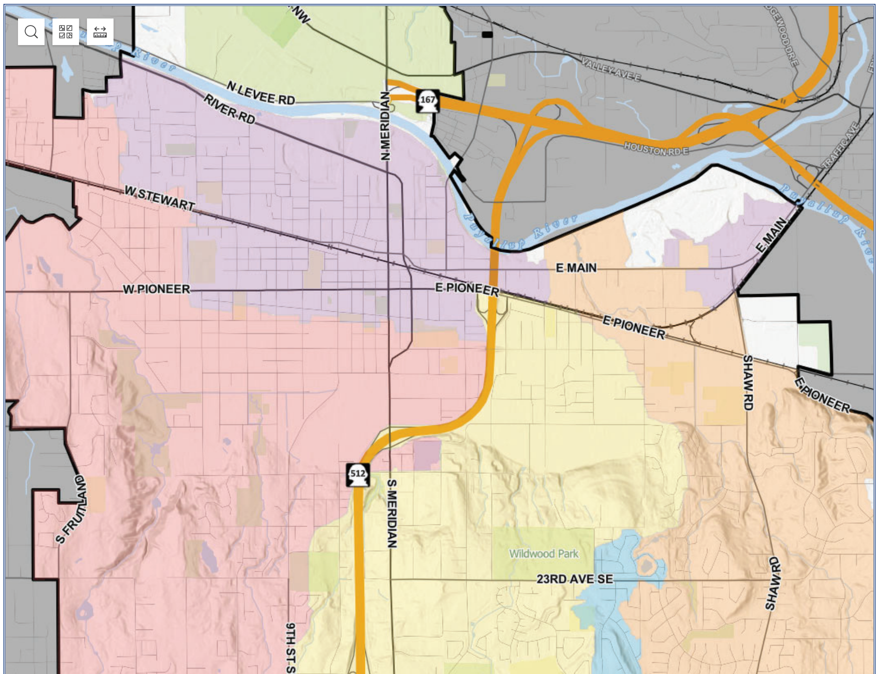
The proposed project site plan does not significantly alter the peak rate of flow or volume of discharge leaving the site, when compared to existing conditions. Discharges and runoff from the site will drain to 3rd Street SW. After entering the stormwater system, runoff will travel south approximately 300 feet through a 12-inch diameter concrete pipe and enter into another storm sewer main on 4th Ave SW. The 4th Ave SW storm drain is a 24-inch diameter concrete storm sewer. The 4th Ave SW storm drain will carry the stormwater west for approximately 0.8 miles to Pioneer St. The water is conveyed approximately 100 feet west along Pioneer St until it intersects with a weir box at the intersection of 17th ST SW and Pioneer. Low flows are then diverted north along 15th ST NW towards the Puyallup River and high flows are conveyed west along Pioneer towards Clarks Creek. The Puyallup River is approximately 1.1 miles north of the 15th St SW/Pioneer Intersection. Clarks Creek is approximately 0.5 miles west of the 15th ST SW/Pioneer Intersection. Figure 6-1 shows the City of Puyallup Storm Sewer System Drainage Basins. Low flows for part of the Clarks Creek Drainage basin are diverted north to the Puyallup River in a weir box located at the intersection of Pioneer and 15th St. SW, as shown in Figure 6-1, however peak flows are conveyed west to Clarks Creek.

FIGURE 6-1. DRAINAGE BASINS IN THE CITY OF PUYALLUP

City of Puyallup Public Data Viewer

Data layers

- Utilities
  - Hydrants
  - Storm Water
    - Control Structures
    - Inlets
    - Manholes
    - Outfalls
    - Channels
    - Culverts
    - Pipes
    - Facilities
    - Stormwater Drainage Basins
  - Sanitary Sewer
- Transportation
- Recreation
- Environment
- Zoning
- Parcels



Esri, NASA, NGA, USGS, FEMA | William Keller - GIS Coordinator | Staff from the City of Puyallup Public Works worked on this project. Contact: William Keller, City of Puyallup … Powered by Esri

Legend

Utilities

Storm Water

Stormwater Drainage Basins

BASIN_ID

- Clarks Creek
- Pothole
- Puyallup River North
- Puyallup River South
- Shaw Road
- State Highway

7.0 FLOODPLAIN ANALYSIS

According to the FEMA Flood Insurance Rate Map 53053C0333E (Effective 04/07/2017), this parcel is located outside the 0.2% annual chance floodplain is located in a Zone X flood zone not subject to flooding in a 100-year flood. The nearest flood zone is approximately 3,000 feet to the northeast of this parcel.

8.0 AESTHETIC CONSIDERATIONS FOR FACILITIES

Efforts will be made to create an aesthetically pleasing environment by retaining trees that surround the site, and implementing additional landscaping. Additional trees will be planted along with many other landscaping features. More information regarding proposed site vegetation and SVPAs can be found in the landscape design plans.

Downspout dispersion previously stated as infeasible. [Preliminary Drainage Report, Page 30 of 124]

9.0 FACILITY SELECTION AND SIZING

The Western Washington Hydrology Model (WWHM 2012) was utilized to calculate the hydrologic conditions of the site. Per an agreement with the City of Puyallup, reduction of peak flow rates to levels consistent with those required by the SMMWW will not be required for this project.

Stormwater runoff from the parking lots, sidewalks, and rooftops will be conveyed to the existing stormwater system on 3rd St SW.

Runoff from the underground parking garage area will be conveyed to the sanitary sewer, however, the facility will be graded to drain away from this area, so the flows captured by the storm sewer collection system will not include co-mingled storm water.

Modeled pre-project peak flows range from 0.37 cfs for the 2-year return period to 0.94 cfs for the 100-year return period. Post-project flows are anticipated to be 0.36 cfs for the 2-year return period to 0.90 cfs for the 100-year return period. The post-project 25-year storm event is approximately 0.70 cfs. These peak flow rates are approximately the same as pre-project peak flow rates.

10.0 CONVEYANCE SYSTEM AND ANALYSIS DESIGN

Currently there are several storm inlets and an associated storm sewer collection system located on the property. The property drains to these inlets at slopes varying between 1 and 2%. This local storm system drains to the southeast corner of the property and enters into the City of Puyallup MS4 system, which drains west into Clarks Creek and the Puyallup River.

The proposed project plans are to connect the building rooftop to the existing stormwater collection system and replace any drainage grates necessary to accommodate grading. The existing project facilities will capture runoff from the parking lots, roofs, sidewalks and vegetated areas and convey this runoff to the existing storm sewer.

Any system updates will be designed to convey and contain the 25-year storm event, in accordance with the City of Puyallup Standards. The conveyance pipes between the building and the City of Puyallup's MS4 system will be 8-inch diameter schedule 40 PVC pipe. An 8-inch diameter pipe with a manning's n roughness value of 0.012 at 1% slope would be approximately 50% full when conveying 0.7 cfs, which is the 25-year storm's peak runoff rate. A similar pipe would be approximately 66% full, when conveying the 100-year storm's peak runoff rate. Therefore, the proposed conveyance system can handle the design flows.

Stormwater drainage and runoff facilities will not be modified outside of the property boundary. There will be no changes to the stormwater facilities along 3rd St. SW, with the exception of connecting into the storm sewer.

11.0 OFFSITE ANALYSIS AND MITIGATION

Discharge from the site will be conveyed to the City of Puyallup's MS4 system, where it would travel to a stormwater sewer main, then travel approximately 1.3 miles before discharging at the stormwater outfall into Clarks Creek and the Puyallup River.

This project should not impact flooding on Clarks Creek or the Puyallup River. Calculations suggests that there will not be an increase to existing flows.

Portions of the Clarks Creek do not meet water quality standards and are on the Clean Water Action Section 303(d) list for bacteria, pH, dissolved oxygen (DO), sediment and temperature. Additionally, the stormwater outfall discharges into a portion of Clarks Creek that is listed for two Category 2 (water of concern) pollutants (Ecology, 2022). These two pollutants are Temperature and pH. Further details about these water impairments can be found in Table 11-1.

TABLE 11-1. CLARKS CREEK WATER QUALITY PARAMETERS

	2012 303(d) listings for pollutants addressed by the 2015 TMDL				
Parameter	*Category Listing (2022)*	*WBID Code*	*NHD Reach Code*	*Listing ID*	*Township Range Section*
Temperature	2	WA-10-1025	17110014000641	35345	20N-4E-S29
pH	2	WA-10-1025	17110014000641	7499	20N-4E-S29
Bacteria	4A	WA-10-1025	17110014000641	45207	20N-4E-S29
Dissolved Oxygen	4A	WA-10-1025	17110014000641	47590	20N-4E-S29
Fine Sediment	4A	WA10-1025	17110014000641	78997	20N-4E-S29

The current water quality-based effluent limits (WQBELs) that apply to sites requiring a Western Washington Phase II Municipal Stormwater General Permit are listed below (Ecology, 2015):

- **Temperature:** Washington State uses several criteria to ensure that where a water body is naturally capable of providing full support for its designated aquatic life uses, that condition will be maintained. When a water body is naturally warmer than the criteria, the state provides an allowance for additional warming due to human activities. In this case, the combined effects of all human activities must not cause more than a 0.3°C (0.54°F) increase above the naturally higher (inferior) temperature condition. Whether or not the water-body's temperature is naturally high is determined using a model.

  Additionally, according to the temperature criteria for Core Summer Salmonid Habitat, the 7-day average of daily maximum water temperatures must not exceed 16 ºC. A supplemental spawning / incubation criterion of 13 ºC (as a 7-day average of daily maximum temperatures) from September 15 to July 1 is required for much of Clarks Creek as part of a recent rulemaking, revised in January 2011.

  James, et. al. (2014) determined that water temperatures in Clarks Creek typically range between about 8 and 14 ºC throughout the year and therefore are in compliance with Washington water quality standards. However, they are believed to be elevated over natural conditions due to a lack of riparian shade.

- **pH:** A TMDL for pH has not been prepared for Clarks Creek. The 303d listing states that at least 10 percent of samples were excursions of the criteria in at least one year, however fewer than 3 excursions exist from all data considered. These excursions were on the low side of the acceptable pH range.

- **Bacteria:** Hoffman et al (2008) identified locations on tributaries where bacteria concentrations during storm events must be reduced to meet water quality standards.

The waste load allocation for point sources to Clarks Creek or any of the tributaries, including future sources, is the water quality standards for fecal coliform bacteria. The TMDL lists several action items including implementing BMPs for new development and re-development.

- **Dissolved Oxygen (DO)**: James, et. al. (2014) identified that DO levels in Clarks Creek and its tributaries periodically drop below the minimum allowable DO concentration of 9.5 mg/L. This drop in dissolved oxygen concentrations in Clarks Creek are affected by low reaeration, sediment oxygen demand (SOD), tributary and groundwater inflow DO concentrations, and algal photosynthesis and respiration. If DO concentrations are naturally below or within 0.2 mg/L of the 9.5 mg/L criteria, than human influences should not cause a greater than 0.2 mg/L decrease in the receiving water.

- **Fine sediment:** James, et. al (2014) determined that the sediment reduction project concluded that significant amounts of excess sediment enter Clarks Creek each year. The current, modeled average annual sediment load (673 tons/year) is over 16 times greater than the sediment load that would naturally occur (41 tons/year). For sediment, the key stressor source is hydromodification, especially increased impervious surfaces on the landscape which increase stormwater velocity and discharge volume. This causes both increased upland sediment wash off and in-channel and streambank erosion. Much of this mobilized sediment is deposited in lower gradient reaches where it impairs habitat and becomes a source of nutrients and SOD, encourages elodea growth, and contributes to reduced DO. The target to protect designated uses from sediment impairment is a 64% reduction in sediment loading based on comparing the current percentage of fines and sands to those in Puget Sound lowland reference streams that support a healthy fish habitat.

Portions of the Puyallup River do not meet water quality standards and are on the Clean Water Action Section 303(d) list for Bacteria, Arsenic, Lead, Ammonia-N, Temperature, Zinc, Coper, Mercury and Turbidity. Additionally, the stormwater outfall discharges into a portion of the Puyallup River that is listed for two Category 2 (water of concern) pollutants and two Category 5 (Polluted water that requires a water improvement project) pollutants (Ecology, 2022). These two pollutants are Temperature and pH. Further details about these water impairments can be found in Table 11-1.

TABLE 11-2. PUYALLUP WATER QUALITY PARAMETERS

	2012 303(d) listings for pollutants addressed by the 2015 TMDL				
Parameter	*Category Listing (2022)*	*WBID Code*	*NHD Reach Code*	*Listing ID*	*Township Range Section*
Bacteria	1	Puyallup River	17110014000028	7498	20N-4E-S18
Arsenic	1	Puyallup River	17110014000028	8676	20N-4E-S18
Lead	2	Puyallup River	17110014000028	8677	20N-4E-S18
Ammonia-N	1	Puyallup River	17110014000028	10861	20N-4E-S18
Temperature	5	Puyallup River	17110014000028	10862	20N-4E-S18
Zinc	1	Puyallup River	17110014000028	10865	20N-4E-S18
Copper	1	Puyallup River	17110014000028	10866	20N-4E-S18
Mercury	5	Puyallup River	17110014000028	10874	20N-4E-S18
Turbidity	2	Puyallup River	17110014000028	15914	20N-4E-S18

Additional information regarding these water quality parameters and their associated TMDLs is available from the Department of Ecology.

Ultimately, the proposed project has been designed to not increase the runoff generated from the site for storm events equal to or more frequent than the 50-year storm; therefore there should be no downstream erosion, flooding, or impacts to water quality as a result of the proposed project.

12.0 UTILITIES

The existing onsite utilities include buried power, storm drain and telephone lines. There are no other existing onsite sewage systems (OSS) at the site. The proposed utilities include sewer lines, water lines, downspout conveyance pipe, buried power, and telephone.

The proposed sanitary sewer line will tie into the existing City sanitary sewer and flow to the PVC main on 3rd just south of Pioneer and then north towards Pioneer in the existing 6-inch sanitary sewer. After flowing into the Pioneer sanitary sewer, wastewater will flow west on Pioneer. The Pioneer sanitary sewer pipe is 8-inch diameter PVC. Sewer pipes and cleanouts will be contained within the easement boundaries (See Civil Site Drawings).

A water main line from the City water system will enter the site from the north under E Pioneer Street. An overall water meter will be provided after the water main enters the building. Additionally, there is a fire hydrant on the northeast corner of the site.

The proposed utilities have been designed to meet City of Puyallup standards by maintaining a minimum vertical separation of 18 inches between sanitary sewer and potable water pipes and they have been separated by a horizontal distance of 10-feet outside of the building envelope.

13.0 COVENANTS, DEDICATIONS, EASEMENTS, AGREEMENTS

The site contains an easement granted to the City of Puyallup for public street right-of-way per Ordinance 2486 as a result of a vacated alley. This easement coincides with a 19-foot-wide utility easement (AFN 9609190314). In addition, there is a 10'x25' Utility Easement on the southeast side of the property (AFN 201306120788), a 5'x10' utility easement on the east side of the property (AFN 201401150634). There is also a 10'x25' utility easement on the northeast side of the property (AFN 201401150634).

The Agreement to Maintain Stormwater Facilities can be found in the Stormwater Site Management Plan. This plan also includes details regarding maintenance, inspections, and preventative measures for the building management to maintain water quality and the integrity of the proposed stormwater systems. The stormwater Site Management Plan will be provided following construction.

An agreement between the developer and the City of Puyallup will remove the requirement for the development to meet MR#7, which addresses flow control. This agreement has not yet been executed. As a result of this agreement, on-site detention will not be provided. However, the stormwater runoff's peak post-project flow rates will not exceed peak pre-project flow rates.

14.0 OTHER PERMITS OR CONDITIONS PLACED ON THE PROJECT

No permits from other agencies or jurisdictions are needed. City of Puyallup permits will include building permits, utility connection permits, and site development permits. Other permits may be required that are not listed in this section. A Notice of Intent will need to be submitted to the Washington State Department of Ecology prior to the start of construction.

15.0 REFERENCES

City of Puyallup. 2012. City of Puyallup Comprehensive Storm Drainage Plan. March, 2012.

City of Puyallup. 2017. Stormwater Maintenance Manual for Private Facilities. July 2017.

City of Puyallup. 2019. City Standards, Sections 100, 200, 300, 400. June, 2019.

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APPENDIX A

DRAFT GEOTECHNICAL ENGINEERING SERVICES REPORT

Draft Geotechnical Engineering Services Report

Puyallup AOB Site
Puyallup, Washington

for
MC Construction Consultants

March 28, 2022

GeoEngineers

1101 Fawcett Avenue, Suite 200
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Draft Geotechnical Engineering Services Report

Puyallup AOB Site
Puyallup, Washington

File No. 8947-005-00

March 28, 2022

Prepared for:

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1.0 INTRODUCTION AND PROJECT UNDERSTANIDNG

GeoEngineers, Inc. (GeoEngineers) is pleased to submit this geotechnical engineering study and report for the Puyallup AOB Site. The site is located at 330 3rd Street SW in Puyallup, Washington as shown on the Vicinity Map, Figure 1. Prior experience at this site includes subsurface explorations and a preliminary study prepared by GeoEngineers for the City of Puyallup to support potential improvements to the site. GeoEngineers advanced three borings which we reference to support this study. Our previous report is titled "AOB Site Preliminary Geoenvironmental Study" and is dated September 30, 2011 (September 2011 Report).

Our understanding of the proposed improvements is based on conversations with you and review of preliminary site plans. Proposed improvements include a four-story multifamily residential structure with at grade parking and with three stories of residential space above. Below grade parking is not currently envisioned. Based on our discussions with you, we understand that the preferred foundation support method is conventional shallow foundations underlain by ground improvement.

2.0 SCOPE OF SERVICES

The purpose of our services is to review existing geotechnical information at the site as a basis for providing geotechnical design and construction recommendations for the proposed development. In general, our authorized services included: reviewing selected geotechnical information about the site; completing geotechnical analyses; and preparing this geotechnical report with our conclusions, findings and recommendations. Our services are being provided in general accordance with our agreement with MC Construction Consultants authorized February 22, 2022. Our complete scope of services is provided in our proposal dated February 3, 2022.

3.0 SITE CONDITIONS

3.1. Surface Conditions

The site is located southwest of the intersection of Pioneer Way and 3rd Street SW in downtown Puyallup and is bounded to the north and east by city street right-of-way and by commercial lots to the west and south. The site is currently used as an asphalt paved parking area. Landscaping areas that include small trees, grasses, and shrubs are located on the perimeter.

The site is relatively level with small variations in topography between opposite sides. We understand that prior development of the site included a two-story building in the southeast corner and a grocery store in the center of the site, both of which were removed prior to construction of the parking lot.

3.2. Literature Review

3.2.1. Geologic Conditions

Based on our review of the map titled "Geologic Map of the Tacoma 1:100,000-scale Quadrangle, Washington" (Schuster et. al. 2015) the site is underlain by Holocene Alluvium (map unit Qa). This deposit is described as comprising a mixture of sand, silt, gravel and cobbles. In addition, alluvium deposits in this region can be underlain by lahars and mudflow deposits from Mt. Rainier.

3.2.2. Prior Geotechnical Studies

In addition to the 2011 Report prepared by GeoEngineers for this site, we reviewed two other geotechnical studies that were completed at the site:

- "Groundwater Level Monitoring and Preliminary Infiltration Feasibility Evaluation" Aspect Consulting, June 2, 2021
- "Supplemental Geotechnical Report Small Scale Infiltration Test" Leroy Surveyors and Engineers, Inc., January 6, 2022

These reports were prepared primarily to evaluate stormwater infiltration feasibility at the site.

GeoEngineers prior work at the site also includes completing a Phase 1 Environmental Site assessment for the City of Puyallup (report dated September 15, 2011). This report can be provided for review, if requested.

3.3. Subsurface Conditions

3.3.1. Soil Conditions

As part of GeoEngineers 2011 report, three borings were advanced at the site to depths between 21.5 feet and 80 feet below ground surface (bgs). The locations of these borings are shown on the Site Plan, Figure 2 and the summary explorations logs are included in Appendix A. Borings B-1 and B-2 for this study were completed as monitoring wells; details of well construction are also included in Appendix A. Additional borings were not completed as part of the Aspect Consulting and Leroy Surveyors Reports. A shallow excavation for an infiltration test was completed as part of the Leroy Surveyors report. The location of the infiltration test is also shown on the Site Plan.

The borings completed for the 2011 report were advanced in areas surfaced with asphalt concrete. Asphalt thickness was on the order of 2 inches and was underlain by about 2 inches of base course. Below the asphalt, soil conditions described generally consisted of fill underlain by alluvium.

Fill extended approximately 2 to 5 feet below the ground surface. Fill consisted of brown silty sand and sandy silt in a moist condition and was typically in a loose or soft condition.

Alluvium underlying the fill generally consisted of layers of silt, silty sand, and sand with silt. Within about 20 feet of the ground surface, the alluvium was typically very loose to loose (or very soft to medium stiff). Below about 20 feet the relative density of the alluvium generally increased and was typically medium dense to dense, however intermittent layers of loose soil conditions were also noted. B-1 and B-2 were terminated around 21.5 feet bgs. B-3 was terminated around 80 feet bgs.

3.3.2. Groundwater Conditions

Groundwater was reported between 6 and 7 feet at the time of drilling. Groundwater monitoring in the B-1 and B-2 monitoring wells was completed by Aspect Consulting between December 8, 2020 and May 11, 2021. During that timeframe, seasonal high groundwater levels were measured between 3.5 and 4.5 feet bgs. A plot of groundwater levels provided in the Aspect Consulting Report is included as Figure 3 for reference.

We expect that groundwater levels will fluctuate throughout the year but will typically be within 3 to 7 feet of the ground surface. This interpretation is consistent with the groundwater monitoring competed by Aspect Consulting and our experience in the area.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1. Seismic Design Considerations

4.1.1. Seismic Design Parameters

We understand that seismic design will be completed using procedures outlined in the 2018 International Building Code (IBC). Per the 2018 IBC, structures shall be designed and constructed to resist the effects of earthquake motions in accordance with American Society of Civil Engineers (ASCE) 7-16.

As discussed below, the alluvial soils at the site are potentially liquefiable during the design seismic event. Due to the presence of potentially liquefiable soils, the site is classified as Site Class F, and a site-specific response analysis could be required.

However, an exception is provided in ASCE 7-16 Section 20.3.1. Site-specific response analysis is not required for liquefiable soils, provided the structure has a fundamental period of vibration equal or less than 0.5 seconds. Provided this exception is true, the site-specific response spectrum for Site Class D may be used as a basis for a simplified design and analysis.

Additionally, in accordance with ASCE 7-16 Section 11.4.8, a ground motion hazard analysis is required for sites classified as Site Class D and because the spectral response acceleration at 1-second periods (S_1) is greater than or equal to 0.2. However, an exception is allowed, provided specific requirements are satisfied, related to the fundamental period of the considered structure.

Table 1 below provides recommended seismic design parameters for Site Class D. These values are only valid if the exceptions provided in ASCE 7-16 Sections 11.4.8 and 20.3.1 described apply to the structures. If these expectations do not apply, we should be consulted further as a site-specific response analysis could be required.

TABLE 1. RECOMMENDED SEISMIC DESIGN PARAMETERS

2018 IBC (ASCE 7-16) Seismic Design Parameters	Recommended Value[1,2,3]
Site Class	D
Mapped Spectral Response Acceleration at Short Period (S_S)	1.273 g
Mapped Spectral Response Acceleration at 1 Second Period (S_1)	0.438 g
Site Amplification Factor at 0.2 second period (F_a)	1.0
Site Amplification Factor at 1.0 second period (F_v)	1.862
Design Spectral Acceleration at 0.2 second period (S_{DS})	0.849 g
Design Spectral Acceleration at 1.0 second period (S_{D1})	0.544 g
Site Modified Peak Ground Acceleration (PGA_M)	0.55 g

Notes:

[1] Parameters developed based on Latitude 47.189333307° and Longitude -122.296787743°.

[2] These values are only valid for structures with fundamental periods less than 0.5 seconds.

[3] A ground motion hazard analysis may be required in accordance with Section 11.4.8 of ASCE 7-16 (Site Class D and $S_1 \geq 0.2$).

4.1.2. Liquefaction

Liquefaction refers to a condition where vibration or shaking of the ground, usually from earthquake forces, results in development of excess pore pressures in saturated soils and a subsequent loss of soil strength. In general, soils that are susceptible to liquefaction include loose to medium dense "clean" to silty sands and non-plastic silts that are below the water table. We evaluated the soil profile for liquefaction potential using methods developed by Idriss and Boulanger (2008). This method compares the predicted cyclic shear stress (CSS) induced by the design earthquake to the cyclic shear resistance (CSR) determined by correlations with standard penetration test (SPT) blow counts. The ratio of the CSR to the CSS is the cyclic shear ratio and is considered the factor of safety against liquefaction.

Based on the results of our liquefaction analysis, the alluvium at the site is, in our opinion, potentially liquefiable. Based on the conditions described on the B-3 boring log, the bottom of the potentially liquefiable soils appears to be around 60 feet bgs.

Our analyses indicates that between about 12 and 18 inches of liquefaction-induced settlement could occur within the upper 60 feet of the soil profile during the design seismic event. Due to the variability of underlying soils and the inherent unpredictability of seismic soil liquefaction, differential settlements could be more than half to equal the total estimated settlement between similarly loaded foundations within a distance greater than about 50 to 100 feet apart.

4.1.3. Lateral Spreading Potential

Lateral spreading related to seismic activity typically involves lateral displacement of large, surficial blocks of non-liquefied soil when a layer of underlying soil loses strength during seismic shaking. Lateral spreading usually develops in areas where sloping ground or large grade changes (including retaining walls) are present. Based on the relatively flat topography of the site, our understanding of the liquefaction risk at the site, and the proposed improvements, it is our opinion that the risk of lateral spreading is low.

4.1.4. Surface Rupture

According to the Washington State Department of Natural Resources Interactive Natural Hazards Map (accessed January 31, 2022), there are no mapped faults or other seismogenic features within about 1 mile of the site. Based on the distance to the nearest mapped fault or seismogenic feature, it is our opinion the risk for surface rupture at this site is low.

4.2. Foundation Support

4.2.1. General

We expect that the estimated liquefaction settlement magnitudes will be excessive from a structural perspective and that liquification mitigation or alternative foundation support methods will be necessary. Based on conversations with you, we understand that your preferred approach to foundation support is conventional shallow foundations underlain by ground improvement. Alternatively, we expect that the proposed structure could be supported on deep foundations (driven piles, augercast piles, drilled shafts, etc.). The sections below provide recommendations for design of ground improvement and shallow foundations located within ground improvement areas and outside of ground improvement areas. We can provide recommendations for design of other foundation support methods, if requested.

4.2.2. Ground Improvement

4.2.2.1. General

We understand that compacted aggregate piers (CAPs), is the current ground improvement method proposed for this site. CAPs, which are often referred to by a trade name, GeoPiers or Rammed Aggregate Piers. CAPs consist of discrete columns of compacted crushed rock that are installed on a regular pattern below the proposed improvements, typically a building footprint. There are several benefits that can be achieved by installing CAPs. CAPs can reduce the magnitude of static settlement, increase the allowable soil bearing resistance and reduce the magnitude of total and differential settlement caused by liquefaction. Other ground improvement types including stone columns, or rigid inclusions which are also be feasible for this site. Because many ground improvement methods are proprietary designs, we recommend that the ground improvement system be designed by the ground improvement contractor selected to perform the work. The design criteria for the ground improvement system are summarized in the section below.

4.2.2.2. Ground Improvement Design Criteria

The primary intent of the ground improvement design should be to mitigate the liquefaction settlement hazard and provide an increased bearing resistance for the proposed structure. The ground improvement should encompass the entire building footprint and extend at least 5 feet beyond the footprint of the structure as well as below any other critical/settlement sensitive infrastructure proposed outside of the main structure. We recommend the design of the ground improvement, including the actual layout, length and minimum diameter of each column or pier based on the final foundation plan. The ground improvement designer may determine the required depth of the ground improvement based on the design criteria provided below. We recommend minimum ground improvement elements be at least 30 feet below primary bearing surfaces such as building slabs and foundations. Some alternative depths could be appropriate depending on type, spacing and diameter.

We recommend that the ground improvement be designed to achieve the following minimum performance criteria. It is possible to design ground improvement to achieve higher allowable bearing capacities and less settlement. If a higher level of performance is required for the ground improvement, we should be notified to review the specific application and design prior to preparation of final construction documents. The performance criteria below must be reviewed by the project structural engineer who should confirm that the criteria is appropriate for the proposed building and provide revised performance criteria, if necessary.

- Allowable soil bearing resistance of 3,000 pounds per square foot (psf) with an allowable increase of ⅓ for transient loading conditions.
- Total long-term static settlement of 1 inch and differential static settlement of 0.5 inch over a distance of 40 feet.
- Total liquefaction-induced settlement of 4 inches for the improved area.
- Differential liquefaction-induced settlement of 2 inches over a distance of 40 feet; some variations of this minimum may be accommodated by the structure and with structural design; we suggest we assist with additional review for these cases.

The contractor performing the work should provide adequate verification that the specified design criteria has been achieved after ground improvement installation. This could include modulus tests to verify the specified bearing resistance was achieved and pre-treatment and post-treatment cone penetrometer tests (CPTs) to verify that the specified liquefaction mitigation was achieved. Post treatment performance criteria should be required as part of the project plans and specifications and contractor submittal requirements. We can and recommend we assist with specifications and/or criteria for verification of post treated soil and specific bearing resistance or alternatively, we recommend we review proposed designers' performance verification criteria.

4.2.3. Foundation Support Within Ground Improvement

4.2.3.1. General

The foundation support recommendations provided below assume that ground improvement designed to meet the performance criteria specified above is installed below the proposed structure. We have also developed recommendations for design of foundations outside of the ground improvement area. We recommend a minimum footing width of 1.5 feet for continuous wall footings and 2 feet of isolated column footings. All footing elements should be embedded at least 18 inches below the lowest adjacent external grade.

4.2.3.2. Bearing Surface Preparation

Depending on the ground improvement method selected, shallow foundations will either bear directly on top of the exposed ground improvement elements, or on a load transfer pad that will be specified in the ground improvement design. Load transfer pads typically consist of a few feet of compacted structural fill installed between the top of the ground improvement elements and the design bottom of footing elevation or other structural bearing element. In either case, we recommend that foundation bearing surfaces be proof compacted in place to a uniformly firm and unyielding condition prior to placement of formwork or rebar. Loose or disturbed materials present at the base of footing excavations should be removed or compacted. Prepared foundation bearing surfaces should be observed and evaluated by a member of our firm prior to placement of formwork or steel reinforcement. Our representative will confirm that the bearing surfaces have been prepared in accordance with our recommendations and the project documents.

4.2.3.3. Allowable Soil Bearing Resistance

Provided ground improvement meeting the design criteria described above is installed at the site we recommend that foundations for the proposed structures within the ground improvement be designed assuming an allowable soil bearing resistance of 3,000 psf. The provided bearing pressures apply to the total of dead and long-term live loads and may be increased by one-third when considering total loads, including earthquake or wind loads. These are net bearing pressures. The weight of the footing and overlying backfill can be ignored in calculating footing sizes. The ground improvement designer must confirm that the minimum allowable bearing pressure stated above is achievable with their proposed design. Some designs may yield and attain higher values. This should be reviewed by project geotechnical and structural engineers.

4.2.3.4. Foundation Static Settlement

We estimate that static settlement of footings designed and constructed as recommended will be less than 1 inch, with differential settlements of less than ½ inch between comparably loaded isolated column footings or along 50 feet of continuous footing. These settlement estimates must be confirmed by the ground improvement designer. We estimate that liquefaction induced settlements will be as described previously.

4.2.3.5. Lateral Resistance

The ability of the soil to resist lateral loads is a function of frictional resistance, which can develop on the base of footings and slabs and passive resistance, which can develop on the face of below-grade elements of the structure as these elements tend to move into the soil. The allowable frictional resistance on the base of the footing may be computed using a coefficient of friction of 0.40 applied to the vertical dead-load forces. The allowable passive resistance on the face of the footing or other embedded foundation elements may be computed using an equivalent fluid density of 275 pounds per cubic foot (pcf) for undisturbed site soils or structural fill extending out from the face of the foundation element a distance at least equal to two and one-half times the depth of the element. These values include a factor of safety of about 1.5.

The passive earth pressure and friction components may be combined provided that the passive component does not exceed two-thirds of the total. The passive earth pressure value is based on the assumptions that the adjacent grade is level and that groundwater remains below the base of the footing throughout the year. The top foot of soil should be neglected when calculating passive lateral earth pressure unless the area adjacent to the foundation is covered with pavement or a slab-on-grade.

4.2.3.6. Footing Drains

We recommend that perimeter foundation drains be installed at the base of exterior footings. The perimeter drains should be provided with cleanouts and at minimum, should consist of a 4-inch-diameter perforated pipe surrounded on all sides by 6 inches of drain material enclosed in a non-woven geotextile fabric for underground drainage to prevent fine soil from migrating into the drain material. We recommend that the drainpipe consist of either heavy-wall solid pipe or rigid corrugated smooth interior polyethylene pipe. We do not recommend using flexible tubing for footing drainpipes. The drain material should consist of pea gravel or material similar to "Gravel Backfill for Drains" per WSDOT Standard Specifications Section 9-03.12(4). The perimeter drains should be sloped to drain by gravity, if practical, to a suitable discharge point. Water collected in roof downspout lines must not be routed to the perimeter footing drains.

4.2.4. Foundations Outside of Ground Improvement Zone

Small, non-critical structures that can tolerate differential settlements during a seismic event without risking life safety or the functionality of the primary structure can be supported on shallow foundations without ground improvement. We recommend that foundations in areas outside of the ground improvement zone be underlain by at least an 18-inch-thick layer of compacted structural fill. Foundation bearing surfaces should be thoroughly compacted to a dense, non-yielding condition. Loose or disturbed materials present at the base of foundation excavations should be removed or compacted. Foundation bearing surfaces should not be exposed to standing water. Should water infiltrate and pool in the excavation, it should be removed and surface repaired before placing structural fill or reinforcing steel.

We recommend that footings in non-ground improvement areas with bearing surfaces prepared as described above be proportioned using an allowable soil bearing pressure of 2,000 psf. This is a net bearing pressure; the weight of the footing and overlying backfill can be ignored in calculating footing sizes. We estimate that settlements of footings due to static column loads less than about 30 kips will be less than 1 inch. We estimate that differential settlements across the base of foundations will be less than ½ inch. These estimates are exclusive of settlement resulting from fill placed to raise site grades. The lateral resistance parameters provided previously can also be used for design of footings located outside of ground improvement areas.

4.2.5. Slab on Grade Floors

We understand that the ground level of the structure will be used for vehicle parking and large at grade building slabs are not envisioned. We expect that relatively small slab on grade floors will be included at ground level for entrances and lobby areas. It is also possible that the ground level parking area pavements will be designed as a slab on grade or mat foundation for structural reasons. We recommend that ground improvement be included below parking areas that are within the building footprint and below ground level slab on grade floors.

We recommend that the slab subgrades be prepared in accordance with Section 4.6.6 "Subgrade Preparation" of this report and that the slab be underlain by at least 8 inches of capillary break material consisting of crushed surfacing base course (CSBC) conforming 9-03.9(3) of the Washington State Department of Transportation (WSDOT) Standard Specifications with the exception that the percent of material passing the No.200 sieve should be less than 5 percent.

Provided that loose soil is removed and the subgrade is prepared as recommended, we recommend slabs-on-grade be designed using a modulus of subgrade reaction of 300 pounds per cubic inch (pci). We estimate that settlement for slabs-on-grade with improved ground constructed as recommended will be less than ¾ inch for a floor load of 500 psf.

4.3. Retaining Walls and Below-Grade Structures

4.3.1. Design Parameters

We recommend the following lateral earth pressures be used for design of conventional retaining walls and below-grade structures up to about 10 feet in height. Our design pressures assume that the ground surface around the structures will be level or near level. If drained design parameters are used, drainage systems must be included in the design in accordance with the recommendations presented in the "Drainage" section below.

- Active soil pressure may be estimated using an equivalent fluid density of 35 pcf for the drained condition.
- Active soil pressure may be estimated using an equivalent fluid density of 80 pcf for the undrained condition; this value includes hydrostatic pressures.
- At-rest soil pressure may be estimated using an equivalent fluid density of 55 pcf for the drained condition.
- At-rest soil pressure may be estimated using an equivalent fluid density of 90 pcf for the undrained condition; this value includes hydrostatic pressures.
- For seismic considerations, a uniform lateral pressure of 11H psf (where H is the height of the retaining structure or the depth of a structure below ground surface) should be added to the lateral earth pressure.

- Active soil pressure condition assumes the wall is free to move laterally 0.001 H, where H is the wall height). The at-rest condition is applicable where walls are restrained from movement.
- For backfill sloping conditions up to 2H:1V, the soil pressures presented above should be increased by 15 percent.
- A typical traffic surcharge representing an additional 2 feet of fill equal to 250 psf should be included if vehicles are allowed to operate within ½ the height of the retaining walls.
- Other surcharge and backfill conditions can increase the magnitude of the loads upon the wall requiring alternative design considerations. We should be consulted if other surcharge or backfill conditions will be considered above retaining walls. Examples of other loading conditions may include nearby structures, construction equipment and stockpiled soil or materials.

Over-compaction of fill placed directly behind retaining walls or below-grade structures must be avoided. We recommend use of hand-operated compaction equipment and maximum 6-inch loose lift thickness when compacting fill within about 5 feet of retaining walls and below-grade structures.

Retaining wall foundation bearing surfaces should be prepared following Section "4.2 Foundation Support" of this report. Provided bearing surfaces are prepared as recommended retaining wall foundations may be designed using the allowable soil bearing values and lateral resistance values presented above. In general, we estimate settlement of retaining structures will be similar to the values previously presented for spread foundations.

In applications where retaining walls are designed as a fill wall and fill soil is added behind the wall to generate new grade and the new grade, or height of the wall exceeds about 4 to 5 feet, there is a potential for additional static settlement if subsurface soil below the retaining wall if unimproved. We recommend we provide further review of this specific situation where the wall becomes greater than about 4 feet, will retain new fill, and be on unimproved ground. A specific overexcavation depth and possibly a pre-load could be required for this specific situation and will be based, in part on the new fill and depths placed.

4.3.2. Drainage

If retaining walls or below-grade structures are designed using drained parameters, a drainage system behind the structure must be constructed to collect water and prevent the buildup of hydrostatic pressure against the structure. We recommend the drainage system include a zone of free-draining backfill a minimum of 18 inches in width against the back of the wall. The drainage material should consist of coarse sand and gravel containing less that 5 percent fines based on the fraction of material passing the ¾-inch sieve. Other systems, such as waffle drain boards may also be considered. Drainage products should be reviewed to determine adequate coverage, drainage flow and proper connection to outlets.

A perforated, rigid, smooth-walled drainpipe with a minimum diameter of 4 inches should be placed along the base of the structure within the free-draining backfill and extend for the entire wall length. The drainpipe should be metal or rigid PVC pipe and be sloped to drain by gravity. Discharge should be routed properly to reduce erosion potential.

Cleanouts should be provided to allow routine maintenance. We recommend roof downspouts or other types of drainage systems not be connected to retaining wall drain systems

4.4. Pavement Design

4.4.1. General

Paved areas are expected to include parking areas, driveways and sidewalk areas. Based on our experience, we provide recommended conventional asphalt concrete pavement (ACP) and Portland cement concrete (PCC) sections below. These pavement sections may not be adequate for heavy construction traffic loads such as those imposed by concrete transit mixers, dump trucks or cranes. Additional pavement thickness may be necessary to prevent pavement damage during construction if other loading types are planned. The recommended sections assume that final improvements surrounding the pavements will be designed and constructed such that stormwater or excess irrigation water from landscape areas does not accumulate below the pavement section or pond on pavement surfaces.

Existing pavements, hardscaping or other structural elements should be removed prior to placement of new pavement sections. Pavement subgrade should be prepared as recommended in Section "4.4.6 Subgrade Preparation" of this report. Crushed surfacing base course and subbase should be moisture conditioned to near optimum moisture content and compacted to at least 95 percent of the theoretical MDD per ASTM D 1557.

CSBC and crushed surfacing top course (CSTC) should conform to applicable sections of 4-04 and 9-03.9(3) of the WSDOT Standard Specifications. The top approximate 2 inches of the CSBC sections provided may consist of CSTC as a leveling layer and for more precise grade development.

Hot mix asphalt should conform to applicable sections of 5-04, 9-02 and 9-03 of the WSDOT Standard Specifications.

PCC mix design should conform with Section 5-05.3(1) of the WSDOT Standard Specifications. Aggregates for PCC should conform to applicable sections of 9-03.1 of the WSDOT Standard Specifications.

Some areas of pavement may exhibit settlement and subsequent cracking over time. Cracks in the pavement will allow water to infiltrate to the underlying base course, which could increase the amount of pavement damage caused by traffic loads. To prolong the effective life of the pavement, cracks should be sealed as soon as possible.

4.4.2. Asphalt Concrete Pavement Sections

Recommended minimum ACP sections are provided below.

4.4.2.1. Standard-Duty ACP – Automobile Driveways and Parking Areas

- 2 inches of hot mix asphalt, class ½ inch, PG 58-22
- 4 inches of compacted CSBC
- 6 inches of subbase consisting of imported granular structural fill to provide uniform grading and pavement support, to maintain drainage, and to provide separation from fine-grained subgrade soil
- Native soil, existing fill or structural fill prepared as recommended in Section "4.5.6 Subgrade Preparation" of this report

4.4.2.2. Heavy-Duty ACP – Areas Subject to Heavy-Duty Traffic

- 3 inches of hot mix asphalt, class ½ inch, PG 58-22
- 6 inches of compacted CSBC
- 6 inches of subbase consisting of imported granular structural fill to provide uniform grading and pavement support, to maintain drainage, and to provide separation from fine-grained subgrade soil
- Native soil, existing fill or structural fill prepared as recommended in Section "4.5.6 Subgrade Preparation" of this report

4.4.3. Portland Cement Concrete Pavement Design

Recommended minimum PCC pavement sections are provided below. In our opinion steel reinforcement does not need to be included in PCC pavements that will be primarily used in landscaping and pedestrian areas (areas not subjected to heavy vehicle traffic). Reinforcement could be considered to reduce the potential for cracking in areas where the concrete slabs have irregular shapes or where new slabs abut existing concrete slabs, and the joint layout between the slabs cannot be matched. If reinforcement is considered, we are available to discuss typical steel reinforcement volumes with the project structural engineer, who ultimately designs the location, size and layout of reinforcement.

4.4.3.1. Sidewalk PCC Pavement – Pedestrian Areas Not Subjected to Vehicle Loading

- 4 inches of PCC with a minimum 14-day flexural strength of 650 pounds per square inch (psi)
- 2 inches of compacted CSBC
- Native subgrade or structural fill prepared in accordance with Section "4.5.6 Subgrade Preparation" of this report

4.4.3.2. Standard PCC Pavement – Automobile Driveways and Parking Areas

- 6 inches of PCC with a minimum 14-day flexural strength of 650 psi
- 4 inches of compacted CSBC
- Native subgrade, existing fill or structural fill prepared in accordance with Section "4.5.6 Subgrade Preparation" of this report

4.4.3.3. Heavy Duty PCC Pavement – Areas Subject to Heavy Truck Traffic

- 9 inches (minimum) of PCC with a minimum 14-day flexural strength of 650 psi
- 4 inches of compacted CSBC
- Native subgrade, existing fill or structural fill prepared in accordance with Section "4.5.6 Subgrade Preparation" of this report.

4.5. Earthwork

4.5.1. General

We anticipate that site development and earthwork will include demolition of existing features, excavating for shallow foundations, utilities, and other improvements, establishing subgrades for structures and hardscaping, and placing and compacting fill and backfill materials. We expect that site grading and earthwork can be accomplished with conventional earthmoving equipment. We strongly recommend that site development and earthwork activities be scheduled during dry weather months when groundwater levels will be at their lowest. The following sections provide our recommendations for earthwork activities at the site.

4.5.2. Clearing, Stripping and Demolition

We recommend that existing pavements and hardscaping be completely removed from areas that will be developed. During removal and/or demolition, excessive disturbance of surficial soils may occur, especially if left exposed to wet conditions. Disturbed and demolition areas may require additional remediation during construction and grading.

Within landscaped areas, stripping depths on the order of 3 to 6 inches should be expected. The primary root system of trees and shrubs should be removed during stripping activities. Stripped material should

If existing utilities exist beneath new structures, they should be removed and the area backfilled, if practical, or abandoned in place. Abandonment can include filling or pumping using a controlled density fill or other approved flowable fill material that will fill the utility cavity completely and offer support similar to backfill soil. Utility use, ownership and rights of way should also be considered.

4.5.3. Erosion and Sedimentation Control

Erosion and sedimentation rates and quantities can be influenced by construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. Implementing an Erosion and Sedimentation Control Plan will reduce the project impact on erosion-prone areas. The plan should be designed in accordance with applicable city, county and/or state standards. The plan should incorporate basic planning principles, including:

- Scheduling grading and construction to reduce soil exposure;
- Re-vegetating or mulching denuded areas;
- Directing runoff away from exposed soils;
- Reducing the length and steepness of slopes with exposed soils;
- Decreasing runoff velocities;
- Preparing drainage ways and outlets to handle concentrated or increased runoff;
- Confining sediment to the project site; and
- Inspecting and maintaining control measures frequently.

Some sloughing and raveling of exposed or disturbed soil on slopes should be expected. We recommend that disturbed soil be restored promptly so that surface runoff does not become channeled.

Temporary erosion protection should be used and maintained in areas with exposed or disturbed soils to help reduce erosion and reduce transport of sediment to adjacent areas and receiving waters. Permanent erosion protection should be provided by paving, structure construction or landscape planting.

Until the permanent erosion protection is established, and the site is stabilized, site monitoring may be required by qualified personnel to evaluate the effectiveness of the erosion control measures and to repair and/or modify them as appropriate. Provisions for modifications to the erosion control system based on monitoring observations should be included in the Erosion and Sedimentation Control Plan.

4.5.4. Temporary Excavations and Dewatering

Excavations deeper than 4 feet must be shored or laid back at a stable slope if workers are required to enter. Shoring and temporary slope inclinations must conform to the provisions of Title 296 Washington Administrative Code (WAC), Part N, "Excavation, Trenching and Shoring." Regardless of the soil type encountered in the excavation, shoring, trench boxes or sloped sidewalls will be required under Washington Industrial Safety and Health Act (WISHA).

In general, temporary cut slopes at this site should be inclined no steeper than about 1½H to 1V (horizontal to vertical). This guideline assumes that all surface loads are kept at a minimum distance of at least one-half the depth of the cut away from the top of the slope and that seepage is not present on the slope face. We expect that flatter slopes or shoring will be necessary when excavating below the water table which is expected to be present between 3 to 5 feet below ground surface.

We anticipate that dewatering will typically be required to complete excavations extending deeper than 5 feet below existing site grade. If the planned excavation is completed during dry weather months, is only extended a few feet below the groundwater table and will remain open for a short period of time, managing groundwater inflow using sump pumps could be feasible. We expect that dewatering will be necessary to complete deeper excavations at the site or excavations that will remain open for an extended period of time.

Excavation, shoring, and dewatering are interrelated; the design and implementation of these elements must be coordinated and must consider the over-all construction staging to ensure a consistent and compatible approach. We recommend that the contractor performing the work be made responsible for designing and installing construction shoring and for controlling and collecting groundwater encountered. The contract documents must specify that the contractor is responsible for selecting excavation and dewatering methods, monitoring the excavations for safety, and providing shoring, as required, to protect personnel and structures.

4.5.5. Surface Drainage

Surface water from roofs, pavements and landscape areas should be collected and controlled. Curbs or other appropriate measures such as sloping pavements, sidewalks and landscape areas should be used to direct surface flow away from buildings, erosion sensitive areas and from behind retaining structures. Roof and catchment drains should not be connected to wall or foundation drains.

4.5.6. Subgrade Preparation

Subgrades that will support slab-on-grade floors and pavements should be thoroughly compacted to a uniformly firm and unyielding condition on completion of stripping/excavation and before placing structural fill. We recommend that subgrades for structures and pavements be evaluated, as appropriate, to identify areas of yielding or soft soil. Probing with a steel probe rod or proof-rolling with a heavy piece of wheeled construction equipment are appropriate methods of evaluation.

If soft or otherwise unsuitable subgrade areas are revealed during evaluation that cannot be compacted to a stable and uniformly firm condition, we recommend that: (1) the unsuitable soils be scarified (e.g., with a ripper or farmer's disc), aerated and recompacted, if practical; or (2) the unsuitable soils be removed and replaced with compacted structural fill, as needed.

4.5.7. Subgrade Protection and Wet Weather Considerations

The wet weather season generally begins in October and continues through May in Western Washington; however, periods of wet weather can occur during any month of the year. The soils encountered in our explorations contain a significant amount of fines. Soil with high fines content is very sensitive to small changes in moisture and is susceptible to disturbance from construction traffic when wet or if earthwork is performed during wet weather. If wet weather earthwork is unavoidable, we recommend that the following steps be taken.

- The ground surface in and around the work area should be sloped so that surface water is directed away from the work area. The ground surface should be graded so that areas of ponded water do not develop. Measures should be taken by the contractor to prevent surface water from collecting in excavations and trenches. Measures should be implemented to remove surface water from the work area.
- Earthwork activities should not take place during periods of heavy precipitation.
- Slopes with exposed soils should be covered with plastic sheeting.
- The contractor should take necessary measures to prevent on-site soils and other soils to be used as fill from becoming wet or unstable. These measures may include the use of plastic sheeting and controlling surface water with sumps with pumps and grading. The site soils should not be left uncompacted and exposed to moisture. Sealing the exposed soils by rolling with a smooth-drum roller prior to periods of precipitation will help reduce the extent to which these soils become wet or unstable.
- Construction traffic should be restricted to specific areas of the site, preferably areas that are surfaced with working pad materials not susceptible to wet weather disturbance.
- Construction activities should be scheduled so that the length of time that soils are left exposed to moisture is reduced to the extent practical.
- During periods of wet weather, concrete should be placed as soon as practical after preparation of the footing excavations. Foundation bearing surfaces should not be exposed to standing water. If water pools in the base of the excavation, it should be removed before placing structural fill or reinforcing steel. If footing excavations are exposed to extended wet weather conditions, a lean concrete mat or a layer of clean crushed rock can be considered for foundation bearing surface protection.

4.6. Fill Materials

4.6.1. Structural Fill

The workability of material for use as structural fill will depend on the gradation and moisture content of the soil. We recommend that washed crushed rock or select granular fill, as described below, be used for structural fill during the rainy season. If prolonged dry weather prevails during the earthwork phase of construction, materials with a somewhat higher fines content may be acceptable. Weather, material use, schedule, duration exposed, and site conditions should be considered when determining the type of import fill materials purchased and brought to the site for use as structural fill.

Material used for structural fill should be free of debris, organic contaminants and rock fragments larger than 6 inches. For most applications, we recommend that structural fill material consist of material similar to "Select Borrow" or "Gravel Borrow" as described in Section 9-03.14 of the Washington State Department of Transportation (WSDOT) Standard Specifications.

4.6.2. Select Granular Fill/Wet Weather Fill

Select granular fill should consist of well-graded sand and gravel or crushed rock with a maximum particle size of 6 inches and less than 5 percent fines by weight based on the minus ¾-inch fraction. Organic matter, debris or other deleterious material should not be present. In our opinion, material with gradation characteristics similar to WSDOT Specification 9-03.9 (Aggregates for Ballast and Crushed Surfacing), "Gravel Backfill for Walls" as described in Section 9-03.12(2) of the WSDOT Standard Specifications, or Section 9-03.14 (Borrow) is suitable for use as select granular fill, provided that the fines content is less than 5 percent (based on the minus ¾-inch fraction) and the maximum particle size is 6 inches.

4.6.3. Pipe Bedding

Trench backfill for the bedding and pipe zone should consist of well-graded granular material similar to "gravel backfill for pipe zone bedding" described in Section 9-03.12(3) of the WSDOT Standard Specifications. The material must be free of roots, debris, organic matter and other deleterious material. Other materials may be appropriate depending on manufacturer specifications and/or local jurisdiction requirements.

4.6.4. Fill Material Below Groundwater Level

If fill or trench backfill will be placed below or near the groundwater level, we recommend imported material consisting of either permeable ballast or quarry spalls be used.

Permeable ballast should consist of material with gradation characteristics similar to WSDOT Standard Specification 9-03.9 (2). We recommend that quarry spalls consist of 2- to 4-inch washed, crushed stone similar to that described in Section 9-13 of the WSDOT Standard Specifications. Alternative stone size ranges may be considered, depending on the application and availability.

4.6.5. Drainage Zone Material

Free-draining backfill should comprise material similar to WSDOT Standard Specification 9-03.12(2) "Gravel Backfill for Walls."

4.6.6. On-Site Soil

Existing site soils must not be used as base course, top course or as drainage material. Due to moisture content and fines content of existing site soil, in general, we recommend against use of on-site material as a structural fill. If still necessary, we recommend contingencies in the project budget be included for handling, drying, and/or amending site materials as well as importing granular structural fill. We recommend that a representative from GeoEngineers be on site during earthwork activities to evaluate if the existing soil generated during excavation is suitable for reuse and to provide alternative recommendations, if necessary.

The soils at the site contain a significant amount of fines and are extremely moisture sensitive and will be very difficult or impossible to properly compact when wet. Soils generated from below the water table will likely be saturated or at a moisture content above what is optimum for compaction. In this case, the soils would need to be moisture conditioned prior to re-use. Space for drying out material during dryer weather or covering on-site materials generated during wet weather will be necessary. During wetter or even slightly colder times of year, such as when temperatures reach below about 60 degrees, drying becomes more difficult and accommodations to cover and protect stockpiled material generated on-site for re-use should be planned. In many cases, covering of stockpiled material will not be sufficient to allow for the material to dry when near or below this temperature.

4.7. Fill Placement and Compaction

4.7.1. General

To obtain proper compaction, fill soil should be compacted near optimum moisture content and in uniform horizontal lifts. Lift thickness and compaction procedures will depend on the moisture content and gradation characteristics of the soil and the type of equipment used. The maximum allowable moisture content varies with the soil gradation and should be evaluated during construction. Generally, 8- to 12-inch loose lifts are appropriate for steel-drum vibratory roller compaction equipment. Thinner lifts are appropriate for smaller compaction equipment. Compaction should be achieved by mechanical means. During fill and backfill placement, sufficient testing of in-place density should be conducted to check that adequate compaction is being achieved.

4.7.2. Area Fills and Pavement Bases

Fill placed to raise site grades and materials under pavements and structural areas should be placed on subgrades prepared as previously recommended. Fill material placed below structures and footings should be compacted to at least 95 percent of the theoretical MDD per ASTM D 1557. Fill material placed shallower than 2 feet below pavement sections should be compacted to at least 95 percent of the MDD. Fill placed deeper than 2 feet below pavement sections should be compacted to at least 90 percent of the MDD. Fill material placed in landscaping areas should be compacted to a firm condition that will support construction equipment, as necessary, typically at least 85 to 90 percent of the MDD.

4.7.3. Backfill Behind Retaining Walls and Below-Grade Structures

Backfill behind retaining walls or below-grade structures should be compacted to between 90 and 92 percent of the MDD. Overcompaction of fill placed directly behind below-grade structures should be avoided. We recommend use of hand-operated compaction equipment and maximum 6-inch loose lift thickness when compacting fill within about 5 feet behind below-grade structures.

4.7.4. Trench Backfill

For utility excavations, we recommend that the initial lift of fill over the pipe be thick enough to reduce the potential for damage during compaction, but generally should not be greater than about 18 inches above the pipe. In addition, rock fragments greater than about 1 inch in maximum dimension should be excluded from this lift.

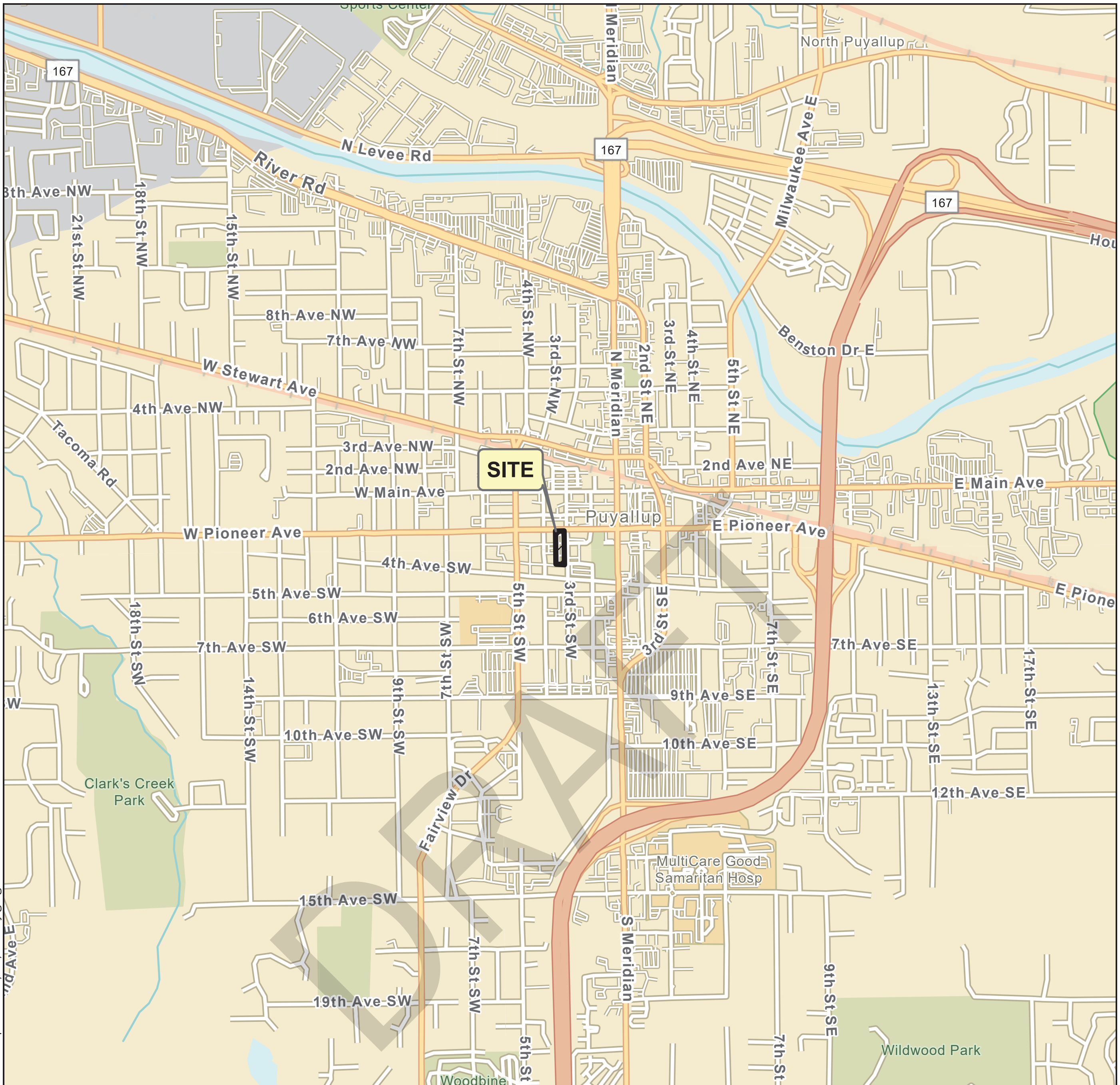
Trench backfill material placed below structures and footings should be compacted to at least 95 percent of the MDD. In paved areas, trench backfill should be uniformly compacted in horizontal lifts to at least 95 percent of the MDD in the upper 2 feet below subgrade. Fill placed below a depth of 2 feet from subgrade in paved areas must be compacted to at least 90 percent of the MDD. In non-structural areas, trench backfill should be compacted to a firm condition that will support construction equipment as necessary.

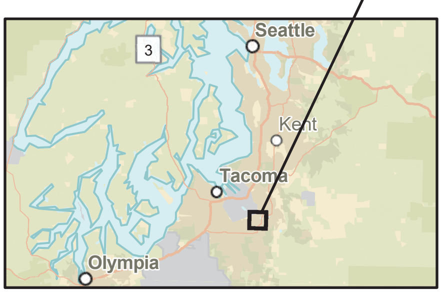
5.0 LIMITATIONS

We have prepared this report for MC Construction Consultants, for the Puyallup AOB Site project in Puyallup, Washington. MC Construction Consultants may distribute copies of this report to owner and owner's authorized agents and regulatory agencies as may be required for the Project.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices for geotechnical engineering in this area at the time this report was prepared. The conclusions, recommendations, and opinions presented in this report are based on our professional knowledge, judgment and experience. No warranty, express or implied, applies to the services or this report.

Please refer to Appendix B titled "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.





Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI

Projection: NAD 1983 UTM Zone 10N

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Vicinity Map

Puyallup AOB Site
Puyallup, WA

GeoEngineers

Figure 1

Site Plan

Puyallup AOB Site
Puyallup, WA

GeoEngineers

Figure 2

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Aerial from Microsoft Bing Images.

Projection: Wahshington State Plane, South Zone, NAD83, US Foot

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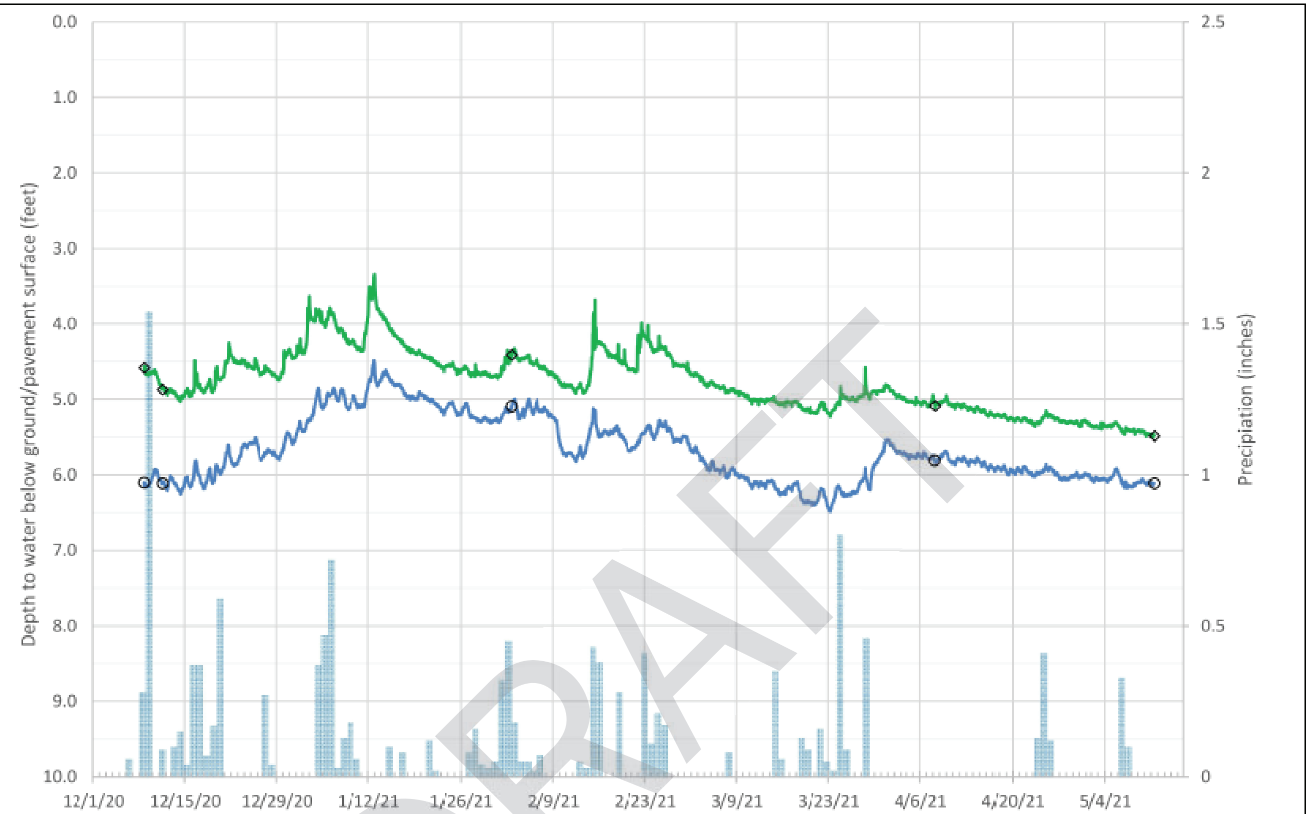


Legend

- Precipitation
- B-1
- B-2

Note:
bgs = feet below ground surface. Ground surface taken at top of existing monument cover.

Precipitation Date Source:
National Oceanic and Atmospheric Administration (NOAA)

Recorded Groundwater Levels

Groundwater Level Monitoring and
Preliminary Infiltration Feasibility Study
City of Puyallup AOB Parking Lot
330 3rd St NW, Puyallup, Washington

Aspect Consulting	May-2021	BY: ECS/CMV	FIGURE NO.
	PROJECT NO. 200589	REVISED BY: -	1

CAD Path: Q:\City of Puyallup\200589\200589-01 May 2021.dwg Fig 1 || Date Saved: May 19, 2021 2:09pm || User: cvanslyke

B-1 and B-1 Groundwater Plot

Puyallup AOB Site
Puyallup, Washington

GeoEngineers

Figure 3

Data Source: "Groundwater Level Monitoring and Preliminary Infiltration Feasibility Evaluation" Aspect Consulting, June 2, 2021

APPENDIX A
Boring Logs from 2011 GeoEngineers Report

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	CC	Cement Concrete
	AC	Asphalt Concrete
	CR	Crushed Rock/ Quarry Spalls
	TS	Topsoil/ Forest Duff/Sod

Measured groundwater level in exploration, well, or piezometer

Groundwater observed at time of exploration

Perched water observed at time of exploration

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata or geologic units

Approximate location of soil strata change within a geologic soil unit

Material Description Contact

Distinct contact between soil strata or geologic units

Approximate location of soil strata change within a geologic soil unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel

Standard Penetration Test (SPT)

Shelby tube

Piston

Sonic Core

Bulk or grab

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

A "P" indicates sampler pushed using the weight of the drill rig.

Laboratory / Field Tests

%F	Percent fines
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
OC	Organic content
PM	Permeability or hydraulic conductivity
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen
NT	Not Tested

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO EXPLORATION LOGS

GEOENGINEERS

FIGURE A-1

Drilled	Start	End	Total Depth (ft)	Logged By	Checked By	Driller	Drilling Method
	8/15/2011	8/15/2011	21.5	MJH	MJH	Holocene	HSA

Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	BK-81
Surface Elevation (ft) Vertical Datum	Undetermined	Top of Casing Elevation (ft)	
Easting (X) Northing (Y)		Horizontal Datum	

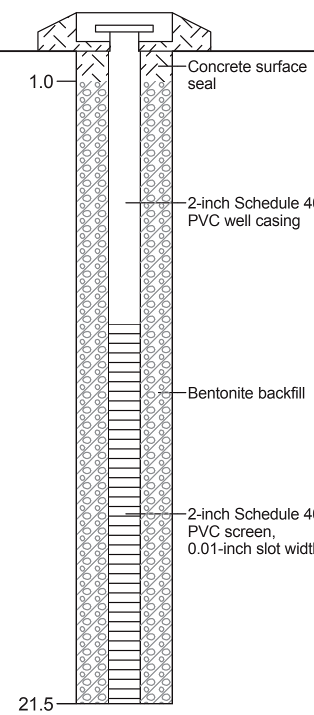
Licensing agency well number: **940**
A 2 (in) well was installed on to a depth of (ft).

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
9/15/2011	7.6	

Notes: Well No. 940

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	FIELD DATA: Recovered (in)	FIELD DATA: Blows/foot	FIELD DATA: Collected Sample	FIELD DATA: Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, (pcf)
	0		16	12		1 / SA			AC	2 inches asphalt concrete with 2 inches base course	6	
									SM	%F=16 Brown fine to medium silty sand (medium dense, moist) (fill)		
	5		18	2		2 & 3			ML	Brown silt with sand (soft, moist)		
									SP	Black fine to medium sand, trace silt (very loose, moist)		
									MH	Gray silt, trace sand and organics (soft, moist)		
	10		15	7		4			SP	Black fine to medium sand, trace silt (loose, wet)		
									ML	Green silt, trace sand (medium stiff, wet)		
									ML	Gray sandy silt (medium stiff, wet)		
	15		18	7		5 / MC			ML	Gray sandy silt interbedded with green silt, trace sand (loose to medium stiff, wet) %F=50	37	
	20		17	8		6 & 7			SP-SM	Gray fine to medium sand with silt (loose, wet)		

WELL LOG



DRAFT

Note: See Figure A-1 for explanation of symbols.

Tacoma: Date:9/13/11 Path:P:\0\0402030\GINT\0402030.GPJ DBTemplate/LibTemplate:GEOENGINEERS8.GDT/GEI8_GEOTECH_WELL

Log of Boring B-1

GeoEngineers

Project: City of Puyallup - AOB Site
Project Location: Puyallup, Washington
Project Number: 0402-030-00

Figure A-2
Sheet 1 of 1

Drilled	Start 8/15/2011	End 8/15/2011	Total Depth (ft)	21.5	Logged By MJH Checked By MJH	Driller	Holocene	Drilling Method	HSA

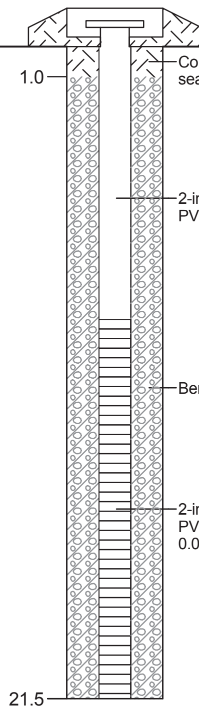
Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop	Drilling Equipment	BK-81	Licensing agency well number: **941** A 2 (in) well was installed on to a depth of (ft).
Surface Elevation (ft) Vertical Datum	Undetermined	Top of Casing Elevation (ft)		
Easting (X) Northing (Y)		Horizontal Datum		

Groundwater Date Measured	Depth to Water (ft)	Elevation (ft)
8/15/2011	6.4	

Notes: Well No. 941

Elevation (feet)	Depth (feet)	Recovered (in)	Blows/foot	Sample Name	Graphic Log / Group Classification	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, (pcf)
	0	12	10	1	AC	2 inches asphalt concrete with 2 inches base course		
					SM	Brown silty fine to medium sand (medium dense, moist) (fill)		
		18	6	2 & 3 SA	ML	Gray mottled silt with sand (loose, moist)	32	
					SP-SM	%F=83 Brown mottled fine to medium sand with silt (loose, moist)		
	5	18	1	4 MC	ML	Gray silt with sand and trace organics (very soft, moist) %F=78	64	
	10	15	3	5		Grades to soft and wet		
					SP-SM	Gray fine to medium sand with silt (loose, wet)		
	15	18	6	6 &7	ML	Gray silt with sand (medium stiff, wet)		
	20	18	7	8				

WELL LOG



Note: See Figure A-1 for explanation of symbols.

Log of Boring B-2

GeoEngineers

Project: City of Puyallup - AOB Site
Project Location: Puyallup, Washington
Project Number: 0402-030-00

Figure A-3
Sheet 1 of 1

Drilled	Start 8/15/2011	End 8/15/2011	Total Depth (ft)	80	Logged By MJH / Checked By MJH	Driller	Holocene	Drilling Method	HSA

Surface Elevation (ft) / Vertical Datum	Undetermined	Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop
Drilling Equipment	BK-81		
Easting (X) / Northing (Y)		System / Datum	
Groundwater	Date Measured	Depth to Water (ft)	Elevation (ft)
Notes:			

Elevation (feet)	Depth (feet)	FIELD DATA: Interval / Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, (pcf)	REMARKS
	0							ML	Brown sandy silt (loose, moist) (fill)			
		12	4		1 / SA					29		%F=57
	5											
								ML/SP	Gray silt with sand interbedded with black sand, trace silt (loose to medium stiff, moist)			
		13	4		2							
	10											
								ML	Gray silt with sand and organics (1 inch thick wood) (soft, wet)			
		18	3		3 / MC					42		%F=93
	15											
								ML/SP	Gray silt, trace sand interbedded with black sand, trace silt (soft to very loose, wet)			
		14	3		4							
	20											
								ML	Gray silt with sand (medium stiff, wet)			
		14	6		5 & 6 / MC					33		%F=80
								SP-SM	Black fine to medium sand with silt (loose, wet)			
	25											
		14	12		7				Grades to medium dense			
	30											
		15	28		8 / MC				Grades to with occasional fine gravel, dense	23		%F=6
	35											
		15	32		9							
	40											

Note: See Figure A-1 for explanation of symbols.

Log of Boring B-3

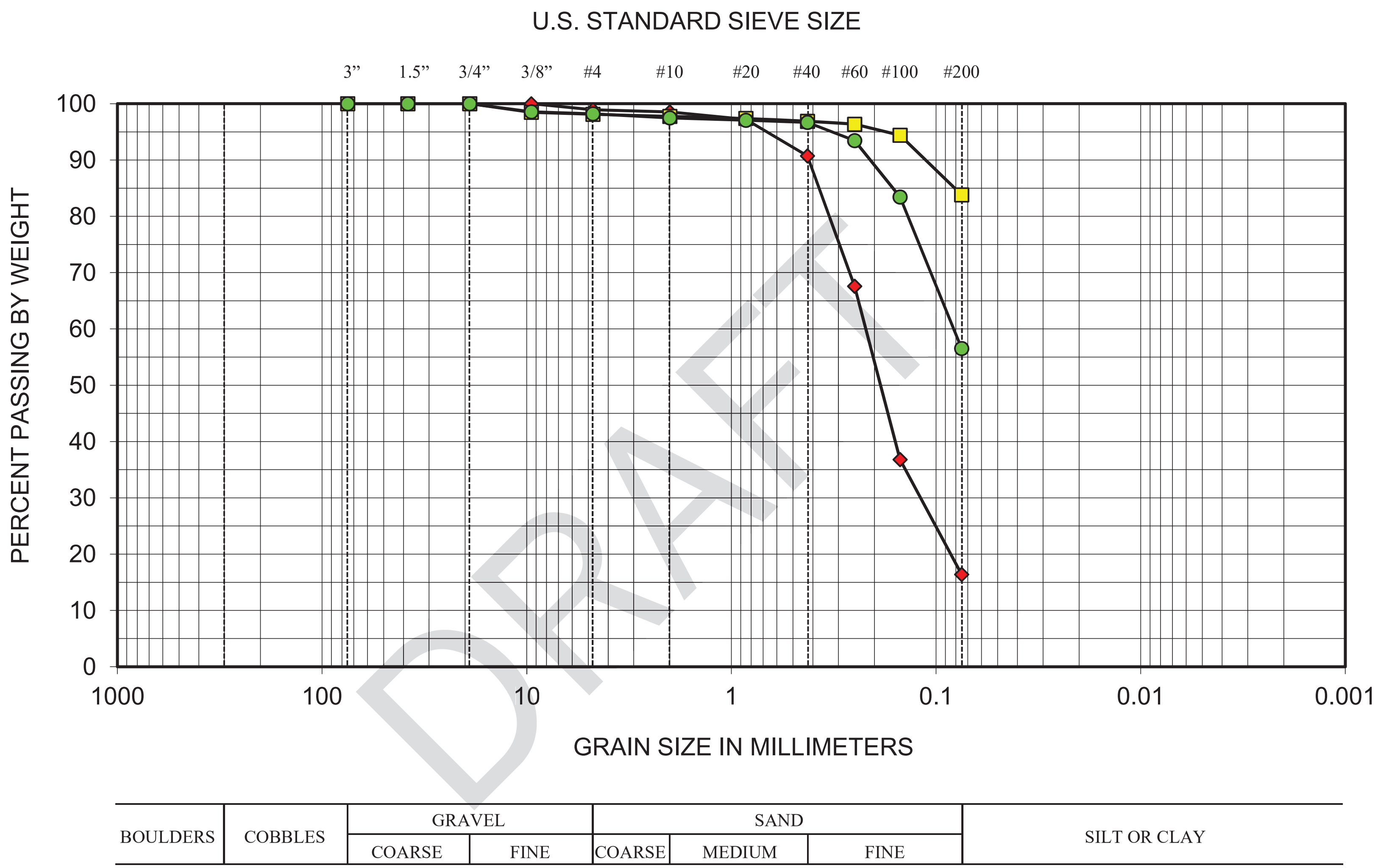
GEOENGINEERS

Project: City of Puyallup - AOB Site
Project Location: Puyallup, Washington
Project Number: 0402-030-00

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Water Level	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content, %	Dry Density, (pcf)	REMARKS
	40												
			10	35		10				Grades to with gravel			
	45												Driller indicates intermittent hard drilling from 45 to 50 feet
									SM	Gray silty fine to coarse sand with gravel (very loose, wet)			
			6	3		11							Rock in shoe tip
	50								GP-GM	Gray fine to coarse gravel with silt and sand (medium dense, wet)			
			2	16		12							
	55								SM	Gray silty fine to coarse sand, occasional gravel (loose wet)			
			15	6		13 / MC					19		%F=27
	60								SP	Black fine to medium sand, trace silt, occasional gravel (dense, wet)			
			10	35		14							
	65								SM	Gray silty fine to medium sand with gravel (dense, wet)			
			10	42		15 / MC					19		%F=33
	70								ML	Gray silt with sand (very stiff, wet)			
			16	16		16 / MC					37		%F=64
	75												
			15	42		17 & 18			SP	Gray fine sand, trace silt (dense, wet)			
	80												

Note: See Figure A-1 for explanation of symbols.

0402-030-00 SAS:SAS:tt 090811



SYMBOL	EXPLORATION NUMBER	DEPTH (ft)	MOISTURE (%)	SOIL CLASSIFICATION
◆	B-1	0	6	Silty sand (SM)
■	B-2	2.5	32	Silt with sand (ML)
●	B-3	2.5	29	Sandy silt (ML)

Sieve Analysis Results

City of Puyallup – AOB Site
Puyallup, Washington

GeoEngineers

Figure A-5

APPENDIX B
Report Limitations and Guidelines for Use

APPENDIX B
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Read These Provisions Closely

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) rely on professional judgment and opinion to a greater extent than other engineering and natural science disciplines, where more precise and/or readily observable data may exist. To help clients better understand how this difference pertains to our services, GeoEngineers includes the following explanatory "limitations" provisions in its reports. Please confer with GeoEngineers if you need to know more how these "Report Limitations and Guidelines for Use" apply to your project or site.

Geotechnical Services are Performed for Specific Purposes, Persons and Projects

This report has been prepared for MC Construction Consultants and for the Project(s) specifically identified in the report. The information contained herein is not applicable to other sites or projects.

GeoEngineers structures its services to meet the specific needs of its clients. No party other than the party to whom this report is addressed may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of the agreed scope of services for the Project, and its schedule and budget, our services have been executed in accordance with generally accepted geotechnical practices in this area at the time this report was prepared, and our Agreement with MC Construction Consultants dated February 22, 2022. We do not authorize, and will not be responsible for, the use of this report for any purposes or projects other than those identified in the report.

A Geotechnical Engineering or Geologic Report is based on a Unique Set of Project-Specific Factors

This report has been prepared for the Puyallup AOB Site project located in Puyallup, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- Not prepared for you,
- Not prepared for your project,
- Not prepared for the specific site explored, or
- Completed before important project changes were made.

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1 Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

For example, changes that can affect the applicability of this report include those that affect:

- The function of the proposed structure;
- Elevation, configuration, location, orientation or weight of the proposed structure;
- Composition of the design team; or
- Project ownership.

If changes occur after the date of this report, GeoEngineers cannot be responsible for any consequences of such changes in relation to this report unless we have been given the opportunity to review our interpretations and recommendations. Based on that review, we can provide written modifications or confirmation, as appropriate.

Environmental Concerns are Not Covered

Unless environmental services were specifically included in our scope of services, this report does not provide any environmental findings, conclusions, or recommendations, including but not limited to, the likelihood of encountering underground storage tanks or regulated contaminants.

Information Provided by Others

GeoEngineers has relied upon certain data or information provided or compiled by others in the performance of our services. Although we use sources that we reasonably believe to be trustworthy, GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, new information or technology that becomes available subsequent to the report date, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Geotechnical and Geologic Findings are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies the specific subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied its professional judgment to render an informed opinion about subsurface conditions at other locations. Actual subsurface conditions may differ, sometimes significantly, from the opinions presented in this report. Our report, conclusions and interpretations are not a warranty of the actual subsurface conditions.

Geotechnical Engineering Report Recommendations are Not Final

We have developed the following recommendations based on data gathered from subsurface investigation(s). These investigations sample just a small percentage of a site to create a snapshot of the subsurface conditions elsewhere on the site. Such sampling on its own cannot provide a complete and accurate view of subsurface conditions for the entire site. Therefore, the recommendations included in this report are preliminary and should not be considered final. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for the recommendations in this report if we do not perform construction observation.

We recommend that you allow sufficient monitoring, testing and consultation during construction by GeoEngineers to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective means of managing the risks associated with unanticipated conditions. If another party performs field observation and confirms our expectations, the other party must take full responsibility for both the observations and recommendations. Please note, however, that another party would lack our project-specific knowledge and resources.

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. The logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Photographic or electronic reproduction is acceptable, but separating logs from the report can create a risk of misinterpretation.

Give Contractors a Complete Report and Guidance

To help reduce the risk of problems associated with unanticipated subsurface conditions, GeoEngineers recommends giving contractors the complete geotechnical engineering or geologic report, including these "Report Limitations and Guidelines for Use." When providing the report, you should preface it with a clearly written letter of transmittal that:

- Advises contractors that the report was not prepared for purposes of bid development and that its accuracy is limited; and
- Encourages contractors to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Contractors are Responsible for Site Safety on Their Own Construction Projects

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and adjacent properties.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants, and no conclusions or inferences should be drawn regarding Biological Pollutants as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria and viruses, and/or any of their byproducts.

A Client that desires these specialized services is advised to obtain them from a consultant who offers services in this specialized field.

APPENDIX B

GROUNDWATER LEVEL MONITORING AND PRELIMINARY INFILTRATION FEASIBILITY EVALUATION

(PROVIDED UNDER A SEPARATE COVER)

APPENDIX C

SUPPLEMENTAL GEOTECHNICAL REPORT

Puyallup AOB Development, LLC
5020 Main St., Suite H
Tacoma, WA. 98407
253-380-7654

January 6, 2022

Supplemental Geotechnical Report
Small Scale Pit Infiltration Test
Parcel No. 5745001371
Site Address – 330 3rd St NW
LS&E Job No. 13637
Tests Performed: 12/22/2021, 12/23/2021

Project Description
The client intends to develop the site referenced above and is required to determine the seasonal high groundwater and the in-situ rate of infiltration for proposed stormwater facilities: seasonal high groundwater has been determined within existing geotechnical reports, as have preliminary, *conceptual* infiltration rates utilizing Grain Size Analysis. Per the 2012 Stormwater Manual for Western Washington (Manual), 2014 Revision, Volume III – Chapter 3; a Small-Scale Pilot Infiltration Test (PIT) is indicated for sites with less than one acre of drainage to proposed infiltration facility (see page 525). The existing geotechnical site investigations, referenced later in this document, confirmed highly variable subsurface characteristics within the expected infiltrative horizon with limited infiltration potential.

Scope of Work
The scope of work includes:
- Document Review: Review of existing geotechnical documents for the project site was necessary for understanding of past work accomplished and work to be conducted.
- Code Review: Review of pertinent stormwater code as adopted by the City of Puyallup was necessary to ensure a thorough and sufficient investigation.
- Design Infiltration Evaluation: Evaluation of in-situ infiltration rates of on-site soils within the expected infiltrative horizon was necessary for design calculation.
- Supplemental Geotechnical Report: A report with a defined in-situ infiltration rate for design calculation was required, as existing geotechnical documents either described the infiltration feasibility in general, conceptual terms or utilized testing that does not fulfill the City's feasibility criteria.

Work by Others
- Geotechnical Engineering Services, AOB Site Development, Puyallup, Washington (GeoEngineers, 2011): A preliminary geotechnical engineering study that was prepared for the City of Puyallup to provide feasibility analysis for future development of the project site. This report detailed soil borings conducted at the site, laboratory testing of in-situ soils from the borings, and thorough foundation, pavement, and seismic recommendations for the subsurface soils.

- Groundwater Level Monitoring and Preliminary Infiltration Feasibility Evaluation – City of Puyallup AOB Parking Lot (Aspect Consulting, 2021): A geotechnical engineering study that further describes the subsurface conditions of the project site, focusing on high winter water monitoring and preliminary, *conceptual* infiltration rates and feasibility. This document provides specific information not included in the previous geotechnical engineering document prepared by GeoEngineers.

Site Soils

Subsurface soils were investigated and described within the GeoEngineers report. The report describes a near surface soil horizon consisting of highly variable fill conditions (2 to 5 feet) throughout the project site. The fill is underlain by interbedded silts, sands, and mixes of both of differing densities to as much as 80 feet below ground surface (bgs). For the purposes of this report and for the determination of infiltration feasibility of the site, this near-surface soil horizon is the focus. We conducted our small-scale PIT in the vicinity of soil boring B-2. The boring log for B-2 illustrates fill to a depth of 3 feet. Our observations during preparation of the PIT agree with this determination to the extent of our excavations.

Infiltration Feasibility

Feasibility for stormwater infiltration facilities is primarily determined by the depth to groundwater and the infiltrative capacity of the in-situ soils. These are separate criteria, although they can be related in many ways. The size of an infiltration facility also determines feasibility but can be manipulated to work in some cases. The final design rate of infiltration will ultimately be determined through correction factors (from Ecology) based on the size of infiltration facilities. Therefore, the final design rate will be determined through calculations by others on a project-specific basis.

Groundwater Level Monitoring

Groundwater level monitoring was conducted by Aspect Consulting. Borings B-1 and B-2, conducted by GeoEngineers during the initial evaluation, were utilized as water logging wells by Aspect Consulting. Between December 8, 2020, and May 11, 2021, the seasonal high groundwater level was found to be 3.5 feet bgs within B-2. This location and associated data best represent our test location.

Design Infiltration Rate

Grain Size Analysis was conducted by Aspect Consulting utilizing the laboratory testing results from the GeoEngineers geotechnical engineering report. This is considered a preliminary, *conceptual* infiltration rate and does not satisfy the City's requirements for design infiltration testing or feasibility. A small-scale PIT is necessary to determine the infiltration rate of-situ soils in the expected location of possible infiltration facilities. The testing methods and results are found below.

Methodology

A Licensed Geologist and representative from our firm oversaw the preparation of the site and conducted the test. An excavation measuring 4-feet wide by 4-feet long (16 square feet) advanced approximately 20 inches into the soil underlying the existing pavement. This depth was chosen to represent the approximate infiltrative horizon for permeable pavement, if utilized for the project. The spoils were set back from the excavation. A water table review pit was advanced adjacent to, and deeper than, the small-scale PIT location for observation of groundwater mounding.

- We installed a vertical measuring stake marked in half inch increments.
- We used a PVC pipe with bell-shaped base and small perforations within the test pit to dissipate water energy and thus limit movement and deposition of silts.
- A large water tank was mobilized with a section of fire hose that reached the pit.
- We pre-soaked the pit by maintaining a standing water head of 12 inches for 6 hours.
- At the end of the soaking period, we added water to the extent we could maintain the level at 12 inches for 1 hour.
- We made a measurement every 15 minutes of the amount of water it took to maintain the water lever at the same point each time (we chose 12 inches). We determined the volume and instantaneous flow rate.
- After 1 hour, we turned off the water and recorded the drop rate in inches per hour until the pit was empty.
- Finally, we reviewed the nearby water table review pit (depth of ~30 inches) to determine if water was mounding laterally. This step is intended for sites with restrictive layers. This analysis of the nearby pit satisfies the requirement to over-excavate the test pit to look for groundwater mounding.

Figure 1: Infiltration Test ( ) Location

Table 1 illustrates the cumulative volume and instantaneous flow rate in gallons per minute to maintain the water level in the pit at 12 inches (measured every 15 minutes).

Table 1: Cumulative Volume and Instantaneous Flow Rate and Influence on Nearby Pit

Period (each @15 min)	Cumulative Volume (gallons)	Instantaneous Flow Rate (gal/min)	Water Table Change in Adjacent Port?
1	0.935	0.06	None – dry (30 in.)
2	0.934	0.06	None – dry (30 in.)
3	0.935	0.06	None – dry (30 in.)
4	0.935	0.06	None – dry (30 in.)

At the conclusion of the test above for 1 hour, we discontinued application of water to the pit and prepared to record the drop in inches per hour until the pit emptied. Table 2 illustrates the results.

Table 2: Infiltration Test Results, Water Off, in Inches per Hour

Pit No.	Inches/Hour Drop Until Empty
1	0.5

As shown in Table 1 above, the nearby water table review pit was observed at points throughout the small-scale PIT, as well as after the PIT was completed. At no point during the on-site visit was water observed within the pit.

The calculated infiltration rates observed for each 15 minute period during the PIT are shown below in Table 3. All 4 periods of 15 minutes yielded the same value, with the average rate of infiltration for all four periods being 0.5 inches per hour. After shutting off the water and preparing to wait until the 4-foot by 4-foot pit was empty, the drop in water level was observed to be approximately 0.5 inches in the first hour. This rate would have taken 24 hours to empty the pit (and more with ongoing precipitation). Leaving a pit this size open in a location with public access, and with water within it, would be a safety concern. An engineering decision was made to end the test at that point in time. Thus, over the course of two hours of close observation, the consistent rate of infiltration was calculated to be 0.5 inches per hour.

Table 3: Infiltration Test Results for Each Period in Inches per Hour

Period (each @15 min)	Converted inches/hour
1	0.5
2	0.5
3	0.5
4	0.5
Average =	0.5

During excavation of soil for placement of the water table review pit and small-scale PIT, the soils were observed for further understanding of the site and ensuring proper depth for the PIT within the expected infiltrative horizon. The soil depths and descriptions agree with the existing reports in that a moist, very fine, silty fill exists beneath a layer of a gravelly, heterogeneous base course.

Figure 2: Small-Scale PIT Excavation

Conclusion

Infiltration infeasibility criteria is defined within the 2012 Ecology Manual, including depth to groundwater and rate of infiltration. Insufficient depth and/or infiltration render stormwater infiltration design as infeasible. As reported by Aspect Consulting, the depth to groundwater is approximately 3.5 feet bgs in the approximate location of boring B-2 and proposed parking (permeable pavement). This depth is sufficient to allow permeable pavement, thus not precluding testing for infiltration rate for design. However, infiltration testing utilizing the small-scale PIT yielded an in-situ rate of infiltration of 0.5 inches per hour which is virtually impermeable. This is insufficient for the use of permeable pavement with this project, in our opinion. Correction factors must be applied to the in-situ rate of infiltration for design per the Manual, which account for long-term maintenance and failure scenarios. This correction will result in a final design value well below our observed value of 0.5 inches per hour.

References

GeoEngineers, 2011, AOB Site Redevelopment, September 30, 2011

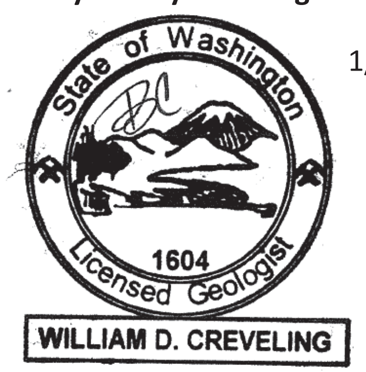
Aspect Consulting, 2021, Groundwater Level Monitoring and Preliminary Infiltration Feasibility Evaluation – City of Puyallup AOB Parking Lot, June 2, 2021

Washington State Department of Ecology (Ecology), 2014, 2012 Stormwater Management Manual for Western Washington, 2014 Revision

Closure

The information gathered for this report is standard practice and relevant for this type of project. The number and distribution of sampling locations is typical and reliable for obtaining an accurate understanding of the site of this size. The conclusions and recommendations presented in this letter are based on our observations, interpretations, and assumptions regarding shallow subsurface conditions. However, if any variations in the site conditions are discovered later, please contact our office to review and if necessary, modify this report accordingly. We appreciate the opportunity to be of service on this project. If you have any questions regarding this letter or any aspects of the project, please feel free to contact our office.

Respectfully submitted,
LeRoy Surveyors & Engineers, Inc.



1/6/2022

Bill Creveling, L.G.
Principal Geologist

Joshua Thompson, E.I.T.
Civil Engineering Technician

APPENDIX D
DESIGN CALCULATIONS

WWHM2012

PROJECT REPORT

General Model Information

Project Name:	Existing Conditions
Site Name:	
Site Address:	
City:	
Report Date:	8/25/2022
Gage:	40 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, Lawn, Flat	0.08
Pervious Total	0.08
Impervious Land Use	acre
PARKING FLAT	1.03
Impervious Total	1.03
Basin Total	1.11

Element Flows To:

Surface	Interflow	Groundwater

Mitigated Land Use

Basin 1

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
A B, Lawn, Flat	0.1
Pervious Total	0.1
Impervious Land Use	acre
ROADS FLAT	0.1
ROOF TOPS FLAT	0.9
SIDEWALKS FLAT	0.01
Impervious Total	1.01
Basin Total	1.11

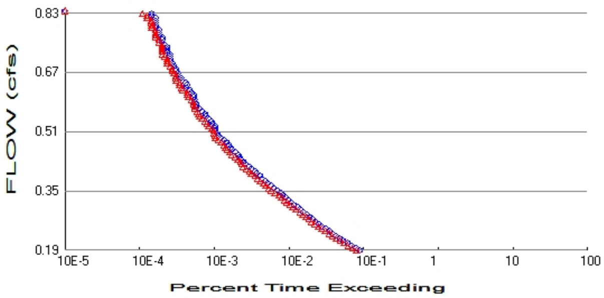
Element Flows To:

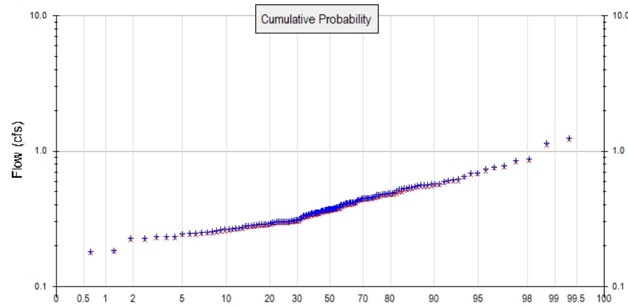
Surface	Interflow	Groundwater

Routing Elements
Predeveloped Routing

Mitigated Routing

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 0.08
Total Impervious Area: 1.03

Mitigated Landuse Totals for POC #1
Total Pervious Area: 0.1
Total Impervious Area: 1.01

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	0.37297
5 year	0.501496
10 year	0.595031
25 year	0.723181
50 year	0.826125
100 year	0.935689

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	0.362406
5 year	0.48627
10 year	0.576267
25 year	0.699408
50 year	0.798216
100 year	0.90328

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1902	0.437	0.429
1903	0.485	0.475
1904	0.562	0.537
1905	0.248	0.241
1906	0.279	0.274
1907	0.375	0.360
1908	0.305	0.296
1909	0.372	0.365
1910	0.359	0.349
1911	0.406	0.393

1912	0.686	0.665
1913	0.287	0.281
1914	1.253	1.206
1915	0.251	0.244
1916	0.464	0.455
1917	0.184	0.181
1918	0.369	0.362
1919	0.235	0.228
1920	0.310	0.299
1921	0.264	0.255
1922	0.417	0.401
1923	0.288	0.279
1924	0.538	0.527
1925	0.228	0.222
1926	0.436	0.428
1927	0.374	0.366
1928	0.267	0.259
1929	0.535	0.517
1930	0.559	0.547
1931	0.270	0.263
1932	0.290	0.282
1933	0.287	0.280
1934	0.475	0.454
1935	0.252	0.247
1936	0.345	0.335
1937	0.448	0.440
1938	0.254	0.248
1939	0.310	0.304
1940	0.560	0.547
1941	0.611	0.598
1942	0.420	0.404
1943	0.412	0.400
1944	0.599	0.577
1945	0.446	0.435
1946	0.354	0.341
1947	0.270	0.264
1948	0.372	0.362
1949	0.571	0.559
1950	0.315	0.309
1951	0.487	0.477
1952	0.567	0.538
1953	0.523	0.497
1954	0.301	0.293
1955	0.281	0.276
1956	0.260	0.255
1957	0.300	0.292
1958	0.379	0.367
1959	0.379	0.366
1960	0.302	0.295
1961	0.849	0.820
1962	0.362	0.353
1963	0.267	0.262
1964	0.786	0.756
1965	0.367	0.352
1966	0.293	0.285
1967	0.418	0.401
1968	0.348	0.338
1969	0.313	0.304

1970	0.355	0.342
1971	0.349	0.335
1972	1.149	1.105
1973	0.651	0.638
1974	0.482	0.467
1975	0.508	0.480
1976	0.534	0.512
1977	0.226	0.220
1978	0.389	0.374
1979	0.417	0.403
1980	0.401	0.384
1981	0.377	0.368
1982	0.303	0.295
1983	0.414	0.399
1984	0.410	0.396
1985	0.472	0.452
1986	0.235	0.228
1987	0.419	0.410
1988	0.247	0.240
1989	0.244	0.239
1990	0.301	0.292
1991	0.456	0.440
1992	0.432	0.423
1993	0.478	0.468
1994	0.333	0.323
1995	0.257	0.250
1996	0.348	0.336
1997	0.309	0.300
1998	0.373	0.359
1999	0.419	0.411
2000	0.350	0.340
2001	0.285	0.279
2002	0.525	0.498
2003	0.297	0.288
2004	0.447	0.436
2005	0.871	0.849
2006	0.400	0.391
2007	0.451	0.438
2008	0.369	0.360
2009	0.280	0.275
2010	0.362	0.353
2011	0.374	0.366
2012	0.355	0.345
2013	0.338	0.325
2014	0.325	0.319
2015	0.546	0.520
2016	0.351	0.344
2017	0.543	0.530
2018	0.332	0.321
2019	0.495	0.471
2020	0.401	0.386
2021	0.335	0.324
2022	0.554	0.540
2023	0.692	0.677
2024	0.742	0.711
2025	0.363	0.356
2026	0.410	0.401
2027	0.446	0.437

2028	0.173	0.169
2029	0.288	0.279
2030	0.606	0.592
2031	0.182	0.177
2032	0.301	0.295
2033	0.381	0.374
2034	0.290	0.284
2035	0.376	0.360
2036	0.299	0.293
2037	0.401	0.394
2038	0.388	0.372
2039	0.762	0.746
2040	0.301	0.293
2041	0.383	0.372
2042	0.444	0.435
2043	0.487	0.477
2044	0.336	0.326
2045	0.273	0.265
2046	0.303	0.294
2047	0.370	0.362
2048	0.304	0.298
2049	0.450	0.441
2050	0.341	0.330
2051	0.484	0.463
2052	0.365	0.358
2053	0.308	0.302
2054	0.625	0.593
2055	0.349	0.340
2056	0.486	0.475
2057	0.233	0.227
2058	0.455	0.446
2059	0.574	0.562

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	1.2530	1.2061
2	1.1489	1.1053
3	0.8705	0.8491
4	0.8488	0.8205
5	0.7855	0.7556
6	0.7615	0.7463
7	0.7421	0.7108
8	0.6915	0.6772
9	0.6864	0.6648
10	0.6514	0.6382
11	0.6248	0.5983
12	0.6107	0.5931
13	0.6063	0.5923
14	0.5988	0.5768
15	0.5735	0.5623
16	0.5712	0.5592
17	0.5674	0.5471
18	0.5618	0.5466
19	0.5598	0.5403
20	0.5593	0.5382
21	0.5542	0.5366
22	0.5460	0.5298

23	0.5433	0.5265
24	0.5377	0.5198
25	0.5350	0.5171
26	0.5342	0.5116
27	0.5254	0.4985
28	0.5235	0.4971
29	0.5078	0.4802
30	0.4953	0.4774
31	0.4869	0.4771
32	0.4869	0.4754
33	0.4855	0.4747
34	0.4847	0.4709
35	0.4838	0.4684
36	0.4820	0.4672
37	0.4779	0.4634
38	0.4750	0.4549
39	0.4723	0.4537
40	0.4644	0.4518
41	0.4558	0.4458
42	0.4547	0.4411
43	0.4513	0.4405
44	0.4501	0.4395
45	0.4482	0.4375
46	0.4469	0.4366
47	0.4461	0.4357
48	0.4460	0.4349
49	0.4438	0.4348
50	0.4374	0.4287
51	0.4362	0.4276
52	0.4315	0.4231
53	0.4197	0.4107
54	0.4194	0.4103
55	0.4186	0.4035
56	0.4176	0.4028
57	0.4174	0.4013
58	0.4167	0.4010
59	0.4137	0.4008
60	0.4117	0.3998
61	0.4105	0.3992
62	0.4096	0.3963
63	0.4063	0.3936
64	0.4015	0.3927
65	0.4011	0.3913
66	0.4010	0.3863
67	0.3995	0.3844
68	0.3892	0.3742
69	0.3879	0.3741
70	0.3829	0.3720
71	0.3814	0.3716
72	0.3793	0.3677
73	0.3791	0.3665
74	0.3772	0.3665
75	0.3758	0.3660
76	0.3745	0.3659
77	0.3737	0.3647
78	0.3735	0.3624
79	0.3726	0.3623
80	0.3720	0.3618

81	0.3718	0.3602
82	0.3696	0.3599
83	0.3695	0.3597
84	0.3692	0.3587
85	0.3671	0.3579
86	0.3649	0.3557
87	0.3627	0.3525
88	0.3620	0.3525
89	0.3619	0.3525
90	0.3585	0.3488
91	0.3548	0.3446
92	0.3546	0.3441
93	0.3536	0.3415
94	0.3509	0.3406
95	0.3503	0.3401
96	0.3490	0.3398
97	0.3488	0.3379
98	0.3484	0.3362
99	0.3477	0.3347
100	0.3448	0.3345
101	0.3413	0.3304
102	0.3375	0.3265
103	0.3357	0.3253
104	0.3350	0.3241
105	0.3333	0.3230
106	0.3322	0.3206
107	0.3248	0.3185
108	0.3150	0.3088
109	0.3130	0.3038
110	0.3104	0.3037
111	0.3099	0.3016
112	0.3090	0.3002
113	0.3079	0.2986
114	0.3054	0.2976
115	0.3036	0.2965
116	0.3030	0.2953
117	0.3030	0.2952
118	0.3022	0.2951
119	0.3015	0.2939
120	0.3014	0.2935
121	0.3014	0.2930
122	0.3013	0.2927
123	0.2999	0.2922
124	0.2995	0.2917
125	0.2972	0.2885
126	0.2926	0.2848
127	0.2904	0.2840
128	0.2896	0.2820
129	0.2881	0.2815
130	0.2880	0.2796
131	0.2874	0.2794
132	0.2871	0.2789
133	0.2850	0.2789
134	0.2813	0.2757
135	0.2800	0.2745
136	0.2793	0.2735
137	0.2728	0.2646
138	0.2704	0.2639

139	0.2701	0.2630
140	0.2672	0.2620
141	0.2670	0.2592
142	0.2642	0.2553
143	0.2603	0.2552
144	0.2568	0.2499
145	0.2537	0.2476
146	0.2519	0.2470
147	0.2512	0.2442
148	0.2475	0.2412
149	0.2468	0.2401
150	0.2435	0.2388
151	0.2353	0.2278
152	0.2345	0.2276
153	0.2331	0.2269
154	0.2282	0.2220
155	0.2257	0.2203
156	0.1841	0.1805
157	0.1816	0.1771
158	0.1728	0.1694

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.1865	4920	4454	90	Pass
0.1929	4363	3932	90	Pass
0.1994	3770	3415	90	Pass
0.2059	3364	3035	90	Pass
0.2123	2958	2671	90	Pass
0.2188	2652	2388	90	Pass
0.2253	2348	2105	89	Pass
0.2317	2117	1929	91	Pass
0.2382	1908	1693	88	Pass
0.2446	1713	1522	88	Pass
0.2511	1516	1359	89	Pass
0.2576	1386	1235	89	Pass
0.2640	1243	1106	88	Pass
0.2705	1134	1014	89	Pass
0.2769	1040	933	89	Pass
0.2834	949	837	88	Pass
0.2899	859	772	89	Pass
0.2963	784	679	86	Pass
0.3028	722	623	86	Pass
0.3092	643	564	87	Pass
0.3157	595	519	87	Pass
0.3222	541	475	87	Pass
0.3286	500	438	87	Pass
0.3351	455	406	89	Pass
0.3415	429	358	83	Pass
0.3480	382	324	84	Pass
0.3545	346	295	85	Pass
0.3609	320	269	84	Pass
0.3674	288	249	86	Pass
0.3739	266	225	84	Pass
0.3803	242	209	86	Pass
0.3868	229	195	85	Pass
0.3932	202	174	86	Pass
0.3997	195	164	84	Pass
0.4062	173	148	85	Pass
0.4126	161	135	83	Pass
0.4191	144	128	88	Pass
0.4255	136	124	91	Pass
0.4320	126	113	89	Pass
0.4385	121	104	85	Pass
0.4449	117	94	80	Pass
0.4514	105	89	84	Pass
0.4578	95	82	86	Pass
0.4643	92	78	84	Pass
0.4708	87	74	85	Pass
0.4772	81	68	83	Pass
0.4837	74	62	83	Pass
0.4902	67	57	85	Pass
0.4966	63	56	88	Pass
0.5031	60	54	90	Pass
0.5095	56	54	96	Pass
0.5160	56	51	91	Pass
0.5225	56	46	82	Pass

0.5289	53	44	83	Pass
0.5354	51	42	82	Pass
0.5418	46	38	82	Pass
0.5483	43	35	81	Pass
0.5548	42	34	80	Pass
0.5612	38	33	86	Pass
0.5677	35	30	85	Pass
0.5741	32	30	93	Pass
0.5806	32	29	90	Pass
0.5871	30	29	96	Pass
0.5935	30	27	90	Pass
0.6000	29	25	86	Pass
0.6065	29	24	82	Pass
0.6129	27	24	88	Pass
0.6194	26	21	80	Pass
0.6258	24	20	83	Pass
0.6323	24	19	79	Pass
0.6388	23	19	82	Pass
0.6452	20	17	85	Pass
0.6517	20	17	85	Pass
0.6581	18	17	94	Pass
0.6646	18	16	88	Pass
0.6711	17	15	88	Pass
0.6775	17	15	88	Pass
0.6840	16	14	87	Pass
0.6904	15	13	86	Pass
0.6969	14	13	92	Pass
0.7034	14	13	92	Pass
0.7098	14	12	85	Pass
0.7163	14	11	78	Pass
0.7227	13	11	84	Pass
0.7292	13	11	84	Pass
0.7357	13	11	84	Pass
0.7421	12	11	91	Pass
0.7486	11	10	90	Pass
0.7551	11	10	90	Pass
0.7615	11	9	81	Pass
0.7680	10	9	90	Pass
0.7744	10	9	90	Pass
0.7809	10	9	90	Pass
0.7874	9	8	88	Pass
0.7938	9	8	88	Pass
0.8003	9	8	88	Pass
0.8067	9	8	88	Pass
0.8132	9	7	77	Pass
0.8197	8	7	87	Pass
0.8261	8	6	75	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	0.1039 acre-feet
On-line facility target flow:	0.1442 cfs.
Adjusted for 15 min:	0.1442 cfs.
Off-line facility target flow:	0.0837 cfs.
Adjusted for 15 min:	0.0837 cfs.

LID Report

LID Technique	Used for Treatment ?	Total Volume Needs Treatment (ac-ft)	Volume Through Facility (ac-ft)	Infiltration Volume (ac-ft)	Cumulative Volume Infiltration Credit	Percent Volume Infiltrated	Water Quality	Percent Water Quality Treated	Comment
Total Volume Infiltrated		0.00	0.00	0.00		0.00	0.00	0%	No Treat. Credit
Compliance with LID Standard 8% of 2-yr to 50% of 2-yr									Duration Analysis Result = Passed

Model Default Modifications

Total of 0 changes have been made.

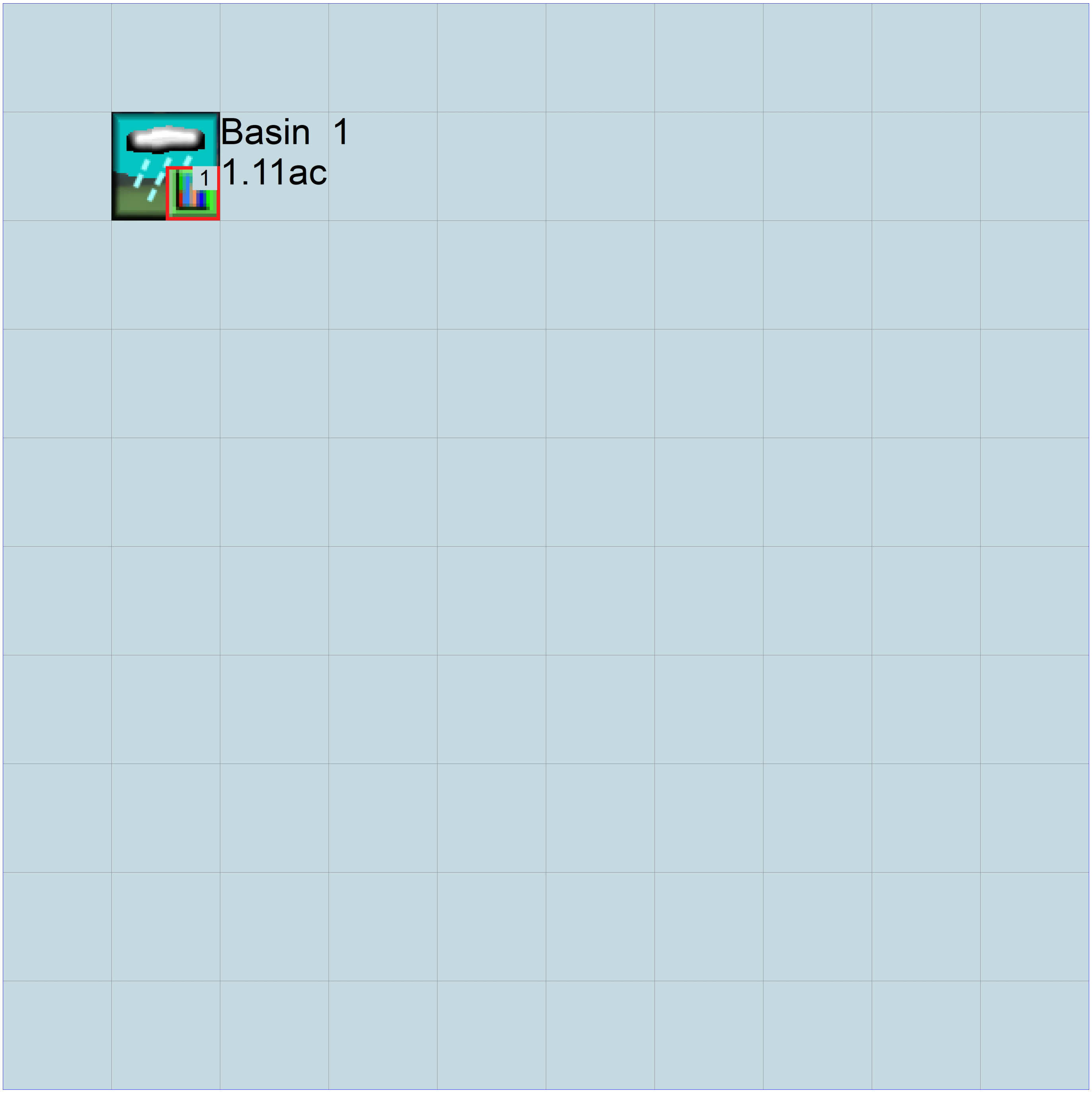
PERLND Changes

No PERLND changes have been made.

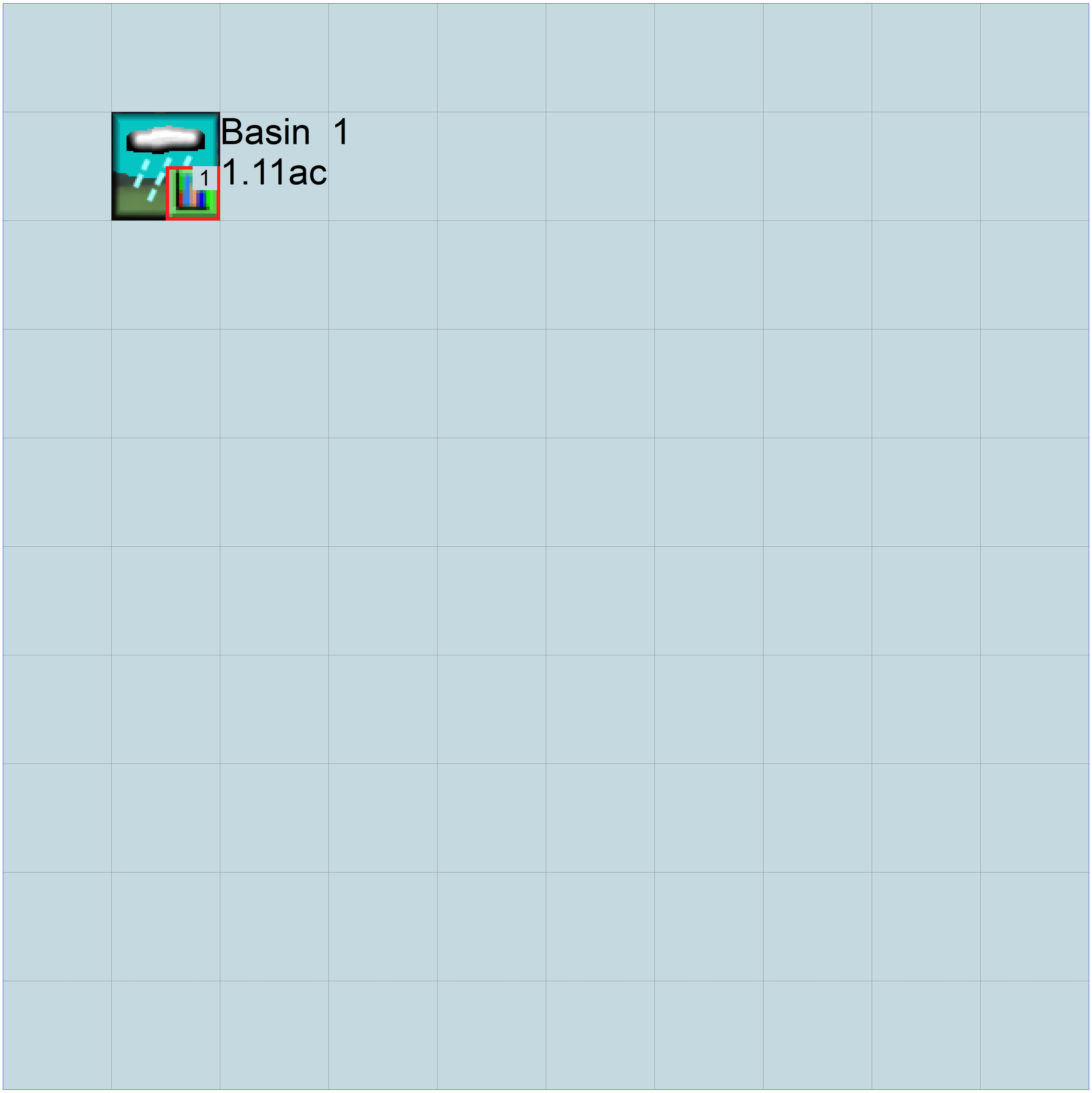
IMPLND Changes

No IMPLND changes have been made.

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   Existing Conditions.wdm
MESSU      25   PreExisting Conditions.MES
           27   PreExisting Conditions.L61
           28   PreExisting Conditions.L62
           30   POCExisting Conditions1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      16
      IMPLND      11
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  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
  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
  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
  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
  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
  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
  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
  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
  END PWAT-STATE1

END PERLND

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

  ACTIVITY
    <PLS > ************* Active Sections *****************************
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL   ***
   11         0    0    1    0    0    0
  END ACTIVITY

  PRINT-INFO
    <ILS > ******** Print-flags ******** PIVL  PYR
    # -  # ATMP SNOW IWAT  SLD  IWG IQAL    *********
   11         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      ***
   11         0    0    0    0    0
  END IWAT-PARM1

  IWAT-PARM2
    <PLS >      IWATER input info: Part 2         ***
    # -  # ***  LSUR     SLSUR      NSUR     RETSC
   11            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
   11              0         0
```

```
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
   11             0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND  16                        0.08     COPY   501     12
PERLND  16                        0.08     COPY   501     13
IMPLND  11                        1.03     COPY   501     15

******Routing******
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                             ***
  END GEN-INFO
  *** Section RCHRES***

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

  PRINT-INFO
    <PLS > ***************** Print-flags ****************** PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  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
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  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
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
```

```
END SPEC-ACTIONS
FTABLES
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

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
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       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


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   Existing Conditions.wdm
MESSU      25   MitExisting Conditions.MES
           27   MitExisting Conditions.L61
           28   MitExisting Conditions.L62
           30   POCExisting Conditions1.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND       7
      IMPLND       1
      IMPLND       4
      IMPLND       8
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        Basin  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           ***
    7      A/B, Lawn, 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 ***
    7         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  *********
```

```
    7         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 ***
    7         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
    7             0         5       0.8       400      0.05       0.3     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
    7             0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
    7           0.1       0.5      0.25         0       0.7      0.25
  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
    7             0         0         0         0         3         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
    4      ROOF TOPS/FLAT         1    1    1   27    0
    8      SIDEWALKS/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
    4         0    0    1    0    0    0
    8         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
    4         0    0    4    0    0    0    1    9
    8         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
    4         0    0    0    0    0
    8         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
    4            400      0.01       0.1       0.1
    8            400      0.01       0.1       0.1
  END IWAT-PARM2

  IWAT-PARM3
    <PLS >      IWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN
    1              0         0
    4              0         0
    8              0         0
  END IWAT-PARM3

  IWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
    # -  # ***  RETS      SURS
    1              0         0
    4              0         0
    8              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
Basin  1***
PERLND   7                        0.1     COPY   501     12
PERLND   7                        0.1     COPY   501     13
IMPLND   1                        0.1     COPY   501     15
IMPLND   4                        0.9     COPY   501     15
IMPLND   8                       0.01     COPY   501     15

******Routing******
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                           ***
  END GEN-INFO
  *** Section RCHRES***

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

  PRINT-INFO
    <PLS > ***************** Print-flags ******************* PIVL  PYR
    # -  # HYDR ADCA CONS HEAT  SED  GQL OXRX NUTR PLNK PHCB PIVL  PYR  *********
  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
             *  *  *  *    *  *  *  *  *       *  *  *  *  *         ***
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
  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
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
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

END EXT SOURCES

EXT TARGETS
<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Volume-> <Member> Tsys Tgap Amd ***
<Name>   #        <Name> # #<-factor->strg <Name>   # <Name>    tem strg strg***
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       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


END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

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APPENDIX E

STORMWATER MANAGEMENT MANUAL FOR WESTERN WASHINGTON

FIGURES

Figure I-3.1: Flow Chart for Determining Requirements for New Development

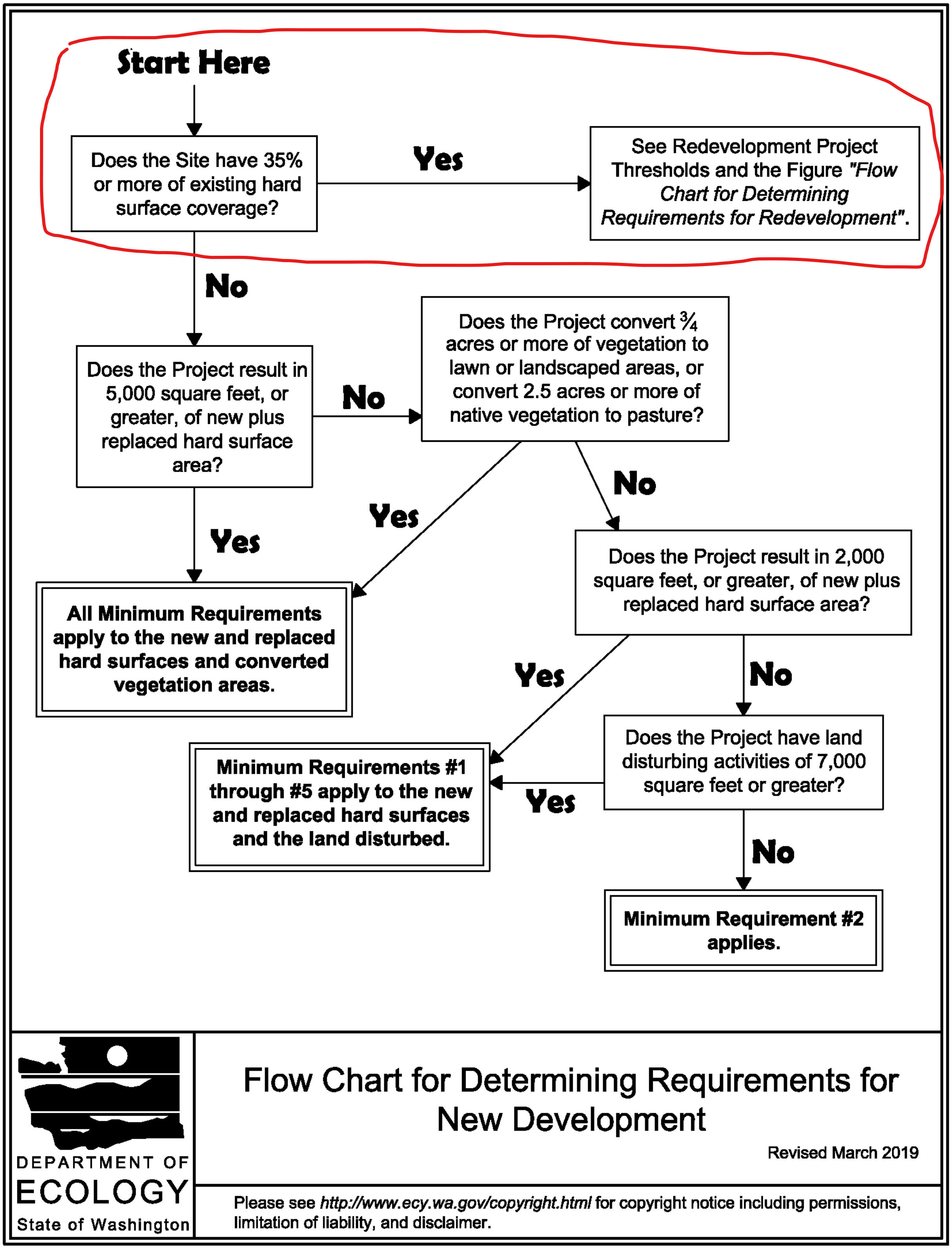

Figure I-3.2: Flow Chart for Determining Requirements for Redevelopment

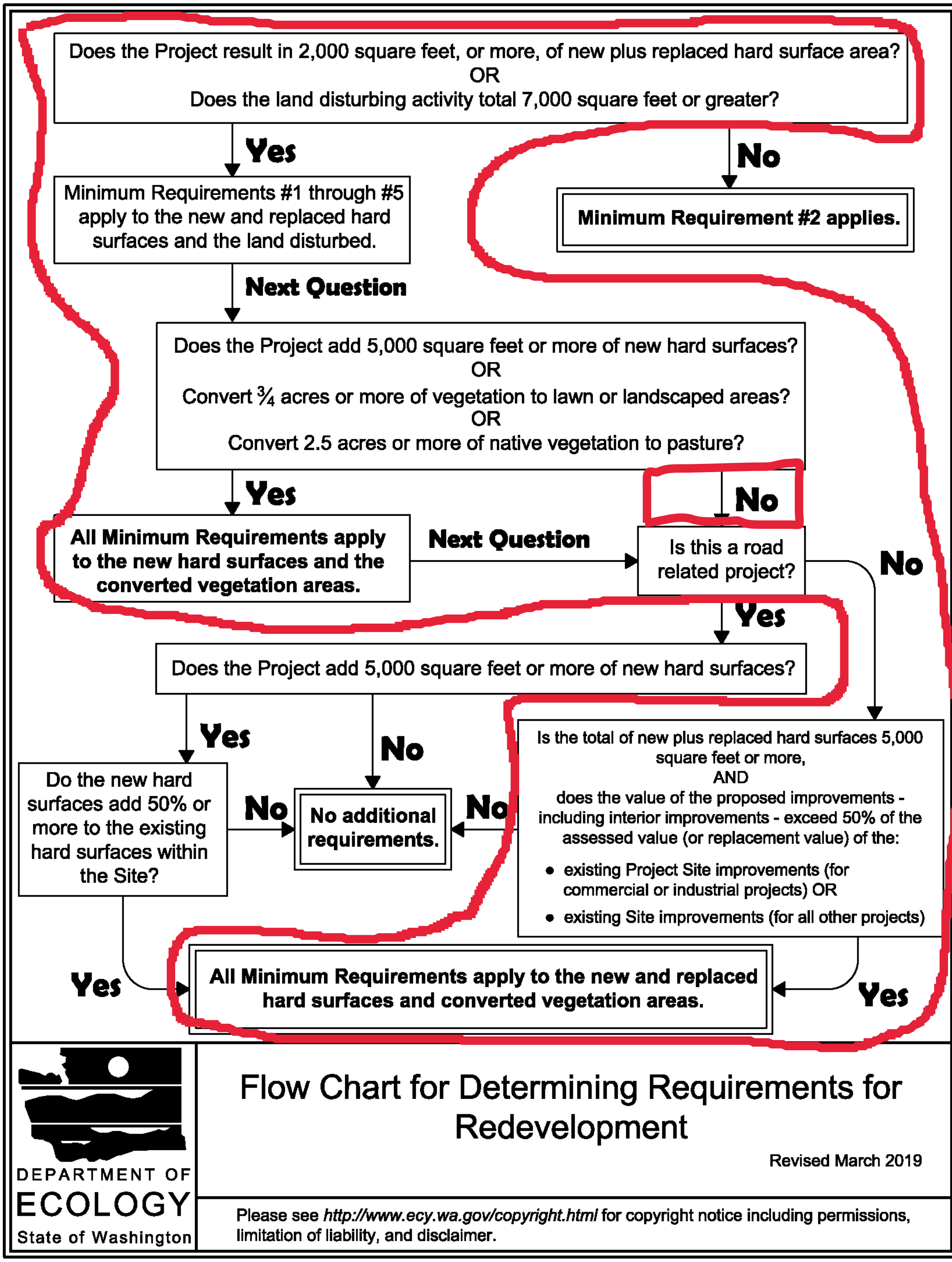

Figure I-3.3: Flow Chart for Determining MR #5 Requirements

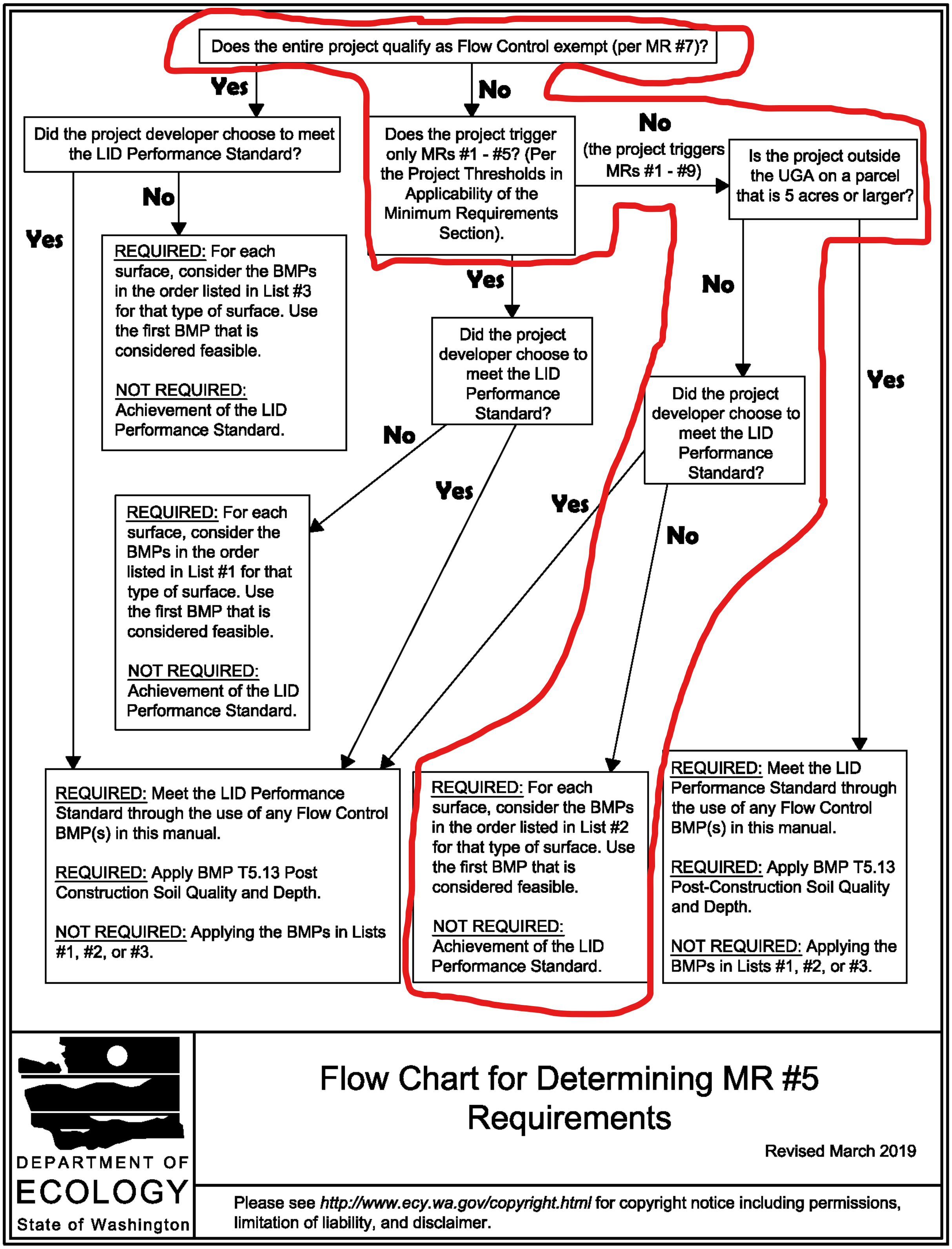

Figure III-1.1: Runoff Treatment BMP Selection Flow Chart