MOMENTUM CIVIL
ENGINEERING CONSULTANTS

1145 BROADWAY, SUITE 115
TACOMA, WA 98402

MOMENTUMCIVIL.COM
(253) 319-1504

CENTRALIA

WOODLAND GLEN

Planned Unit Development and Preliminary Plat Stormwater Report

MC# DDIP-0003
9/21/2023

Planned Unit Development and Preliminary Plat Stormwater Report

9/21/2023

Prepared for: APJJ, LLC

Point of Contact: John Mastandrea

Email: JDM4077@comcast.net

Phone: (206) 276-7124

Civil Engineer:

Momentum Civil

1145 Broadway, Suite 115

Tacoma, WA 98402

Prepared by: J. Kyle Murphy, P.E.

Email: kylem@momentumcivil.com

Phone: (253) 319-1508

Q/A by: Drew Harris, P.E.

Email: drewh@momentumcivil.com

Phone: (253)-319-1506

Table of Contents

Table of Figures

Table of Tables

Table of Appendices

Section 1 - Project Information

The project proponent, APJJ, LLC, is applying for Preliminary Plat approval on a proposed 194-Lot Planned Unit Development (PUD). The project consists of six parcels located in the Northwest ¼ of Section 9, Township 14 North, Range 2 West, W.M. (Lewis County parcel numbers 003681009000, 021256000000, 001301001000, 001365001002, and 001365001003). These parcels have a current site address of XX Duffy Street in Centralia, Washington. The proposed PUD has a cumulative size of 47.97 acres, excluding offsite roadway improvements. Please refer to **Figure 1** on the next page for the project Vicinity Map.

Associated Permits

The following approvals are anticipated for this project.

Entitlement/Land-Use:

- Planned Unit Development (Concurrent with Preliminary Plat)
- Preliminary Plat (Concurrent with Planned Unit Development)
- State Environmental Policy Act (SEPA) determination.
- Joint Aquatic Resources Permit Application for proposed stream crossings (to be permitted through Washington Department of Fish and Wildlife).

Note: this report is intended to accompany the permits required for a land use decision. Additional information and calculations will be forthcoming as required for construction ready documents.

Construction/Final Platting:

- Clearing and Grading/Site Development Permit
- Right-of-Way Construction Permits for Offsite Improvements
- Dam Safety Permit with Ecology
- Final Plat
- Building Permit(s)

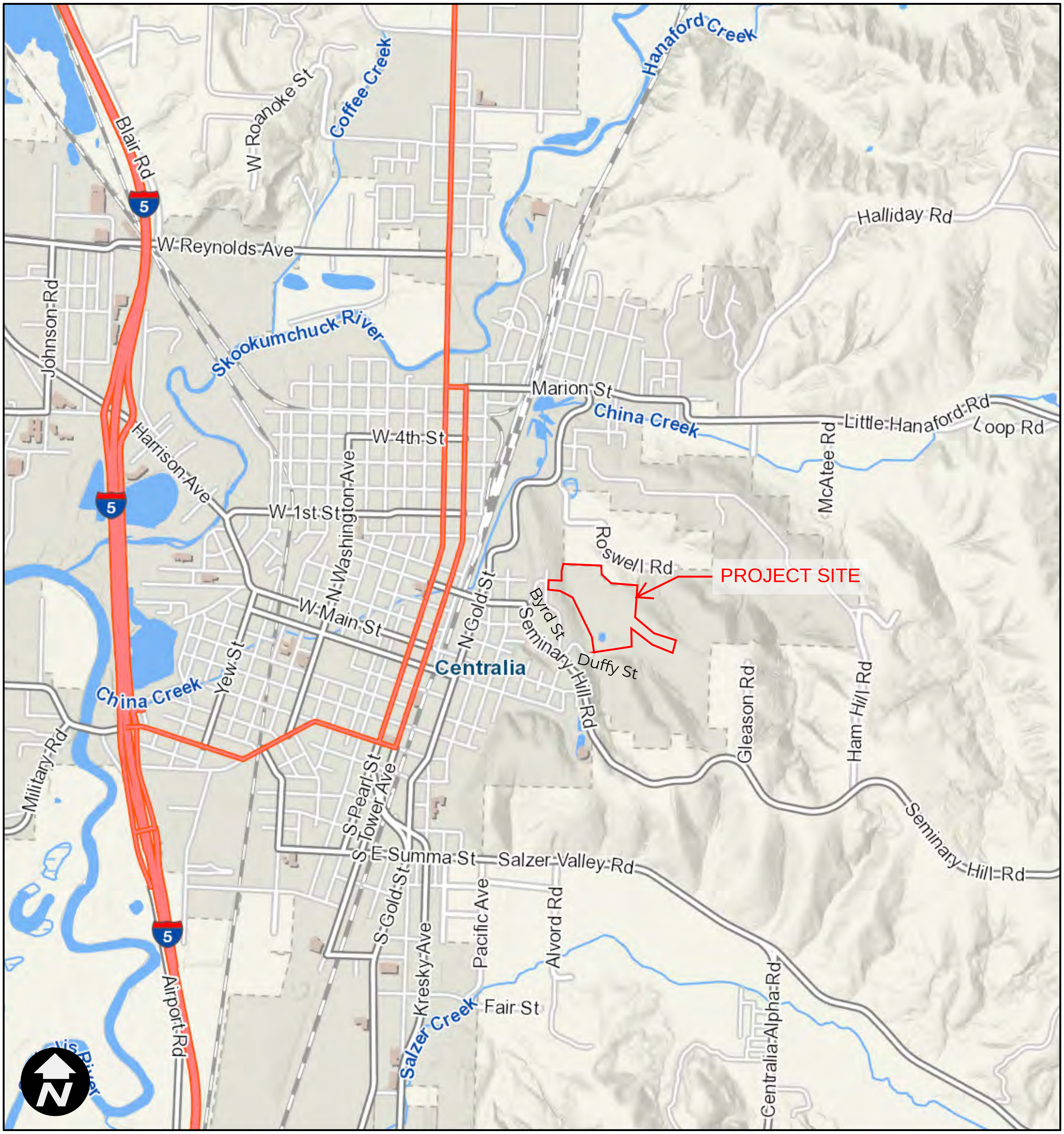
Applicable Stormwater Manual

As noted in the 2021 City of Centralia Stormwater Management Program:

The city adopted (CMC 15.37) the latest Stormwater Management Manual for Western Washington (SWMMWW) to help control runoff from developments and construction sites. The requirements, limitations, and criteria of the SWMMWW will protect water quality, reduce the discharge of pollutants to the maximum extent possible, and satisfy all known, available, and reasonable methods of prevention, control, and treatment (AKART).

As of this writing, the current Manual is the 2019 Department of Ecology Stormwater Management Manual for Western Washington (referred to herein as the "Manual"), which will be the guiding document for this development's stormwater management design.

Figure 1 - Vicinity Map



7/26/2023, 4:25:25 PM

1:30,000

0 0.25 0.5 1 mi

NAD 1983 StatePlane Washington South FIPS 4602 Feet

LEWIS COUNTY — est. 1845 —

Lewis County G.I.S.

Project Overview

- **Threshold Discharge Areas (TDAs).** There are three distinct Threshold Discharge Areas (TDAs) within the project limits: TDA-1 and TDA-2 are located within the PUD boundary and discharge into stream beds that are tributaries to China Creek; TDA-3 is located offsite and is associated with required intersection improvements for Duffy Street. Please refer to the Proposed Basin Maps for delineation of the TDAs and Section 6 of this report for further information concerning these TDAs.
- **Onsite Stormwater Management (MR#5).** Stormwater Best Management Practices (BMPs) on individual lots are generally not feasible since infiltration has been deemed infeasible by the geotechnical engineer, and dispersion is generally infeasible due to the required density by land-use and the presence of slopes greater than 15 percent. Soil amendment will be applied throughout the development.
- **Water Quality (Basic) Treatment** (MR #6) will be provided by one of the following means within TDA-1:
    1. A basic wet pond may be constructed within the footprint of the detention pond. Live storage would subsequently be stacked on top of the "dead" storage of the permanent wet pool.
    2. A proprietary media filter device may be constructed that treats 91% of the annual volume of runoff. This option is shown within the Preliminary Civil PUD plans.
- **Flow control** (MR#7) for TDA-1 will be provided by means of a single detention pond with a potential maximum impoundment volume greater than 10 acre-feet. This detention pond is thus classified as a dam by Ecology, so the pond will be designed, constructed, and permitted according to the Department of Ecology Dam Safety Requirements. Detained stormwater will be discharged into Stream Y/Z.
- **Wetlands Protection** (MR #8) applies to this development, as there are three existing wetlands that are downstream of the existing and proposed basin areas of the development. Wetland 'A' is located within the north segment of the PUD and partially resides within Assessor's Parcel Number (APN) 021002000000; Wetland 1 resides offsite to the south of the development within APN 003682001001, and Wetland 2 resides offsite to the north of the development. Wetland Protection will be provided for these wetlands as required under Minimum Requirement #8.
- **Ongoing Environmental Studies.** This drainage report has been prepared based upon the best available environmental data at the time of this writing. Additional geotechnical explorations will be necessary to validate the underlying soil types and properties. The current geotechnical explorations and correspondence with the geotechnical engineer indicate that the site is underlain by Hydrologic Group C soils throughout the development. If future geotechnical explorations indicate the presence of infiltrative soils beneath portions of the development, then infiltration BMPs for rooftops and driveways will be considered where appropriate.

Section 2 – Existing Site Conditions

Existing Site Use and Topography

Most of the PUD area (45.7 acres) was previously developed and used as a public golf course. While the golf course is no longer in operation, the existing ground coverage is consistent with that usage, so the existing site has been extensively graded and largely cleared of trees and native vegetation. There are no existing structures left onsite from the golf course operations, and existing utility infrastructure within the PUD is limited to an existing 18-inch city-owned water main and a public storm drain line which will both be rerouted around the proposed lots and storm pond as part of this development.

Currently, the site is vacant and is zoned R4, Low Density Residential District in accordance with the Amended 2022 Comprehensive Plan of Centralia. The proposed Planned Unit Development is consistent with current land use and density regulations.

The site topography includes two existing streams which are labeled in the Soundview critical areas report as “Stream Y” and “Stream Z.” Stream Y is a short (less than 100 feet) stream that joins into Stream Z, which traverses the site in a south to north direction. On the east and west banks of the stream, there is a flat area (under 5% slopes) that is approximately 200 feet wide, and which runs the full length of the stream within the development. Elsewhere in the development, existing slopes increase with average slopes between 15% and 40%. Overall topographic relief ranges from an approximate low elevation of 198 in the vicinity of Wetland ‘A’ to the north to an approximate high elevation of 420 at the extreme east edge of the development.

Please see **Figure 2** for representation of the existing conditions.

Soils Properties

USDA Web Soil Conservation Service Survey

According to the USDA Soils Conservation Service Survey, the lowland of the site is predominantly underlain by **Reed silty clay loam (172)** which belongs to Hydrologic Soil Group D (poorly drained).

The predominant soils underlying the uplands of the site are mapped as **Centralia Loam, (43 and 44)** which form on benches, hillsides, and broad ridgetops. This very deep, well-drained soil has moderate permeability and belongs to Hydrologic Soil Group B.

Buckpeak silt loam (27), 30 to 65 percent slopes, is mapped on portions of the existing site slopes. This soil is moderately permeable, well-drained, and belongs to Hydrologic Soil Group B.

Other less prevalent mapped soils include **Galvin silt loam (89), Prather silty clay loam (167), and Scamman silty clay loam (194).** These soils are all classified as Hydrologic Soil Group C/D soils.

Please refer to Appendix B for the USDA Web Soil Survey mapping within the development.

Site-Specific Explorations by Jason Engineering, Inc.,

A site-specific geotechnical investigation was conducted by Jason Engineering, Inc., and his report, dated February 4th, 2022, is included under Appendix G. Site exploration was conducted in February of 2022, and three explorations were advanced a minimum of 12 feet below existing grade.

Based upon visual inspection of the explorations, the geotechnical engineer believed that the entire site falls within the Type C/D soil classification. For this reason, the entire development has been modeled with Type C soils within WWHM. Please refer to Appendix G for the written correspondence with the geotechnical engineer.

A site-specific Pilot Infiltration Test (PIT) was performed in the lowland soil (Reed silty clay loam) and a resulting long-term factored infiltration rate of 0.58 inches per hour has been determined by the geotechnical engineer. In the opinion of the geotechnical engineer, *"because there is a natural drainage feature in the middle of the site and the infiltration rate is slow, we do not recommend infiltration."*

Pilot Infiltration Tests were not conducted within the upland soils (mapped as Centralia Loam), but boring logs indicate the presence of brown silty sand until the termination of the explorations (over 12 feet below existing grade). For this reason, infiltration may be feasible for the development located on the uplands, but this assumption requires further investigation to confirm the infiltrative capacity of this soil. Of importance, all the proposed residential lots will be located on soils classified as Centralia Loam or Buckpeak silt loam and may therefore have the potential for infiltration, excluding any lots that are mass graded beyond limits for infiltration.

Further geotechnical explorations will be required to discover the following prior to Final Platting:

- Maximum seasonal high ground water elevation, particularly in relation to the proposed pond elevation.
- Long-term factored design infiltration rates for the upland soils (mapped as Centralia Loam and Buckpeak silt loam) where infiltration BMPs may prove feasible.
- Additional explorations for the pond, in conformance with Ecology's Dam Safety Guidelines.

Wells and Septic Tanks

No wells or septic tanks are known to exist within the footprint of the Planned Unit Development.

Floodplain Analysis

According to the City of Centralia Adopted Floodway and Floodplain Map dated 2/8/2019, the development is not located within the 100-year floodplain or any mapped floodway.

Critical Areas

A Wetland, Stream, and Fish and Wildlife Habitat Assessment was performed by Soundview Consultants and their report, dated November 1, 2022, is included under Appendix H. A summary of their findings is listed below concerning streams and wetlands.

Streams

Two streams were identified by the Soundview Consultants that traverse the site: Stream Y and Stream Z. These streams form a non-continuous flow channel that runs south to north through the lowlands of the site. Stream Y and Stream Z are mapped as fish-bearing (Type F) waters by Lewis County and the Department of Natural Resources (DNR). However, in the opinion of the biologist, *"onsite observations determined there was no defined channel to provide potential fish passage on the northwestern portion of the subject property continuing offsite into Wetland A… the saturation-only portions and lack of channel are defined break potential [for] fish use and/or potential presence. Additionally, WDFW SalmonScape does not identify any salmonid or fish species on the subject property… As such, Stream Y and Stream Z are classified as seasonal, non-fish bearing (Type Ns) streams."* A buffer width of 35 feet from stream edge is applied within the development, consistent with the classification for a Type Ns stream.

Wetlands

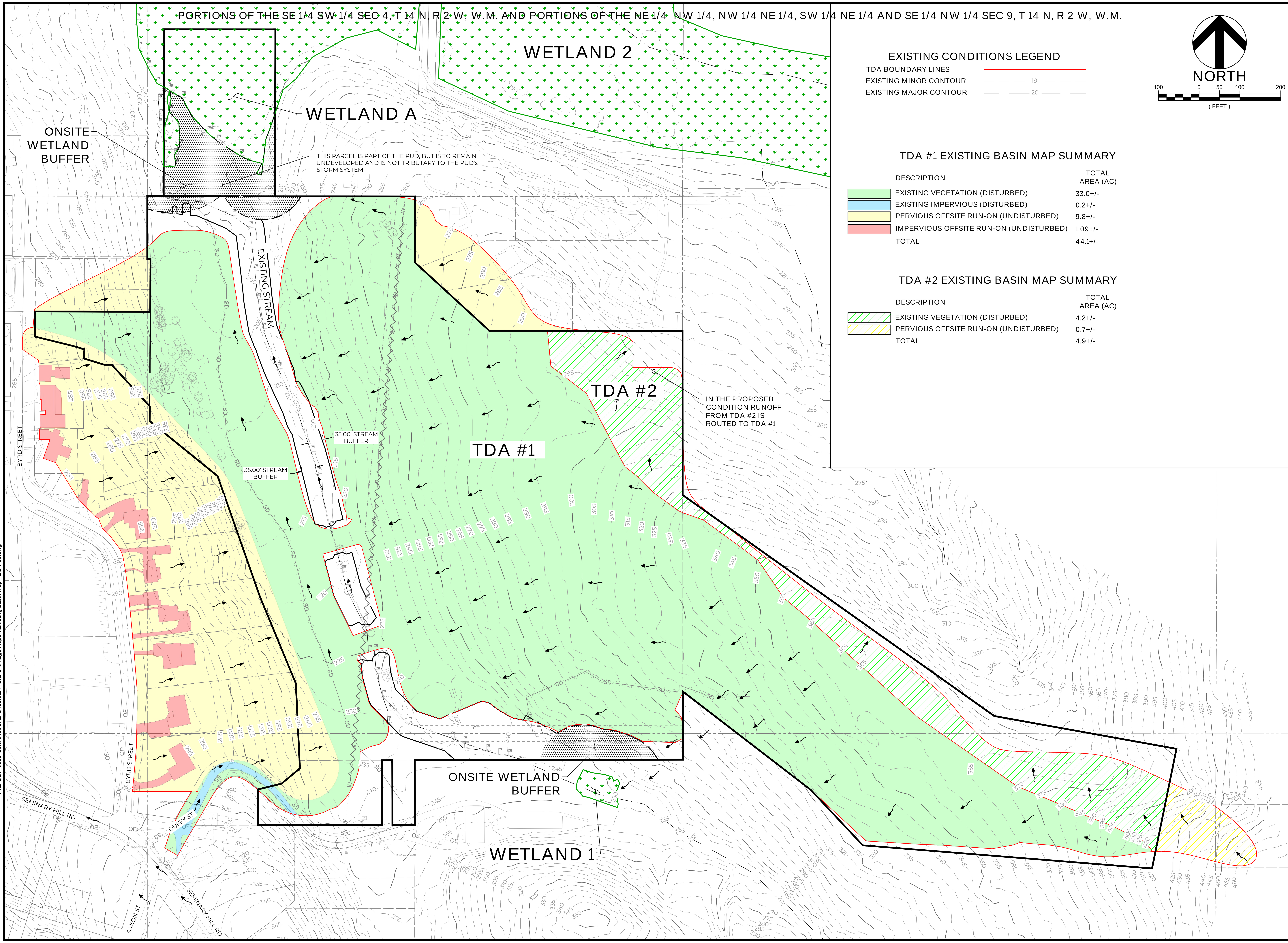
Three wetlands were identified by Soundview Consultants in the vicinity of the site: Wetland 1 is a Type III slope wetland and is located offsite to the south; Wetland 2 is a Type II depressional wetland and is located offsite to the north; and Wetland A is a Type II depressional wetland and is located within the PUD to the north on Parcel 021002000000.

These wetlands will be mitigated pursuant to Minimum Requirement #8 – please refer to Section 4 of this report for pertinent mitigation measures.

Steep Slopes

According to Lewis County GIS data, the site has several locations mapped onsite and in the immediate vicinity with existing slopes exceeding 40%. All existing steep slopes located onsite (40% or greater) will be eliminated by the proposed grading, whereas existing steep slopes present around the perimeter of the development will be respected with appropriate setbacks. Please refer to the PUD Critical Areas Map prepared by Momentum Civil for representation of the existing steep slopes located within and around the development. Of importance, no stormwater runoff from the development is directed towards any identified steep slope.

PORTIONS OF THE SE 1/4 SW 1/4 SEC 4, T 14 N, R 2 W, W.M. AND PORTIONS OF THE NE 1/4 NW 1/4, NW 1/4 NE 1/4, SW 1/4 NE 1/4 AND SE 1/4 NW 1/4 SEC 9, T 14 N, R 2 W, W.M.



TDA #1 EXISTING BASIN MAP SUMMARY

DESCRIPTION	TOTAL AREA (AC)
EXISTING VEGETATION (DISTURBED)	33.0+/-
EXISTING IMPERVIOUS (DISTURBED)	0.2+/-
PERVIOUS OFFSITE RUN-ON (UNDISTURBED)	9.8+/-
IMPERVIOUS OFFSITE RUN-ON (UNDISTURBED)	1.09+/-
TOTAL	44.1+/-

TDA #2 EXISTING BASIN MAP SUMMARY

DESCRIPTION	TOTAL AREA (AC)
EXISTING VEGETATION (DISTURBED)	4.2+/-
PERVIOUS OFFSITE RUN-ON (UNDISTURBED)	0.7+/-
TOTAL	4.9+/-

NO.	DATE	REVISION DESCRIPTION	BY	CK

PUD

WOODLAND GLEN
APJJ, LLC

EXISTING BASIN MAP

0 DUFFY STREET / SEMINARY HILL ROAD
CENTRALIA, WA 98531

MOMENTUM CIVIL
1145 BROADWAY, SUITE 115
TACOMA, WA 98402
PHONE: 253.319.1504

CHECKED BY: AKH
DESIGNED BY: JKM
DRAWN BY: JKM
HORZ. DATUM: NAD83
VERT. DATUM: NAVD88
DATE: 9/21/23
PROJECT NO. DDIP0003
SHEET NO. 1 OF 1
REFERENCE NO. FIG2

Plot Date: 9/21/2023 2:52 PM By: Kyle Murphy
Save Date: 9/21/2023 2:50 PM By: KyleMurphy
File:P:\D\DDIP0003-Cent\0400CAD\Sheets\Exhibits\Drainage Report\Existing Basin Map - DDIP03.dwg

Section 3 - Proposed Conditions Summary

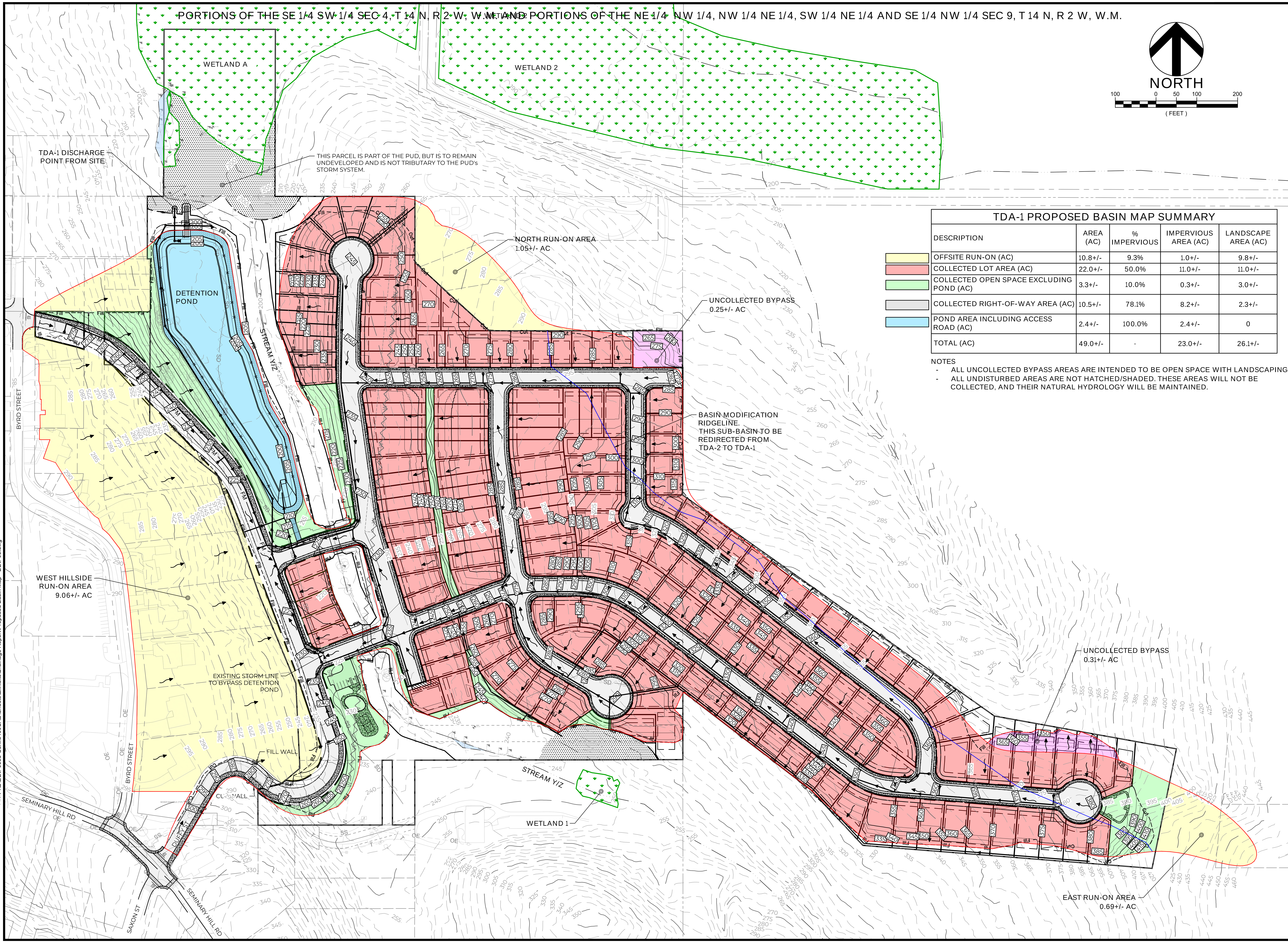
This Planned Unit Development will create 194 residential lots, each having a minimum lot area of 4,000 square feet. The anticipated cumulative lot area is 23.29+/- acres. The new right-of-way and open space area are 10.09+/- acres and 14.60+/- acres, respectively. Most of the lots are intended to be detached single family homes, consistent with the marketplace economics of Centralia. Approximately 45 lots will be constructed as townhome lots with zero lot line construction with 3, 4, or 5-plex buildings. Each residence will have a private driveway that can park up to 2 cars per lot, and each lot will have an assumed total lot coverage of 50% pursuant to CMC 20.21.050.

As required by Centralia's PUD code, at least 30% of the total development acreage (14.7+/- ac) will be established as permanent open space which will include the detention pond, the existing streams Y and Z, onsite portions of Wetland A and its buffer, the onsite portion of the buffer for Wetland 1, and landscaped areas. Most of the open space that will receive grading and landscaping will have stormwater managed by dispersion BMPs.

The remainder of the development will be dedicated as right-of-way and will be deeded to the City of Centralia, (10.09+/- acres). All stormwater runoff generated within the right-of-way, excluding off-site improvements, will be collected and routed to the central detention pond by means of catch basins and piped conveyance lines.

The project's single detention pond has been graded to allow for a maximum live storage volume of 12.1+/- acre-feet. The total impoundment volume, measured to the top of embankment, is approximately 15.9 acre-feet. Because the volume impounded by the proposed stormwater berm embankment exceeds 10 acre-feet, a dam safety permit from the Washington State Department of Ecology will be required. The proposed pond stormwater outfall will discharge to the adjacent Stream Y and Stream Z to the north within the limits of the development.

Please see **Figure 3** for representation of the proposed conditions.



TDA-1 PROPOSED BASIN MAP SUMMARY

DESCRIPTION	AREA (AC)	% IMPERVIOUS	IMPERVIOUS AREA (AC)	LANDSCAPE AREA (AC)
OFFSITE RUN-ON (AC)	10.8+/-	9.3%	1.0+/-	9.8+/-
COLLECTED LOT AREA (AC)	22.0+/-	50.0%	11.0+/-	11.0+/-
COLLECTED OPEN SPACE EXCLUDING POND (AC)	3.3+/-	10.0%	0.3+/-	3.0+/-
COLLECTED RIGHT-OF-WAY AREA (AC)	10.5+/-	78.1%	8.2+/-	2.3+/-
POND AREA INCLUDING ACCESS ROAD (AC)	2.4+/-	100.0%	2.4+/-	0
TOTAL (AC)	49.0+/-	-	23.0+/-	26.1+/-

NOTES
- ALL UNCOLLECTED BYPASS AREAS ARE INTENDED TO BE OPEN SPACE WITH LANDSCAPING
- ALL UNDISTURBED AREAS ARE NOT HATCHED/SHADED. THESE AREAS WILL NOT BE COLLECTED, AND THEIR NATURAL HYDROLOGY WILL BE MAINTAINED.

NO. | DATE | REVISION DESCRIPTION | BY | CK

PUD

WOODLAND GLEN
APJJ, LLC

PROPOSED BASIN MAP TDA #1 AND #2

0 DUFFY STREET / SEMINARY HILL ROAD
CENTRALIA, WA 98531

MOMENTUM CIVIL
1145 BROADWAY, SUITE 115
TACOMA, WA 98402
PHONE: 253.319.1504

CHECKED BY: AKH
DESIGNED BY: JKM
DRAWN BY: JKM
HORZ. DATUM: NAD83
VERT. DATUM: NAVD88
DATE: 9/21/23
PROJECT NO. DDIP0003
SHEET NO. 1 of 1
REFERENCE NO. FIG3

Plot Date: 9/21/2023 2:55 PM By: Kyle Murphy
Save Date: 9/21/2023 2:25 PM By: DaveDiaz
File:P:\D\DDIP0003-Cent\0400CAD\Sheets\Exhibits\Drainage Report\Proposed Basin Map - DDIP03.dwg

PORTIONS OF THE SE 1/4 SW 1/4 SEC 4, T 14 N, R 2 W, W.M. AND PORTIONS OF THE NE 1/4 NW 1/4, NW 1/4 NE 1/4, SW 1/4 NE 1/4 AND SE 1/4 NW 1/4 SEC 9, T 14 N, R 2 W, W.M.

PROPOSED OFF-SITE BASIN MAP SUMMARY - TDA #3

DESCRIPTION	AREA (SF)
ROADWAY(SF)	15,800+/-
SIDEWALK (SF)	2,100+/-
TOTAL (SF)	17,900+/-

NOTE: THIS PLAN IS CONCEPTUAL IN NATURE AND IS INTENDED FOR PLANNING PURPOSES ONLY. STORM DRAINAGE AND GRADING CONCEPTS WILL BE PREPARED ONCE A GENERAL PLANIMETRIC LAYOUT IS AGREED UPON.

NO	DATE	REVISION DESCRIPTION	BY	CK
△				

PUD

WOODLAND GLEN
APJJ, LLC

OFFSITE PROPOSED BASIN MAP TDA #3

0 DUFFY STREET / SEMINARY HILL ROAD
CENTRALIA, WA 98531

MOMENTUM CIVIL
1145 BROADWAY, SUITE 115
TACOMA, WA 98402
PHONE: 253.319.1504

CHECKED BY: AKH
DESIGNED BY: JKM
DRAWN BY: JKM

HORZ. DATUM: NAD83
VERT. DATUM: NAVD88

DATE: 9/21/23

PROJECT NO. DDIP0003

SHEET NO. 1 of 1

REFERENCE NO. FIG3.1

Plot Date: 9/20/2023 3:08 PM By: Dave Diaz
Save Date: 9/20/2023 9:10 AM By: DaveDiaz
File:P:\D\DDIP0003-Cent\0400CAD\Sheets\Exhibits\Drainage Report\Proposed Basin Map TDA #2- DDIP03.dwg

Section 4 – Offsite Analysis

Upstream Tributary Sub-basin

There are three distinct upstream tributary areas to the development which are described below.

West Hillside Run-On

Most of the upstream tributary area for the development is located to the west between Byrd Street and the proposed development (approximately 9.92 acres). This hillside area consists predominantly of native vegetation along with landscaped backyards and dispersed roof runoff from the existing homes that front on Byrd Street. This upstream run-on will be intercepted by means of a roadside ditch on the west side of proposed Road 'A' which will collect and discharge runoff into the central detention pond. The stormwater pond model includes this upstream collected basin in both the pre-developed and developed condition. In this way, the natural drainage pattern of the existing hillside will be maintained.

North Run-On

Run-on occurs near the north edge of the site, predominantly from APN 021003001000, but this upstream area is relatively small (1.05+/- acres), vegetated, and dispersed. This area will be routed into Stream Y and Stream Z as in the existing condition. This area is likewise included in the stormwater pond model in both the predeveloped and developed conditions.

East Run-On

Run-on occurs at the extreme east of the development. This upstream hillside is predominantly undeveloped and directs runoff to the west towards the development. An existing ridge line exists onsite whereby overland flow is split between two existing ravines located to the north and south of the development. Most of the offsite hillside avoids direct run-on to the development and discharges stormwater into the off-site ravines. An area of approximately 0.69 acres directs run-on through the development. This run-on will be dispersed over the adjacent proposed open space Tract and will either infiltrate or enter the drainage system within the newly created roadway. This area is included within the stormwater pond model for the developed condition only, as a basin modification makes this necessary.

Downstream Analysis

Threshold Discharge Area 1 (TDA-1)

Stream Y lacks channel definition in the vicinity of Wetland A and dissipates into the seasonally saturated-only portions of Wetland A within the development limits. From there, Stream Y transitions into Stream Z which flows through Wetland A, before extending offsite to the northwest. From that point, Stream Z continues north for approximately 0.15 miles until reaching a culvert crossing with Roswell Road. From Roswell Road, flow continues in a northwesterly direction for approximately 0.28 miles until reaching China Creek. This information was corroborated with Lewis County GIS data.

Please see **Figure 4** for representation of the Downstream Analysis for this TDA.

Threshold Discharge Area 2 (TDA-2)

According to Lewis County GIS, an unnamed stream originates offsite to the northeast of the development (within APN 021253001000). This stream is mapped flowing northwest through Wetland 2, but according to Soundview Consultants, *"does not appear to provide at least 10% of overbank flooding to the wetland as a primary source of hydrology given the small size of the stream."*

This unnamed stream flows to the northwest for approximately 0.6 miles prior to convergence with Stream Y. From thence, the combined stream continues northwest for approximately 0.21 miles until reaching China Creek.

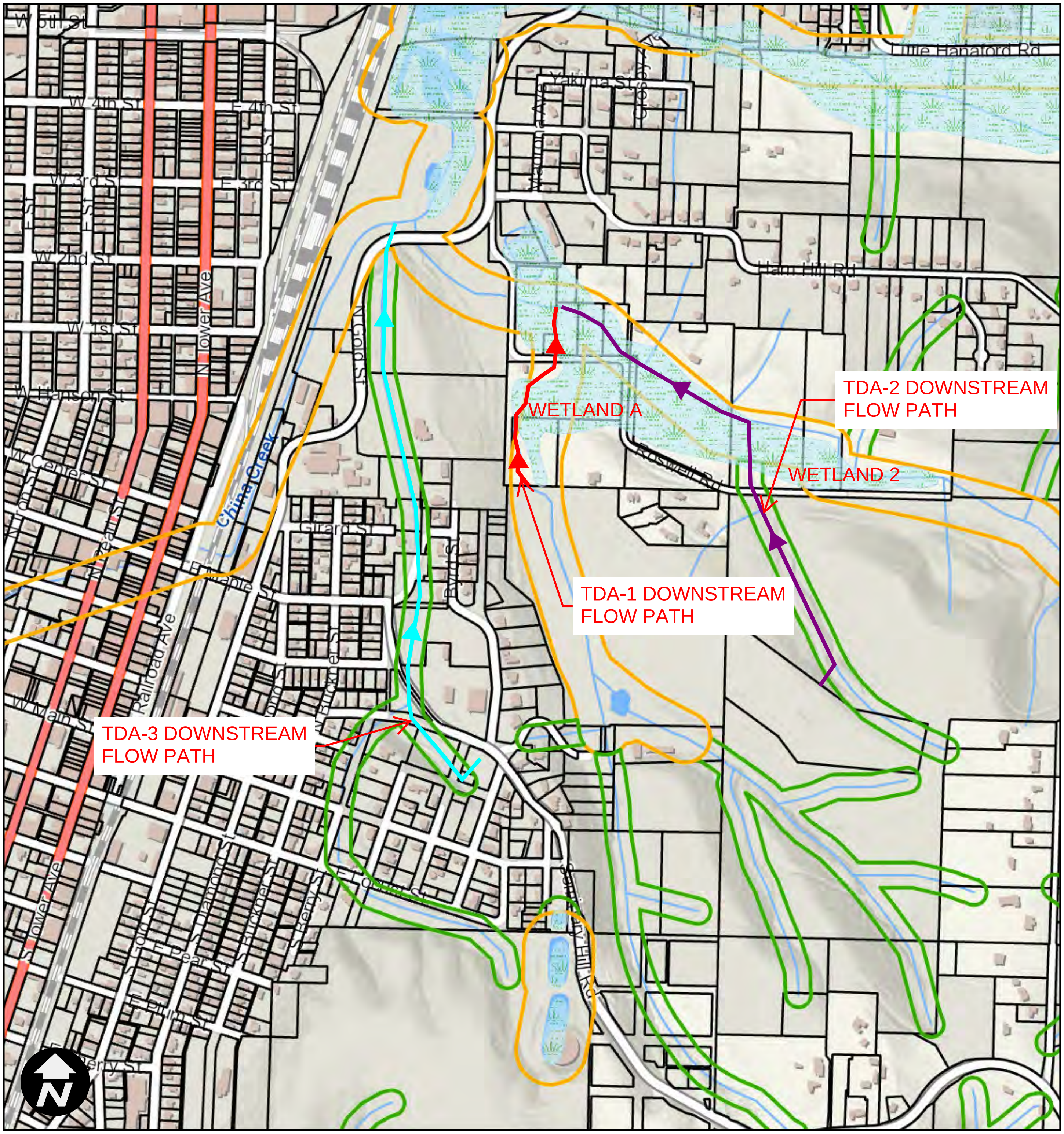
Please see **Figure 4** for representation of the Downstream Analysis for this TDA.

Threshold Discharge Area 3 (TDA-3)

According to Lewis County GIS, an unnamed stream is located to the south of the proposed intersection improvements (within APN 000889001000). This unnamed stream directs flows to the north for approximately 0.62 miles until reaching China Creek.

Please see **Figure 4** for representation of the Downstream Analysis for this TDA.

Figure 4 - Offsite Flow Paths Analysis



Lewis County does not guarantee the accuracy of the information shown on this map and is not responsible for any use or misuse by others regarding this material. It is provided for general informational purposes only. This map does not meet legal, engineering, or survey standards. Please practice due diligence and consult with licensed experts before making decisions.

Section 5 – Discussion of Minimum Requirements and Site Layout

Stormwater Minimum Requirements Summary

This project is considered a new development since less than 35% of the existing surface coverage is hard surface. Because this development will introduce more than 5,000 square feet of new and replaced hard surface, all Minimum Requirements (#1-9) must be considered for this project.

MR #1 – Preparation of Stormwater Site Plans

A preliminary stormwater Site Plan has been prepared in accordance with land use requirements. A final Stormwater Site Plan including a completed drainage report and construction civil plans will be submitted at time of the site development permit submittal to fulfill this requirement.

MR #2 – Construction Stormwater Pollution Prevention Plan (CSWPPP)

A Stormwater Pollution Prevention Plan will be prepared and submitted at time of side development permit which will detail the site-specific Temporary Erosion and Sediment Control (TESC) measures that are applicable to this site.

MR #3 – Source Control of Pollution

Permanent source control Best Management Practices will be selected at the time of Final Plat engineering. Since this project is primarily a residential project with low average daily trip traffic generation for the proposed roads, source control BMPs will be geared towards single-family residential usage.

MR #4 – Preservation of Natural Drainage Systems and Outfalls

As discussed in the project overview, there are three existing Threshold Discharge Areas (TDAs) that are located within the project area. These TDAs will have their natural drainage patterns maintained to the maximum extent practical and all outfalls will have energy dissipation at their respective outfalls. These outfalls will be further designed and documented at the time of site development permit.

A minor basin modification is proposed that directs approximately 5 acres from TDA-2 into TDA-1 in the developed condition. This is caused by existing slopes located immediately offsite which prohibit dispersion within TDA-2. Since there is no legal access for stormwater discharge into the unnamed stream within TDA-2, stormwater runoff from this converted basin area will instead be collected as part of TDA-1. In the existing condition, Runoff from TDA-1 and TDA-2 converge approximately 0.6 miles downstream of the development (measured along the flow path Hof TDA-2). Downstream hydrology will therefore be preserved beyond the convergence point.

MR #5 – Onsite Stormwater Management

This project will employ the List #2 approach as it must address all minimum requirements. Please refer to Table 2 below for the completed List #2 approach.

Table 1: List Approach #2 Onsite Management BMPs for Projects Triggering MR #1-9.

BMP	Feasible?	Limitations on Feasibility
Lawn and Landscaped Areas:		
T5.13: Post Construction Soil Quality and Depth	Y	This BMP will be employed
Roofs		
T5.30: Full Dispersion	N	Lack of vegetative flowpath area for the required density and slopes greater than 15%
T5.10A Downspout Infiltration System	N	These BMPs are currently considered infeasible due to the geotechnical explorations and recommendations. If additional explorations discover infiltrative soils, this BMP will be reconsidered.
T7.30: Bioretention	N	
T5.10B: Downspout Dispersion Systems	N	
T5.10C: Perforated Stub-Out Connections	N	
Other Hard Surfaces		
T5.30: Full Dispersion	N	Lack of vegetative flowpath area for the required density and slopes greater than 15%
T5.15: Permeable Pavement	N	This BMP is currently considered infeasible due to the geotechnical explorations and recommendations. If additional explorations on the upland areas discover infiltrative soils, this BMP will be reconsidered for individual driveways.
T7.30: Bioretention	N	Due to mass grading, it is not desirable to infiltrate at surface level within fill; lack of available space due to required density.
T5.12 Sheet Flow Dispersion	N	lack of available space due to required density; slopes greater than 15% throughout development.
T5.11: Concentrated Flow Dispersion	N	lack of available space due to required density; slopes greater than 15% throughout development.

In general, infiltration BMPs are considered infeasible due to the geotechnical explorations and recommendations. If additional geotechnical explorations on the upland areas discover infiltrative soils, then infiltration of roof runoff may be accomplished via dry wells or infiltration trenches. Any proposed infiltration systems must be at least 50 feet from the top of any slope over 40%. However, this setback may be reduced to 15 feet based on a geotechnical evaluation if site conditions justify it.

MR #6 – Runoff Treatment

TDA-1

Since this project is a residential project, basic treatment applies to all pollution generating hard surfaces. Basic treatment will be provided by one of the following means:

1. A basic wet pond may be constructed within the footprint of the detention pond. Live storage would subsequently be stacked on top of the "dead" storage of the permanent wet pool.
2. A proprietary media filter device may be constructed downstream of the detention pond and would treat 91% of the annual volume of runoff. This option is shown within the Preliminary Civil PUD plans.

TDA-2

TDA-2 will be incorporated within TDA-1 in the developed condition.

TDA-3

The proposed intersection improvements to Duffy Street, Seminary Hill Road, Byrd Street, and Saxon Street are characterized as a road-related project pursuant to Figure I-3.2 of the Manual. Because this project will likely introduce more than 5,000 square feet of new hard surface area, and since the new hard surface area will likely add more than 50% to the existing hard surface area, all minimum requirements must be considered. Treatment will likely be required for the new and replaced hard surface areas since this project will likely introduce more than 5,000 square feet of new pollution generating hard surface coverage. Please refer to Figure 5 for the annotated DOE flow chart for determining minimum requirements for redevelopment.

Based on information contained within the project Traffic Impact Assessment, 2,042 daily weekday trips are forecasted for this development. This trip generation amount is less than 7,500 AADT, so basic treatment applies. Potential treatment BMPs appropriate for this TDA include a media filter device, biofiltration swale, filtration by native soils, or a sand layer. A finalized treatment plan with supporting calculations will be provided at the time of site development permit.

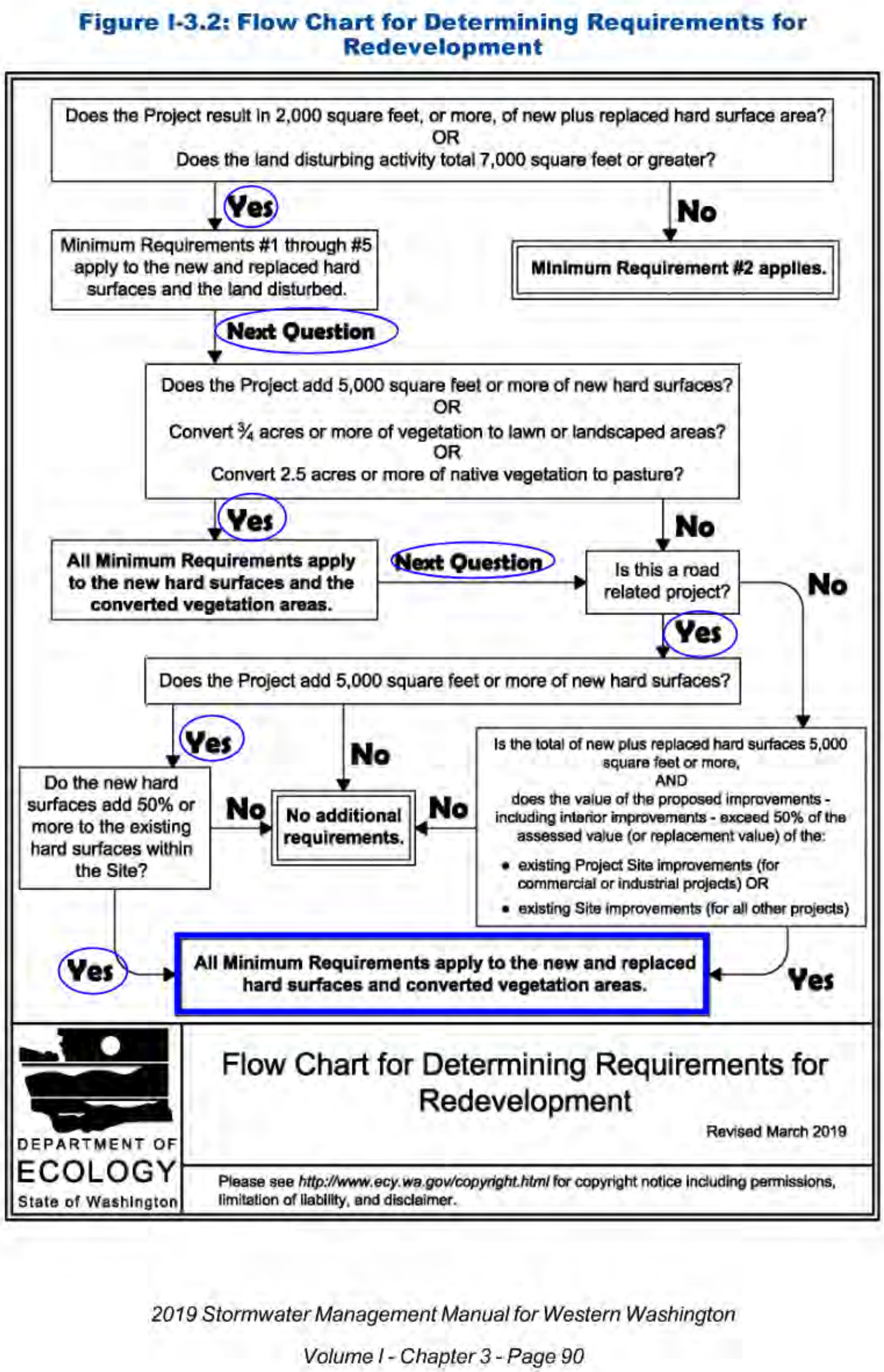


Figure 5: Flow Chart for Determining Requirements for Redevelopment

MR #7 – Flow Control

TDA-1

Flow control will be provided by means of a central detention pond which will discharge into Stream Y. Please refer to Section 6 for further information concerning the design of the central detention pond.

TDA-2

TDA-2 will be incorporated within TDA-1 in the developed condition.

TDA-3

The proposed intersection improvements to Duffy Street, Seminary Hill Road, Byrd Street, and Saxon Street are characterized as a road-related project pursuant to Figure I-3.2 of the Manual. Because this project will likely introduce more than 5,000 square feet of new hard surface area, and since the new hard surface area will likely add more than 50% to the existing hard surface area, all minimum requirements must be considered. Flow control will likely be required as this project will likely introduce more than 10,000 square feet of new hard surface coverage. Please refer to Figure 5 for the annotated DOE flow chart for determining minimum requirements for redevelopment.

Potential flow control measures include, but are not limited, to the following:

1. Infiltration of paved surfaces within an infiltration trench or drywell, pending favorable infiltration rates in the native soils. This area is mapped by the USDA soil survey as having Centralia Loam soils (43), which are favorable for infiltration.
2. Underground detention chambers within the right-of-way.

A finalized flow control plan with supporting calculations will be provided at the time of site development permit.

MR #8 – Wetlands Protection

TDA-1 and Wetland A

Wetland A is located offsite and to the north of the development. This wetland is adjacent to Stream Z and in the opinion of the biologist, *"Stream Z dissipates into Wetland A but does not provide overbank flooding as a primary source of hydrology."* For this reason, Wetland A is considered a depressional wetland, not a riverine wetland, but is hydrologically connected to Stream Y/Z. TDA-1 is therefore tributary to Wetland A. The following wetland protection requirements apply:

- General Protection
- Protection from Pollutants
- Hydroperiod Protection using Method 2

Please refer to Figure for the annotated DOE flow chart for determining wetland protection requirements.

According to the Hydroperiod Map contained within the Wetland, Stream, And Fish and Wildlife Habitat Assessment Report (see Appendix H), only a portion of Wetland A is located within the development limits, making legal access to the wetland difficult. Most of the wetland is located offsite to the north within private property, and the portion of the wetland that is located within the development is categorized as “saturated only,” indicating that bathymetry and creation of a stage storage table is not possible for this portion of the wetland. For this reason, Method 2 analysis is considered appropriate for hydroperiod protection.

A Method 2 hydroperiod protection simulation was performed within WWHM, and the results are included within Appendix D. Although this analysis fails regarding wetland input volume, the variations in wetland input volume fluctuations are considered minor, and in the opinion of the biologist there is no detrimental effect to the wetland caused by the development. Of importance, the development will slightly increase wetland volume inputs annually, but the presence of Stream Y/Z and the elasticity of the saturated only zone should make this impact de minimis.

TDA-1.1 and Wetland 1

Wetland 1 is categorized as a Type III Slope Wetland and is located offsite and to the south of the development. The following wetland protection requirements apply to this TDA:

- General Protection
- Protection from Pollutants
- Hydroperiod Protection (Method 2)

Because Wetland 1 is a slope wetland, it is not subject to a contributing basin caused by Stream Y which runs through the wetland. Only the upland slope that directs runoff through the wetland (not Stream Y) is considered tributary to the wetland, a disturbed area of approximately 32,000 square feet within the development. This area, referred to as TDA 1.1, is a subcomponent of TDA-1, and since flow control is required for TDA-1, hydroperiod protection is applicable.

In the developed condition, the existing onsite tributary area for Wetland 1 will have its stormwater routed to the detention pond and will therefore bypass Wetland 1. In its place, a substitute basin will be created that is comprised of portions of Lots 67 through 85 that will be managed by a control structure that splits flows between TDA 1 and TDA 1.1 followed by a level flow spreader at the edge of the wetland buffer. A hydroperiod protection WWHM model will be performed at the time of Final Engineering.

TDA-2

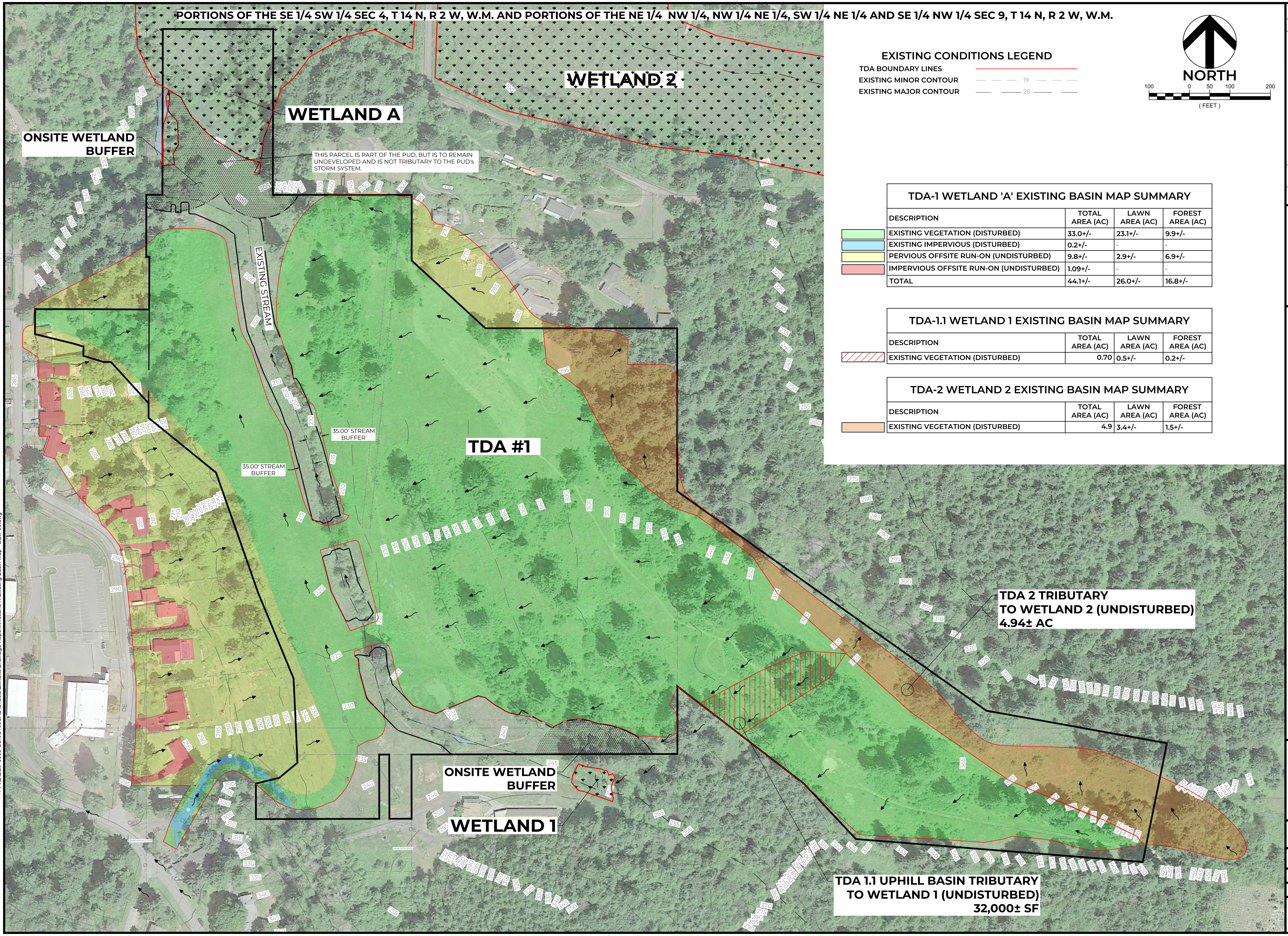
Wetland 2 is located offsite and to the north of TDA-2. Since this TDA does not trigger the requirement for Flow Control BMPs under Minimum Requirement #7, the following wetland protection requirements apply to this TDA:

- General Protection
- Protection from Pollutants

A proposed minor basin modification will redirect approximately 5 acres from Wetland 2 towards Wetland A. According to the Contributing Basin Map contained with the Wetland, Stream, and Fish and Wildlife Habitat Assessment Report (see Appendix H), the total existing tributary area for Wetland 2 is approximately 356 acres. The proposed minor basin modification will result in a basin change of approximately 1.4% which is considered de minimis.

TDA-3

No wetlands are identified downstream of TDA-3, so this minimum requirement does not apply to this TDA.



TDA-1 WETLAND 'A' EXISTING BASIN MAP SUMMARY

DESCRIPTION	TOTAL AREA (AC)	LAWN AREA (AC)	FOREST AREA (AC)
EXISTING VEGETATION (DISTURBED)	33.0+/-	23.1+/-	9.9+/-
EXISTING IMPERVIOUS (DISTURBED)	0.2+/-	-	-
PERVIOUS OFFSITE RUN-ON (UNDISTURBED)	9.8+/-	2.9+/-	6.9+/-
IMPERVIOUS OFFSITE RUN-ON (UNDISTURBED)	1.09+/-	-	-
TOTAL	44.1+/-	26.0+/-	16.8+/-

TDA-1.1 WETLAND 1 EXISTING BASIN MAP SUMMARY

DESCRIPTION	TOTAL AREA (AC)	LAWN AREA (AC)	FOREST AREA (AC)
EXISTING VEGETATION (DISTURBED)	0.70	0.5+/-	0.2+/-

TDA-2 WETLAND 2 EXISTING BASIN MAP SUMMARY

DESCRIPTION	TOTAL AREA (AC)	LAWN AREA (AC)	FOREST AREA (AC)
EXISTING VEGETATION (DISTURBED)	4.9	3.4+/-	1.5+/-

NO. | DATE | REVISION DESCRIPTION | BY | CK

PUD

WETLANDS EXISTING BASIN MAP

WOODLAND GLEN
APJJ, LLC
0 DUFFY STREET / SEMINARY HILL ROAD
CENTRALIA, WA 98531

MOMENTUM CIVIL
1145 BROADWAY, SUITE 115
TACOMA, WA 98402
PHONE: 253.319.1504

CHECKED BY: AKH
DESIGNED BY: JKM
DRAWN BY: JKM

HORZ. DATUM: NAD83
VERT. DATUM: NAVD88

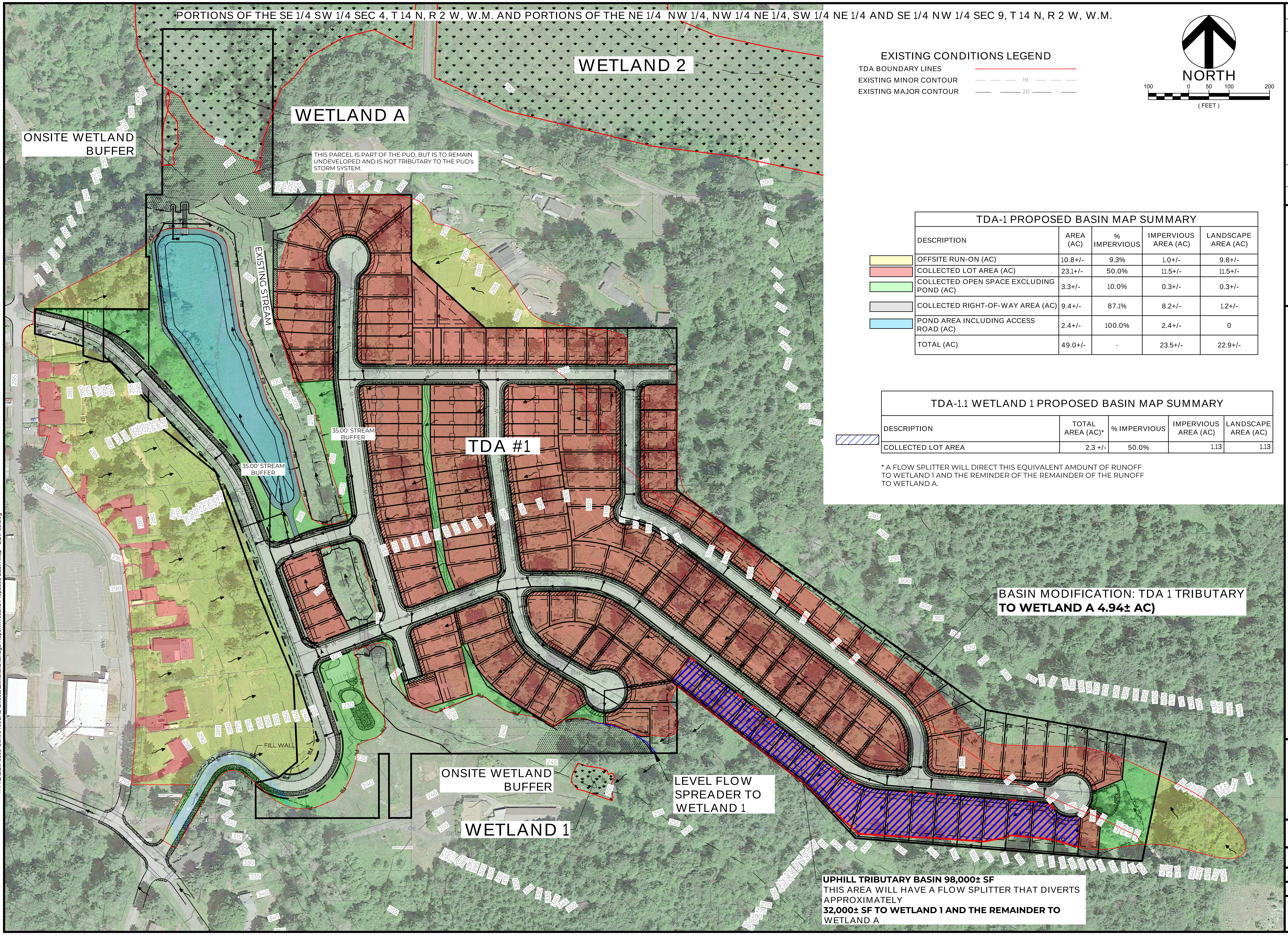
DATE: 9/21/23

PROJECT NO. DDIP0003

SHEET NO. 1 OF 1

REFERENCE NO. FIG5

Plot Date: 9/20/2023 3:09 PM By: Dave Diaz
Save Date: 9/20/2023 3:00 PM By: DaveDiaz
File:P:\D\DDIP0003-Cent\0400CAD\Sheets\Exhibits\Drainage Report\Wetland A Existing Basin Map - DDIP03.dwg



TDA-1 PROPOSED BASIN MAP SUMMARY				
DESCRIPTION	AREA (AC)	% IMPERVIOUS	IMPERVIOUS AREA (AC)	LANDSCAPE AREA (AC)
OFFSITE RUN-ON (AC)	10.8+/-	9.3%	1.0+/-	9.8+/-
COLLECTED LOT AREA (AC)	23.1+/-	50.0%	11.5+/-	11.5+/-
COLLECTED OPEN SPACE EXCLUDING POND (AC)	3.3+/-	10.0%	0.3+/-	0.3+/-
COLLECTED RIGHT-OF-WAY AREA (AC)	9.4+/-	87.1%	8.2+/-	1.2+/-
POND AREA INCLUDING ACCESS ROAD (AC)	2.4+/-	100.0%	2.4+/-	0
TOTAL (AC)	49.0+/-	-	23.5+/-	22.9+/-

TDA-1.1 WETLAND 1 PROPOSED BASIN MAP SUMMARY				
DESCRIPTION	TOTAL AREA (AC)*	% IMPERVIOUS	IMPERVIOUS AREA (AC)	LANDSCAPE AREA (AC)
COLLECTED LOT AREA	2.3 +/-	50.0%	1.13	1.13

* A FLOW SPLITTER WILL DIRECT THIS EQUIVALENT AMOUNT OF RUNOFF TO WETLAND 1 AND THE REMINDER OF THE REMAINDER OF THE RUNOFF TO WETLAND A.

NO. | DATE | REVISION DESCRIPTION | BY | CK

PUD

WOODLAND GLEN
APJJ, LLC

WETLAND PROPOSED BASIN MAP

XX DUFFY STREET / SEMINARY HILL ROAD
CENTRALIA, WA 98531

MOMENTUM CIVIL
1145 BROADWAY, SUITE 115
TACOMA, WA 98402
PHONE: 253.319.1504

CHECKED BY: AKH
DESIGNED BY: JKM
DRAWN BY: JKM

HORZ. DATUM: NAD83
VERT. DATUM: NAVD88

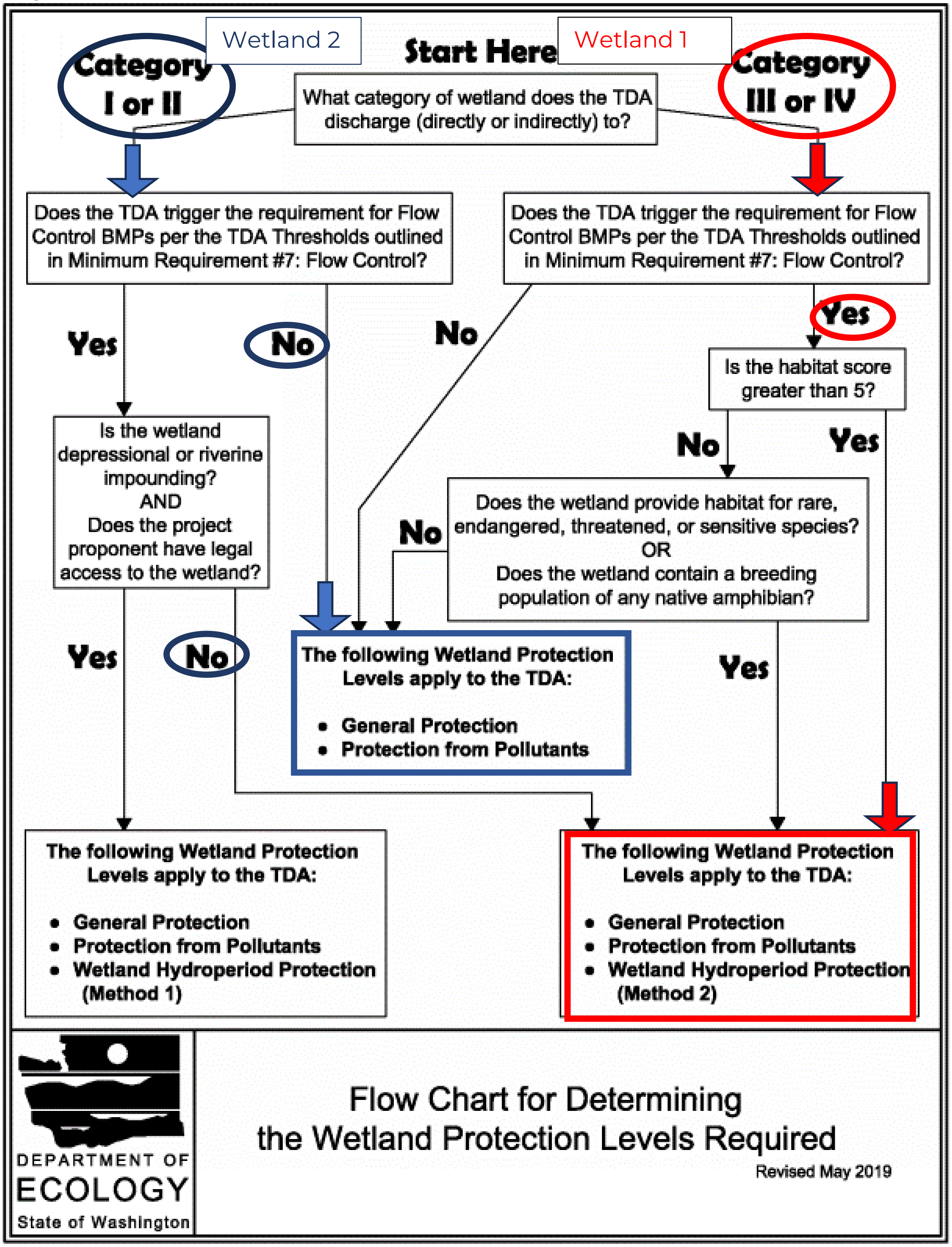
DATE: 9/21/23

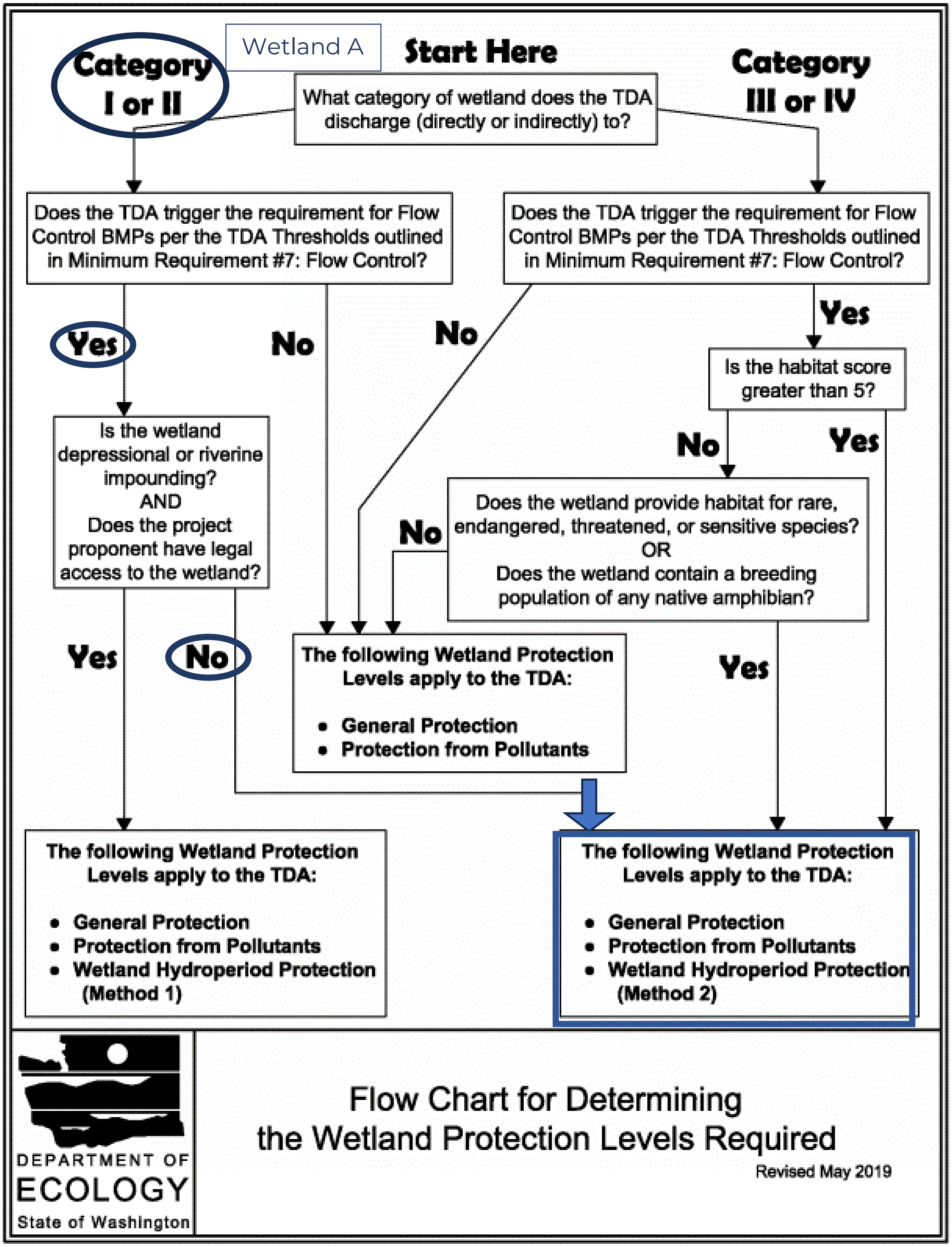
PROJECT NO. DDIP0003

SHEET NO. 1 OF 1

REFERENCE NO. FIG6

Figure 8: Flow Chart for Determining Wetland Protection Level Requirements




Wetland A
Start Here
Category I or II
What category of wetland does the TDA discharge (directly or indirectly) to?
Category III or IV
Does the TDA trigger the requirement for Flow Control BMPs per the TDA Thresholds outlined in Minimum Requirement #7: Flow Control?
Does the TDA trigger the requirement for Flow Control BMPs per the TDA Thresholds outlined in Minimum Requirement #7: Flow Control?
Yes
No
No
Yes
Is the habitat score greater than 5?
Is the wetland depressional or riverine impounding? AND Does the project proponent have legal access to the wetland?
No
Yes
Does the wetland provide habitat for rare, endangered, threatened, or sensitive species? OR Does the wetland contain a breeding population of any native amphibian?
No
Yes
No
The following Wetland Protection Levels apply to the TDA:
General Protection
Protection from Pollutants
Yes
The following Wetland Protection Levels apply to the TDA:
General Protection
Protection from Pollutants
Wetland Hydroperiod Protection (Method 1)
The following Wetland Protection Levels apply to the TDA:
General Protection
Protection from Pollutants
Wetland Hydroperiod Protection (Method 2)
DEPARTMENT OF ECOLOGY State of Washington
Flow Chart for Determining the Wetland Protection Levels Required
Revised May 2019

MR #9 – Operation and Maintenance

An Operation and Maintenance (O&M) Manual will be produced at the time of site development permit. This O&M Manual will provide prescriptive maintenance activities for the selected BMPs (central pond, treatment device, roof infiltration trenches), maintenance logs, and contact persons responsible for operation and maintenance. Of note, the pond and treatment device are anticipated to be maintained by a homeowner's association for the plat.

Section 6 – Permanent Stormwater Control Plan

Basin Delineation

- **TDA-1:** The majority of the onsite Planned Unit Development belongs to a Threshold Discharge Area (TDA-1) associated with an existing stream (referred to as Stream Y and Stream Z within this report) that is located onsite. Runoff collected within the onsite development will be collected, detained, treated, and discharged into Stream Y and Stream Z at a location near the northwest corner of the development.

- **TDA-2**: An existing topographic ridgeline is present within the eastern portion of the development. Runoff generated to the south and west of this ridgeline belongs to TDA-1 whereas runoff generated to the north and east of the ridge line belong to TDA-2. In the existing condition, runoff within TDA-2 is directed into a natural ravine to the north, which connects to Stream Y and Stream Z beyond ¼ mile from the point of discharge for TDA-1. In the proposed condition, all roof runoff within this TDA is anticipated to be infiltrated to help match the existing hydrology of the basin. A minor basin modification is proposed, approximately 5.0 acres, as the proposed roadway within this basin will be directed to TDA-1 in the developed condition.

- **TDA-3:** The Offsite Right-of-Way Improvements for the Duffy Intersection belong to a separate Threshold Discharge Area (TDA) associated with a separate stream. Since the scope of improvements to the Duffy Intersection is still uncertain, no stormwater improvements or calculations for this TDA have been performed. It is assumed that stormwater treatment and flow control will be required for this TDA.

Stormwater Conveyance System

A complete conveyance system analysis will be performed at the time of site development permit. For preliminary design, a single-segment pipe analysis using Manning's Equation results in a pipe flow capacity of 16.1 cubic feet per second (cfs) for an 18-inch diameter pipe at 2% slope, utilizing a Manning's n value of 0.012 (typical for PVC pipe). In contrast, for TDA-1 the calculated peak runoff is 14.7 cfs for the 25-year return storm and 20.2 cfs for the 100-year return storm using the Santa Barbara Unit Hydrograph (SBUH) method. Please refer to Appendix E for the full inputs and results for the Manning's Equation and SBUH calculations associated with TDA-1.

Central Detention Pond for TDA-1

The central detention pond was sized using WWHM to calculate the required detention volume for stream protection. The initial simulation utilized the auto-pond feature within the program which results in a pond volume at riser head of 12.1 acre-feet to achieve proper stream protection. Please refer to Table 2 for the auto-pond features.

This initial auto-pond was used as the starting basis for the graded pond which is shown on the plans. The graded pond utilized the same outlet structure data as the auto-pond but has an irregular footprint, resulting in a pond volume at the riser of 12.1 acre-feet.

Table 2: Detention Pond Properties

Description	**Auto-pond**	**Graded Pond**
Pond volume at Riser Height	12.1 ac-ft	12.1 ac-ft
Live Storage Bottom Elevation	199.0 feet (based on survey datum)	199.0 feet (based on survey datum)
Riser Height	7.5 feet	8 feet
Side Slopes (wetted)	2H:1V	2H:1V
Bottom Length	250 feet	550 feet (irregular)
Bottom Width	250 feet	130 feet (irregular)
Bottom Live Storage Area	62,500 square feet	54,974 square feet
Orifice 1 Dia.	3.91 inches	3.98 inches
Orifice 1 Elevation	199.0	199.0
Orifice 2 Dia.	NA	2.80 inches
Orifice 2 Elevation	NA	203.5
Orifice 3 Dia.	NA	4.0 inches
Orifice 3 Elevation	NA	206.25
Riser Diameter	30 inches	48 inches
Riser Type	Notched	Notched
Notch Type	Rectangular	Rectangular
Notch Height	3.31 feet	3.31 feet
Notch Width	1.1 inches	1.1 inches

The proposed pond was designed in AutoCAD and the contours extracted at an interval of 0.5 feet to create the live stage storage table shown in Table 3. This stage storage table was subsequently input within WWHM to ensure the proposed pond provides proper stream protection under Minimum Requirement #7. The facility passed.

Table 3: Stage Storage Table for Graded Pond

ELEV	AREA (sq. ft.)	DEPTH (ft)	AVG END INC. VOL. (cu. ft.)	CUMULATIVE AVG END TOTAL VOL. (cu. ft.)	CUMULATIVE AVG END TOTAL VOL. (ac. ft.)
199	53,783	N/A	N/A	0	0.00
199.5	55,248	0.5	27,258	27,258	0.63
200	56,721	0.5	27,992	55,250	1.27
200.5	58,202	0.5	28,731	83,980	1.93
201	59,693	0.5	29,474	113,454	2.60
201.5	61,192	0.5	30,221	143,675	3.30
202	62,703	0.5	30,974	174,649	4.01
202.5	64,231	0.5	31,733	206,382	4.74

203	65,769	0.5	32,500	238,882	5.48
203.5	67,313	0.5	33,270	272,153	6.25
204	68,871	0.5	34,046	306,199	7.03
204.5	70,453	0.5	34,831	341,030	7.83
205	72,036	0.5	35,622	376,652	8.65
205.5	73,627	0.5	36,416	413,068	9.48
206	75,239	0.5	37,216	450,284	10.34
206.5	76,869	0.5	38,027	488,311	11.21
207	78,506	0.5	38,844	527,155	12.10
207.5	80,169	0.5	39,669	566,824	13.01
208	81,860	0.5	40,507	607,331	13.94
208.5	83,586	0.5	41,362	648,693	14.89
209	85,905	0.5	42,373	691,066	15.86

The proposed pond will ultimately outlet into Stream Z within the development limits. This stream has an approximate stream bed elevation of 197 north of the detention pond but further field survey of the stream bed channel is required to verify the pond outlet configuration. The elevations shown in Table 4 determine the pond hydraulic design.

Table 4: Detention Pond Significant Elevations

Stream Z Elevation at Point of Discharge	197.0 feet
Media Filter Device Outlet Invert	197.25 feet
Media Filter Device Inlet Invert	199.0 feet
Bottom of Live Storage	199.0 feet
Top of Riser	207.0 feet
Water Surf. Elev. At Overflow into Riser 100-Year Unattenuated Flow	207.48 feet
Bottom of Emergency Overflow Weir	207.75 feet
Top of Embankment	209.0 feet

The primary overflow will be provided by a stand-alone 48-inch diameter manhole equipped with a trash barrier cage. This overflow structure will connect to the outlet pipe downstream of the control structure which will contain the riser.

An emergency overflow weir and spillway will be constructed at the north end of the pond and will be designed and constructed in conformance with the Dam Safety Regulations by Ecology. This emergency spillway will consist of a trapezoidal weir that is paved where the pond access road crosses the spillway at the top of the embankment, and will have gabion reinforcement along the full length of the spillway until reaching the Stream Z buffer edge. The emergency spillway will be sized to accommodate the 500-year-frequency unmitigated flow for the developed basin. Please see Table 5 below for the calculated flow values for various storm return frequencies.

Table 5: Return Frequency Flows for TDA-1

Return Frequency	Predeveloped Scenario (501 series)	Mitigated Developed Scenario (801 series)	Unmitigated Developed Scenario (701 series)
2 years	1.73 cfs	0.96 cfs	9.13 cfs
5 years	2.64 cfs	1.46 cfs	11.72 cfs
10 years	3.22 cfs	1.87 cfs	13.35 cfs
25 years	3.93 cfs	2.49 cfs	15.34 cfs
50 years	4.43 cfs	3.03 cfs	16.78 cfs
100 years	4.92 cfs	3.65 cfs	18.19 cfs
200 years	5.46 cfs	4.39 cfs	19.72 cfs
500 years	6.05 cfs	5.28 cfs	21.37 cfs

Please refer to Appendix C for the WWHM simulation results associated with the auto-pond and the graded pond within the plans.

Stormwater Treatment System for TDA-1

It is envisioned that stormwater treatment will be provided by either a permanent wet pond or a media filter device.

Wet Pond

A basic wet pond can be constructed within the footprint of the detention pond and live storage would subsequently be stacked on top of the "dead" storage of the permanent wet pool. According to the WWHM simulation for TDA-1, the required water quality BMP facility volume is 3.25 acre-feet. A two-cell wet pond can be graded within the footprint of the proposed detention pond that has a minimum depth of 4 feet for the first cell and the required volume. However, this may necessitate excavating the bottom of the wet pond below the level of the adjacent stream bed, which would require pumping the facility to perform maintenance (as opposed to gravity draining the wet pond). The geometry of the pond is conducive for plug flow with a length-to-width ratio of approximately 4.2, based on an approximate pond length or 550 feet compared to an average width of 125 feet.

Media Filter Device

It is envisioned that a proprietary media filter device will be installed downstream of detention which will treat the required 91% of the annual volume of runoff from the pond prior to discharge within Stream Y and Stream Z. According to the WWHM simulation for TDA-1, the required 2-year mitigated flow from the pond is 0.96 cfs (22 gpm). Several manufactured treatment devices can treat this flow rate in an offline configuration while providing bypass for higher flows. As an example, Contech Engineered Solutions has a product called the "Jellyfish" which is approved for General Use Level Designation for basic (TSS) and phosphorus treatment. This filter can operate within a 72-inch precast manhole and contains up to six discrete cartridges. The maximum treatment capacity flow rate for a 72-inch manhole Jellyfish is 1.16 cfs, which is greater than the anticipated 2-year design water quality flow rate of 0.96 cfs. The required minimum drop across the structure is 21 inches (1.75 feet), which will allow the filter to operate under normal upstream head conditions for the 2-year storm and under.

Please refer to Appendix F for the DOE TAPE approval and the Jellyfish standard detail from the manufacturer. Please refer to Appendix C for the WWHM simulation results associated with the water quality flow rate and volume calculations.

List of Appendices

Appendix A - Civil Engineering Plans

[Submitted Under Separate Cover]

Appendix B - USDA Web Soil Survey

Map Scale: 1:6,210 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 300, 600, 1200, 1800

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Lewis County Area, Washington
Survey Area Data: Version 22, Sep 8, 2022

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 21, 2021—Nov 22, 2021

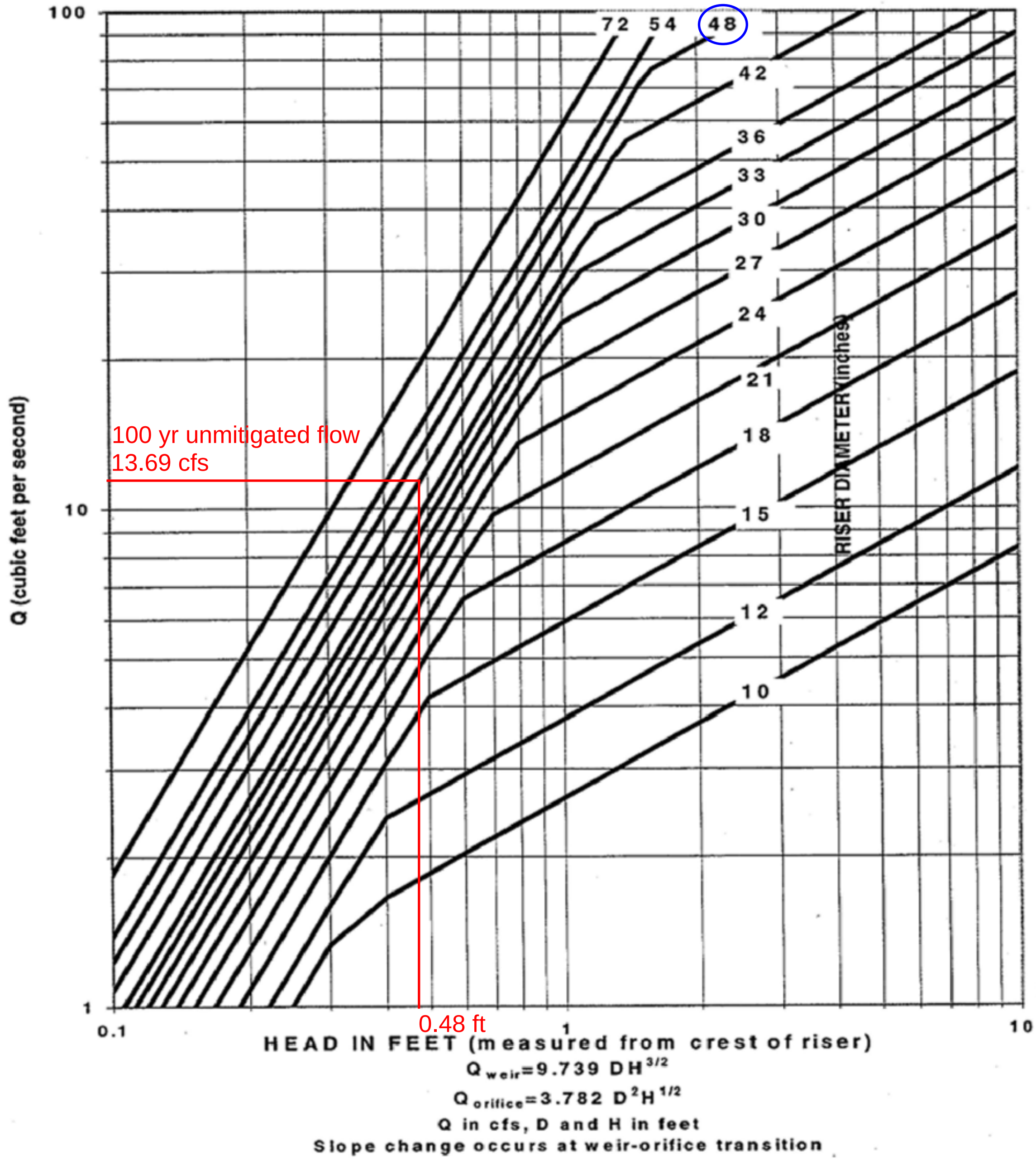
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
27	Buckpeak silt loam, 30 to 65 percent slopes	27.6	30.5%
43	Centralia loam, 8 to 15 percent slopes	17.0	18.8%
44	Centralia loam, 15 to 30 percent slopes	20.7	22.9%
89	Galvin silt loam, 0 to 8 percent slopes	1.9	2.1%
167	Prather silty clay loam, 0 to 5 percent slopes	5.1	5.6%
172	Reed silty clay loam	17.7	19.5%
194	Scamman silty clay loam, 5 to 15 percent slopes	0.5	0.6%
Totals for Area of Interest		**90.4**	**100.0%**

Appendix C - Flow Control and Water Quality WWHM Calculations

Figure V-12.8: Riser Inflow Curves



DEPARTMENT OF ECOLOGY
State of Washington

Riser Inflow Curves

Revised June 2016

WWHM2012

PROJECT REPORT

MR#7 FLOW CONTROL
DETENTION POND DESIGN WITH STAGE STORAGE TABLE FROM GRADED POND

General Model Information

WWHM2012 Project Name: Pond for PUD Application DDIP03

Site Name:	Double Dip Plat
Site Address:	
City:	Centralia
Report Date:	9/21/2023
Gage:	Olympia
Data Start:	1955/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	0.800
Version Date:	2023/01/27
Version:	4.2.19

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

ONSITE BASIN

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	33.21
Pervious Total	33.21
Impervious Land Use	acre
Impervious Total	0
Basin Total	33.21

OFFSITE RUN ON

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Steep	9.8
Pervious Total	9.8
Impervious Land Use	acre
ROADS FLAT	0.32
ROOF TOPS FLAT	0.7
SIDEWALKS FLAT	0.07
Impervious Total	1.09
Basin Total	10.89

Mitigated Land Use

IMPROVEMENTS

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Mod	16.3
Pervious Total	16.3
Impervious Land Use	acre
ROADS FLAT	19.6
POND	2.4
Impervious Total	22
Basin Total	38.3

THIS QUANTITY INCLUDES PAVING, SIDEWALKS, ROOFS, ETC.

OFFSITE RUN ON

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Steep	8.17
C, Forest, Mod	2.33
Pervious Total	10.5
Impervious Land Use	acre
ROADS FLAT	0.32
ROOF TOPS FLAT	0.7
SIDEWALKS FLAT	0.07
Impervious Total	1.09
Basin Total	11.59

Routing Elements
Predeveloped Routing

Mitigated Routing

Trapezoidal Pond 1 (PRECURSER POND - NOT USED AS POINT OF COMPLIANCE)

Bottom Length:	249.28 ft.
Bottom Width:	249.28 ft.
Depth:	8.5 ft.
Volume at riser head:	12.1382 acre-feet.
Side slope 1:	2 To 1
Side slope 2:	2 To 1
Side slope 3:	2 To 1
Side slope 4:	2 To 1
Discharge Structure	
Riser Height:	7.5 ft.
Riser Diameter:	30 in.
Notch Type:	Rectangular
Notch Width:	0.092 ft.
Notch Height:	3.309 ft.
Orifice 1 Diameter:	3.951 in. Elevation:0 ft.
Element Flows To:	
Outlet 1	Outlet 2

Pond Hydraulic Table

Stage(feet)	**Area(ac.)**	**Volume(ac-ft.)**	**Discharge(cfs)**	**Infilt(cfs)**
0.0000	1.426	0.000	0.000	0.000
0.0944	1.430	0.134	0.130	0.000
0.1889	1.435	0.270	0.184	0.000
0.2833	1.439	0.406	0.225	0.000
0.3778	1.443	0.542	0.260	0.000
0.4722	1.448	0.678	0.291	0.000
0.5667	1.452	0.815	0.318	0.000
0.6611	1.457	0.953	0.344	0.000
0.7556	1.461	1.091	0.368	0.000
0.8500	1.465	1.229	0.390	0.000
0.9444	1.470	1.367	0.411	0.000
1.0389	1.474	1.506	0.431	0.000
1.1333	1.478	1.646	0.451	0.000
1.2278	1.483	1.786	0.469	0.000
1.3222	1.487	1.926	0.487	0.000
1.4167	1.492	2.067	0.504	0.000
1.5111	1.496	2.208	0.520	0.000
1.6056	1.501	2.350	0.536	0.000
1.7000	1.505	2.492	0.552	0.000
1.7944	1.509	2.634	0.567	0.000
1.8889	1.514	2.777	0.582	0.000
1.9833	1.518	2.920	0.596	0.000
2.0778	1.523	3.064	0.610	0.000
2.1722	1.527	3.208	0.624	0.000
2.2667	1.532	3.352	0.637	0.000
2.3611	1.536	3.497	0.650	0.000
2.4556	1.541	3.642	0.663	0.000
2.5500	1.545	3.788	0.676	0.000
2.6444	1.550	3.934	0.688	0.000
2.7389	1.554	4.081	0.701	0.000
2.8333	1.559	4.228	0.713	0.000
2.9278	1.563	4.376	0.724	0.000

3.0222	1.568	4.523	0.736	0.000
3.1167	1.572	4.672	0.747	0.000
3.2111	1.577	4.821	0.759	0.000
3.3056	1.581	4.970	0.770	0.000
3.4000	1.586	5.119	0.781	0.000
3.4944	1.591	5.269	0.791	0.000
3.5889	1.595	5.420	0.802	0.000
3.6833	1.600	5.571	0.813	0.000
3.7778	1.604	5.722	0.823	0.000
3.8722	1.609	5.874	0.833	0.000
3.9667	1.614	6.026	0.843	0.000
4.0611	1.618	6.179	0.853	0.000
4.1556	1.623	6.332	0.863	0.000
4.2500	1.627	6.485	0.877	0.000
4.3444	1.632	6.639	0.900	0.000
4.4389	1.637	6.794	0.928	0.000
4.5333	1.641	6.949	0.959	0.000
4.6278	1.646	7.104	0.992	0.000
4.7222	1.651	7.260	1.026	0.000
4.8167	1.655	7.416	1.062	0.000
4.9111	1.660	7.572	1.099	0.000
5.0056	1.665	7.729	1.136	0.000
5.1000	1.669	7.887	1.173	0.000
5.1944	1.674	8.045	1.211	0.000
5.2889	1.679	8.203	1.256	0.000
5.3833	1.683	8.362	1.302	0.000
5.4778	1.688	8.521	1.349	0.000
5.5722	1.693	8.681	1.397	0.000
5.6667	1.697	8.841	1.588	0.000
5.7611	1.702	9.001	1.653	0.000
5.8556	1.707	9.162	1.720	0.000
5.9500	1.712	9.324	1.788	0.000
6.0444	1.716	9.486	1.858	0.000
6.1389	1.721	9.648	1.929	0.000
6.2333	1.726	9.811	2.002	0.000
6.3278	1.731	9.974	2.076	0.000
6.4222	1.735	10.13	2.152	0.000
6.5167	1.740	10.30	2.229	0.000
6.6111	1.745	10.46	2.307	0.000
6.7056	1.750	10.63	2.387	0.000
6.8000	1.754	10.79	2.468	0.000
6.8944	1.759	10.96	2.550	0.000
6.9889	1.764	11.13	2.634	0.000
7.0833	1.769	11.29	2.719	0.000
7.1778	1.774	11.46	2.805	0.000
7.2722	1.778	11.63	2.892	0.000
7.3667	1.783	11.80	2.981	0.000
7.4611	1.788	11.96	3.070	0.000
7.5556	1.793	12.13	3.459	0.000
7.6500	1.798	12.30	4.657	0.000
7.7444	1.803	12.47	6.314	0.000
7.8389	1.808	12.64	8.293	0.000
7.9333	1.812	12.81	10.49	0.000
8.0278	1.817	12.99	12.80	0.000
8.1222	1.822	13.16	15.12	0.000
8.2167	1.827	13.33	17.34	0.000
8.3111	1.832	13.50	19.36	0.000
8.4056	1.837	13.68	21.12	0.000

8.5000	1.842	13.85	22.55	0.000
8.5944	1.847	14.02	23.66	0.000

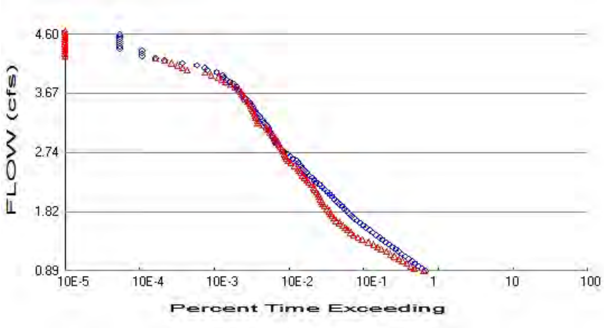
SSD Table 2 GRADED POND - USED AS POINT OF COMPLIANCE

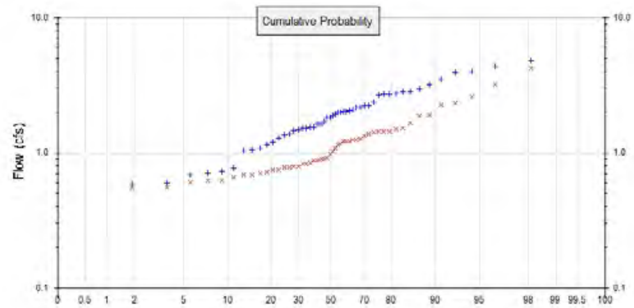
Depth: 209 ft.
Discharge Structure: 1
Riser Height: 207 ft.
Riser Diameter: 48 in.
Notch Type: Rectangular
Notch Width: 0.100 ft.
Notch Height: 3.300 ft.
Orifice 1 Diameter: 3.980 in. Elevation:199 ft.
Orifice 2 Diameter: 2.800 in. Elevation:203.5 ft.
Orifice 3 Diameter: 4.000 in. Elevation:206.25 ft.
Element Flows To:
Outlet 1 Outlet 2

SSD Table Hydraulic Table

Stage (feet)	Area (ac.)	Volume (ac-ft.)	Outlet Struct	NotUsed	NotUsed	NotUsed	NotUsed
199.0	1.230	0.000	0.000	0.000	0.000	0.000	0.000
199.5	1.270	0.630	0.304	0.000	0.000	0.000	0.000
200.0	1.300	1.270	0.430	0.000	0.000	0.000	0.000
200.5	1.340	1.930	0.526	0.000	0.000	0.000	0.000
201.0	1.370	2.600	0.608	0.000	0.000	0.000	0.000
201.5	1.400	3.300	0.680	0.000	0.000	0.000	0.000
202.0	1.440	4.010	0.745	0.000	0.000	0.000	0.000
202.5	1.470	4.740	0.804	0.000	0.000	0.000	0.000
203.0	1.510	5.480	0.860	0.000	0.000	0.000	0.000
203.5	1.550	6.250	0.912	0.000	0.000	0.000	0.000
204.0	1.580	7.030	1.163	0.000	0.000	0.000	0.000
204.5	1.620	7.830	1.421	0.000	0.000	0.000	0.000
205.0	1.650	8.650	1.708	0.000	0.000	0.000	0.000
205.5	1.690	9.480	2.219	0.000	0.000	0.000	0.000
206.0	1.730	10.34	2.661	0.000	0.000	0.000	0.000
206.5	1.760	11.21	3.358	0.000	0.000	0.000	0.000
207.0	1.800	12.10	4.030	0.000	0.000	0.000	0.000
207.5	1.840	13.01	19.04	0.000	0.000	0.000	0.000
208.0	1.880	13.94	43.32	0.000	0.000	0.000	0.000
208.5	1.920	14.89	64.28	0.000	0.000	0.000	0.000
209.0	1.970	15.86	75.13	0.000	0.000	0.000	0.000

Analysis Results
POC 1





+ Predeveloped x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 43.01
Total Impervious Area: 1.09

Mitigated Landuse Totals for POC #1
Total Pervious Area: 26.8
Total Impervious Area: 23.09

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	1.783716
5 year	2.721108
10 year	3.328257
25 year	4.067694
50 year	4.595687
100 year	5.103576

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	1.029533
5 year	1.551885
10 year	1.966958
25 year	2.577467
50 year	3.099545
100 year	3.683461

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	1.933	1.208
1957	3.195	1.270
1958	1.189	0.626
1959	1.476	0.875
1960	2.357	2.319
1961	1.641	0.902
1962	0.598	0.624
1963	2.750	1.441
1964	1.981	0.907
1965	1.698	0.797

1966	1.143	0.683
1967	1.886	0.885
1968	1.449	0.786
1969	0.772	0.684
1970	1.529	0.986
1971	1.824	1.342
1972	2.838	2.252
1973	1.540	1.379
1974	1.366	0.880
1975	3.499	0.703
1976	2.243	1.509
1977	0.589	0.550
1978	2.019	1.246
1979	2.732	0.743
1980	1.550	1.215
1981	2.731	1.138
1982	1.379	1.085
1983	2.688	0.896
1984	2.064	0.828
1985	0.684	0.655
1986	2.854	1.653
1987	3.994	1.912
1988	1.088	0.777
1989	1.287	0.750
1990	3.959	1.446
1991	4.783	3.188
1992	1.050	0.835
1993	0.703	0.609
1994	0.728	0.558
1995	1.821	1.216
1996	2.949	1.892
1997	1.626	1.410
1998	2.002	0.794
1999	2.030	1.428
2000	2.177	1.245
2001	0.429	0.517
2002	2.162	1.523
2003	1.043	0.714
2004	1.626	1.163
2005	1.515	0.824
2006	2.243	1.026
2007	2.059	2.591
2008	4.356	4.247

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	4.7828	4.2469
2	4.3564	3.1883
3	3.9937	2.5908
4	3.9592	2.3195
5	3.4993	2.2522
6	3.1946	1.9124
7	2.9490	1.8917
8	2.8538	1.6525
9	2.8382	1.5233
10	2.7496	1.5091
11	2.7319	1.4462

12	2.7311	1.4406
13	2.6883	1.4282
14	2.3575	1.4103
15	2.2426	1.3794
16	2.2425	1.3421
17	2.1773	1.2696
18	2.1622	1.2456
19	2.0636	1.2452
20	2.0590	1.2162
21	2.0304	1.2155
22	2.0192	1.2079
23	2.0018	1.1631
24	1.9806	1.1380
25	1.9331	1.0849
26	1.8860	1.0259
27	1.8242	0.9860
28	1.8211	0.9073
29	1.6982	0.9021
30	1.6410	0.8956
31	1.6263	0.8845
32	1.6261	0.8799
33	1.5500	0.8754
34	1.5397	0.8346
35	1.5289	0.8284
36	1.5147	0.8240
37	1.4759	0.7967
38	1.4487	0.7938
39	1.3793	0.7856
40	1.3660	0.7771
41	1.2871	0.7501
42	1.1887	0.7431
43	1.1435	0.7137
44	1.0882	0.7030
45	1.0496	0.6843
46	1.0434	0.6833
47	0.7715	0.6547
48	0.7276	0.6259
49	0.7026	0.6237
50	0.6843	0.6085
51	0.5979	0.5581
52	0.5894	0.5502
53	0.4294	0.5174

Duration Flows

The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
0.8919	12400	11892	95	Pass
0.9293	11166	8913	79	Pass
0.9667	10038	7965	79	Pass
1.0041	9030	6966	77	Pass
1.0415	8196	6179	75	Pass
1.0789	7426	5473	73	Pass
1.1163	6726	4812	71	Pass
1.1537	6090	4271	70	Pass
1.1912	5514	3737	67	Pass
1.2286	4983	3206	64	Pass
1.2660	4510	2830	62	Pass
1.3034	4053	2528	62	Pass
1.3408	3680	2150	58	Pass
1.3782	3315	1770	53	Pass
1.4156	3011	1560	51	Pass
1.4530	2739	1359	49	Pass
1.4905	2466	1250	50	Pass
1.5279	2247	1138	50	Pass
1.5653	2018	1054	52	Pass
1.6027	1832	971	53	Pass
1.6401	1664	881	52	Pass
1.6775	1519	800	52	Pass
1.7149	1380	736	53	Pass
1.7523	1272	704	55	Pass
1.7898	1181	675	57	Pass
1.8272	1100	641	58	Pass
1.8646	1026	603	58	Pass
1.9020	949	553	58	Pass
1.9394	875	528	60	Pass
1.9768	813	509	62	Pass
2.0142	751	489	65	Pass
2.0516	701	472	67	Pass
2.0891	655	454	69	Pass
2.1265	606	436	71	Pass
2.1639	563	416	73	Pass
2.2013	521	396	76	Pass
2.2387	478	373	78	Pass
2.2761	430	344	80	Pass
2.3135	402	322	80	Pass
2.3509	378	303	80	Pass
2.3884	347	283	81	Pass
2.4258	321	270	84	Pass
2.4632	298	257	86	Pass
2.5006	281	244	86	Pass
2.5380	268	222	82	Pass
2.5754	249	196	78	Pass
2.6128	234	179	76	Pass
2.6502	208	171	82	Pass
2.6877	193	165	85	Pass
2.7251	176	160	90	Pass
2.7625	154	156	101	Pass
2.7999	146	149	102	Pass
2.8373	136	144	105	Pass

2.8747	126	137	108	Pass
2.9121	121	131	108	Pass
2.9495	116	124	106	Pass
2.9870	112	118	105	Pass
3.0244	109	110	100	Pass
3.0618	105	105	100	Pass
3.0992	101	98	97	Pass
3.1366	98	92	93	Pass
3.1740	92	85	92	Pass
3.2114	87	71	81	Pass
3.2488	83	70	84	Pass
3.2863	77	67	87	Pass
3.3237	72	66	91	Pass
3.3611	68	64	94	Pass
3.3985	65	61	93	Pass
3.4359	62	60	96	Pass
3.4733	59	57	96	Pass
3.5107	56	55	98	Pass
3.5481	53	52	98	Pass
3.5856	49	49	100	Pass
3.6230	45	47	104	Pass
3.6604	43	44	102	Pass
3.6978	40	42	104	Pass
3.7352	38	39	102	Pass
3.7726	37	35	94	Pass
3.8100	34	31	91	Pass
3.8474	30	26	86	Pass
3.8849	27	23	85	Pass
3.9223	25	21	84	Pass
3.9597	24	17	70	Pass
3.9971	20	14	70	Pass
4.0345	15	8	53	Pass
4.0719	14	7	50	Pass
4.1093	11	6	54	Pass
4.1467	7	5	71	Pass
4.1842	4	4	100	Pass
4.2216	3	3	100	Pass
4.2590	2	0	0	Pass
4.2964	2	0	0	Pass
4.3338	2	0	0	Pass
4.3712	1	0	0	Pass
4.4086	1	0	0	Pass
4.4460	1	0	0	Pass
4.4834	1	0	0	Pass
4.5209	1	0	0	Pass
4.5583	1	0	0	Pass
4.5957	1	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	3.2492 acre-feet
On-line facility target flow:	3.2059 cfs.
Adjusted for 15 min:	3.2059 cfs.
Off-line facility target flow:	1.8068 cfs.
Adjusted for 15 min:	1.8068 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
SSD Table 2 POC	☐	4243.84			☐	0.00			
Total Volume Infiltrated		4243.84	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 = Failed

Model Default Modifications

Total of 0 changes have been made.

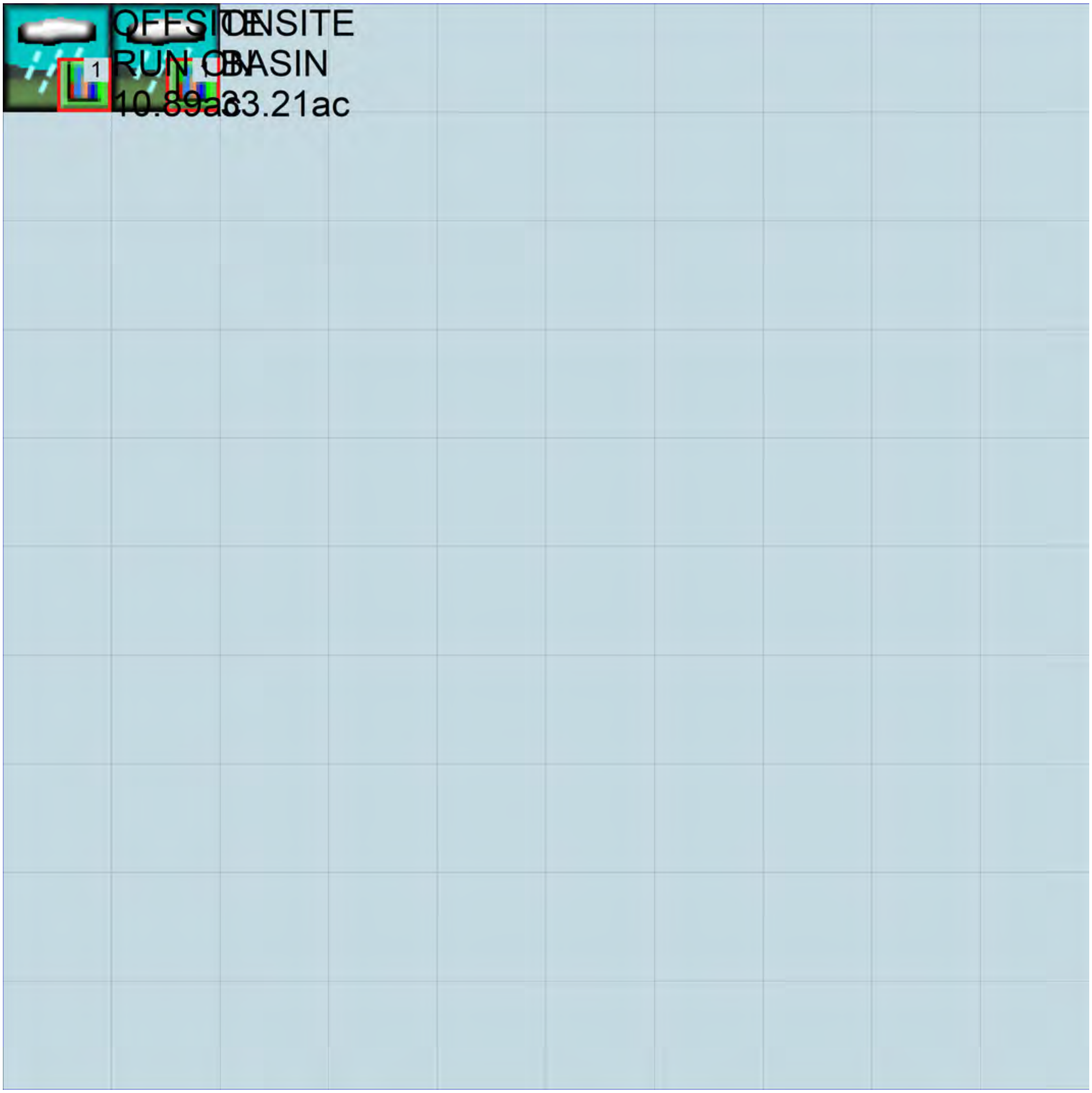
PERLND Changes

No PERLND changes have been made.

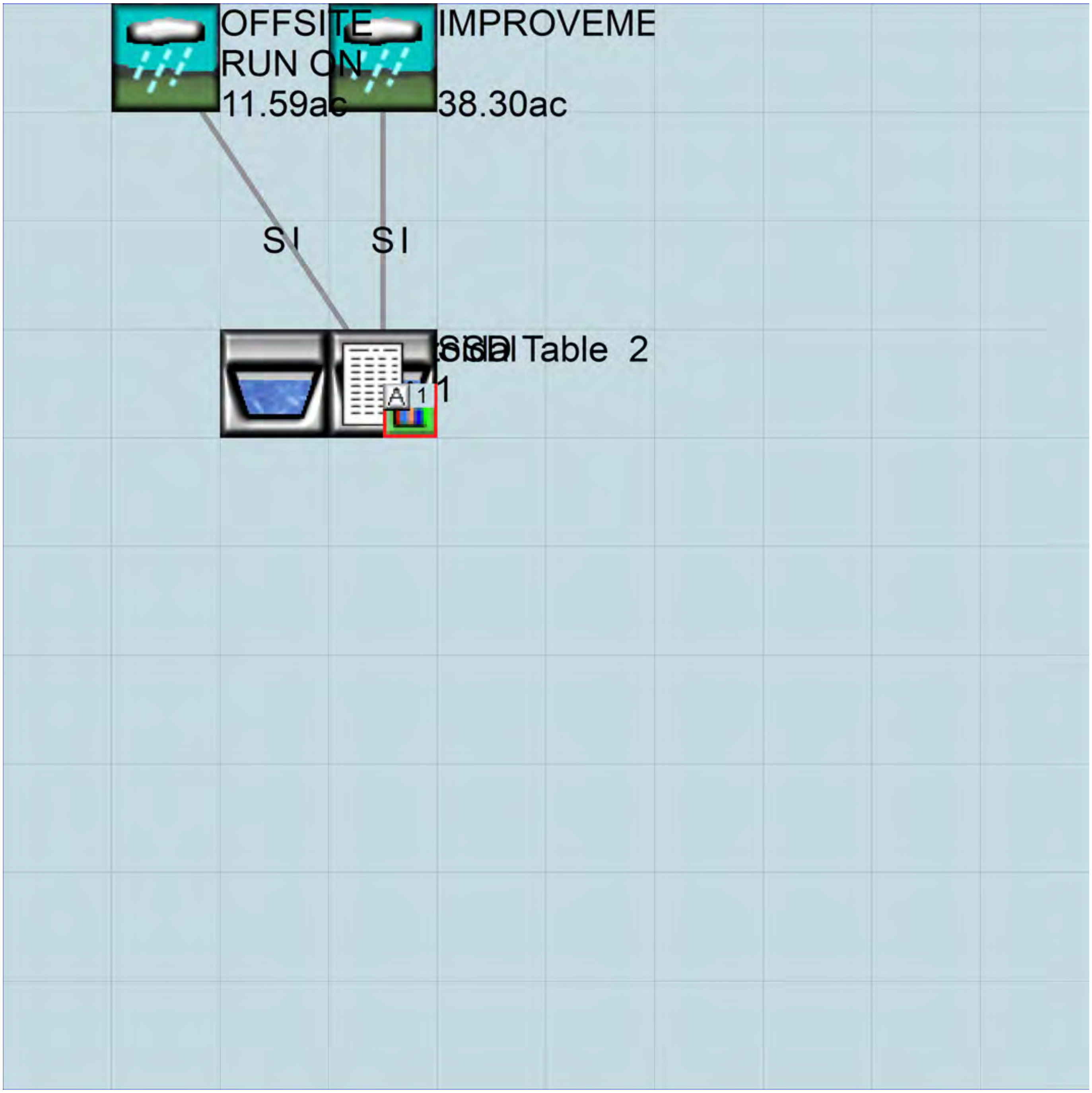
IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic



Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2008 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   Pond for PUD Application DDIP03.wdm
MESSU      25   PrePond for PUD Application DDIP03.MES
           27   PrePond for PUD Application DDIP03.L61
           28   PrePond for PUD Application DDIP03.L62
           30   POCPond for PUD Application DDIP031.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      PERLND      12
      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        ONSITE BASIN                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           ***
   11      C, Forest, Mod          1    1    1    1   27    0
   12      C, Forest, Steep        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 ***
   11         0    0    1    0    0    0    0    0    0    0    0    0
   12         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  *********
   11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   12         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 ***
   11         0    0    0    0    0    0    0    0    0    0    0
   12         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
   11              0       4.5      0.08       400       0.1       0.5     0.996
   12              0       4.5      0.08       400      0.15       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   11              0         0         2         2         0         0         0
   12              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   11            0.2       0.5      0.35         6       0.5       0.7
   12            0.2       0.3      0.35         6       0.3       0.7
  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
   11              0         0         0         0       2.5         1         0
   12              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                       in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    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    4    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#   ***
ONSITE BASIN***
PERLND  11                       33.21     COPY   501     12
PERLND  11                       33.21     COPY   501     13
OFFSITE RUN ON***
PERLND  12                         9.8     COPY   501     12
PERLND  12                         9.8     COPY   501     13
IMPLND   1                        0.32     COPY   501     15
IMPLND   4                         0.7     COPY   501     15
IMPLND   8                        0.07     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    0.8            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.8            IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           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       1955 10 01        END    2008 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   Pond for PUD Application DDIP03.wdm
MESSU      25   MitPond for PUD Application DDIP03.MES
           27   MitPond for PUD Application DDIP03.L61
           28   MitPond for PUD Application DDIP03.L62
           30   POCPond for PUD Application DDIP031.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      RCHRES       1
      PERLND      14
      IMPLND       1
      IMPLND      14
      PERLND      12
      PERLND      11
      IMPLND       4
      IMPLND       8
      RCHRES       2
      COPY         1
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        SSD Table  2                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           ***
   14     C, Pasture, Mod         1    1    1    1   27    0
   12     C, Forest, Steep        1    1    1    1   27    0
   11     C, Forest, Mod          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 ***
   14         0    0    1    0    0    0    0    0    0    0    0    0
   12         0    0    1    0    0    0    0    0    0    0    0    0
   11         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  *********
   14         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   12         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   11         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 ***
   14         0    0    0    0    0    0    0    0    0    0    0
   12         0    0    0    0    0    0    0    0    0    0    0
   11         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
   14              0       4.5      0.06       400       0.1       0.5     0.996
   12              0       4.5      0.08       400      0.15       0.5     0.996
   11              0       4.5      0.08       400       0.1       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   14              0         0         2         2         0         0         0
   12              0         0         2         2         0         0         0
   11              0         0         2         2         0         0         0
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   14           0.15       0.4       0.3         6       0.5       0.4
   12            0.2       0.3      0.35         6       0.3       0.7
   11            0.2       0.5      0.35         6       0.5       0.7
  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
   14              0         0         0         0       2.5         1         0
   12              0         0         0         0       2.5         1         0
   11              0         0         0         0       2.5         1         0
  END PWAT-STATE1

END PERLND

IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                    User  t-series Engl Metr ***
                                     in  out           ***
    1      ROADS/FLAT            1    1    1   27    0
   14      POND                  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
   14         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    4    1    9
   14         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
   14         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
   14            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
   14              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
   14              0         0
    4              0         0
    8              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
IMPROVEMENTS***
PERLND  14                        16.3     RCHRES   2      2
PERLND  14                        16.3     RCHRES   2      3
IMPLND   1                        19.6     RCHRES   2      5
IMPLND  14                         2.4     RCHRES   2      5
OFFSITE RUN ON***
PERLND  12                        8.17     RCHRES   2      2
PERLND  12                        8.17     RCHRES   2      3
PERLND  11                        2.33     RCHRES   2      2
PERLND  11                        2.33     RCHRES   2      3
IMPLND   1                        0.32     RCHRES   2      5
IMPLND   4                         0.7     RCHRES   2      5
```

```
IMPLND   8                        0.07     RCHRES   2      5

******Routing******
PERLND  14                        16.3     COPY     1     12
IMPLND   1                        19.6     COPY     1     15
IMPLND  14                         2.4     COPY     1     15
PERLND  14                        16.3     COPY     1     13
PERLND  12                        8.17     COPY     1     12
PERLND  11                        2.33     COPY     1     12
IMPLND   1                        0.32     COPY     1     15
IMPLND   4                         0.7     COPY     1     15
IMPLND   8                        0.07     COPY     1     15
PERLND  12                        8.17     COPY     1     13
PERLND  11                        2.33     COPY     1     13
RCHRES   2                           1     COPY   501     16
END SCHEMATIC

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



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

RCHRES
  GEN-INFO
    RCHRES       Name        Nexits   Unit Systems   Printer                 ***
    # -  #<------------------><---> User T-series  Engl Metr LKFG           ***
                                           in  out                           ***
    1     Trapezoidal Pond-011    1    1    1    1   28    0    1
    2     SSD Table  2            1    1    1    1   28    0    1
  END GEN-INFO
  *** Section RCHRES***

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

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

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

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50       ***
  <------><--------><--------><--------><--------><--------><-------->       ***
    1             1      0.05       0.0       0.0       0.5       0.0
    2             2      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                         ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
```

```
         *** ac-ft     for each possible exit        for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1          0          4.0  0.0  0.0  0.0  0.0        0.0  0.0  0.0  0.0  0.0
    2          0          4.0  0.0  0.0  0.0  0.0        0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   91    4
     Depth       Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)    (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  0.000000  1.426587  0.000000  0.000000
  0.094444  1.430914  0.134938  0.130185
  0.188889  1.435247  0.270284  0.184109
  0.283333  1.439588  0.406040  0.225487
  0.377778  1.443934  0.542206  0.260370
  0.472222  1.448288  0.678784  0.291103
  0.566667  1.452648  0.815772  0.318887
  0.661111  1.457014  0.953173  0.344437
  0.755556  1.461387  1.090986  0.368219
  0.850000  1.465767  1.229213  0.390555
  0.944444  1.470153  1.367854  0.411681
  1.038889  1.474545  1.506909  0.431775
  1.133333  1.478945  1.646379  0.450974
  1.227778  1.483350  1.786265  0.469389
  1.322222  1.487763  1.926568  0.487108
  1.416667  1.492182  2.067288  0.504204
  1.511111  1.496607  2.208425  0.520740
  1.605556  1.501039  2.349980  0.536767
  1.700000  1.505478  2.491955  0.552328
  1.794444  1.509923  2.634349  0.567463
  1.888889  1.514374  2.777163  0.582205
  1.983333  1.518832  2.920397  0.596583
  2.077778  1.523297  3.064054  0.610622
  2.172222  1.527769  3.208132  0.624345
  2.266667  1.532246  3.352632  0.637774
  2.361111  1.536731  3.497556  0.650925
  2.455556  1.541222  3.642904  0.663816
  2.550000  1.545719  3.788676  0.676461
  2.644444  1.550223  3.934873  0.688874
  2.738889  1.554734  4.081496  0.701068
  2.833333  1.559251  4.228546  0.713053
  2.927778  1.563775  4.376022  0.724839
  3.022222  1.568305  4.523926  0.736438
  3.116667  1.572842  4.672258  0.747856
  3.211111  1.577385  4.821018  0.759103
  3.305556  1.581935  4.970209  0.770185
  3.400000  1.586492  5.119829  0.781110
  3.494444  1.591055  5.269879  0.791885
  3.588889  1.595624  5.420362  0.802514
  3.683333  1.600200  5.571275  0.813005
  3.777778  1.604783  5.722622  0.823362
  3.872222  1.609372  5.874401  0.833591
  3.966667  1.613968  6.026615  0.843695
  4.061111  1.618570  6.179262  0.853680
  4.155556  1.623179  6.332345  0.863550
  4.250000  1.627795  6.485863  0.877663
  4.344444  1.632417  6.639818  0.900833
  4.438889  1.637045  6.794209  0.928472
  4.533333  1.641680  6.949038  0.959146
  4.627778  1.646322  7.104304  0.992044
  4.722222  1.650970  7.260010  1.026604
  4.816667  1.655625  7.416155  1.062395
  4.911111  1.660286  7.572739  1.099071
  5.005556  1.664954  7.729765  1.136339
  5.100000  1.669629  7.887231  1.173946
  5.194444  1.674310  8.045139  1.211890
```

```
  5.288889  1.678997  8.203490  1.256216
  5.383333  1.683691  8.362284  1.302031
  5.477778  1.688392  8.521521  1.349272
  5.572222  1.693099  8.681202  1.397885
  5.666667  1.697813  8.841329  1.588535
  5.761111  1.702533  9.001901  1.653473
  5.855556  1.707260  9.162919  1.720070
  5.950000  1.711993  9.324383  1.788279
  6.044444  1.716733  9.486295  1.858055
  6.138889  1.721480  9.648656  1.929357
  6.233333  1.726233  9.811464  2.002149
  6.327778  1.730993  9.974722  2.076394
  6.422222  1.735759  10.13843  2.152061
  6.516667  1.740531  10.30259  2.229120
  6.611111  1.745311  10.46720  2.307541
  6.705556  1.750096  10.63226  2.387298
  6.800000  1.754889  10.79777  2.468366
  6.894444  1.759688  10.96374  2.550721
  6.988889  1.764493  11.13016  2.634340
  7.083333  1.769305  11.29703  2.719203
  7.177778  1.774124  11.46436  2.805288
  7.272222  1.778949  11.63214  2.892576
  7.366667  1.783781  11.80038  2.981050
  7.461111  1.788619  11.96908  3.070691
  7.555556  1.793464  12.13823  3.459549
  7.650000  1.798315  12.30785  4.657774
  7.744444  1.803173  12.47792  6.314449
  7.838889  1.808037  12.64845  8.293411
  7.933333  1.812908  12.81943  10.49007
  8.027778  1.817786  12.99088  12.80109
  8.122222  1.822670  13.16279  15.12010
  8.216667  1.827561  13.33517  17.34136
  8.311111  1.832458  13.50800  19.36756
  8.405556  1.837362  13.68130  21.12023
  8.500000  1.842272  13.85506  22.55215
  END FTABLE  1
  FTABLE      2
   21    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  199.0000  1.230000  0.000000  0.000000
  199.5000  1.270000  0.630000  0.303955
  200.0000  1.300000  1.270000  0.429858
  200.5000  1.340000  1.930000  0.526466
  201.0000  1.370000  2.600000  0.607911
  201.5000  1.400000  3.300000  0.679665
  202.0000  1.440000  4.010000  0.744536
  202.5000  1.470000  4.740000  0.804190
  203.0000  1.510000  5.480000  0.859716
  203.5000  1.550000  6.250000  0.911866
  204.0000  1.580000  7.030000  1.163065
  204.5000  1.620000  7.830000  1.421010
  205.0000  1.650000  8.650000  1.708366
  205.5000  1.690000  9.480000  2.218769
  206.0000  1.730000  10.34000  2.660921
  206.5000  1.760000  11.21000  3.357515
  207.0000  1.800000  12.10000  4.030263
  207.5000  1.840000  13.01000  19.04292
  208.0000  1.880000  13.94000  43.31743
  208.5000  1.920000  14.89000  64.27974
  209.0000  1.970000  15.86000  75.12541
  END FTABLE  2
END FTABLES

EXT SOURCES
<-Volume-> <Member> SsysSgap<--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   # <Name> # tem strg<-factor->strg <Name>   #   #        <Name> # #  ***
WDM      2 PREC     ENGL    0.8            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.8            IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
```

```
WDM      1 EVAP     ENGL    0.76           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***
RCHRES   2 HYDR   RO     1 1        1      WDM   1004 FLOW     ENGL      REPL
RCHRES   2 HYDR   STAGE  1 1        1      WDM   1005 STAG     ENGL      REPL
COPY     1 OUTPUT MEAN   1 1     48.4      WDM    701 FLOW     ENGL      REPL
COPY   501 OUTPUT MEAN   1 1     48.4      WDM    801 FLOW     ENGL      REPL
END EXT TARGETS

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

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

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

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

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

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

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

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

This program and accompanying documentation are provided 'as-is' without warranty of any kind. The entire risk regarding the performance and results of this program is assumed by End User. Clear Creek Solutions Inc. and the governmental licensee or sublicensees disclaim all warranties, either expressed or implied, including but not limited to implied warranties of program and accompanying documentation. In no event shall Clear Creek Solutions Inc. be liable for any damages whatsoever (including without limitation to damages for loss of business profits, loss of business information, business interruption, and the like) arising out of the use of, or inability to use this program even if Clear Creek Solutions Inc. or their authorized representatives have been advised of the possibility of such damages.

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

www.clearcreeksolutions.com

Appendix D - WWHM Wetland Input Volumes

WWHM2012

PROJECT REPORT

MR#8 METHOD 2 ANALYSIS FOR WETLAND 1

General Model Information

WWHM2012 Project Name: Wetlana A Input Volumes DDIP03

Site Name:	Double Dip Plat
Site Address:	
City:	Centralia
Report Date:	9/21/2023
Gage:	Olympia
Data Start:	1955/10/01
Data End:	2008/09/30
Timestep:	15 Minute
Precip Scale:	0.800
Version Date:	2023/01/27
Version:	4.2.19

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

ONSITE BASIN

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Mod	9.4
C, Lawn, Mod	23.8
Pervious Total	33.2
Impervious Land Use	acre
Impervious Total	0
Basin Total	33.2

OFFSITE RUN ON

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C, Forest, Steep	6.9
C, Lawn, Steep	2.9
Pervious Total	9.8
Impervious Land Use	acre
ROADS FLAT	0.32
ROOF TOPS FLAT	0.7
SIDEWALKS FLAT	0.07
Impervious Total	1.09
Basin Total	10.89

WETLAND BUFFER

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
C IMP DISP FLAT	1.2

Mitigated Land Use

IMPROVEMENTS

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
C, Pasture, Mod	16.3
Pervious Total	16.3
Impervious Land Use	acre
ROADS FLAT	19.6
POND	2.4
Impervious Total	22
Basin Total	38.3

WETLAND A BUFFER

Bypass:	No
GroundWater:	No
Pervious Land Use	acre
SAT IMP DIS FLAT	1.2

OFFSITE RUNON

Bypass:	Yes
GroundWater:	No
Pervious Land Use	acre
C, Forest, Steep	8.17
C, Forest, Mod	2.33
Pervious Total	10.5
Impervious Land Use	acre
ROADS FLAT	0.32
ROOF TOPS FLAT	0.7
SIDEWALKS FLAT	0.07
Impervious Total	1.09
Basin Total	11.59

Routing Elements
Predeveloped Routing

Mitigated Routing

SSD Table 2

Depth:	209 ft.
Discharge Structure: 1	
Riser Height:	207 ft.
Riser Diameter:	48 in.
Notch Type:	Rectangular
Notch Width:	0.100 ft.
Notch Height:	3.310 ft.
Orifice 1 Diameter:	3.850 in. Elevation:199 ft.
Orifice 2 Diameter:	2.900 in. Elevation:204 ft.

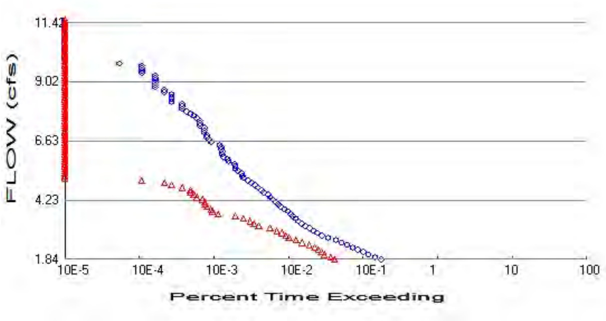
Element Flows To:
Outlet 1 Outlet 2
WETLAND A BUFFER

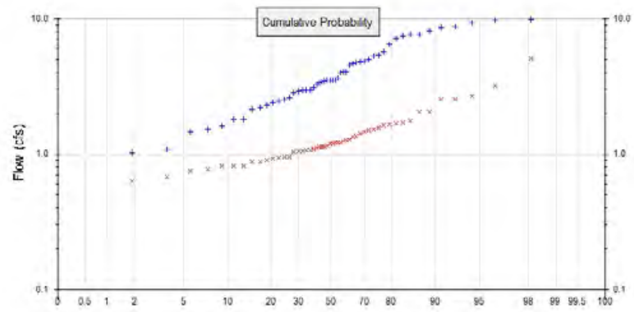
SSD Table Hydraulic Table

Stage (feet)	**Area (ac.)**	**Volume (ac-ft.)**	**Outlet Struct**	**NotUsed**	**NotUsed**	**NotUsed**	**NotUsed**
199.0	1.230	0.000	0.000	0.000	0.000	0.000	0.000
199.5	1.270	0.630	0.284	0.000	0.000	0.000	0.000
200.0	1.300	1.270	0.402	0.000	0.000	0.000	0.000
200.5	1.340	1.930	0.493	0.000	0.000	0.000	0.000
201.0	1.370	2.600	0.569	0.000	0.000	0.000	0.000
201.5	1.400	3.300	0.636	0.000	0.000	0.000	0.000
202.0	1.440	4.010	0.697	0.000	0.000	0.000	0.000
202.5	1.470	4.740	0.753	0.000	0.000	0.000	0.000
203.0	1.510	5.480	0.804	0.000	0.000	0.000	0.000
203.5	1.550	6.250	0.853	0.000	0.000	0.000	0.000
204.0	1.580	7.030	0.953	0.000	0.000	0.000	0.000
204.5	1.620	7.830	1.308	0.000	0.000	0.000	0.000
205.0	1.650	8.650	1.613	0.000	0.000	0.000	0.000
205.5	1.690	9.480	2.134	0.000	0.000	0.000	0.000
206.0	1.730	10.34	2.582	0.000	0.000	0.000	0.000
206.5	1.760	11.21	3.066	0.000	0.000	0.000	0.000
207.0	1.800	12.10	3.583	0.000	0.000	0.000	0.000
207.5	1.840	13.01	18.49	0.000	0.000	0.000	0.000
208.0	1.880	13.94	42.67	0.000	0.000	0.000	0.000
208.5	1.920	14.89	63.56	0.000	0.000	0.000	0.000
209.0	1.970	15.86	74.34	0.000	0.000	0.000	0.000

Analysis Results

POC 1





+ Predeveloped   x Mitigated

Predeveloped Landuse Totals for POC #1
Total Pervious Area: 44.2
Total Impervious Area: 1.09

Mitigated Landuse Totals for POC #1
Total Pervious Area: 28
Total Impervious Area: 23.09

Flow Frequency Method: Log Pearson Type III 17B

Flow Frequency Return Periods for Predeveloped. POC #1

Return Period	**Flow(cfs)**
2 year	3.678473
5 year	5.96728
10 year	7.60064
25 year	9.75807
50 year	11.416864
100 year	13.109974

Flow Frequency Return Periods for Mitigated. POC #1

Return Period	**Flow(cfs)**
2 year	1.197589
5 year	1.733821
10 year	2.1556
25 year	2.771367
50 year	3.294852
100 year	3.877881

Annual Peaks

Annual Peaks for Predeveloped and Mitigated. POC #1

Year	**Predeveloped**	**Mitigated**
1956	3.370	1.340
1957	7.462	1.360
1958	2.463	0.811
1959	3.096	1.106
1960	4.682	2.528
1961	3.531	1.150
1962	0.893	0.768
1963	8.750	1.652
1964	4.509	1.128
1965	4.073	1.052

1966	2.405	0.905
1967	2.844	1.067
1968	2.142	0.926
1969	1.616	0.811
1970	2.547	1.132
1971	2.956	1.467
1972	6.503	2.528
1973	2.285	1.528
1974	3.421	1.087
1975	8.532	0.957
1976	5.383	1.628
1977	3.258	0.635
1978	4.884	1.422
1979	7.683	1.062
1980	2.979	1.288
1981	7.627	1.205
1982	3.503	1.198
1983	5.262	1.208
1984	4.018	1.057
1985	1.530	0.819
1986	4.812	1.744
1987	9.849	2.048
1988	1.806	0.938
1989	3.529	0.879
1990	8.131	1.491
1991	9.702	3.180
1992	2.207	1.031
1993	1.461	0.749
1994	1.083	0.678
1995	2.616	1.218
1996	4.730	2.037
1997	3.462	1.669
1998	5.707	1.121
1999	3.995	1.556
2000	5.032	1.272
2001	1.019	0.612
2002	3.519	1.707
2003	1.812	0.874
2004	3.671	1.246
2005	2.933	0.947
2006	2.942	1.195
2007	7.181	2.675
2008	9.338	5.086

Ranked Annual Peaks

Ranked Annual Peaks for Predeveloped and Mitigated. POC #1

Rank	Predeveloped	Mitigated
1	9.8490	5.0864
2	9.7024	3.1797
3	9.3385	2.6755
4	8.7502	2.5282
5	8.5322	2.5277
6	8.1314	2.0475
7	7.6833	2.0370
8	7.6265	1.7441
9	7.4623	1.7072
10	7.1813	1.6694
11	6.5034	1.6522

12	5.7068	1.6283
13	5.3829	1.5563
14	5.2616	1.5284
15	5.0316	1.4909
16	4.8840	1.4669
17	4.8120	1.4222
18	4.7305	1.3596
19	4.6820	1.3398
20	4.5095	1.2882
21	4.0733	1.2725
22	4.0181	1.2464
23	3.9953	1.2183
24	3.6708	1.2076
25	3.5314	1.2054
26	3.5292	1.1980
27	3.5186	1.1953
28	3.5028	1.1504
29	3.4624	1.1323
30	3.4210	1.1282
31	3.3702	1.1212
32	3.2579	1.1056
33	3.0957	1.0867
34	2.9794	1.0667
35	2.9557	1.0623
36	2.9418	1.0570
37	2.9329	1.0521
38	2.8438	1.0306
39	2.6159	0.9571
40	2.5468	0.9472
41	2.4626	0.9380
42	2.4053	0.9258
43	2.2845	0.9046
44	2.2066	0.8791
45	2.1422	0.8744
46	1.8119	0.8187
47	1.8064	0.8113
48	1.6165	0.8109
49	1.5302	0.7675
50	1.4607	0.7488
51	1.0831	0.6778
52	1.0186	0.6349
53	0.8934	0.6121

Duration Flows
The Facility PASSED

Flow(cfs)	Predev	Mit	Percentage	Pass/Fail
1.8392	3252	765	23	Pass
1.9360	2689	685	25	Pass
2.0327	2187	560	25	Pass
2.1295	1864	511	27	Pass
2.2262	1588	467	29	Pass
2.3230	1340	415	30	Pass
2.4197	1139	353	30	Pass
2.5164	953	284	29	Pass
2.6132	806	233	28	Pass
2.7099	630	188	29	Pass
2.8067	523	172	32	Pass
2.9034	454	153	33	Pass
3.0002	400	130	32	Pass
3.0969	355	105	29	Pass
3.1936	312	74	23	Pass
3.2904	279	64	22	Pass
3.3871	252	57	22	Pass
3.4839	231	46	19	Pass
3.5806	212	36	16	Pass
3.6774	196	21	10	Pass
3.7741	183	18	9	Pass
3.8709	164	17	10	Pass
3.9676	146	15	10	Pass
4.0643	135	14	10	Pass
4.1611	126	14	11	Pass
4.2578	115	13	11	Pass
4.3546	106	11	10	Pass
4.4513	99	10	10	Pass
4.5481	86	9	10	Pass
4.6448	80	9	11	Pass
4.7415	72	7	9	Pass
4.8383	66	5	7	Pass
4.9350	59	4	6	Pass
5.0318	53	2	3	Pass
5.1285	46	0	0	Pass
5.2253	45	0	0	Pass
5.3220	43	0	0	Pass
5.4188	39	0	0	Pass
5.5155	36	0	0	Pass
5.6122	36	0	0	Pass
5.7090	35	0	0	Pass
5.8057	29	0	0	Pass
5.9025	28	0	0	Pass
5.9992	25	0	0	Pass
6.0960	24	0	0	Pass
6.1927	24	0	0	Pass
6.2894	23	0	0	Pass
6.3862	23	0	0	Pass
6.4829	22	0	0	Pass
6.5797	17	0	0	Pass
6.6764	16	0	0	Pass
6.7732	15	0	0	Pass
6.8699	15	0	0	Pass

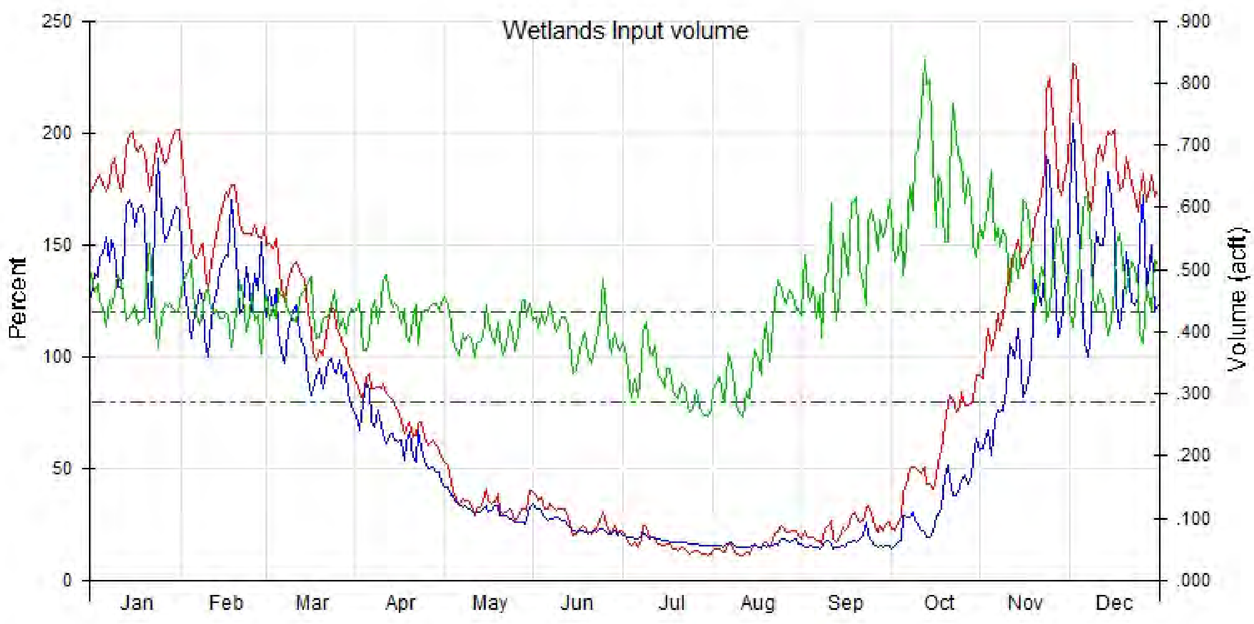
6.9667	14	0	0	Pass
7.0634	14	0	0	Pass
7.1601	14	0	0	Pass
7.2569	12	0	0	Pass
7.3536	12	0	0	Pass
7.4504	12	0	0	Pass
7.5471	11	0	0	Pass
7.6439	10	0	0	Pass
7.7406	9	0	0	Pass
7.8373	8	0	0	Pass
7.9341	7	0	0	Pass
8.0308	7	0	0	Pass
8.1276	7	0	0	Pass
8.2243	5	0	0	Pass
8.3211	5	0	0	Pass
8.4178	5	0	0	Pass
8.5146	5	0	0	Pass
8.6113	4	0	0	Pass
8.7080	4	0	0	Pass
8.8048	3	0	0	Pass
8.9015	3	0	0	Pass
8.9983	3	0	0	Pass
9.0950	3	0	0	Pass
9.1918	3	0	0	Pass
9.2885	3	0	0	Pass
9.3852	2	0	0	Pass
9.4820	2	0	0	Pass
9.5787	2	0	0	Pass
9.6755	2	0	0	Pass
9.7722	1	0	0	Pass
9.8690	0	0	0	Pass
9.9657	0	0	0	Pass
10.0625	0	0	0	Pass
10.1592	0	0	0	Pass
10.2559	0	0	0	Pass
10.3527	0	0	0	Pass
10.4494	0	0	0	Pass
10.5462	0	0	0	Pass
10.6429	0	0	0	Pass
10.7397	0	0	0	Pass
10.8364	0	0	0	Pass
10.9331	0	0	0	Pass
11.0299	0	0	0	Pass
11.1266	0	0	0	Pass
11.2234	0	0	0	Pass
11.3201	0	0	0	Pass
11.4169	0	0	0	Pass

Water Quality

Water Quality BMP Flow and Volume for POC #1

On-line facility volume:	3.2492 acre-feet
On-line facility target flow:	3.2059 cfs.
Adjusted for 15 min:	3.2059 cfs.
Off-line facility target flow:	1.8068 cfs.
Adjusted for 15 min:	1.8068 cfs.

Wetland Input Volumes



- Percent - Predeveloped - Mitigated

Wetlands Input Volume for POC 1
Average Annual Volume (acft)
Series 1: 501 POC 1 Predeveloped flow
Series 2: 801 POC 1 Mitigated flow

Month	Series 1	Series 2	Percent	Pass/Fail
Jan	16.8514	20.8069	123.5	Fail
Feb	13.3462	16.2795	122.0	Fail
Mar	11.4126	13.8510	121.4	Fail
Apr	6.8720	8.1620	118.8	Fail
May	3.5631	4.0007	112.3	Pass
Jun	2.6782	2.9923	111.7	Pass
Jul	1.9958	1.8041	90.4	Pass
Aug	1.7841	1.8209	102.1	Pass
Sep	1.7778	2.5352	142.6	Fail
Oct	3.6088	6.2747	173.9	Fail
Nov	11.1522	15.9993	143.5	Fail
Dec	15.9339	20.8443	130.8	Fail

Day	Predevel	Mitigated	Percent	Pass/Fail
Jan1	0.4549	0.6249	137.4	Fail
2	0.4939	0.6383	129.2	Fail
3	0.4880	0.6472	132.6	Fail
4	0.5219	0.6517	124.9	Fail
5	0.5262	0.6389	121.4	Fail
6	0.5520	0.6248	113.2	Pass
7	0.5130	0.6415	125.1	Fail
8	0.5479	0.6665	121.6	Fail
9	0.5308	0.6790	127.9	Fail
10	0.4724	0.6459	136.7	Fail
11	0.4684	0.6255	133.5	Fail
12	0.4974	0.6396	128.6	Fail
13	0.6002	0.6960	116.0	Pass
14	0.6112	0.7178	117.5	Pass

15	0.5960	0.7208	120.9	Fail
16	0.5700	0.7005	122.9	Fail
17	0.5995	0.6892	115.0	Pass
18	0.6030	0.7015	116.3	Pass
19	0.5879	0.6885	117.1	Pass
20	0.4983	0.6671	133.9	Fail
21	0.4148	0.6248	150.6	Fail
22	0.5037	0.6598	131.0	Fail
23	0.6246	0.6985	111.8	Pass
24	0.6794	0.7112	104.7	Pass
25	0.5960	0.6915	116.0	Pass
26	0.5437	0.6718	123.6	Fail
27	0.5578	0.6801	121.9	Fail
28	0.5661	0.6989	123.5	Fail
29	0.5858	0.7137	121.8	Fail
30	0.6021	0.7241	120.3	Fail
31	0.5947	0.7250	121.9	Fail
Feb1	0.5323	0.6918	130.0	Fail
2	0.4677	0.6362	136.0	Fail
3	0.4313	0.5940	137.7	Fail
4	0.3878	0.5559	143.4	Fail
5	0.4139	0.5294	127.9	Fail
6	0.4375	0.5192	118.7	Pass
7	0.4668	0.5317	113.9	Pass
8	0.4472	0.5413	121.0	Fail
9	0.3912	0.5019	128.3	Fail
10	0.3592	0.4687	130.5	Fail
11	0.4179	0.5089	121.8	Fail
12	0.4557	0.5444	119.5	Pass
13	0.4581	0.5535	120.8	Fail
14	0.4988	0.5845	117.2	Pass
15	0.5159	0.6029	116.8	Pass
16	0.5221	0.6246	119.6	Pass
17	0.5220	0.6176	118.3	Pass
18	0.6112	0.6363	104.1	Pass
19	0.5539	0.6360	114.8	Pass
20	0.4830	0.5995	124.1	Fail
21	0.4287	0.5751	134.2	Fail
22	0.4382	0.5588	127.5	Fail
23	0.5051	0.5594	110.7	Pass
24	0.4704	0.5573	118.5	Pass
25	0.4326	0.5545	128.2	Fail
26	0.4930	0.5721	116.1	Pass
27	0.4663	0.5539	118.8	Pass
28	0.5440	0.5500	101.1	Pass
29	0.4547	0.5693	125.2	Fail
Mar1	0.4231	0.5383	127.2	Fail
2	0.4668	0.5417	116.0	Pass
3	0.4351	0.5332	122.6	Fail
4	0.4702	0.5502	117.0	Pass
5	0.3995	0.5204	130.3	Fail
6	0.3705	0.4724	127.5	Fail
7	0.3498	0.4493	128.5	Fail
8	0.4002	0.4809	120.2	Fail
9	0.4093	0.4910	120.0	Pass
10	0.4356	0.5070	116.4	Pass
11	0.4416	0.5116	115.8	Pass
12	0.3976	0.4990	125.5	Fail

13	0.3842	0.4915	127.9	Fail
14	0.3747	0.4848	129.4	Fail
15	0.3256	0.4355	133.7	Fail
16	0.2964	0.4017	135.5	Fail
17	0.3076	0.3680	119.6	Pass
18	0.3280	0.3550	108.2	Pass
19	0.3398	0.3696	108.8	Pass
20	0.3080	0.3614	117.3	Pass
21	0.3224	0.3795	117.7	Pass
22	0.3506	0.4142	118.1	Pass
23	0.3577	0.4410	123.3	Fail
24	0.3355	0.4343	129.5	Fail
25	0.3339	0.4091	122.5	Fail
26	0.3531	0.3977	112.6	Pass
27	0.3240	0.3787	116.9	Pass
28	0.3364	0.3716	110.5	Pass
29	0.2995	0.3508	117.1	Pass
30	0.2813	0.3420	121.6	Fail
31	0.2698	0.3245	120.3	Fail
Apr1	0.2534	0.3101	122.4	Fail
2	0.2409	0.3022	125.5	Fail
3	0.2835	0.2923	103.1	Pass
4	0.3165	0.3261	103.0	Pass
5	0.3082	0.3331	108.1	Pass
6	0.2562	0.3098	120.9	Fail
7	0.2455	0.3076	125.3	Fail
8	0.2722	0.3124	114.8	Pass
9	0.2493	0.3075	123.4	Fail
10	0.2353	0.3157	134.2	Fail
11	0.2196	0.2992	136.2	Fail
12	0.2324	0.2950	126.9	Fail
13	0.2357	0.2887	122.5	Fail
14	0.2265	0.2803	123.8	Fail
15	0.2239	0.2737	122.3	Fail
16	0.2240	0.2580	115.2	Pass
17	0.1942	0.2353	121.2	Fail
18	0.2220	0.2438	109.8	Pass
19	0.2386	0.2550	106.9	Pass
20	0.1978	0.2313	116.9	Pass
21	0.1892	0.2329	123.1	Fail
22	0.2403	0.2520	104.9	Pass
23	0.2137	0.2554	119.6	Pass
24	0.1919	0.2317	120.8	Fail
25	0.1796	0.2162	120.4	Fail
26	0.1807	0.2211	122.3	Fail
27	0.1819	0.2252	123.8	Fail
28	0.1751	0.2172	124.0	Fail
29	0.1742	0.2086	119.7	Pass
30	0.1589	0.1977	124.4	Fail
May1	0.1501	0.1904	126.9	Fail
2	0.1503	0.1851	123.2	Fail
3	0.1361	0.1574	115.6	Pass
4	0.1361	0.1455	106.9	Pass
5	0.1263	0.1301	103.0	Pass
6	0.1208	0.1217	100.8	Pass
7	0.1177	0.1302	110.6	Pass
8	0.1193	0.1277	107.0	Pass
9	0.1164	0.1273	109.4	Pass

10	0.1124	0.1215	108.1	Pass
11	0.1059	0.1057	99.8	Pass
12	0.1094	0.1156	105.7	Pass
13	0.1104	0.1180	106.9	Pass
14	0.1164	0.1266	108.7	Pass
15	0.1196	0.1474	123.3	Fail
16	0.1104	0.1282	116.2	Pass
17	0.1130	0.1234	109.2	Pass
18	0.1194	0.1268	106.2	Pass
19	0.1193	0.1380	115.7	Pass
20	0.1043	0.1125	107.8	Pass
21	0.1057	0.1060	100.3	Pass
22	0.1044	0.1104	105.7	Pass
23	0.0995	0.1159	116.5	Pass
24	0.0964	0.1059	109.8	Pass
25	0.0944	0.0970	102.8	Pass
26	0.0935	0.1016	108.7	Pass
27	0.0927	0.1151	124.2	Fail
28	0.0921	0.1155	125.4	Fail
29	0.0953	0.1122	117.7	Pass
30	0.1168	0.1441	123.4	Fail
31	0.1229	0.1425	115.9	Pass
Jun1	0.1163	0.1372	118.0	Pass
2	0.1144	0.1286	112.4	Pass
3	0.1124	0.1343	119.4	Pass
4	0.1010	0.1158	114.6	Pass
5	0.0961	0.1144	119.1	Pass
6	0.0997	0.1238	124.2	Fail
7	0.0996	0.1165	117.0	Pass
8	0.1011	0.1124	111.1	Pass
9	0.0997	0.1145	114.9	Pass
10	0.0974	0.1148	117.8	Pass
11	0.0976	0.1150	117.8	Pass
12	0.0880	0.1013	115.1	Pass
13	0.0824	0.0816	98.9	Pass
14	0.0789	0.0728	92.3	Pass
15	0.0782	0.0736	94.0	Pass
16	0.0805	0.0837	103.9	Pass
17	0.0804	0.0871	108.3	Pass
18	0.0769	0.0857	111.4	Pass
19	0.0762	0.0764	100.3	Pass
20	0.0774	0.0750	96.9	Pass
21	0.0791	0.0821	103.8	Pass
22	0.0781	0.0831	106.5	Pass
23	0.0826	0.0957	115.8	Pass
24	0.0816	0.1103	135.2	Fail
25	0.0765	0.0921	120.3	Fail
26	0.0752	0.0823	109.5	Pass
27	0.0749	0.0759	101.3	Pass
28	0.0794	0.0879	110.6	Pass
29	0.0735	0.0760	103.5	Pass
30	0.0778	0.0798	102.6	Pass
Jul1	0.0728	0.0775	106.4	Pass
2	0.0697	0.0695	99.8	Pass
3	0.0683	0.0592	86.7	Pass
4	0.0683	0.0561	82.2	Pass
5	0.0667	0.0602	90.2	Pass
6	0.0666	0.0544	81.7	Pass

7	0.0693	0.0669	96.5	Pass
8	0.0782	0.0871	111.4	Pass
9	0.0730	0.0844	115.6	Pass
10	0.0680	0.0689	101.3	Pass
11	0.0683	0.0687	100.6	Pass
12	0.0666	0.0698	104.7	Pass
13	0.0655	0.0600	91.6	Pass
14	0.0631	0.0567	89.8	Pass
15	0.0638	0.0552	86.6	Pass
16	0.0634	0.0601	94.7	Pass
17	0.0619	0.0584	94.5	Pass
18	0.0611	0.0518	84.8	Pass
19	0.0609	0.0501	82.3	Pass
20	0.0602	0.0489	81.3	Pass
21	0.0616	0.0544	88.3	Pass
22	0.0601	0.0519	86.4	Pass
23	0.0592	0.0461	77.9	Fail
24	0.0584	0.0438	74.9	Fail
25	0.0590	0.0455	77.1	Fail
26	0.0577	0.0490	84.8	Pass
27	0.0572	0.0447	78.1	Fail
28	0.0567	0.0425	75.0	Fail
29	0.0563	0.0415	73.7	Fail
30	0.0561	0.0411	73.2	Fail
31	0.0571	0.0437	76.5	Fail
Aug1	0.0568	0.0482	84.8	Pass
2	0.0564	0.0502	88.9	Pass
3	0.0553	0.0504	91.2	Pass
4	0.0546	0.0448	81.9	Pass
5	0.0570	0.0454	79.6	Fail
6	0.0583	0.0591	101.3	Pass
7	0.0607	0.0588	97.0	Pass
8	0.0571	0.0493	86.4	Pass
9	0.0545	0.0427	78.3	Fail
10	0.0534	0.0399	74.7	Fail
11	0.0538	0.0393	73.1	Fail
12	0.0527	0.0445	84.4	Pass
13	0.0531	0.0430	81.1	Pass
14	0.0553	0.0500	90.4	Pass
15	0.0570	0.0585	102.8	Pass
16	0.0540	0.0541	100.1	Pass
17	0.0545	0.0501	91.8	Pass
18	0.0571	0.0598	104.8	Pass
19	0.0542	0.0626	115.6	Pass
20	0.0548	0.0535	97.8	Pass
21	0.0549	0.0630	114.6	Pass
22	0.0591	0.0738	124.8	Fail
23	0.0573	0.0768	134.1	Fail
24	0.0681	0.0894	131.4	Fail
25	0.0655	0.0818	124.9	Fail
26	0.0628	0.0777	123.8	Fail
27	0.0601	0.0780	129.8	Fail
28	0.0628	0.0802	127.7	Fail
29	0.0666	0.0803	120.6	Fail
30	0.0594	0.0721	121.3	Fail
31	0.0576	0.0681	118.2	Pass
Sep1	0.0542	0.0789	145.5	Fail
2	0.0539	0.0694	128.8	Fail

3	0.0568	0.0707	124.3	Fail
4	0.0536	0.0704	131.3	Fail
5	0.0538	0.0630	116.9	Pass
6	0.0501	0.0639	127.4	Fail
7	0.0540	0.0585	108.3	Pass
8	0.0608	0.0820	135.0	Fail
9	0.0644	0.0885	137.5	Fail
10	0.0578	0.0974	168.4	Fail
11	0.0507	0.0675	133.0	Fail
12	0.0532	0.0620	116.5	Pass
13	0.0530	0.0684	129.0	Fail
14	0.0553	0.0860	155.3	Fail
15	0.0539	0.0804	149.4	Fail
16	0.0619	0.0843	136.2	Fail
17	0.0623	0.1053	169.0	Fail
18	0.0641	0.1088	169.6	Fail
19	0.0613	0.1051	171.6	Fail
20	0.0670	0.0933	139.3	Fail
21	0.0712	0.0952	133.7	Fail
22	0.0940	0.1155	122.8	Fail
23	0.0754	0.1203	159.6	Fail
24	0.0646	0.1070	165.7	Fail
25	0.0564	0.0895	158.6	Fail
26	0.0522	0.0769	147.3	Fail
27	0.0548	0.0882	160.9	Fail
28	0.0527	0.0811	153.7	Fail
29	0.0566	0.0897	158.6	Fail
30	0.0552	0.0936	169.7	Fail
Oct1	0.0507	0.0824	162.5	Fail
2	0.0560	0.0797	142.4	Fail
3	0.0616	0.0900	146.1	Fail
4	0.0633	0.1004	158.7	Fail
5	0.1039	0.1419	136.6	Fail
6	0.1013	0.1514	149.5	Fail
7	0.1019	0.1804	177.1	Fail
8	0.1096	0.1816	165.7	Fail
9	0.0961	0.1819	189.2	Fail
10	0.0913	0.1760	192.7	Fail
11	0.0806	0.1702	211.2	Fail
12	0.0781	0.1817	232.5	Fail
13	0.0702	0.1556	221.8	Fail
14	0.0698	0.1561	223.6	Fail
15	0.0786	0.1476	187.7	Fail
16	0.1048	0.1657	158.1	Fail
17	0.1043	0.1889	181.1	Fail
18	0.1167	0.2082	178.4	Fail
19	0.1658	0.2504	151.0	Fail
20	0.1856	0.2807	151.3	Fail
21	0.1629	0.2967	182.1	Fail
22	0.1361	0.2901	213.1	Fail
23	0.1375	0.2708	197.0	Fail
24	0.1496	0.2794	186.8	Fail
25	0.1620	0.3041	187.7	Fail
26	0.1678	0.2822	168.2	Fail
27	0.1559	0.2803	179.8	Fail
28	0.1670	0.2831	169.5	Fail
29	0.1956	0.2930	149.8	Fail
30	0.2291	0.3307	144.3	Fail

31	0.2082	0.3301	158.6	Fail
Nov1	0.2127	0.3253	153.0	Fail
2	0.2246	0.3567	158.8	Fail
3	0.2424	0.4045	166.8	Fail
4	0.2019	0.3710	183.7	Fail
5	0.2585	0.3925	151.8	Fail
6	0.2735	0.4294	157.0	Fail
7	0.2702	0.4036	149.3	Fail
8	0.2732	0.4270	156.3	Fail
9	0.3047	0.4657	152.9	Fail
10	0.3809	0.4913	129.0	Fail
11	0.3755	0.5148	137.1	Fail
12	0.3563	0.5272	148.0	Fail
13	0.4052	0.5478	135.2	Fail
14	0.3382	0.5091	150.5	Fail
15	0.2956	0.5029	170.1	Fail
16	0.3098	0.5230	168.8	Fail
17	0.3340	0.5324	159.4	Fail
18	0.4072	0.5504	135.2	Fail
19	0.4821	0.5822	120.8	Fail
20	0.4629	0.5971	129.0	Fail
21	0.4431	0.6219	140.3	Fail
22	0.4904	0.6605	134.7	Fail
23	0.6805	0.7852	115.4	Pass
24	0.6646	0.8092	121.8	Fail
25	0.5357	0.7467	139.4	Fail
26	0.4457	0.6900	154.8	Fail
27	0.3922	0.6326	161.3	Fail
28	0.4109	0.6202	150.9	Fail
29	0.4711	0.6490	137.8	Fail
30	0.4945	0.6754	136.6	Fail
Dec1	0.6056	0.7268	120.0	Fail
2	0.7358	0.8311	113.0	Pass
3	0.6332	0.8268	130.6	Fail
4	0.5312	0.7511	141.4	Fail
5	0.4683	0.7178	153.3	Fail
6	0.3836	0.6592	171.8	Fail
7	0.3584	0.6138	171.3	Fail
8	0.4076	0.5954	146.1	Fail
9	0.4906	0.6211	126.6	Fail
10	0.5617	0.6786	120.8	Fail
11	0.5384	0.7001	130.0	Fail
12	0.5393	0.6757	125.3	Fail
13	0.5620	0.6934	123.4	Fail
14	0.6577	0.7215	109.7	Pass
15	0.6145	0.7154	116.4	Pass
16	0.5542	0.7246	130.7	Fail
17	0.4464	0.6715	150.4	Fail
18	0.4045	0.6276	155.2	Fail
19	0.4472	0.6324	141.4	Fail
20	0.5295	0.6807	128.5	Fail
21	0.5034	0.6689	132.9	Fail
22	0.4481	0.6383	142.4	Fail
23	0.4427	0.6209	140.2	Fail
24	0.4527	0.5941	131.2	Fail
25	0.5604	0.6176	110.2	Pass
26	0.6190	0.6547	105.8	Pass
27	0.4647	0.6083	130.9	Fail

28	0.5068	0.6323	124.8	Fail
29	0.5399	0.6520	120.8	Fail
30	0.4319	0.6172	142.9	Fail
31	0.4449	0.6270	140.9	Fail

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
SSD Table 2	☐	4244.43			☐	0.00			
Total Volume Infiltrated		4244.43	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 = Failed

Model Default Modifications

Total of 0 changes have been made.

PERLND Changes

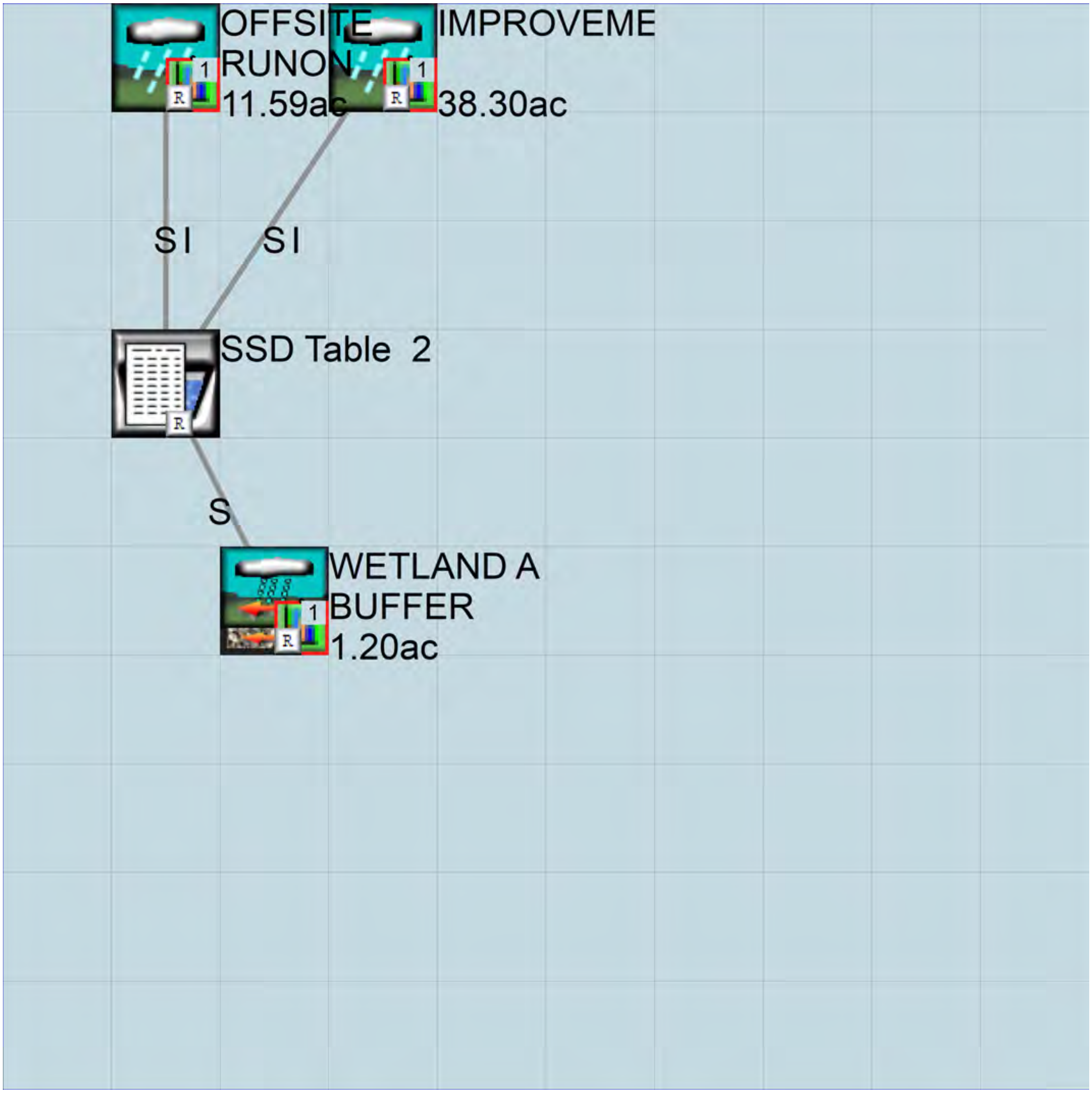
No PERLND changes have been made.

IMPLND Changes

No IMPLND changes have been made.

Appendix
Predeveloped Schematic

Mitigated Schematic



Predeveloped UCI File

```
RUN

GLOBAL
  WWHM4 model simulation
  START       1955 10 01        END    2008 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   Wetlana A Input Volumes DDIP03.wdm
MESSU      25   PreWetlana A Input Volumes DDIP03.MES
           27   PreWetlana A Input Volumes DDIP03.L61
           28   PreWetlana A Input Volumes DDIP03.L62
           30   POCWetlana A Input Volumes DDIP031.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      11
      PERLND      17
      PERLND      12
      PERLND      18
      IMPLND       1
      IMPLND       4
      IMPLND       8
      PERLND      46
      COPY       501
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        ONSITE BASIN                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           ***
   11      C, Forest, Mod          1    1    1    1   27    0
   17      C, Lawn, Mod            1    1    1    1   27    0
   12      C, Forest, Steep        1    1    1    1   27    0
   18      C, Lawn, Steep          1    1    1    1   27    0
   46       C/IMP DISP /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 ***
 11         0    0    1    0    0    0    0    0    0    0    0    0
 17         0    0    1    0    0    0    0    0    0    0    0    0
 12         0    0    1    0    0    0    0    0    0    0    0    0
 18         0    0    1    0    0    0    0    0    0    0    0    0
 46         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  *********
 11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 17         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 12         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 18         0    0    4    0    0    0    0    0    0    0    0    0    1    9
 46         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 ***
 11         0    0    0    0    0    0    0    0    0    0    0
 17         0    0    0    0    0    0    0    0    0    0    0
 12         0    0    0    0    0    0    0    0    0    0    0
 18         0    0    0    0    0    0    0    0    0    0    0
 46         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
 11              0       4.5      0.08       400       0.1       0.5     0.996
 17              0       4.5      0.03       400       0.1       0.5     0.996
 12              0       4.5      0.08       400      0.15       0.5     0.996
 18              0       4.5      0.03       400      0.15       0.5     0.996
 46              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
 11              0         0         2         2         0         0         0
 17              0         0         2         2         0         0         0
 12              0         0         2         2         0         0         0
 18              0         0         2         2         0         0         0
 46              0         0         2         2         0         0         0
END PWAT-PARM3
PWAT-PARM4
  <PLS >     PWATER input info: Part 4                               ***
  # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
 11            0.2       0.5      0.35         6       0.5       0.7
 17            0.1      0.25      0.25         6       0.5      0.25
 12            0.2       0.3      0.35         6       0.3       0.7
 18            0.1      0.15      0.25         6       0.3      0.25
 46            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
 11              0         0         0         0       2.5         1         0
 17              0         0         0         0       2.5         1         0
 12              0         0         0         0       2.5         1         0
 18              0         0         0         0       2.5         1         0
 46              0         0         0         0       2.5         1         0
END PWAT-STATE1

END PERLND
```

```
IMPLND
  GEN-INFO
    <PLS ><-------Name------->   Unit-systems   Printer ***
    # -  #                     User  t-series Engl Metr ***
                                      in  out           ***
    1      ROADS/FLAT             1    1    1   27    0
    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    4    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#   ***
ONSITE BASIN***
PERLND  11                         9.4     COPY   501     12
PERLND  11                         9.4     COPY   501     13
PERLND  11                         9.4     COPY   501     14
PERLND  17                        23.8     COPY   501     12
```

```
PERLND  17                         23.8     COPY   501     13
PERLND  17                         23.8     COPY   501     14
OFFSITE RUN ON***
PERLND  12                          6.9     COPY   501     12
PERLND  12                          6.9     COPY   501     13
PERLND  12                          6.9     COPY   501     14
PERLND  18                          2.9     COPY   501     12
PERLND  18                          2.9     COPY   501     13
PERLND  18                          2.9     COPY   501     14
IMPLND   1                         0.32     COPY   501     15
IMPLND   4                          0.7     COPY   501     15
IMPLND   8                         0.07     COPY   501     15
WETLAND BUFFER***
PERLND  46                          1.2     COPY   501     12
PERLND  46                          1.2     COPY   501     13
PERLND  46                          1.2     COPY   501     14

******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> # #  ***
PERLND  11 PWATER AGWI           .7833     COPY   390     INPUT  MEAN   1
PERLND  17 PWATER AGWI          1.9833     COPY   390     INPUT  MEAN   1
PERLND  12 PWATER AGWI            .575     COPY   390     INPUT  MEAN   1
PERLND  18 PWATER AGWI           .2417     COPY   390     INPUT  MEAN   1
PERLND  46 PWATER AGWI              .1     COPY   390     INPUT  MEAN   1
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    0.8            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.8            IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           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       14
PERLND     PWATER AGWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   14

  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       1955 10 01        END    2008 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   Wetlana A Input Volumes DDIP03.wdm
MESSU      25   MitWetlana A Input Volumes DDIP03.MES
           27   MitWetlana A Input Volumes DDIP03.L61
           28   MitWetlana A Input Volumes DDIP03.L62
           30   POCWetlana A Input Volumes DDIP031.dat
END FILES

OPN SEQUENCE
    INGRP              INDELT 00:15
      PERLND      14
      IMPLND       1
      IMPLND      14
      PERLND      12
      PERLND      11
      IMPLND       4
      IMPLND       8
      RCHRES       1
      PERLND      38
      COPY       501
      COPY         1
      DISPLY       1
    END INGRP
END OPN SEQUENCE
DISPLY
  DISPLY-INFO1
    # -  #<----------Title----------->***TRAN PIVL DIG1 FIL1  PYR DIG2 FIL2 YRND
    1        WETLAND A BUFFER            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           ***
   14      C, Pasture, Mod        1    1    1    1   27    0
   12      C, Forest, Steep       1    1    1    1   27    0
   11      C, Forest, Mod         1    1    1    1   27    0
   38       SAT/IMP DIS/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 ***
   14         0    0    1    0    0    0    0    0    0    0    0    0
   12         0    0    1    0    0    0    0    0    0    0    0    0
   11         0    0    1    0    0    0    0    0    0    0    0    0
   38         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  *********
   14         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   12         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   11         0    0    4    0    0    0    0    0    0    0    0    0    1    9
   38         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 ***
   14         0    0    0    0    0    0    0    0    0    0    0
   12         0    0    0    0    0    0    0    0    0    0    0
   11         0    0    0    0    0    0    0    0    0    0    0
   38         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
   14              0       4.5      0.06       400       0.1       0.5     0.996
   12              0       4.5      0.08       400      0.15       0.5     0.996
   11              0       4.5      0.08       400       0.1       0.5     0.996
   38              0         4         1       100     0.001       0.5     0.996
  END PWAT-PARM2

  PWAT-PARM3
    <PLS >      PWATER input info: Part 3         ***
    # -  # ***PETMAX    PETMIN    INFEXP    INFILD    DEEPFR    BASETP    AGWETP
   14              0         0         2         2         0         0         0
   12              0         0         2         2         0         0         0
   11              0         0         2         2         0         0         0
   38              0         0        10         2         0         0      0.35
  END PWAT-PARM3
  PWAT-PARM4
    <PLS >     PWATER input info: Part 4                               ***
    # -  #     CEPSC      UZSN      NSUR     INTFW       IRC     LZETP ***
   14           0.15       0.4       0.3         6       0.5       0.4
   12            0.2       0.3      0.35         6       0.3       0.7
   11            0.2       0.5      0.35         6       0.5       0.7
   38            0.1         3       0.5         1       0.7       0.4
  END PWAT-PARM4

  PWAT-STATE1
    <PLS > *** Initial conditions at start of simulation
              ran from 1990 to end of 1992 (pat 1-11-95) RUN 21 ***
    # -  # ***  CEPS      SURS       UZS      IFWS       LZS      AGWS      GWVS
   14              0         0         0         0       2.5         1         0
   12              0         0         0         0       2.5         1         0
   11              0         0         0         0       2.5         1         0
   38              0         0         0         0       4.2         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
   14      POND                   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
   14         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    4    1    9
   14         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
   14         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
   14            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
   14              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
   14              0         0
    4              0         0
    8              0         0
  END IWAT-STATE1

END IMPLND

SCHEMATIC
<-Source->                  <--Area-->     <-Target->   MBLK   ***
<Name>   #                  <-factor->     <Name>   #   Tbl#   ***
IMPROVEMENTS***
PERLND  14                        16.3     RCHRES   1      2
PERLND  14                        16.3     RCHRES   1      3
IMPLND   1                        19.6     RCHRES   1      5
```

```
IMPLND  14                       2.4     RCHRES   1       5
OFFSITE RUNON***
PERLND  12                      8.17     RCHRES   1       2
PERLND  12                      8.17     RCHRES   1       3
PERLND  11                      2.33     RCHRES   1       2
PERLND  11                      2.33     RCHRES   1       3
IMPLND   1                      0.32     RCHRES   1       5
IMPLND   4                       0.7     RCHRES   1       5
IMPLND   8                      0.07     RCHRES   1       5
IMPROVEMENTS***
PERLND  14                      16.3     COPY   501      14
PERLND  14                      16.3     COPY   601      14
WETLAND A BUFFER***
PERLND  38                       1.2     COPY   501      12
PERLND  38                       1.2     COPY   501      13
PERLND  38                       1.2     COPY   501      14
OFFSITE RUNON***
PERLND  12                      8.17     COPY   501      14
PERLND  12                      8.17     COPY   601      14
PERLND  11                      2.33     COPY   501      14
PERLND  11                      2.33     COPY   601      14

******Routing******
RCHRES   1                     .8333     PERLND  38      60
RCHRES   1                               COPY     1      16
END SCHEMATIC

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



<-Volume-> <-Grp> <-Member-><--Mult-->Tran <-Target vols> <-Grp> <-Member->  ***
<Name>   #        <Name> # #<-factor->strg <Name>   #   #        <Name> # #  ***
PERLND  14 PWATER AGWI          1.3583     COPY   390     INPUT  MEAN   1
PERLND  38 PWATER AGWI              .1     COPY   390     INPUT  MEAN   1
PERLND  12 PWATER AGWI           .6808     COPY   390     INPUT  MEAN   1
PERLND  11 PWATER AGWI           .1942     COPY   390     INPUT  MEAN   1
PERLND  14 PWATER AGWI          1.3583     COPY   390     INPUT  MEAN   1
PERLND  12 PWATER AGWI           .6808     COPY   390     INPUT  MEAN   1
PERLND  11 PWATER AGWI           .1942     COPY   390     INPUT  MEAN   1
END NETWORK

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

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

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

  HYDR-PARM1
    RCHRES  Flags for each HYDR Section                                      ***
    # -  #  VC A1 A2 A3  ODFVFG for each *** ODGTFG for each     FUNCT  for each
            FG FG FG FG  possible  exit  *** possible  exit      possible  exit
```

```
            *  *  *  *    *  *  *  *  *       *  *  *  *  *          ***
    1       0  1  0  0    4  0  0  0  0       0  0  0  0  0       2  2  2  2  2
  END HYDR-PARM1

  HYDR-PARM2
    # -  #    FTABNO       LEN     DELTH     STCOR        KS      DB50        ***
  <------><--------><--------><--------><--------><--------><-------->        ***
    1              1      0.01       0.0       0.0       0.5       0.0
  END HYDR-PARM2
  HYDR-INIT
    RCHRES  Initial conditions for each HYDR section                          ***
    # -  # ***   VOL     Initial  value  of COLIND     Initial  value  of OUTDGT
          *** ac-ft     for each possible exit       for each possible exit
  <------><-------->     <---><---><---><---><---> *** <---><---><---><---><--->
    1          0         4.0  0.0  0.0  0.0  0.0       0.0  0.0  0.0  0.0  0.0
  END HYDR-INIT
END RCHRES

SPEC-ACTIONS
END SPEC-ACTIONS
FTABLES
  FTABLE      1
   21    4
     Depth      Area    Volume  Outflow1 Velocity  Travel Time***
      (ft)   (acres) (acre-ft)   (cfs)   (ft/sec)    (Minutes)***
  199.0000  1.230000  0.000000  0.000000
  199.5000  1.270000  0.630000  0.284423
  200.0000  1.300000  1.270000  0.402235
  200.5000  1.340000  1.930000  0.492636
  201.0000  1.370000  2.600000  0.568847
  201.5000  1.400000  3.300000  0.635990
  202.0000  1.440000  4.010000  0.696692
  202.5000  1.470000  4.740000  0.752513
  203.0000  1.510000  5.480000  0.804471
  203.5000  1.550000  6.250000  0.853270
  204.0000  1.580000  7.030000  0.953338
  204.5000  1.620000  7.830000  1.308132
  205.0000  1.650000  8.650000  1.612922
  205.5000  1.690000  9.480000  2.133838
  206.0000  1.730000  10.34000  2.581952
  206.5000  1.760000  11.21000  3.065674
  207.0000  1.800000  12.10000  3.582664
  207.5000  1.840000  13.01000  18.48769
  208.0000  1.880000  13.94000  42.67459
  208.5000  1.920000  14.89000  63.56100
  209.0000  1.970000  15.86000  74.33869
  END FTABLE  1
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    0.8            PERLND   1 999 EXTNL  PREC
WDM      2 PREC     ENGL    0.8            IMPLND   1 999 EXTNL  PREC
WDM      1 EVAP     ENGL    0.76           PERLND   1 999 EXTNL  PETINP
WDM      1 EVAP     ENGL    0.76           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
COPY   601 OUTPUT MEAN   1 1     48.4      WDM    901 FLOW     ENGL      REPL
END EXT TARGETS

MASS-LINK
<Volume>   <-Grp> <-Member-><--Mult-->     <Target>       <-Grp> <-Member->***
<Name>            <Name> # #<-factor->     <Name>                <Name> # #***
```

```
  MASS-LINK        2
PERLND     PWATER SURO       0.083333      RCHRES         INFLOW IVOL
  END MASS-LINK    2

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

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

  MASS-LINK       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       14
PERLND     PWATER AGWO       0.083333      COPY           INPUT  MEAN
  END MASS-LINK   14

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

  MASS-LINK       60
RCHRES     ROFLOW            12.00000      PERLND         EXTNL  SURLI
  END MASS-LINK   60

END MASS-LINK

END RUN
```

Predeveloped HSPF Message File

Mitigated HSPF Message File

Disclaimer

Legal Notice

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

www.clearcreeksolutions.com

Appendix E - Single Segment Conveyance Analysis for TDA-1

$$Q = vA = \left(\frac{1.49}{n}\right) AR^{2/3}\sqrt{S}$$

Q = flow ft^3/s
v = velocity ft/s
A = area ft^2
n = Manning's Roughness Coefficient
R = Hydraulic Radius = Channel Area/Wetted Perimeter ft

Input Variables		
Diam	18	in
Slope	2.00%	%
n	0.012	-
R	0.375	ft

Output		
Aft^2	1.767	sf
Qft^3/s	16.137	cfs
Qgpm	7243	gpm
v ft/s	9.13	fps

Mannings N Value

- Lead 0.011
- Masonry 0.025
- Metal - corrugated 0.022
- Natural streams - clean and straight 0.03
- Natural streams - major rivers 0.035
- Natural streams - sluggish with deep pools 0.04
- Natural channels, very poor condition 0.06
- Plastic 0.009
- Polyethylene PE - Corrugated with smooth inner walls 0.012
- Polyethylene PE - Corrugated with corrugated inner walls 0.025
- Polyvinyl Chloride PVC - with smooth inner walls 0.011
- Rubble Masonry 0.022
- Steel - Coal-tar enamel 0.01
- Steel - smooth 0.012
- Steel - New unlined 0.011
- Steel - Riveted 0.019
- Vitrified clay sewer pipe 0.015
- Wood - planed 0.012
- Wood - unplaned 0.013
- Wood stave pipe, small diameter 0.012

NOTE: this calculator assumes full pipe flow - if pipe has partial flow, then area (A) must be altered to the wetted channel area

Project Description

File Name .... Preliminary Plat - SBUH for TDA1 Basin.SPF

Project Options

Flow Units .... CFS
Elevation Type .... Elevation
Hydrology Method .... Santa Barbara UH
Time of Concentration (TOC) Method .... SCS TR-55
Link Routing Method .... Steady Flow
Enable Overflow Ponding at Nodes .... YES
Skip Steady State Analysis Time Periods ... YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins...	1
Nodes...	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links...	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	TS-25	Cumulative	inches	Washington	Lewis	25.00	3.45	SCS Type IA 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Impervious Area (%)	Impervious Area Curve Number	Pervious Area Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-01	29.60	43.00	98.00	76.00	3.44	2.13	63.14	14.74	0 00:05:00

Subbasin Hydrology

Subbasin : Sub-01

Input Data

Area (ac) 29.6
Impervious Area (%) 43
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	29.6		85.46

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

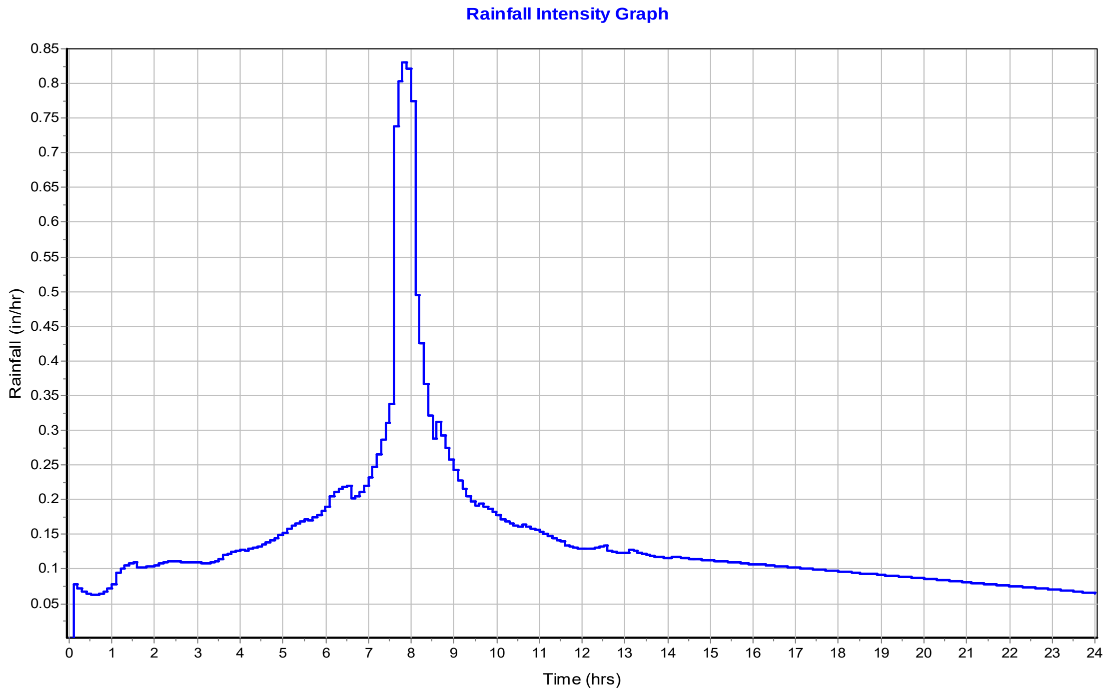
Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

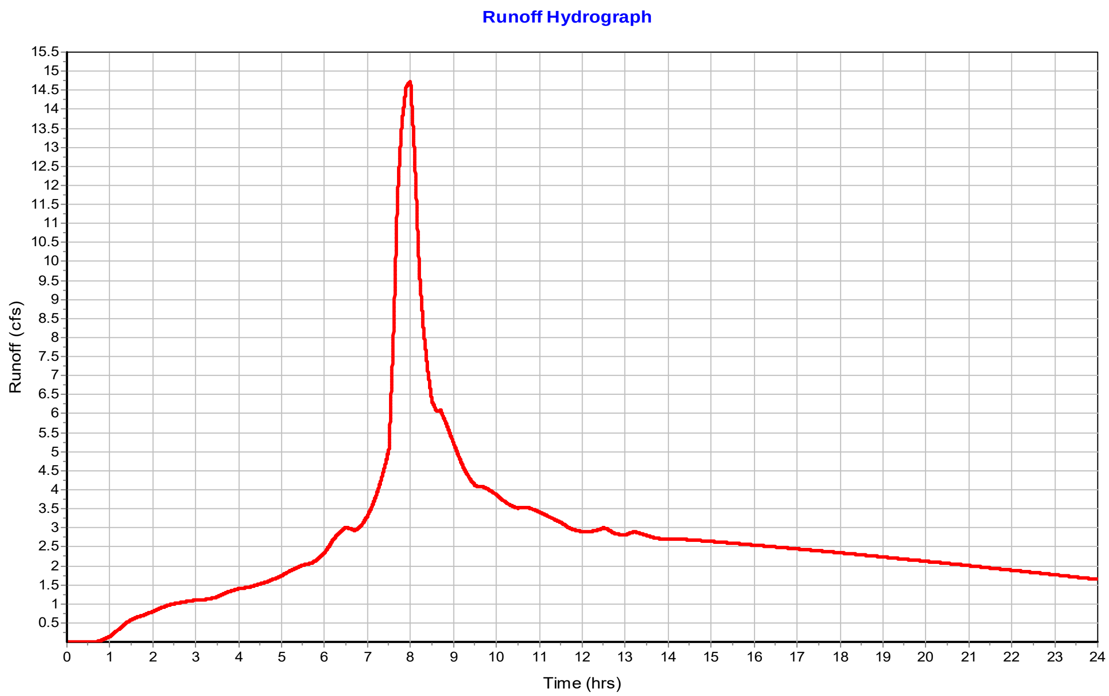
User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in) 3.44
Total Runoff (in) 2.13
Peak Runoff (cfs) 14.74
Weighted Curve Number 85.46
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-01





Project Description

File Name .... Preliminary Plat - SBUH for TDA1 Basin.SPF

Project Options

Flow Units .... CFS
Elevation Type .... Elevation
Hydrology Method .... Santa Barbara UH
Time of Concentration (TOC) Method .... SCS TR-55
Link Routing Method .... Steady Flow
Enable Overflow Ponding at Nodes .... YES
Skip Steady State Analysis Time Periods ... YES

THIS ANALYSIS WAS PERFORMED WITH STORM AND SANITARY ANALYSIS, AN AUTODESK PRODUCT.

ANALYSIS WAS RUN FOR A FULL 24-HOUR PERIOD

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins...	1
Nodes...	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links...	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	TS-100	Cumulative	inches	Washington	Lewis	100.00	4.30	SCS Type IA 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Impervious Area (%)	Impervious Area Curve Number	Pervious Area Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-01	29.60	43.00	98.00	76.00	4.29	2.86	84.72	20.16	0 00:05:00

Subbasin Hydrology

Subbasin : Sub-01

Input Data

Area (ac) 29.6
Impervious Area (%) 43
Impervious Area Curve Number 98
Pervious Area Curve Number 76
Rain Gage ID .... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Composite Area & Weighted CN	29.6		85.46

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

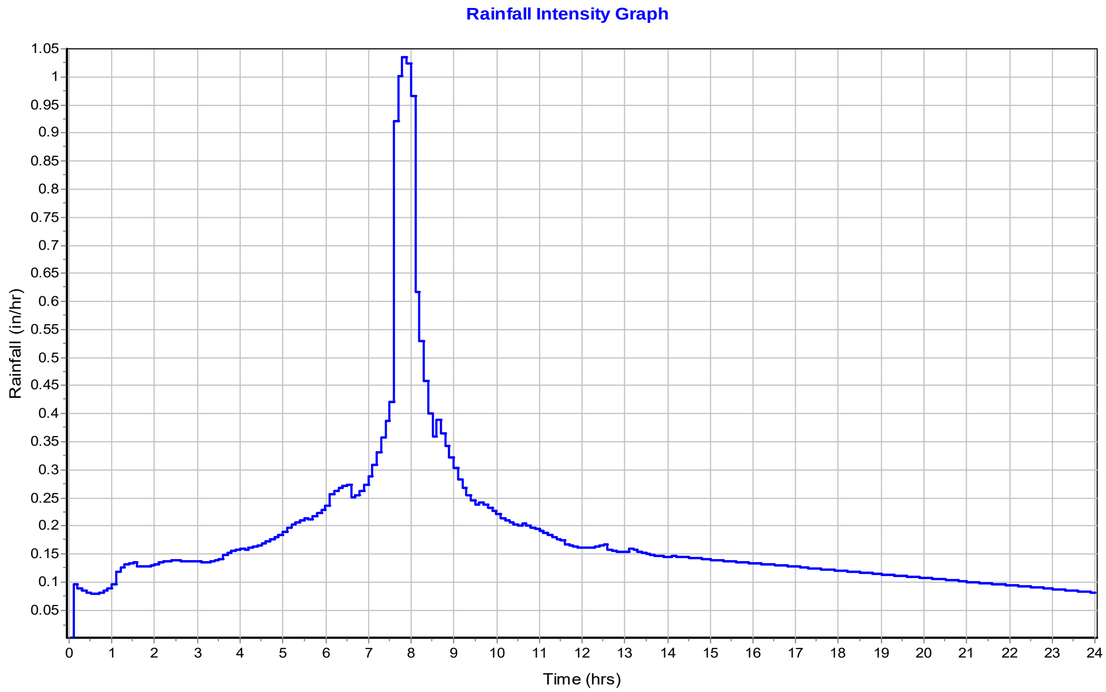
Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

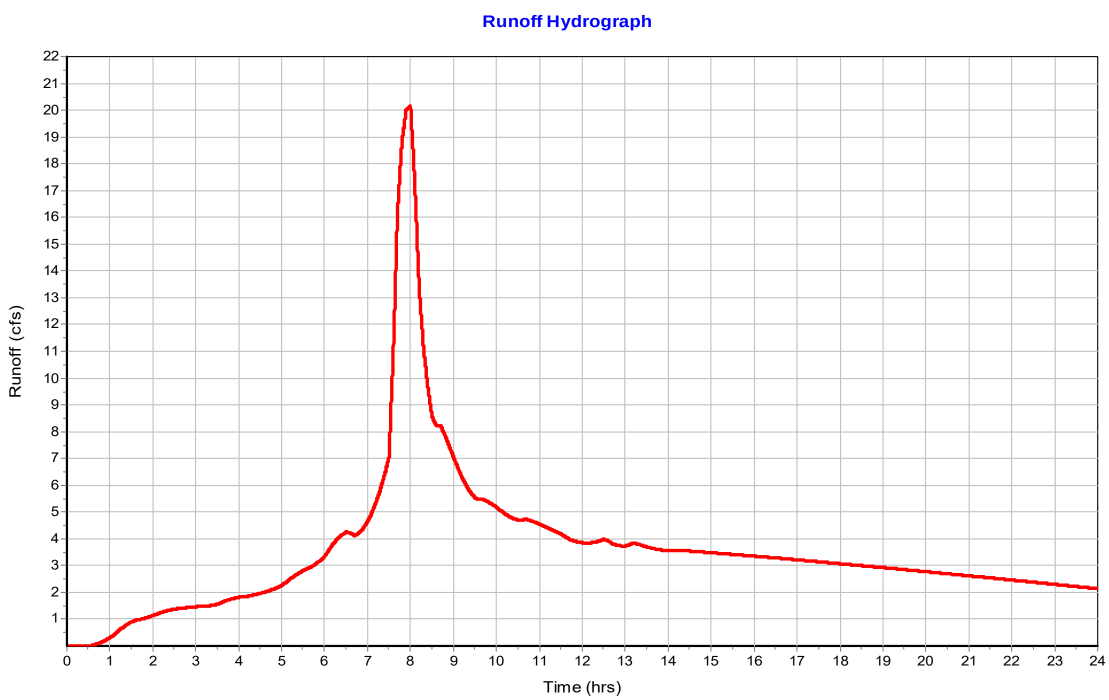
User-Defined TOC override (minutes): 5.00

Subbasin Runoff Results

Total Rainfall (in) 4.29
Total Runoff (in) 2.86
Peak Runoff (cfs) 20.16
Weighted Curve Number 85.46
Time of Concentration (days hh:mm:ss) 0 00:05:00

Subbasin : Sub-01





Appendix F - DOE TAPE General Use Level Designation for Jellyfish by Contech

WASHINGTON STATE DEPARTMENT OF ECOLOGY

January 2021

GENERAL USE LEVEL DESIGNATION FOR BASIC (TSS) AND PHOSPHORUS TREATMENT For Contech Engineered Solutions Jellyfish® Filter

Ecology's Decision:

1. Based on Contech Engineered Solution's application submissions, Ecology hereby issues a General use level designation (GULD) for Basic (TSS) and Phosphorus Treatment for Contech's Jellyfish® Filter:
   - Sized at a hydraulic loading rate of no greater than 0.21 gpm/sf filter surface for hi-flo cartridges and 0.11 gpm/sf filter surface for draindown cartridges

   Table 1. Jellyfish® cartridge hydraulic loading rates and sediment capture capacity[1] associated with various filter cartridge sizes.

Cartridge Length	Design Treatment Flow Rate	Design Sediment Mass Loading Capacity
15 inches	Hi-Flo 22 gpm Draindown 11 gpm	Hi-Flo 35 lbs Draindown 17 lbs
27 inches	Hi-Flo 40 gpm Draindown 20 gpm	Hi-Flo 63 lbs Draindown 31 lbs
40 inches	Hi-Flo 60 gpm Draindown 30 gpm	Hi-Flo 93 lbs Draindown 46 lbs
54 inches	Hi-Flo 80 gpm Draindown 40 gpm	Hi-Flo 125 lbs Draindown 63 lbs

[1] Design sediment mass loading capacity based on laboratory testing using silica sediment.

2. Ecology approves Jellyfish® Filter units at the design treatment flow rates shown in Table 1. Total Jellyfish Filter system design treatment capacity is the sum of the design treatment capacity of individual cartridges and must equal or exceed the water quality design flow rate. Calculate the water quality design flow rate that must be treated by an individual treatment system using the following procedures:

   - Western Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using the latest version of the Western Washington Hydrology Model or other Ecology-approved continuous runoff model.
   - Eastern Washington: For treatment installed upstream of detention or retention, the water quality design flow rate is the peak 15-minute flow rate as calculated using one of the three methods described in Chapter 2.7.6 of the 2019 Stormwater Management Manual for Eastern Washington (SWMMEW) or local manual.
   - Entire State: For treatment installed downstream of detention, the water quality design flow rate is the full 2-year release rate of the detention facility.

3. The GULD has no expiration date but may be amended or revoked by Ecology.

<u>Ecology's Conditions of Use:</u>

Jellyfish® Filter units shall comply with the following conditions:

1. Design, assemble, install, operate, and maintain Jellyfish® Filter units in accordance with Contech's applicable manuals and documents and this Ecology Decision.
2. Contech uses sediment-loading capacity, in conjunction with the water quality design flow rate, to determine the target maintenance interval.
3. Jellyfish® Filters shall conform to specifications submitted to and approved by Ecology.
4. Maintenance: The required inspection/maintenance interval for stormwater treatment devices is often dependent on the efficiency of the device and the degree of pollutant loading from a particular drainage basin. Therefore, Ecology does not endorse or recommend a "one size fits all" maintenance cycle for a particular model/size of manufactured filter treatment device.

   - The Jellyfish® Filter is designed for a target maintenance interval of 12 months. Maintenance includes floatable trash, debris, and oil removal; sediment removal; and the rinsing or replacement of filter cartridges.
   - A Jellyfish® Filter tested in Dundee, OR averaged a 3.2 month maintenance interval. Construction activities were ongoing in the drainage basin and near the monitoring site during the first two years of the study. Monitoring personnel observed significant amounts of roadway sediments and organic debris in the runoff, and TSS concentrations were higher than typical for roadway runoff. The runoff that occurred during the study may be unusual, and the maintenance interval the Jellyfish® Filter required may not be indicative of other, more typical, sites.

- Owner/s operators must inspect Jellyfish® Filter systems for a minimum of twelve months from the start of post-construction operation to determine site-specific inspection/maintenance schedules and requirements. Owners/operators must conduct inspections monthly during the wet season, and every other month during the dry season. (According to the SWMMWW, the wet season in westerns Washington is October 1 to April 30. According to the SWMMEW, the wet season in eastern Washington is October 1 to June 30.) After the first year of operation, owners/operators must conduct inspections based on the findings during the first year of inspections.
- Conduct inspections by qualified personnel, follow manufacturer's guidelines, and use methods capable of determining either a decrease in treated effluent flow rate and/or a decrease in pollutant removal ability.

5. Install the Jellyfish® Filter in such a manner such that flows exceeding the maximum operating rate of the system are bypassed and will not resuspend captured sediment.
6. Discharges from the Jellyfish® Filter units shall not cause or contribute to water quality standards violations in receiving waters.

Applicant: CONTECH Engineered Solutions

Applicant's Address: 11835 NE Glenn Widing Dr
Portland, OR 97220

Application Documents:

- *Jellyfish® Filter Dundee, OR, General Use Level Designation Technical Evaluation Report*, Prepared by CONTECH Engineered Solutions, December 28, 2020
- Application Letter for CULD for Jellyfish Filter - Basic Treatment, Phosphorus Treatment, and Oil Treatment, dated April 27, 2012.
- Letter from Imbrium Systems dated September 4, 2012 regarding the draft CULD/PULD document.
- *TAPE Analysis of Jellyfish Filter UF Field Study Data*, prepared by Stormwater Management Services, LLC.
- *TARP Field Test Performance Monitoring of a Jellyfish Filter JF4-2-1. Performance Monitoring Report for JF4-2-1* Prepared By: University of Florida, Engineering School of Sustainable Infrastructure and Environment (ESSIE), University of Florida, Gainesville, FL 32611. Final Version: 01 November 2011.
- *Jellyfish Filter Systems Evaluation Report in Consideration for Pilot Level Designation (PLD) for Imbrium Systems Corporation*, by Gary R. Minton, PhD, PE, with Resource Planning Associates in Seattle, Washington May 7, 2008 (updated July 1, 2008).

- *NJCAT Technology Verification, Jellyfish Fine Sediment Filter*, by the New Jersey Corporation for Advanced Technology (NJCAT) Program Imbrium Systems Corporation, June 2008

Applicant's Use Level Request:

- General use level designation as a Basic (TSS) and Phosphorus Treatment device in accordance with Ecology's 2019 Stormwater Management Manual for Western Washington.

Applicant's Performance Claims:

Based on results from a laboratory and field-testing, the applicant claims the Jellyfish® Filter, operating at a hydraulic loading rate of no more than 0.21 gpm/sf for hi-flo cartridges and 0.11 gpm/sf for draindown cartridges, is able to remove:

- 80% of total suspended solids (TSS) for influent concentrations greater than 100 mg/L and achieve a 20 mg/L effluent for influent concentrations less than 100 mg/L.
- 50% of total phosphorus for influent concentrations 0.1 to 0.5 mg/L

Recommendations:

Ecology finds that:

- Contech Engineered Solutions has shown Ecology, through laboratory and field testing, that the Jellyfish® Filter is capable of attaining Ecology's Basic (TSS) and Total Phosphorus treatment goals.

Findings of Fact:

<u>Field Testing 2017-2020</u>

Contech completed field testing in Dundee, OR on a Jellyfish® Filter unit containing six 54-inch hi-flo cartridges and one 54-inch draindown cartridge. This combination of cartridges resulted in a design flow capacity of 520 gpm (1.16 cfs). Since Contech conducted the field evaluation they contracted with Herrera Environmental Consultants to provide third party oversight.

- The field evaluation was completed between March 2017 and April 2020. Throughout the evaluation a total of 23 individual storm events (18 flow-weighted composite samples and 5 peak flow grab samples) were sampled to evaluate system performance. All sampled events met the TAPE sampling event qualification criteria, while 21 of the 23 events met the influent requirements for TSS and/or total phosphorus. Peak flows during these 21 events ranged from 26% to 106% of the design treatment capacity of 520 gpm, with a mean peak flow rate of 67% of design.
- Of the 23 TAPE qualified events, 21 met the requirements for TSS analysis (16 flow weighted composite; 5 peak flow grab samples). Influent concentrations ranged from 24 mg/L to 755 mg/L, with a mean concentration of 208 mg/L. Concentrations that exceeded the upper end of TAPE influent range were capped at 200 mg/L prior to calculating the pollutant removal efficiency. For all samples with influent concentrations greater than 100 mg/L the bootstrap estimate of the lower 95 percent confidence limit (LCL95) of the mean TSS reduction was 82%, meeting the 80% performance goal for Basic Treatment. The TAPE bootstrap calculator could not be used on samples with influent concentrations

between 20 mg/L to 100 mg/L due to the limited number of events available (n=6). For these events the mean and median effluent TSS concentrations were 19.7 and 18.1 mg/L respectively, again meeting the 20 mg/L effluent goal for Basic Treatment.

- Of the 23 TAPE qualified events, 18 met the requirements for total phosphorus analysis (13 flow-weighted composite; 5 peak flow grab samples). Influent concentrations ranged from 0.211 mg/L to 1.75 mg/L, with a mean concentration of 0.535 mg/L. Concentrations that exceeded the upper end of TAPE influent range were capped at 0.5 mg/L prior to calculating the pollutant removal efficiency. The LCL 95 mean percent removal goal was 70.1%, meeting the 50% performance goal for Phosphorus Treatment.
- Median particle sized distribution results from three samples showed 20% of sediment >250 µm, 31% of sediment between 62.5 to 250 µm, and 51% of sediment <62.5 µm. This demonstrates the influent to the Jellyfish consisted of primarily silt-sized particles (3.9 to 62.5 µm) and is thus representative of Pacific Northwest Stormwater.
- Contech encountered several unanticipated events and challenges that disrupted the sampling and/or resulted in lost data: the Jellyfish was taken offline twice to avoid atypical sediment loading that was the result of construction within the drainage basin; monitoring was suspended to repair or replace equipment that was damaged from vandalism and extreme weather; and, a cyber-attack on Contech storage drives resulted in a loss of approximately 15% of non-sampled flow and precipitation data.

<u>Field Testing 2010-2011</u>

Results (second-generation membrane filtration cartridges) – University of Florida (Gainesville, FL) installed and tested a Jellyfish JF4-2-1. The University conducted monitoring of the system from May 28, 2010 to June 27, 2011, with runoff from 15.01 inches of rainfall. The monitoring followed the Technology Acceptance Reciprocity Partnership (TARP) field test protocol, per the guidelines of the New Jersey Department of Environmental Projection (NJDEP). The New Jersey Corporation for Advanced Technology (NJCAT), on May 14, 2012 certified the Jellyfish Filter for 80 percent TSS removal.

- The JF4-2-1 operating at a maximum treatment flow rate of 200 gpm provided a median total suspended solids (TSS) removal of 89 percent, and a median suspended sediment concentration (SSC) removal of 99 percent. Influent TSS concentrations ranged from 16.3 to 261.0 mg/L. TSS concentrations in the range of 20-100 mg/L were reduced to less than 20 mg/L for 16 of 17 events. Average TSS removal for influent TSS between 100-200 mg/L was 90 percent.
- Other median pollutant removals included: total phosphorus, 59 percent; total nitrogen, 51 percent; total copper, 90 percent; and total zinc 70 percent.
- Total oil and grease influent concentrations ranged from 0.2 to 4.1 mg/L, with a median removal efficiency of 62 percent.
- No maintenance was required or carried out during the 13-month monitoring period. Curves of head loss versus flow rate were nearly identical for the system with fresh cartridges (beginning of monitoring) and dirty cartridges (end of monitoring period). The sump and filter cartridges captured 166 pounds of dry basis particulate matter.

- Runoff treated by the JF4-2-1 was from a nearby parking lot (approximately 75 percent pavement and 25 percent planting islands). Depending on storm event intensity and wind direction, the drainage area varied from 0.12 to 0.20 acres.

Laboratory Testing and Results

Imbrium conducted testing at the Monteco Limited Research & Development Centre (RDC) in Mississauga, Ontario with third party testing oversight provided by Prof. James Li of Ryerson University in Toronto. The laboratory set-up used a single cartridge fitted into a tank sized to be 1/7 the volume of a full-scale 7-cartridge Jellyfish Filter system. Based on the lab test results:

- A Jellyfish Filter system fitted with a single Jellyfish cartridge or multiple Jellyfish cartridges can remove greater than 86% Sil-Co-Sil 106 (mean particle size 22 microns) within a 95% confidence interval of +/- 1.3% at the system's 100% operating rate with influent sediment concentrations ranging from 100 to 300 mg/L. For systems using 12-inch diameter cartridges, each cartridge containing 91filtration tentacles of 54-inch length, the 100% operating rate is 50 gpm per cartridge operating at 12 inches driving head (i.e., 0.66 gpm/ft2). Each (of the) 91 filtration tentacles is composed of three 18-inch long segments for a total length of 54 inches with 76 ft2 of surface area (first generation membrane filtration cartridges).
- Test runs at 100 mg/L influent concentration resulted in effluent concentrations ranging from 12 to 21 mg/L. Ten of the 11 test runs had effluent less than 20 mg/L (as required for Basic Treatment).
- Sampling of effluent found an average D90 of about 14 microns indicating the Jellyfish Filter System is capable of removing most particles above 15 microns.

Other Jellyfish Filter Related Issues Recommended to be Addressed by the Company:

1. Conduct hydraulic testing to obtain information about maintenance requirements on a site with runoff that is more typical of the Pacific Northwest.

Technology Description: Download at: http://www.conteches.com/products/stormwater-management/treatment/jellyfish-filter

Contact Information:

Applicant: Jeremiah Lehman
Contech Engineered Solutions, LLC.
11815 Glenn Widing Dr
Portland, OR 97220
(503) 258-3136
jlehman@conteches.com

Applicant website: www.conteches.com

Ecology web link: http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

Ecology: Douglas C. Howie, P.E.
Department of Ecology
Water Quality Program
(360) 407-6444
douglas.howie@ecy.wa.gov

Revision History

Date	Revision
August 2008	PULD granted
January 2012	PULD Extension granted
September 2012	CULD for Basic treatment; PULD for Oil and Phosphorus treatment.
January 2013	Modifications to format document in line with other Use Level Documents, Changes dates for QAPP, TER, and Expiration
August 2014	Revised contact information and due dates for QAPP, TER, and expiration
March 2015	Revised Contact Information to Contech from Imbrium
November 2016	Revised Contech contact information
March 2018	Revised TER delivery and Expiration dates, Changed text from Imbrium to Contech in selected locations
April 2019	Revised TER delivery and Expiration dates
September 2020	Revised TER delivery and Expiration dates
January 2021	GULD Granted

Appendix G - Geotechnical Report

DOUBLE DIP, LLC
9837 Hilltop Road,
Bellevue WA 98004

Attn: Dr. Paul Joos, John Mastandrea
Re: Geotechnical Engineering Report, Infiltration rate: 1 Duffy Street, Centralia
Parcel#s: 021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002

At your request, we have conducted a subsurface soils exploration and foundation evaluation for the above mentioned project. The results of this investigation and recommendations have been presented for the site in this report.

The results of the exploration and analysis indicate that conventional spread footing foundation founded upon a built up soil section appears to be the most suitable type of foundation for the support of the proposed structures. Native soil bearing was estimated to be 500 psf. Most single family residences require a minimum bearing capacity of 1,500 psf for the foundation. In order to achieve this in the lower area, 2 feet of crushed structural fill will be required under each concrete foundation with a minimum 2.0 feet width for columns and perimeter strip footings if used. A mat foundation may use 1 foot of crushed rock and should be placed under each concrete foundation.

Because there is a natural drainage location in the middle of the site and the infiltration rate is slow (0.58 inches/hour), we do not recommend infiltration. We recommend full dispersion and connection to the natural drainage location. The Cation Exchange capacity and the organic content tests are provided below.

Test	Result
Cation Exchange Capacity	15.6 meq/100g
Organic Content	7.96 %

We appreciate this opportunity to be of service to you and we look forward to working with you in the future. If you have any questions concerning this report, the procedures used, or if we can be of any further assistance please call us at **(206) 786-8645**.

Respectfully,
JASON ENGINEERING, INC
Jason E.C. Bell, P.E.
Geotechnical Engineer

JASON E. C. BELL
STATE OF WASHINGTON
37343
REGISTERED
PROFESSIONAL ENGINEER

Table of Contents

1.0 Investigation Information

The purpose of this section is to describe details of the proposed construction. The surrounding parcels are already developed with single family residences. The proposed construction is wood framed single family residences. Conventional spread and column footings, slab-on-grade floors are anticipated. Differential settlements are limited to ¾ inch.

This report presents the results of a soils exploration and foundation analysis for the proposed reparations located at 1 Duffy Street in Centralia WA. This investigation included: a review of geological maps of the area and related literature, a reconnaissance of the immediate site, a description of the topography, surface and subsurface hydrology, soils, geology, and vegetation of the site, and an engineering analysis and evaluation of the area's inherent landslide and erosion hazards per the Critical Areas Ordinance regulations. The exploration and analysis determines the various soil profile components, the engineering characteristics of the foundation materials and provides criteria for the design engineers and architects to prepare or verify the suitability of the foundation.

Parcel information, size and legal description are summarized below:

Address:	1 Duffy Street in Centralia WA 98531
Parcels:	021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002
Legal:	Section 09 Township 14N Range 02W Ptn Lots 3-12 Blk 1 Lying Wly Duffy St Baker Addition
Lot size:	210,6562 SF (48.4 AC)

Investigation Summary:

We investigated this site in late February of 2022. A site plan was obtained from the county for the approximate building location. The test pits were located by the field crew relative to the nearest property corner for orientation and position of the excavations by means of normal taping and pacing procedures. Measurements are presumed to be accurate to within a few feet. After completion, the pits were backfilled with excavated soils and the site cleaned and leveled as required.

Drilling & Sampling Procedures:

We excavated test pits with a track excavator, used a track mounted auger for deep boring, and performed soil probing to investigate the existing soil conditions to depth of 25 feet below the existing ground surface. Representative samples were obtained at various soil intervals. The samples obtained by this procedure were classified in the field by a soils technician, identified according to pit number and depth, placed in plastic bags to protect against moisture loss and transported to the laboratory for additional testing. The types of foundation materials encountered were visually classified and described in detail on the logs provided in the Appendix. It is recommended that the logs not to be used for estimating quantities due to highly interpretive results.

Laboratory Testing

The laboratory testing program included supplementary visual classification and water content determinations on all samples. In addition, selected samples were subjected to Moisture Content Analysis - D4959, and Grain Size Analysis - ASTM designation C-117, C-136. All phases of the laboratory testing program were conducted according to applicable ASTM Specifications and the results of these tests are to be found on the accompanying logs located in the Appendix.

2.0 Site Description

Location and Surface Conditions

The following information was provided by the project owner. The site is 48 acres and the proposed buildings will be single family residences with typical spread and continuous perimeter foundation supports. Slab-on-grade floors are also contemplated for lower areas. Differential settlements are limited to ¾ inch. A pavement section has not been requested but has been provided within this report. The site of the proposed building addition upon which this soils exploration has been made is located at 1 Duffy street in Centralia WA. Access to the site is from the south through an existing driveway.

The site topography consists of flat land through the middle of property with slopes on both east and west sides. There is a ditch through the middle of the lower area that sometimes has water from nearby runoff. Most slopes are less than 20% on the site. There is one small area in the middle of the east side that measured up to 30%. There are no slopes that would be considered steep slope (over 40%). The total vertical relief of the site is 100 feet in the main section of the site (15% slope). There is a skinny leg to the south east where the vertical relief is up to 200 feet over a distance of 2500 linear feet (8% slope).

The site drainage consists of natural ground seepage and surface flow to the natural drainage location. The natural drainage location that handles runoff from the site and various other nearby properties runs through the middle of the site and flows to the north to a designated wetland at the north end. There is a wetland buffer zone depicted for the ditch line that accepts the runoff. The wetland at the north end of the property is about 1.25 acres (0.02% of the property). The site vegetation is grass, brush and trees. Prior grading has not occurred.

Subsurface Geology

The geology of the site and surrounding area as taken from the USDA Soil Conservation Service Survey consists of (172) Reed silty clay loam. This very deep, poorly drained soil is on flood plains. Drainage has been altered by tiling. This soil formed in mixed alluvium. Slope is 0 to 3 percent. The native vegetation is mainly shrubs, grasses, sedges, and a few mixed deciduous and coniferous trees. Elevation is 130 to 500 feet.

Typically, the upper part of the surface layer is mottled, very dark grayish brown silty clay loam about 6 inches thick and the lower part is mottled, very dark grayish brown silty clay loam about 8 inches thick. The upper 6 inches of the subsoil is mottled, brown silty clay, the next part is mottled, very dark gray and dark gray clay and dark grayish brown silty clay loam 17 inches thick, and the lower part to a depth of 60 inches or more is mottled, black clay.
Included in this unit are as much as 5 percent well drained Chehalis and Cloquato soils and Alvor soils. Also included are small areas of Reed soils that are in old river and stream channels of flood plains. About 35 percent of this unit is undrained and has a seasonal high water table at or near the surface in winter and early in spring.

If used for homesite development, the main limitations are the hazard of flooding, the seasonal high water table, shrink-swell potential, and slow permeability. Dikes and channels that have outlets for floodwater can be used to protect buildings from flooding. Tile drainage can be used to lower the water table if suitable outlets are available. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Septic tank absorption fields do not function properly because of wetness and slow permeability. Also, effluent from the absorption fields can contaminate ground water. Community sewage systems may be needed.

Permeability of this Reed soil is slow. Available water capacity is high. Effective rooting depth is limited by a high water table that is at a depth of 18 to 36 inches from November to May. Runoff is very slow, and the hazard of water erosion is slight. This soil is subject to frequent, brief periods of flooding in winter and early in spring.

The (43) and (44) soil type is Centralia loam. This very deep, well drained soil is on benches, hillsides, and broad ridgetops. It formed in residuum derived dominantly from micaceous marine sandstone. Slopes generally are plane or rolling. The native vegetation is mainly conifers. Elevation is 200 to 1,600 feet.

Typically, the surface is covered with a mat of partially decomposed and decomposed organic litter about 1.5 inches thick. The surface layer is very dark grayish brown and dark brown loam about 17 inches thick. The upper 21 inches of the subsoil is dark brown and dark yellowish brown clay loam, and the lower 11 inches is mottled, grayish brown clay loam. The substratum to a depth of 60 inches or more is mottled, grayish brown clay loam. Included in this unit are as much as 10 percent Melbourne soils, 5 percent Buckpeak soils, 3 percent somewhat poorly drained Galvin soils and somewhat poorly drained Scamman soils, and 2 percent Centralia soils that have slopes of less than 8 percent or more than 15 percent.

If used for homesite development, the main limitations are shrink-swell potential and steepness of slope. The effects of shrinking and swelling can be minimized by using proper engineering designs and by backfilling with material that has low shrink-swell potential. Slope is a concern in installing septic tank absorption fields. Absorption lines should be installed on the contour. If the unit is used for septic tank absorption fields, the limitation of moderate permeability can be overcome by increasing the size of the absorption field. If the density of housing is moderate to high, community sewage systems may be needed.

Permeability of this Centralia soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more, but few roots are below a depth of 49 inches. Runoff is medium, and the hazard of water erosion is moderate.

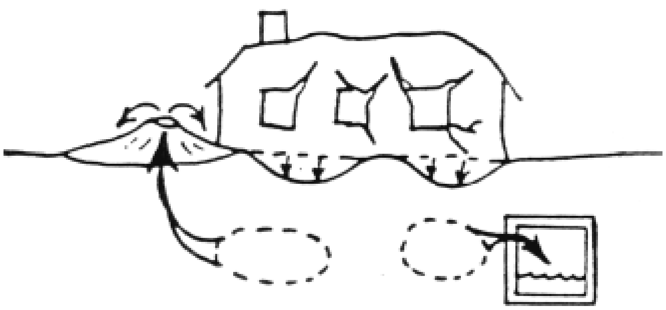
Our exploration pits confirm the soil types as 172 - Reed silty clay loam around the lower ditch area, and 44 and 43 - Centralia loam on upper east and west side slopes.

Liquefaction

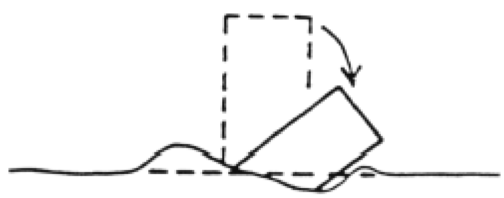
Liquefaction is when saturated, cohesionless soils are temporarily turned in to a liquid state usually from a seismic event. If ground motion lasts for extended amounts of time, the grain to grain contact shifts and the grain structure can collapse. If the water within the soil cannot flow easily between the grain and out of a collapsing area, the water pressure increases. When pore pressures build up within the soil and exceed the effective contact pressure of the soil, the water can push the soil particles apart. When the particles lose contact with each other, the soil mass can behave like a liquid. If pore pressures are great enough, water may discharge out of the ground like a geyser leaving characteristic signs, such as sand boils. Liquefaction is generally related to; soil characteristics, water table depths and the degree of seismic activity. The results are lower bearing capacities, increased settlement issues, landslides, and lateral spreading to name a few things. Liquefaction potential for this site is provided within the boundaries of the site. Seismic events which affect land masses on a greater scale are beyond the scope of this report.

The largest earthquakes in recent history in the Puget Sound Region are the 1949 surface wave (magnitude 7.1) in Olympia, the 1965 Seattle-Tacoma earthquake (magnitude 6.5) and the 2001 (magnitude 6.8). All of the historic liquefaction sites are located in the Duwamish valley in Holocene alluvium (Category I deposits). Liquefaction during the 1949 and 1965 earthquakes were mostly in the form of sand blows and surface cracking which was substantiated with many eyewitness observers living in the Pacific/Algona area. Broken water lines were reported in Auburn during the 1949 event suggests lateral spreading. Vertical ground water seepage around sewer manholes was also observed in Auburn, but no broken sewer lines were reported. From well records, Osceola deposits are 265 ft below sea level at a site 4 miles north of Auburn. The deposit is found at this depth because the Duwamish valley was an arm of the Puget Sound at that time. An important surface exposure of the Osceola Mudflow in a cut bank of the Puyallup River at Sumner suggests that the mudflow extended in the subsurface to Puyallup. In our review we found no evidence of liquefaction of the soils in the immediate area from the 1949, 1965 and 2001 earthquakes.

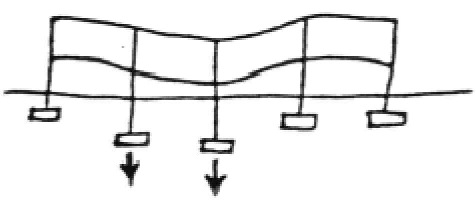
Sandy soils, and silty soils of very low plasticity, tend to experience "triggering" of cyclically induced soil liquefaction at relatively low shear strains (typically on the order of 3% to 6%), and the loss of strength can be severe. In other words, smaller displacements and stresses may result in liquefaction. Soils of higher plasticity, on the other hand, may also experience the same loss of strength and stiffness, and increased pore pressures. But the pore pressure ratios may be somewhat lower than those associated with more "classically" liquefiable soils, and the loss of strength and stiffness becomes pronounced at somewhat larger shear strains. The in-situ soils are non-plastic but also contain some cohesive properties. Non-plastic soils would typically liquefy quicker than plastic soils. The fact that these soils have cohesion, which is characteristic of a plastic soil, will give an additional safety factor against liquefaction. These soils are less likely to be "triggered" by small stresses and displacements. Larger stresses and pore pressures will need to build up in order to influence liquefaction. However, if the pressures do build up, in the case of a large seismic event, the effects could be severe. If liquefaction should occur, soil movements are likely to be one of the following instances:



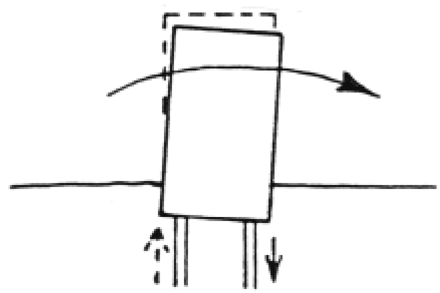
"Boil" ejecta from underground pools of free water.



Bearing failure by localized lateral soil movement.



Partial bearing failure by "punching" shear.



Differential settlement due to ground softening and inertial rocking.

Due to the slowly permeable nature of the soil, no groundwater was noted during the site visit. Our test pit was excavated and backfilled rather quickly and not left open for a long period of time. Groundwater can be expected at depths greater than 6 feet during construction, or if excavations are left open for long periods of time.

Information on the site has been reviewed on Liquefaction Susceptibility Map provided by the Department of Natural Resources which rates the site VERY LOW for susceptibility to liquefaction. Some hazardous areas for the site are shown per the County GIS including: wetlands, steep slopes, liquefaction, erosion hazard and stream buffers.

- ✓ Wetlands account for 0.02 % of the site and are only located on the north end.
- ✓ There are no steep slopes on the property.
- ✓ We do not anticipate flooding in this area.
- ✓ The liquefaction susceptibility is LOW.
- ✓ The erosion hazard is slight.
- ✓ The stream buffer for the ditch in the middle of the site is the only hazardous area that needs attention.

We utilized several methods to analyze the potential for liquefaction in this area. The most preferred method and currently used for the state of Washington is provided in 'WSDOT Evaluation of Liquefaction Hazards in Washington State Report': WA-RD 668.1 (December 2008) by Dr. Steven Kramer, Univ of Wash. It is very extensive and accounts for many factors including; groundwater elevation, geology, history, past seismic events, soil quality, and current compositional factors of the soil such as water content, particle shape, fines content, plasticity, and layers of impermeability. The results of the analysis provide a Susceptibility Rating Factor (SRF) to characterize the overall potential for liquefaction hazard. Included here are the results of our analysis using the WSDOT method which indicates a SRF = 6. According to the research, it matches the rating provided by the Department of Natural Resources as LOW. We are in agreement with this rating.

The most important factors for this site that reduce the liquefaction potential are:

- Proximity to the Puget Sound
- Low permeability soils
- High fines content

Table 4.1 Characterization of overall site susceptibility to liquefaction hazards.

SRF	**Site Susceptibility**
0 – 5	Very Low
5 – 10	Low
10 – 25	Moderate
25 – 50	High
> 50	Very High

LIQUEFACTION HISTORY FACTOR					F_{hist} =	1.50
	C_{obs} =	1.0	Low per USGS			
	C_{seis} =	1.5	PHA = 0.22g			
GEOLOGY FACTOR					$F_{geology}$ =	6.60
	C_{class} =	6.0	nearby wetlands			
	$C_{quality}$ =	1.1	Engineer site visit, site maps			
COMPOSITIONAL FACTOR					F_{comp} =	0.64
	$C_{gradation}$ =	0.75	Cu = 6			
	C_{shape} =	1.00	rounded			
	C_{fines} =	0.85	Fines > 70%			
	$C_{plasticity}$ =	1.00	nonplastic			
	C_{wc} =	1.00	high water table			
	C_{cap} =	1.00	silty loam on top of impermeable layer			
GROUNDWATER FACTOR				Elev = 30 FT	F_{gw} =	1.00
Susceptibility Rating Factor					**SRF =**	**6**

Seismic Setting/ Site Class

Foundation soils on this site are designated Site Class B per the Washington State Department of Natural Resources map which is normally associated with bedrock material. However, the site visit and the USGS soil map indicates the on-site soils are more of a silty clay loam to silty sandy loam which is typically a Site Class D. The presence of soft wet soils also indicates the site should be considered a Site Class D. Foundation soils on this site are designated Site Class D per the Washington State Department of Natural Resources map. All building structures on this project should be designed per Code Requirements for such a seismic classification. These types of soils have a shear wave velocity in the range of 600 to 1,200 ft/sec. The undrained shear strength is typically 1,000-2,000 psf with blow counts less than 30 blows per foot. Site specific coefficients were obtained from (https://hazards.atcouncil.org/). USGS Seismic Design Summary report is provided in the Appendix.

Mine Hazards

No mine hazards were noted on the subject property.

Site Photos

View looking west along west slope

View looking north at east slope.

Some areas had sink holes approximately 3 feet deep, mostly on south end.

Blue silt found in B-1, 6-25 ft

3.0 Discussion & Recommendations

Foundation Design

Various foundation types have been considered for the support of the proposed building structure. Two requirements must be fulfilled in the design of foundations. First, the load must be less than the ultimate bearing capacity of the foundation soils to maintain stability; and secondly, the differential settlement must not exceed an amount that will produce adverse behavior of the superstructure. The allowable settlement is usually exceeded before bearing capacity considerations become important; thus, the allowable bearing pressure is normally controlled by settlement considerations.

Considering the subsurface conditions and the proposed construction, it is recommended that the structure be founded upon mat foundations with a built up soil section. Conventional spread footing foundations with a built up soil section may also be feasible but require more imported materials.

Considering the subsurface conditions and the topography of the site, a daylight basement structure could also make good use of the slopes on the west and east sides.

It is to be noted that, whereas the test pits were placed and sampled by an experienced technician, it is sometimes difficult to record changes in stratification within narrow limits. Silt layers were encountered beneath the existing topsoil and extended to depths beyond the scope of this investigation. Lines of demarcation represent the approximate boundary between the soil types, but the transition may be gradual.

On the basis of the data obtained from the site and the test results from the various laboratory tests performed, we recommend that the following guidelines be used for the net allowable soils bearing capacity of 1,500 psf.

- Footings are required to be a minimum of 18 inches below grade for freeze thaw purposes. We expect most footings to be 2 feet below the surface. The excavation should be a minimum of 1 foot out from the side of the foundation.

- Most footings should use a mat foundation. Place at least 1 foot of clean, structural fill beneath all mat foundations and compact to at least 95% of the maximum dry density as determined by ASTM D-1557.

- As an alternative to the mat foundation, square and continuous footings may be also be used. Place at least 2 feet of clean, structural fill beneath all square and continuous footings and compact to at least 95% of the maximum dry density as determined by ASTM D-1557.

- We recommend a footing width of 2.0 foot (minimum) for square footings and continuous strip footings. Square and continuous footings will require 2 feet of structural fill under the concrete.

- All organic material should be removed below any and all foundations to a depth of at least 3 feet below bottom of concrete, regardless of footing type.

- A daylight basement type structure could make good use of the side slopes in the lower middle of the property and also elevate the structures to provide gravity fall for roof drains.

All footings should be proportioned to meet the stated bearing capacity and/or the current minimum requirements of the current International Building Code. Total settlement should be limited to 1 inch total with differential settlement of ¾ inch. Any excessively loose or soft spots or areas that do not meet the compaction requirements that are encountered in the footing subgrade will require over-excavation and backfilling with an additional 1 foot of structural fill. In order to minimize the effects of any slight differential movement that may occur due to variations in the characters of the supporting soils and any variations in seasonal moisture contents, it is recommended that all continuous footings be suitably reinforced to make them as rigid as possible.

Steep Slopes

Per 17.38.1030(1); 'To protect vegetation and other critical area features, buildings and other structures shall be set back a minimum of 15 feet from the edge of the critical area buffer, or from the edge of a critical area where no buffer is required. This provision shall only apply to features in or near wetlands, wildlife habitat areas, and geologically hazardous areas, except for seismic and volcanic hazards. There are no geologically hazardous areas on the site. Slope stability results are included in the Appendix.

The slopes on the west and east sides are mostly less than 20% and not considered steep. We have done a slope stability analysis for confirmation. Because the slopes on the site are not considered "steep", no setback is required from any of the slopes. The results of the analysis indicate slopes are stable and are not expected to have any negative effects on the proposed construction. The factors of safety for the slopes exceed the minimum standards, FS=1.5 for static and FS=1.2 for seismic.

We do not anticipate that the proposed residential structures and construction of the project will have any off-site impacts. On-site care should be taken during construction to make sure that runoff caused by wet weather is directed away from all open excavations. There were no signs of previous slope instability or failures.

Settlement

Settlements should not exceed tolerable limits if the following design and construction recommendations are observed. We expect the structure to utilize mat foundations. Organic material was noted in the investigation and may extend down to 10 feet below the surface. Organic material can compress and result in differential settlement that is detrimental the life and integrity of any foundation. Excessively organic top soils be removed and wasted or stockpiled for later use prior to the start of any construction. It is recommended that the final exposed subgrade be inspected by a representative of the soils engineer. This inspection should verify that all organic material has been removed.

Estimates were made for the total settlement over the lifespan of the structures based on the allowable bearing capacity. The majority of the settlement (primary settlement) will occur within in the first year, if not during construction. Larger footing loads will create larger settlement. A deeper footing depth will allow for a larger bearing capacity; however a deeper footing depth will also cause slightly greater settlement potential. Spreading the load out over a larger base will reduce the amount of total settlement. Organic material was found and may be located at depths deeper than our site investigation.

The post construction settlement will be comprised of immediate settlement, primary settlement, and secondary (or long term) settlement. The rapidly occurring immediate and primary settlement will contribute to some of the settlement that occurs on the site. Approximately 60% of the settlement will occur during construction and the first month after construction. Settlement calculations are included in the Appendix.

Structural Fill

Structural fill should consist of a 3 inch minus select, clean, granular soil with no more than 10% fines (-#200). Suitable structural fill should consist of material that meets one of the following specifications: WSDOT Section 9-03.9(3) Crushed Surfacing (Base Course Specs), WSDOT Section 9-03.9(3) Crushed Surfacing (Top Course Specs), WSDOT Section 9-03.9 Aggregates for Ballast and Crushed Surfacing, WSDOT Section 9-13.1(5) Quarry spalls. Material that does not meet one of the specifications should be submitted with sieve analysis results for approval prior to placement.

The fill should be placed in lifts not to exceed 12 inches in loose thickness. Each layer of structural fill should be compacted to at least 95% of the maximum dry density as determined by ASTM designation D-1557. For structural fill below footings, the area of the compacted backfill must extend outside the perimeter of the foundation for a distance at least equal to the thickness of the fill between the bottom of the foundation and the underlying soils. If it is elected to utilize a compacted backfill for the support of foundations, the subgrade preparation and the placing of the backfill should be monitored continuously by a qualified engineer or his representative so that the work is performed according to these recommendations.

The use of on-site soils as structural fill is not recommended. These materials require very high moisture contents for compaction and require a long time to dry out if natural moisture contents are too high. This makes moisture content, lift thickness, and compactive effort difficult to control.

Temporary Shoring & Excavation

Shallow excavations required for construction of foundations that do not exceed four feet in depth may be constructed. Side slopes are likely to naturally slough to a 1H:1V ratio although the native soils stood vertical during the investigation. For deep excavations, the soils present cannot be expected to remain in position for extended periods. These materials can be expected to fail, and collapse into any excavation thereby undermining the upper soils materials. This is especially true when working at depths near any groundwater or runoff. Temporary shoring should be implemented for cuts steeper than 1H:1V and greater than 4 feet in height, such as the case on the east and south side. The soil will maintain a temporary cut of 1H:1V. All excavations made for the foundations should be properly backfilled with suitable material compacted according to the procedures outlined in this report. Before the backfill is placed, all water and loose debris should be removed from these excavations.

Lateral earth pressures are dependent upon the backfill materials and their configuration and moisture content. Three inch minus sand and gravel mixtures that are free draining are recommended for backfilling walls greater than four feet tall. Below grade retaining walls or walls designed for retaining earthen fills on this project may use the following values for design. Values were obtained based on a unit weight of 125 pcf, and a phi angle of 30 degrees for the material on the side slopes of the property.

Earth Pressure Coefficients		Earth Pressure		
Active, K_a:	0.333	Active:	42	lbs./ft^3
At Rest, K_o:	0.500	At Rest:	63	lbs./ft^3
Passive, K_p:	3.000	Passive:	375	lbs./ft^3
		Coefficient of Friction:	0.35	

It is our opinion that maintaining safe working conditions is the responsibility of the contractor. Proper care must be taken to protect personnel and equipment. Jobsite conditions such as soil moisture content, weather condition, earth movements and equipment type and operation can all affect slope stability. All excavations should be sloped or braced as required by applicable local, state and federal requirements.

Utilities

There are no existing utilities expected on site. There will be utilities near the south entranance to the site due to the existing house on the south border of the property. Care should be taken to avoid disruption or breakage of water, power, sewer, gas, cable, phone and any other utility that may exist. Call 811 prior to excavation to have utilities marked.

Groundwater Control and Drainage

Groundwater was not encountered during the time the field exploration was conducted. The soils are not highly permeable in the lower area so groundwater cannot flow easily to open excavations. Groundwater may be present at depths level with the flow path in the centerline ditch. The depth will vary throughout the year and correspond to rainfall amounts. If construction is performed during the dry season, groundwater may not be visible. With proper site drainage procedures, groundwater is not expected to cause difficulties during construction of this project. It is recommended that runoff caused by wet weather be directed away from all open excavations. Exterior grades should be sloped away from the structure a minimum of 2% for the at least 10 feet from the structure. The on-site silty soils can be expected to become soft and pump if subjected to excessive traffic after becoming wet during periods of bad weather. This can be avoided by constructing temporary or permanent driveway sections should wet weather be forecast. The on-site drainage (roof drains & catch basins for pavement areas) should be collected and directed away from the buildings by tight-lining the drainage to the on site storm drainage system. Contractor should notify the engineer if excessive water is encountered during construction.

A perimeter footing drain is not recommended. The permeability of the soils is not sufficient for a footing drain. It will quickly clog with the native silt. The downspout system should be tighltined to the approved drainage system. Any and all roof drains should be rigid, solid PVC pipe and placed with positive gradient to allow gravity discharge away from the foundation.

Mottled soil was noted in one of the test pits. Mottled soil indicates seasonal soil saturation (alternate oxidizing and reducing conditions). In other words, water flows through this layer periodically creating a saturated soil condition at times and at other times the soil may be dry. This can create soft, saturated areas, problems for basement and septic fields, and poor aeration for landscape plantings. Implementation of perimeter footing drains should alleviate many difficulties associated with these soil conditions.

Percolation Rate:

At your request, we have performed a site specific PIT infiltration tests for the subject site. The tests were performed in accordance with KCSWDM standard Section 5.2.1 for a Pilot Infiltration test (PIT). The depth of the test was 4 feet beneath the existing surface. The resulting factored rate was 0.58 inches/hour. Infiltration test results indicate infiltration is not feasible for the site. Because there is a natural drainage location in the middle of the site and the infiltration rate is slow, we do not recommend infiltration. We recommend full dispersion and connection to the natural drainage location.

Erosion and Sediment Control

1. The implementation of these ESC plans and the construction, maintenance, replacement, and upgrading of these ESC facilities is the responsibility of the owner/ESC supervisor until all construction is approved.
2. The boundaries of the clearing limits shown on this plan shall be clearly flagged by a continuous length of survey tape (or fencing, if required) prior to construction. During the construction period, no disturbance beyond the clearing limits shall be permitted. The clearing limits shall be maintained by the applicant/ESC supervisor for the duration of construction.
3. The ESC facilities shown on this plan must be constructed prior to or in conjunction with all clearing and grading so as to ensure that the transport of sediment to surface waters, drainage systems, and adjacent properties is minimized.
4. The ESC facilities shown on this plan are the minimum requirements for anticipated site conditions. During the construction period, these ESC facilities shall be upgraded as needed for unexpected storm events and modified to account for changing site conditions (e.g., additional sump pumps, relocation of ditches and silt fences, etc.).
5. The ESC facilities shall be inspected daily by the applicant/ESC supervisor and maintained to ensure continued proper functioning. Written records shall be kept of weekly reviews of the ESC facilities during the wet season (Oct. 1 to April 30) and of monthly reviews during the dry season (May 1 to Sept. 30).
6. Any areas of exposed soils, including roadway embankments, that will not be disturbed for two days during the wet season or seven days during the dry season shall be immediately stabilized with the approved ESC methods (e.g., seeding, mulching, plastic covering, etc.).
7. Any area needing ESC measures not requiring immediate attention shall be addressed within fifteen (15) days.
8. The ESC facilities on inactive sites shall be inspected and maintained a minimum of once a month or within forty-eight (48) hours following a storm event.
9. At no time shall more than one (1) foot of sediment be allowed to accumulate within a catch basin. All catch basins and conveyance lines shall be cleaned prior to paving. The cleaning operation shall not flush sediment-laden water into the downstream system.
10. Stabilized construction entrances and roads shall be installed at the beginning of construction and maintained for the duration of the project. Additional measures, such as wash pads, may be required to ensure that all paved areas are kept clean for the duration of the project.
11. Any permanent flow control facility used as a temporary settling basin shall be modified with the necessary erosion control measures and shall provide adequate storage capacity. If the facility is to function ultimately as an infiltration system, the temporary facility must be graded so that the bottom and sides are at least three feet above the final grade of the permanent facility.
12. Where straw mulch for temporary erosion control is required, it shall be applied at a minimum thickness of 2 to 3 inches.

13. Prior to the beginning of the wet season (Oct. 1), all disturbed areas shall be reviewed to identify which ones can be seeded in preparation for the winter rains. Disturbed areas shall be seeded within one week of the beginning of the wet season.

Earthwork:

Excessively organic top soils generally undergo high volume changes when subjected to loads. This is detrimental to the behavior of pavements, floor slabs, structural fills and foundations placed upon them. It is recommended that excessively organic top soils be stripped from these areas to depths of 6-12 inches and wasted or stockpiled for later use. Exact depths of stripping should be adjusted in the field to assure that the entire root zone is removed. It is recommended that the final exposed subgrade be inspected by a representative of the soils engineer. This inspection should verify that all organic material has been removed. Any soft spots or deflecting areas should be removed to native soils and replaced with structural fill.

Once the existing soils are excavated to the design grade, proper control of the subgrade conditions (i.e., moisture content) and the placement & compaction of new fill should be maintained by a representative of the soils engineer. The recommendations for structural fill presented within this report, can be utilized to minimize the volume changes and differential settlements that are detrimental to the behavior of footings, and floor slabs. Enough density tests should be taken to monitor proper compaction. For structural fill beneath building structures one in-place density test per lift for every 1,000 ft^2 is recommended. In parking and driveway areas this can be increased to two tests per lift for every 1,000 ft^2.

Excavation equipment may disturb the bearing soils and loose pockets can occur at bearing levels that were not disclosed by the test pits. For this reason, it is recommended that the bottoms of the excavations be compacted in-place by vibratory compactors. The upper 12 inches should be re-compacted to achieve an in-place density of not less than 95% of the maximum dry density as determined by ASTM D-1557. Exterior grades should be sloped away from the structure a minimum of 2% for the at least 10 feet from the structure.

Floor Slab-On-Grade:

Before the placing of concrete floors or pavements on the site, or before any floor supporting fill is placed, the organic, loose or obviously compressive materials must be removed. The subgrade should then be verified by the geotechnical engineer or his representative that all soft or deflecting areas have been removed. Areas of excessive yielding should be excavated and backfilled with structural fill.

Any additional fill used to increase the elevation of the floor slab should meet the requirement for structural fill. Structural fill should be placed in layers of not more than 12 inches in thickness, at moisture contents at or above optimum, and compacted to a minimum density of 95% of the maximum dry density as determined by ASTM designation D-1557.

A granular mat should be provided below the floor slabs. This should be a minimum of four inches in thickness and properly compacted. The mat should consist of sand or sand and gravel mixture with non-plastic fines. All material should pass a ¾ inch sieve and contain less than 10% passing the #200 sieve. Groundwater can be expected at shallower depths during the winter months. A moisture barrier, such as visqueen or plastic sheeting, should be placed beneath all floor slabs that are within a foot of the water table, as determined during excavation.

Conclusion

The results of the exploration and analysis indicate that a mat foundation. A mat foundation may use 1 foot of structural fill should be placed and compacted under each concrete foundation. For conventional spread/column footing foundations, 2 feet of compacted structural fill will be required under each concrete foundation with a minimum 2.0 feet width.

The fill material will act to bridge and distribute the loads of the new construction. On site soils are estimated at 500 psf bearing and therefore need additional structural fill to accommodate a 1,500 psf foundation. The west and east sides of the property have a slope that could be utilized with a daylight basement type structure.

Due to the existing soil type, infiltration will be difficult. Dispersion and/or conveyance to the natural drainage location of the property is the best alternative.

It is recommended that the services of our firm be engaged to test and evaluate the soil conditions during the construction phase of the project. The design values and recommendations made herein are valid only insomuch as they are followed during the construction phase. Additionally, monitoring and testing during the construction phase needs be performed to verify the subgrade conditions and that suitable materials are used and that they are properly placed and compacted.

Pavement Design Recommendations

Based on the soil conditions and the assumed traffic counts of the proposed project, the pavement profile should consist of the following recommendations:

Existing Native:

1) All subgrade preparation work to be performed should be monitored by a representative of our firm.
2) Over-excavate any areas that exhibit pumping of the subgrade soils at least 12 inches (or as directed by a representative from our firm). Replace with gravel base material. If subgrade is saturated or pumping excessively after over-excavating then it may be necessary to place quarry spalls on the subgrade prior to placement of any gravel base material.
3) Compact the existing soils to 95% of the maximum dry density as determined by ASTM D-1557 (Modified Proctor).
4) Under certain site conditions the existing subgrade can be accepted by proof-rolling the subgrade using a fully loaded dump truck. This procedure (if used) should be witnessed and accepted by a representative of our firm.

Aggregate Subgrade:

1) The gravel base material should consist of 12.0 inches of material that is placed and compacted to 95% of the maximum dry density as determined by ASTM D-1557 (Modified Proctor).
2) The gravel base material should consist of a clean free draining granular material that has less than 10% passing the #200 sieve. This material should meet one of the following specifications, WSDOT Section 9-03.10 Aggregate for Gravel Base, WSDOT Section 9-03.14(1) Gravel Borrow, WSDOT Section 9-03.14(2) Select Borrow, APWA Class A Pit Run, or APWA class B Pit Run. Material that does not meet one of the specifications should be submitted for approval.
3) The material should be placed in lifts not to exceed 6 inches, with each lift being compacted and verified.

Crushed Aggregate Base:

1) The layer of crushed surfacing material should consist of 12.0 inches of WSDOT Section 9-03.9(3) Crushed Surfacing (Base Course Specs) that is placed and compacted to 95% of the maximum dry density as determined by ASTM D-1557 (Modified Proctor).
2) All of the gravel base and crushed surfacing material could, at the contractor's option, consist of WSDOT Section 9-03.9(3) Crushed Surfacing (Top Course Specs) that is placed and compacted to 95% of the maximum dry density as determined by ASTM D-1557 (Modified Proctor).
3) The crushed surfacing material should be placed to provide the proper grade and drainage for the asphalt pavement.

Asphalt Concrete Pavement:

1) The asphalt pavement should consist of at least 3.0 inches of WSDOT Class B asphalt that is placed and compacted to at least 91% of the theoretical maximum density as determined by ASTM D-2041 (Rice Method).
2) Provide a tack coat on all concrete surfaces that the pavement will be placed against, and for multiple lifts that are not placed within an hour time period.

AASHTO Pavement Section Design

Project Location:	1 Duffy St, Centralia		
Average Daily Traffic Count:	2,000	All Lanes & Both Directions	
Pavement Design Life:	20	Years	
% of Traffic in Design Lane:	100%		
Terminal Seviceability Index (P_t):	2.0		
Level of Reliability:	95		
Expected Growth Rate:	2.0%		
Subgrade CBR Value:	5	**Subgrade M_r:**	7,500

Calculation of Design 18 kip ESALs

	Daily Traffic Breakdown	Load Factors	Design ESAL's
Passenger Cars:	672	0.0008	4,766
Buses:	10	0.6806	60,359
Panel & Pickup Trucks:	150	0.0122	16,229
2 Axle, 6 Tire Trucks:	40	0.1890	67,046
Concrete Trucks:	0	4.4800	11,919
Dump Trucks:	20	3.6300	643,856
Tractor Semi Trailer Trucks:	100	2.3719	2,103,529
Double Trailer Trucks	4	2.3187	82,254
eavy Tractor Trailer Combo Trucks:	4	2.9760	105,571
verage Daily Traffic in Design Lane:	1,000		

Total Design Life 18 kip ESAL's:	3,095,530	
Actual Log (ESAL's):	6.491	
Trial Log (ESAL's):	6.499	
Trial SN:	4.15	**OK**

	Design Depth Inches	Structural Coefficient	Drainage Coefficient
Asphalt Concrete:	3.00	0.42	n/a
Asphalt Treated Base:	0.00	0.25	n/a
Cement Treated Base:	0.00	0.17	n/a
Crushed Aggregate:	12.00	0.14	1.0
Gravel Base:	12.00	0.11	1.0

Pavement Section Design SN: 4.26 **OK**

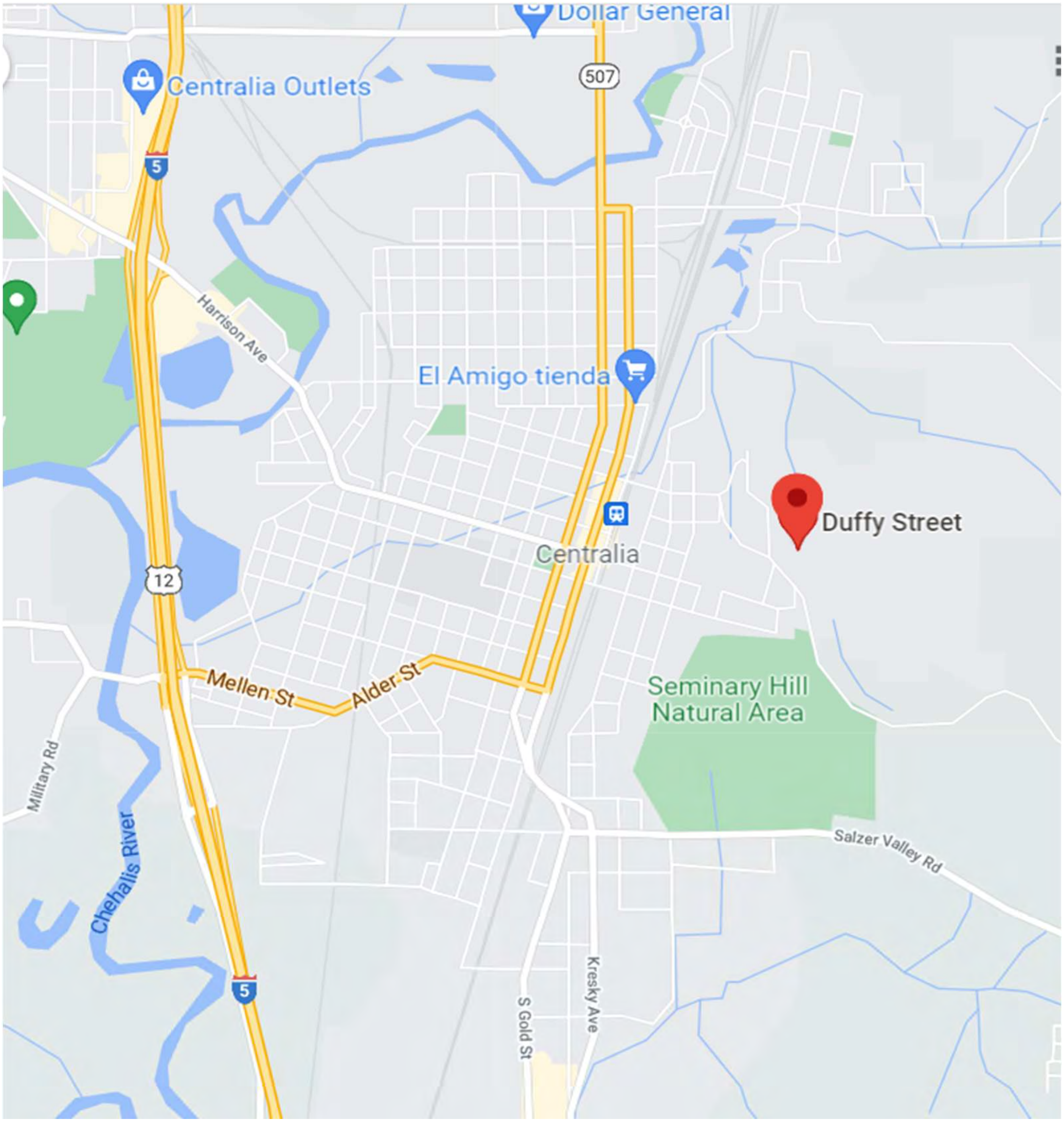
4.0 Scope and Limitations:

Written authorization to perform this exploration and analysis was provided by Dr Paul Joos. A site plan was obtained from the county to approximate the proposed building orientation. This investigative report has been prepared for the exclusive use of Dr Paul Joos and retained design consultants thereof. Findings and recommendations within this report are site specific and applicable to the subject property and proposed project. The exploration and analysis of the foundation conditions reported herein are considered sufficient in detail and scope to form a reasonable basis regarding the foundation. Any revision in the plans for the proposed structure from those enumerated in this report should be brought to the attention of the soils engineer so that he may determine if changes in the foundation recommendations are required. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to the attention of the soils engineer.

We were not requested to provide an Environmental Site Assessment for this property. Any comments concerning onsite conditions and/or observations, including soil appearances and odors, are provided as general information. Information in this report is not intended to describe, quantify or evaluate any environmental concern or situation.

All recommendations are in accordance with generally accepted soils and foundation engineering practices in the fields of foundation engineering, soil mechanics and engineering geology. No other warranties are implied or expressed.

Appendix: Figures & Illustrations



Not to Scale

Double Dip, LLC Centralia
1 Duffy Steet
Centralia WA 98531
Parcel: 021002000000, 003681009000, 021256000000, 001365001003, 001365006070, 001365001002

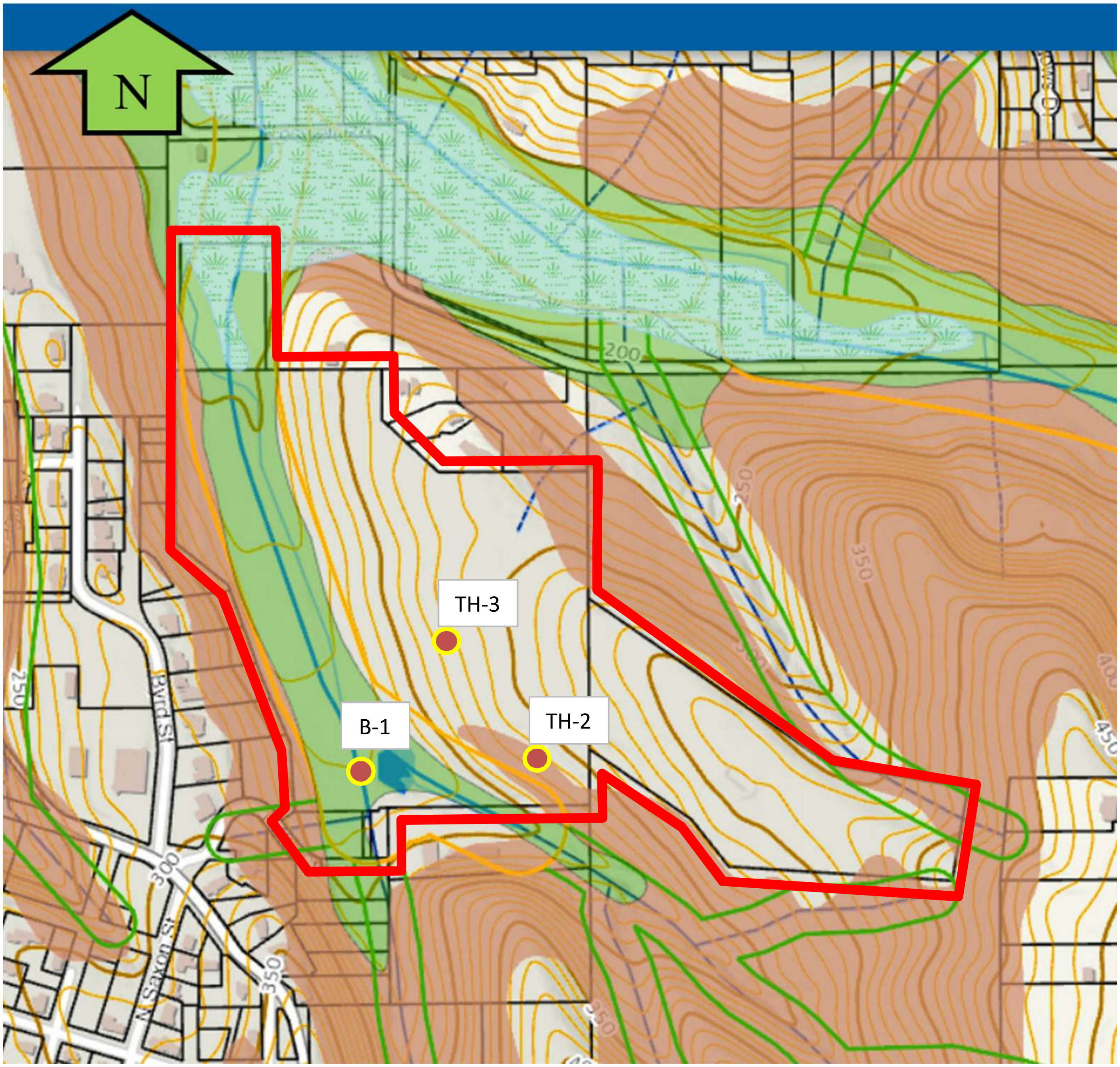
SITE LOCATION

Date: 2022.02.04

Figure A.1.0

File#: 22003

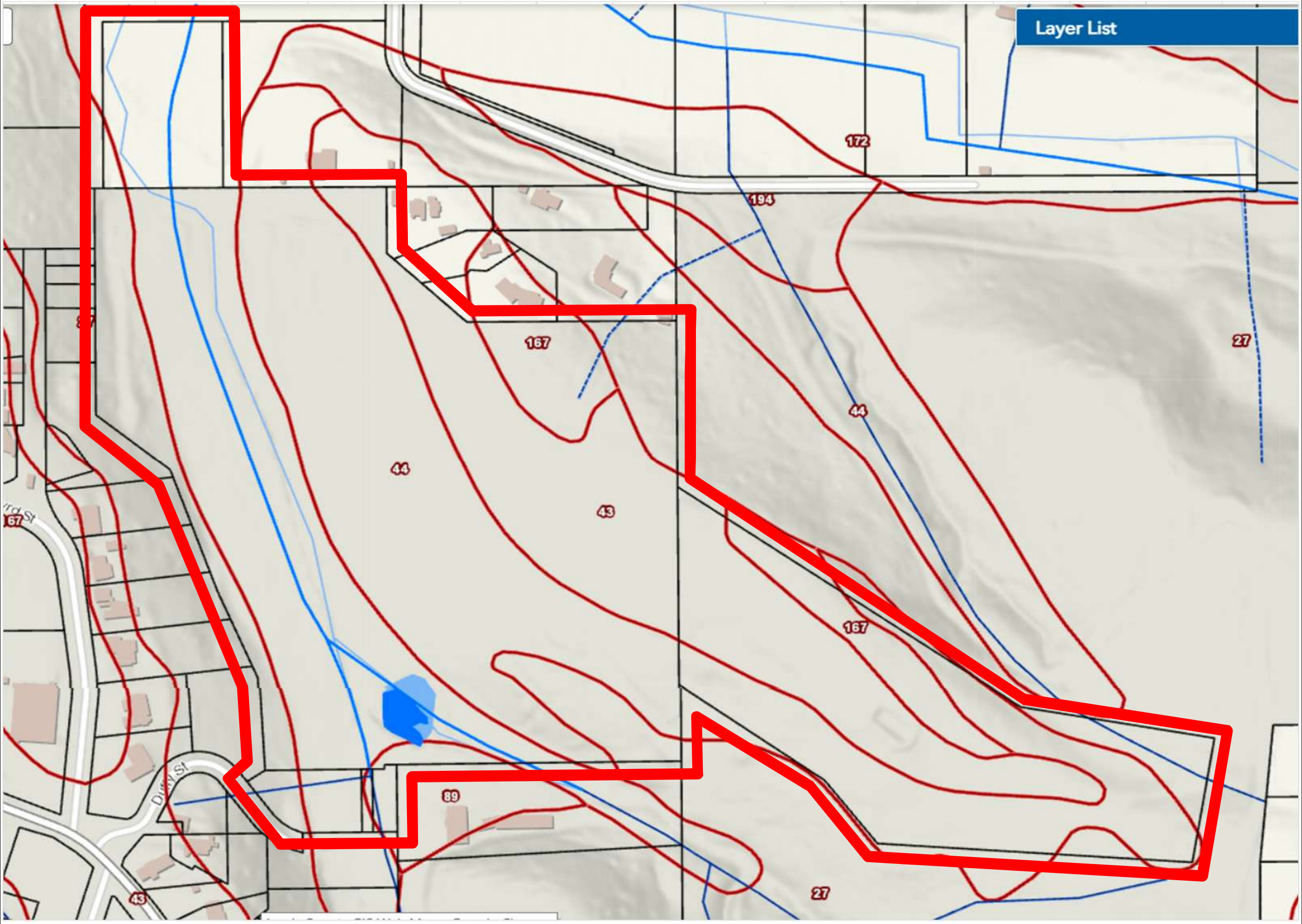
Jason Engineering - (206) 786-8645 - Jason@Jasonengineering.com



HAZARDOUS AREAS ON SITE PER COUNTY GIS
WETLAND
STEEP SLOPES
LIQUEFACTION
EROSION HAZARD
STREAM BUFFERS

48 ACRE SITE
PARCELS: 021002000000, 003681009000, 021256000000, 001365001003, 001365006070, 001365001002

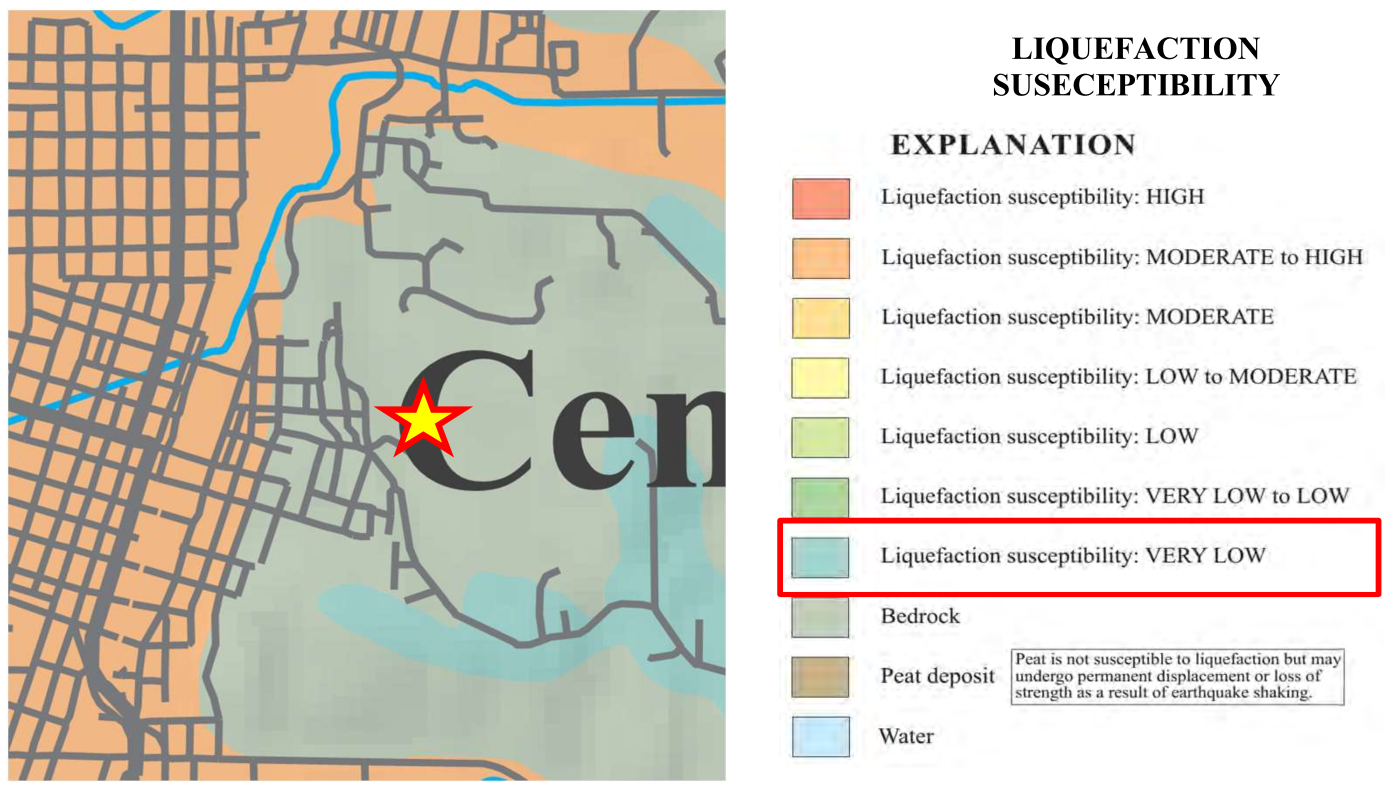
Double Dip, LLC Centralia 1 Duffy Steet Centralia WA 98531 Parcel: 021002000000, 003681009000, 021256000000, 001365001003, 001365006070, 001365001002	Not to Scale GIS MAP Date: 2022.02.04 Figure A.2.0



The geology of the site and surrounding area as taken from the USDA Soil Conservation Service Survey consists of (172) Reed silty clay loam. and (43) and (44) Centralia loam. Reed silty clay loam is very deep, poorly drained soil is on flood plains. Drainage has been altered by tiling. This soil formed in mixed alluvium. The main limitations are the hazard of flooding, the seasonal high water table, shrink-swell potential, and slow permeability. Dikes and channels that have outlets for floodwater can be used to protect buildings from flooding. Permeability of the Reed soil is slow.

Centralia loam. This very deep, well drained soil is on benches, hillsides, and broad ridgetops. It formed in residuum derived dominantly from micaceous marine sandstone. Permeability of the Centralia soil is moderate.

Double Dip, LLC Centralia 1 Duffy Steet Centralia WA 98531 Parcel: 021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002	Not to Scale USGS SOIL TYPE Date: 2022.02.04 Figure A.3.0



Not to Scale

Double Dip, LLC Centralia
1 Duffy Steet
Centralia WA 98531
Parcel: 021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002

LIQUEFACTION SUSECEPTIBILITY

SITE CLASS

Date: 2022.02.04

Figure A.4.0

File#: 22003

Jason Engineering - (206) 786-8645 - Jason@Jasonengineering.com

Excavation Date:	2022.01.14	**Boring ID:**	B-1
Project Name:	1 Duffy St	**Technician:**	JB
Sample Method:	Track mounted auger	**SPT:**	NA
Total depth (ft):	25	**Surface Elevation (ft):**	240

Depth, ft		Sample: Moist %	Sample: type	Sample: USCS	SPT (N) blows per 6"	Description / Notes
1						Grass and Topsoil
2				**ML**		Brown silty sand, mottled, many sink holes in random areas of the site, mainly in the south portion. Centralia loam
3						
4						
5					6,25,8	
6						Large wood chunk found in split spoon sampler. Likely additional organic material to be found in top 10 feet.
7						
8						
9						
10				**ML**	2,3,4	Blue gray silt. Random wood and organics found. Reed silt clay loam
11						
12						
13						
14						
15				**ML**	2,3,5	Blue gray silt
16						
17						
18						
19						
20				**ML**	1,2,2	Blue gray silt
21						
22						No groundwater found during investigation
23						
24						
25						

Double Dip, LLC Centralia 1 Duffy Steet Centralia WA 98531 Parcel: 021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002	BORING LOG Date: 2022.02.04 Figure A.5.1

File#: 22003 Jason Engineering - (206) 786-8645 - Jason@Jasonengineering.com

Excavation Date:	2022.02.04	**Boring ID:**	TH-2
Project Name:	1 Duffy St	**Technician:**	JB
Sample Method:	Track Exc	**SPT:**	NA
Total depth (ft):	10	**Surface Elevation (ft):**	280

Depth, ft	Sample: Moist %	Sample: type	Sample: USCS	SPT (N) blows per 6"	Description / Notes
					Grass and Topsoil
2					
4			ML		
6					Brown silty sand Centralia loam
8					
10					End test pit No groundwater found during investigation

Excavation Date:	2022.02.04	**Boring ID:**	TH-3
Project Name:	1 Duffy St	**Technician:**	JB
Sample Method:	Track Exc	**SPT:**	NA
Total depth (ft):	10	**Surface Elevation (ft):**	240

Depth, ft	Sample: Moist %	Sample: type	Sample: USCS	SPT (N) blows per 6"	Description / Notes
					Grass and Topsoil
2					
4			ML		
6					Brown silty sand Centralia loam
8					
10					End test pit No groundwater found during investigation

Double Dip, LLC Centralia
1 Duffy Steet
Centralia WA 98531
Parcel: 021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002

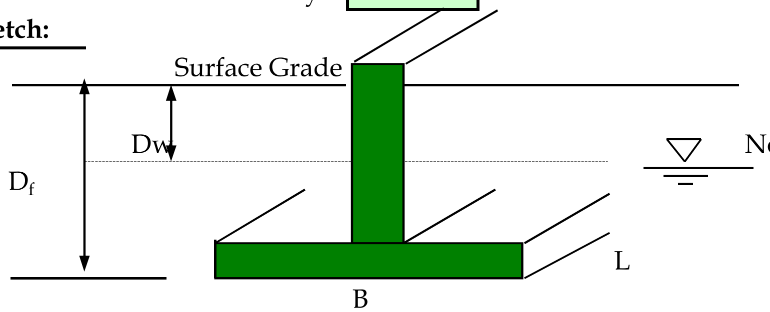
SOIL LOGS

Date: 2022.02.04 Figure A.5.2

Given: Strip Footing, lower flat area

In-situ density, γ_{sat} =	115	pcf	Cohesion, C =	0	psf
dry density, γ =	115	pcf	Width, B =	1.50	ft
footing depth, D_f =	2	ft	Length, L =	15.00	ft
depth of water table, Dw =	5	ft	Phi angle, ϕ =	24	degrees
Factor of Safety =	3		β =	0	degrees

Sketch:



No groundwater within 2x footing depth

Determinᴇ Allowable Bearing Capacity (psf) for Footing size, B

Solution: q_{ult} = c Nc Fcs Fcd Fci + q Nq Fqs Fqd Fqi + 0.5 g B Ng Fgs Fgd Fgi (Meyerhof)

Table 3.4	Nc =	19.31	Nq =	9.60	Ng =	9.43	(Vesic)
		19.31		9.60		6.89	(Brinch Hansen)
		19.31		9.60		5.71	(Meyerhof)

Shape Factors		Depth Factors		Inclination Factors	
Fcs =	1.050	Fcd =	1.533	Fci = Fqi =	1.000
Fqs =	1.045	Fqd =	1.418		
Fgs =	0.960	Fgd =	1.000	Fgi =	1.000

plete) q_{ult} =	0	+	3,268	+	781	= q_{ult} =	**4,050**	psf	(Vesic)
plete) q_{ult} =	0	+	3,268	+	570	= q_{ult} =	**3,839**	psf	(Brinch Hansen)
plete) q_{ult} =	0	+	3,268	+	473	= q_{ult} =	**3,741**	psf	(Meyerhof)

Average of 3, using all soil factors and the applied safety factor

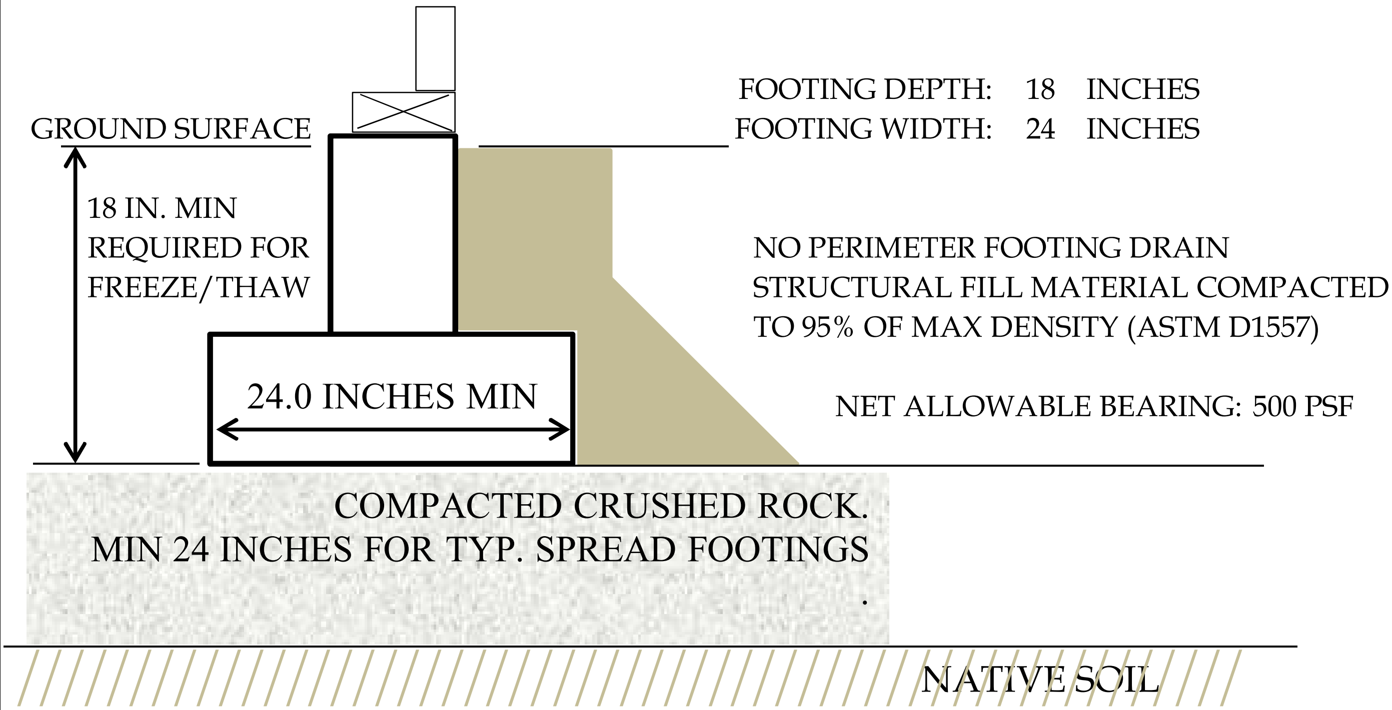
$q_{allowable}$ = 1,350 psf

Not to Scale

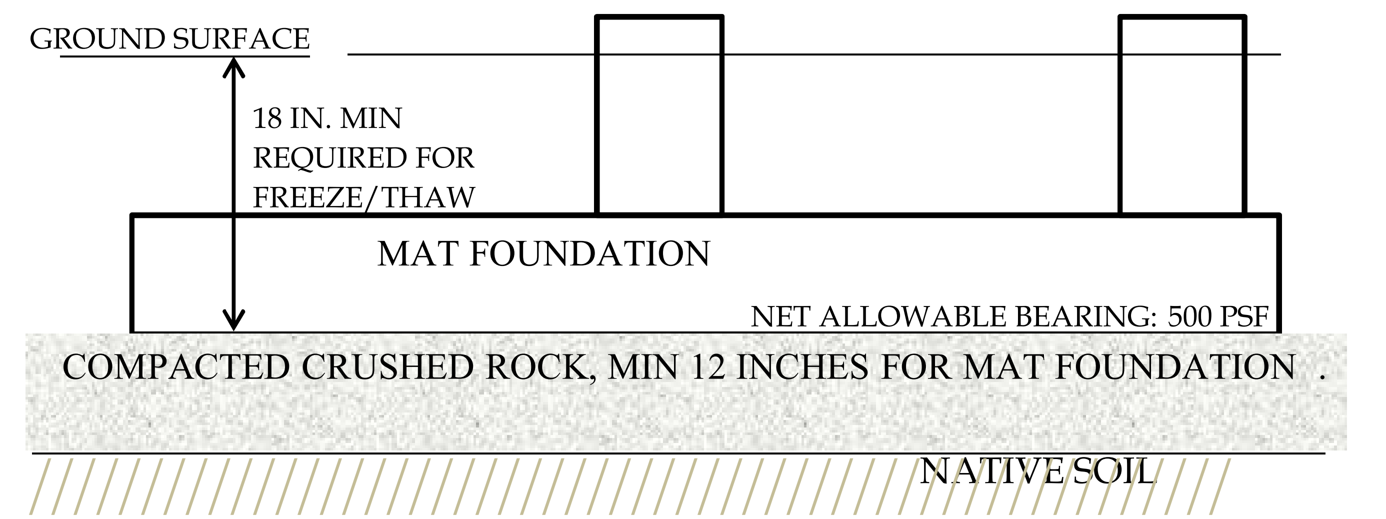
Double Dip, LLC Centralia 1 Duffy Steet Centralia WA 98531 rcel: 021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002	BEARING CAPACITY Date: 2022.02.04 Figure A.6.0
File#: 22003	Jason Engineering - (206) 786-8645 - Jason@Jasonengineering.com

COLUMN (Terzaghi Method)			CONTINUOUS WALL (Terzaghi Method)		
Unit Weight of Soil, in lbs/ft^3=	115		Unit Weight of Soil, in lbs/cf=	115	
Average Corrected SPT N-value=	4		Average Corrected SPT N-value=	4	
Total Load (load, footing, soil) in kips=	1.5		Total Load (load, footing, soil), in kips=	1.5	
Soil Internal Friction Angle (from Fig. 9-9)=	24		Soil Internal Friction Angle (from Fig. 9-9)=	24	
General or local shear (determine for Fig.9-9)=					
N_g (using above results and figure 9-7)=	9.60		N_g (using above results and figure 9-7)=	9.60	
N_v (using above results and Figure 9-7)=	9.43		N_v (using above results and Figure 9-7)=	9.43	
N_c (using figure 9-7)=	19.31		N_c (using figure 9-7)=	19.31	
Unconfined Compressive Strength, Cohesion (kips/sf)=	0		Unconfined Comp. Strength, Cohesion (kips/sf)=	0	
Cohesion of Soil=	0		Unit Cohesion=	0	
Embedment Depth, in feet=	2		Embedment Depth, in feet=	2	
Footing Width (square), in feet=	3		Footing Width, in feet=	2	
Ultimate Bearing Capacity (lbs/ft^2)=	3,509		Ultimate Bearing Capacity (lbs/ft2)=	3,292	
Actual Bearing from Total Load (lbs/ft^2)=	167		Actual Bearing from Total Load (lbs/ft2)=	375	
F_s Against Bearing Capacity Failure (>3.0)=	**21.05**		Fs Against Bearing Capacity Failure (>3.0)=	**8.78**	
SETTLEMENT CHECK (for sand and SPT values only)					
Maximum Settlement on Dry Sand=	**0.09**	feet	**Maximum Settlement on Dry Sand=**	**0.17**	feet
	1.13	inches		2.00	inches
If encountered, depth to groundwater, in feet=	5		If encountered, depth to groundwater, in feet=	5	
Max Settlement on Wet Sand (if applicable)=	0.08	feet	**Max Settlement on Wet Sand (if applicable)=**	0.12	feet
	0.91	inches		1.47	inches

TYPICAL SPREAD, COLUMN AND PERIMETER FOOTINGS



MAT FOUNDATION



FOOTING DEPTH: 18 INCHES
FOOTING WIDTH: MAT FOUNDATION
NO PERIMETER FOOTING DRAIN

STRUCTURAL FILL MATERIAL COMPACTED
TO 95% OF MAX DENSITY (ASTM D1557)

Double Dip, LLC Centralia 1 Duffy Steet Centralia WA 98531 Parcel: 021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002	FOOTING DETAIL Date: 2022.02.04 Figure A.8.0

File#: 22003 Jason Engineering - (206) 786-8645 - Jason@Jasonengineering.com

Name	Value	Description
S_S	1.177	MCE_R ground motion (period=0.2s)
S_1	0.506	MCE_R ground motion (period=1.0s)
S_{MS}	1.212	Site-modified spectral acceleration value
S_{M1}	0.758	Site-modified spectral acceleration value
S_{DS}	0.808	Numeric seismic design value at 0.2s SA
S_{D1}	0.506	Numeric seismic design value at 1.0s SA
SDC	D	Seismic design category
F_a	1.029	Site amplification factor at 0.2s
F_v	1.5	Site amplification factor at 1.0s
CR_S	0.952	Coefficient of risk (0.2s)
CR_1	0.908	Coefficient of risk (1.0s)
PGA	0.506	MCE_G peak ground acceleration
F_{PGA}	1	Site amplification factor at PGA
PGA_M	0.506	Site modified peak ground acceleration
T_L	16	Long-period transition period (s)
SsRT	1.177	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.236	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.506	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.556	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.6	Factored deterministic acceleration value (PGA)

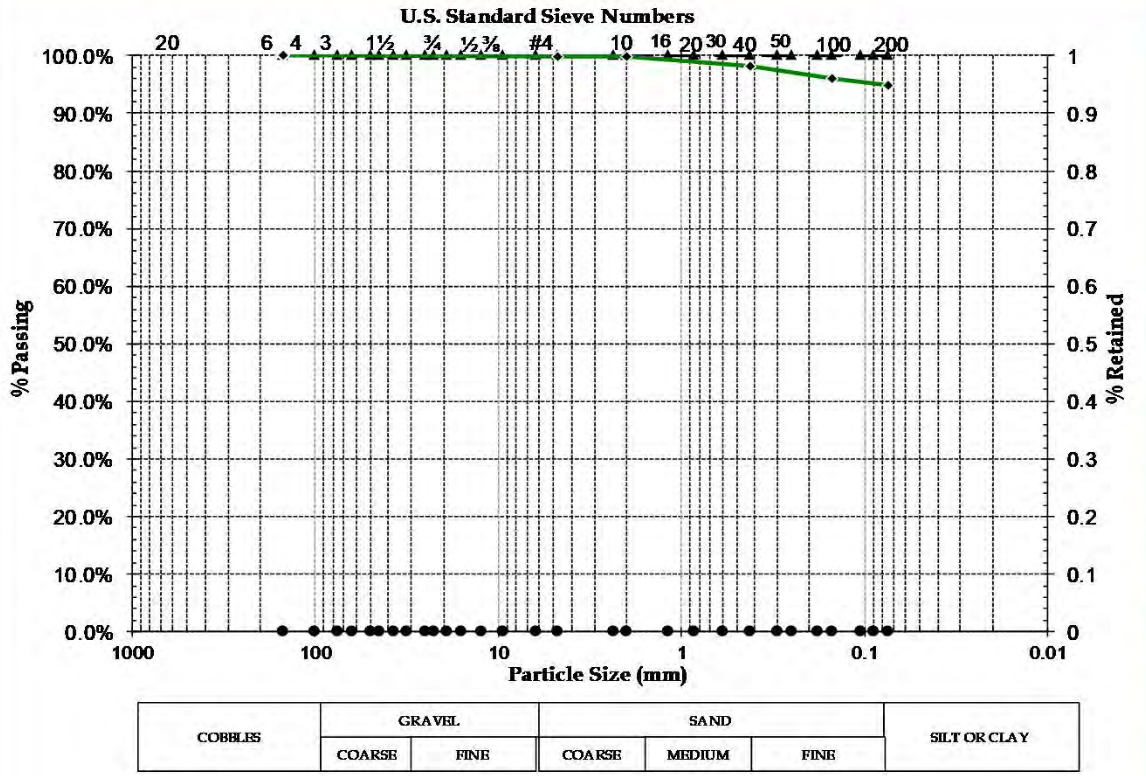
Coordinates:
46.7164758, -122.9436464
Elevation:
268
Hazard Type:
Seismic
Reference Document:
IBC 2015
Risk Catergory:
III
Site Class:
D

Double Dip, LLC Centralia
1 Duffy Steet
Centralia WA 98531
Parcel: 021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002

SEISMIC DESIGN DATA

Date: 2022.02.04 Figure A.9.0

Date Received:	Sample Description:	Source:	Unified Soils Classification System:
1/14/22	Boring #1- 10' BSG	1 Duffy Rd	ML, Silt
Project:	**Location**	**Sample #**	**Specifications:**
Centralia Golf Course	Boring #1- 10' BSG	22-0002B	No Specs



Sample Meets Specs ?
n/a
% Gravel: 0.0%
% Sand: 5.2%
% Fines: 94.8%
$D_{(10)}$ = 0.01 mm
$D_{(30)}$ = 0.02 mm
$D_{(60)}$ = 0.05 mm
$D_{(90)}$ = 0.10 mm
Curvature Coef, C_C: 1.50
Uniformity Coef, C_U: 6.00
Fineness Modulus: 0.09
Dust Ratio (#200/#40): 0.96
Sand/Silt ratio (#10/#200): 1.1
Sand Equivalent: N/A
Fracture count (Sgl/Dbl): N/A

Coarse Aggregate Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min	Fine Aggregate Sieve Size US	Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%			#4	4.75	100.0%	100.0%		
4.00"	100.00		100.0%			#8	2.360		99.8%		
3.00"	75.00		100.0%			#10	2.000	99.8%	99.8%		
2.50"	63.00		100.0%			#16	1.180		99.0%		
2.00"	50.00		100.0%			#20	0.850		98.7%		
1.75"	45.00		100.0%			#30	0.600		98.4%		
1.50"	37.50		100.0%			#40	0.425	98.2%	98.2%		
1.25"	31.50		100.0%			#50	0.300		97.3%		
1.00"	25.00		100.0%			#60	0.250		96.9%		
7/8"	22.40		100.0%			#80	0.180		96.4%		
3/4"	19.00		100.0%			#100	0.150	96.1%	96.1%		
5/8"	16.00		100.0%			#140	0.106		95.3%		
1/2"	12.50		100.0%			#170	0.090		95.0%		
3/8"	9.50		100.0%			#200	0.075	94.8%	94.8%		
1/4"	6.30		100.0%								

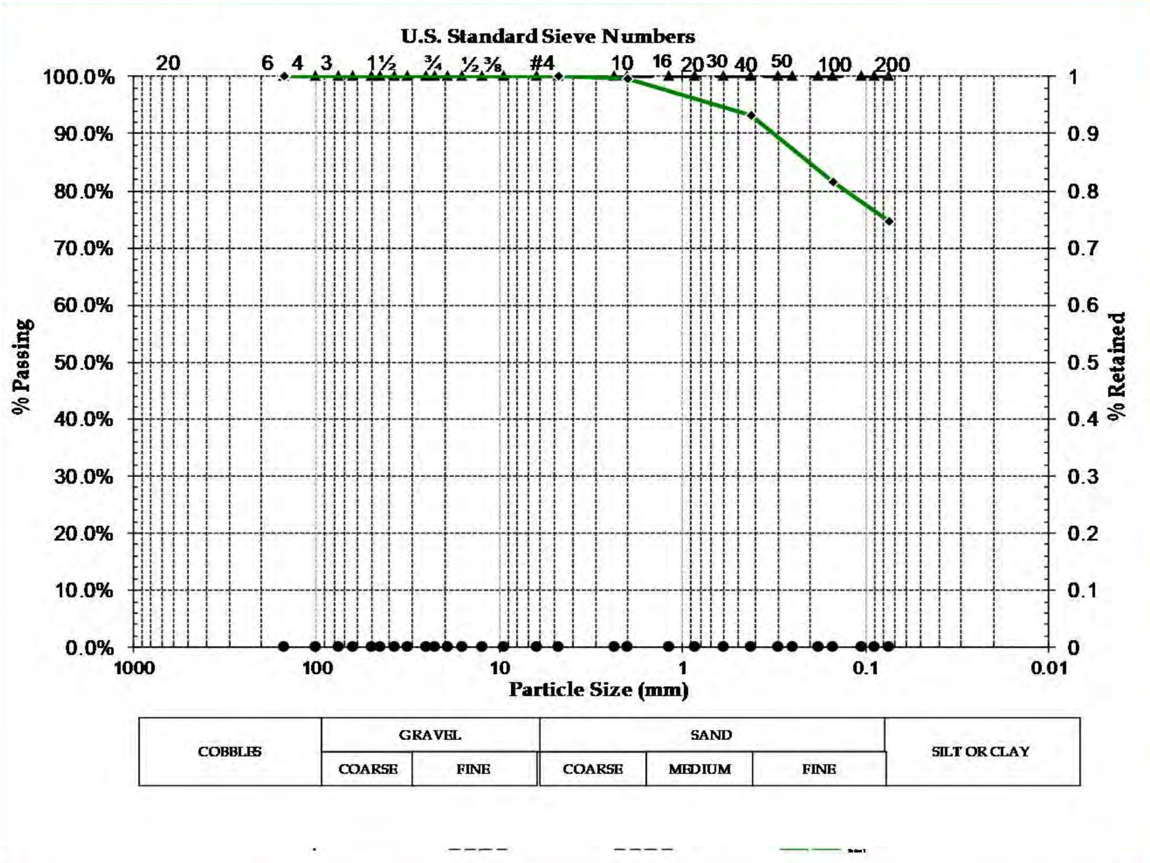
Double Dip, LLC Centralia
1 Duffy Steet
Centralia WA 98531
Parcel: 021002000000, 003681009000, 021256000000,
1365001003, 1365006070, 1365001002

SIEVE ANALYSIS
BORING B-1, 10 FT

Date: 2022.02.04 Figure A.10.1

File#: 22003 Jason Engineering - (206) 786-8645 - Jason@Jasonengineering.com

Date Received:	Sample Description:	Source:	Unified Soils Classification System:
1/14/22	Boring #1- 15' BSG	1 Duffy Rd	ML, Silt with Sand
Project:	**Location**	**Sample #**	**Specifications:**
Centralia Golf Course	Boring #1- 15' BSG	22-0002C	No Specs



Sample Meets Specs ?
n/a

% Gravel: 0.0%
% Sand: 25.4%
% Fines: 74.6%

$D_{(10)}$ = 0.01 mm
$D_{(30)}$ = 0.03 mm
$D_{(60)}$ = 0.06 mm
$D_{(90)}$ =

Curvature Coef, C_C: 1.50

Uniformity Coef, C_U: 6.00

Fineness Modulus: 0.41

Dust Ratio (#200/#40): 0.80

Sand/Silt ratio (#10/#200): 1.3

Sand Equivalent: N/A

Fracture count (Sgl/Dbl): N/A

Coarse Aggregate		Actual Cumulative	Interpolated Cumulative		
Sieve Size US	Metric	Percent Passing	Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%		
4.00"	100.00		100.0%		
3.00"	75.00		100.0%		
2.50"	63.00		100.0%		
2.00"	50.00		100.0%		
1.75"	45.00		100.0%		
1.50"	37.50		100.0%		
1.25"	31.50		100.0%		
1.00"	25.00		100.0%		
7/8"	22.40		100.0%		
3/4"	19.00		100.0%		
5/8"	16.00		100.0%		
1/2"	12.50		100.0%		
3/8"	9.50		100.0%		
1/4"	6.30		100.0%		

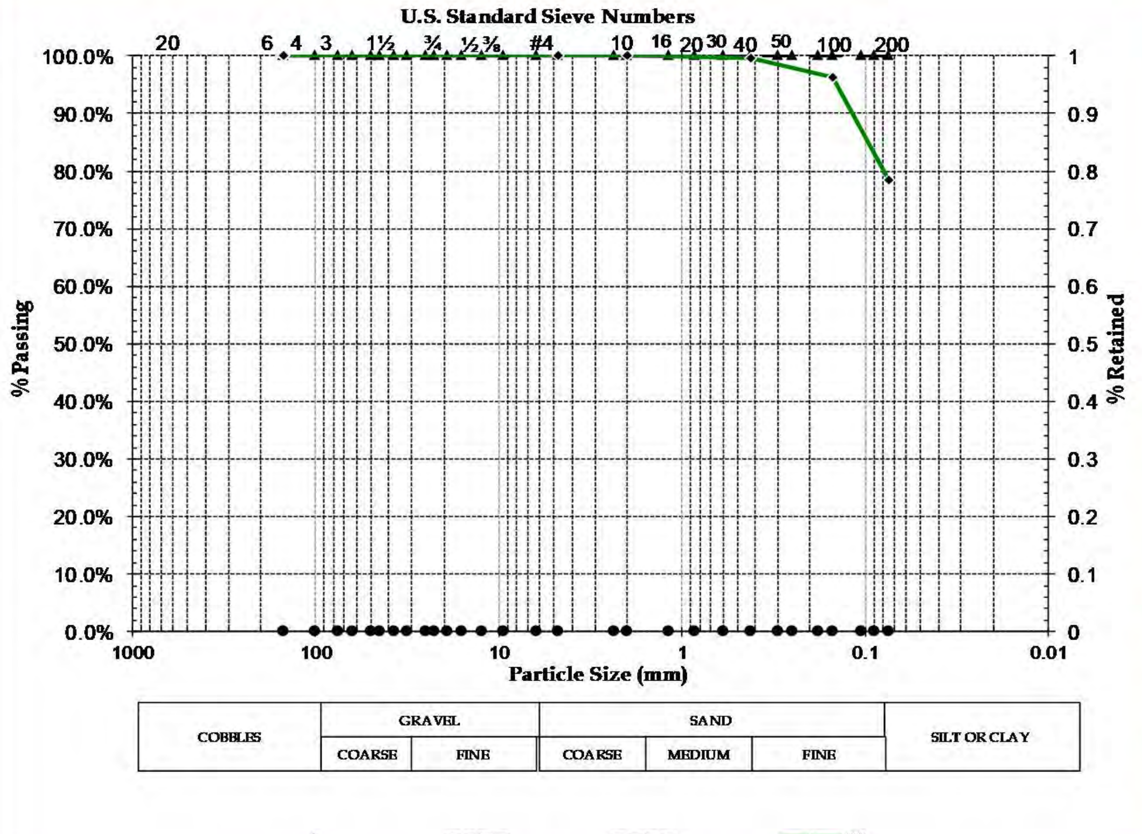
Fine Aggregate		Actual Cumulative	Interpolated Cumulative		
Sieve Size US	Metric	Percent Passing	Percent Passing	Specs Max	Specs Min
#4	4.75	100.0%	100.0%		
#8	2.360		99.7%		
#10	2.000	99.7%	99.7%		
#16	1.180		96.3%		
#20	0.850		94.9%		
#30	0.600		93.8%		
#40	0.425	93.1%	93.1%		
#50	0.300		87.8%		
#60	0.250		85.7%		
#80	0.180		82.7%		
#100	0.150	81.5%	81.5%		
#140	0.106		77.4%		
#170	0.090		76.0%		
#200	0.075	74.6%	74.6%		

Double Dip, LLC Centralia
1 Duffy Steet
Centralia WA 98531
Parcel: 021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002

SIEVE ANALYSIS
BORING B-1, 15 FT

Date: 2022.02.04 Figure A.10.2

Date Received:	Sample Description:	Source:	Unified Soils Classification System:
1/14/22	Boring #1- 20' BSG	1 Duffy Rd	ML, Silt with Sand
Project:	**Location**	**Sample #**	**Specifications:**
Centralia Golf Course	Boring #1- 20' BSG	22-0002D	No Specs



Sample Meets Specs ?
n/a

% Gravel: 0.0%
% Sand: 21.6%
% Fines: 78.4%

$D_{(10)}$ = 0.01 mm
$D_{(30)}$ = 0.03 mm
$D_{(60)}$ = 0.06 mm
$D_{(90)}$ =

Curvature Coef, C_C: 1.50

Uniformity Coef, C_U: 6.00

Fineness Modulus: 0.06

Dust Ratio (#200/#40): 0.79

Sand/Silt ratio (#10/#200): 1.3

Sand Equivalent: N/A

Fracture count (Sgl/Dbl): N/A

Coarse Aggregate

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100.0%		
4.00"	100.00		100.0%		
3.00"	75.00		100.0%		
2.50"	63.00		100.0%		
2.00"	50.00		100.0%		
1.75"	45.00		100.0%		
1.50"	37.50		100.0%		
1.25"	31.50		100.0%		
1.00"	25.00		100.0%		
7/8"	22.40		100.0%		
3/4"	19.00		100.0%		
5/8"	16.00		100.0%		
1/2"	12.50		100.0%		
3/8"	9.50		100.0%		
1/4"	6.30		100.0%		

Fine Aggregate

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
#4	4.75	100.0%	100.0%		
#8	2.360		100.0%		
#10	2.000	100.0%	100.0%		
#16	1.180		99.7%		
#20	0.850		99.6%		
#30	0.600		99.6%		
#40	0.425	99.5%	99.5%		
#50	0.300		98.0%		
#60	0.250		97.4%		
#80	0.180		96.6%		
#100	0.150	96.2%	96.2%		
#140	0.106		85.8%		
#170	0.090		82.0%		
#200	0.075	78.4%	78.4%		

Double Dip, LLC Centralia
1 Duffy Steet
Centralia WA 98531
Parcel: 021002000000, 003681009000, 021256000000,
1365001003, 1365006070, 1365001002

SIEVE ANALYSIS
BORING B-1, 5 FT

Date: 2022.02.04

Figure A.10.3

Project Name: 1 Duffy St Centralia

Project Address: 1 Duffy St Centralia   Date: 2/4/2022

Permit Number: ____

Other Project Information: ____

This infiltration test was performed by:

Company Name: Jason Engineering   Primary Contact Name: Jason Bell

Phone Number: 206-786-8645   Email Address: jason@jasonengineering.com

SMALL PILOT INFILTRATION TEST (PIT) AND LARGE PILOT INFILTRATION TEST (PIT):

Note: The test methods outlined below may be modified due to site conditions if recommended by the licensed professional and the reasoning is documented in the report.

A site map with test locations is included with this information.

1 Indicate type of test:

[X] Small Pit   [ ] Large Pit

2 Date and time of test: 2-4-2022, 10 am

3 Is the infiltration test within the footprint of the proposed infiltration facility

YES [X]   No [ ]

4 If "no" is testing being conducted within 50 feet of the proposed facility?

YES [ ]   No [ ]

Explain why: ____

5 What is the total proposed impervious area (does not include permeable pavement surfaces) to be infiltrated on the site? approximately 3,000 SF

6 Test pit excavated to bottom elevation of the proposed infiltration facility?

YES [X]   No [ ]

7 Test pit surface dimension (ft)   Length: 6.0   Width: 3.0   Depth: 4.0

8 Test pit bottom dimension (ft)   Length: 4.5   Width: 3.0

9 Test pit bottom area (ft^2)   13.5 = 1944 in^2

10 Small pit only: Is the surface area of the test pit bottom at least 12 ft^2

YES [X]   No [ ]

11 Large pit only: Is the surface area of the test pit bottom at least 32 ft^2

YES [ ]   No [ ]

a. If "no", indicate why? ____

12 Large pit only: The test pit bottom area should be as close to the bottom area of the proposed infiltration facility as feasible.

a. Bottom area of proposed infiltration facility: ____

b. Bottom area of test pit: ____

13 Identify device used to measure water level in test pit:

[ ] Pressure transducer (recommended for areas with slow draining soils)

[X] Vertical rod (min 5 ft. long, 1/2" increments, placed in center of pit)

14 Identify method of delivering water to the bottom of the test pit

Hose in a perforated pipe

(Method of delivery must reduce erosion that could cause clogging in the test pit)

15 ***Testing Procedure:***

a. Pre-soak period: Add water to maintain water level at least 12 inches above the bottom of the test pit for at least 6 hours. Record the time and depth of water hourly in the table below.

Time of Measurement	Depth of Water, inches
8:00	12
10:00	12
12:00	12
14:00	12

b. Steady-state period: The steady-state data is used to establish the measured infiltration rate (see step 16)

i. Add water to the test pit at a rate that will maintain a depth of 12 inches above the bottom of the test pit for 1 full hour. <u>During this hour, record time, depth of water, cummulative volume, and instantaneous flow rate every 15 minutes in the table below.</u>

ii. Calculate the infiltration rate for each 15 minute interval. First convert the flow rate to in3 /hr and the test pit bottom area (recorded in step 10) into in2. Divide the flow rate by the bottom area and record the result in the table below.

Time of Measurement (min)	Depth of Water (Inches)	Cumulative Volume (Gallons)	Flow Rate (gpm)	Flow Rate (in3/hr)	Infiltration Rate (In/hr)
0	12				
15	12	3.2	0.21	2956.8	1.52
30	12	6.0	0.20	2772	1.43
45	12	8.8	0.20	2710	1.39
60	12	10.8	0.18	2494.8	1.28

Note- 1 gallon = $231 in^3$, $1 ft^2 = 144 in^2$ Test pit bottom area (ft^2) from step 9: 1944 in^2

c. Falling head period: The falling head data is used to confirm the measured infiltration rate calculated from the steady-state data.

i. At the end of the steady-state period, turn off all water and immediately record the time and depth of water in the table below. Record the time and depth of water every 15-minutes for a minimum of 1 hour, or until the pit is empty. (Note: in areas with slow draining soils, a pressure transducer is reccomended to improve the accuracy of change in depth readings. In addition, users are encouraged to extend the testing period and use longer intervals to improve accuracy.)

ii. Calculate the infiltration rate for each 15-minute interval (change in depth at each interval X 4) and record the results in the table below. Alternatively, users may also record the total time for fixed intervals of change in depth, and use those values to compute the infiltration rates.

Time of Measurement (30-minute intervals)	Depth of Water (Inches)	Infiltration Rate (In/hr)
0	12.0	
15	10.8	4.8
30	9.7	4.4
45	8.6	4.4
60	7.6	4.0

d. Check for high groundwater/immediate groundwater mounding:

1 Within 24 hours after the falling head period, excavate the bottom of the pit.

2 Is standing water or seepage visible in the excavation hole?

YES [ ] No [X]

3 If "yes" record depth: ____________

16 ***Data Analysis "Measured Infiltration Rate" Selection*** (use the falling head data to confirm the measured infiltration rate calculated from the steady-state data):

a. Steady-state measured infiltration rate: Provide the lowest infiltration rate table above: 1.28 in/hr

b. Selected "Measured Infiltration Rate" 1.28 in/hr

(Include an explaination if the selected rate deviates from the steady state rate in step 16a)

____

c. If the lowest measured infiltration rate is less than the minimum rate associated with an infiltration BMP, that BMP can not be used.

d. If the measured infiltration rate is less than all minimum infiltration BMPs (see Table 1 in the reference table) no further investigation is required.

17 ***Calculate "Design Infiltration Rate":*** The desing infiltration rate shall be calculated by applying the appropriate correction factor to the above measured infiltration rate.

a. Select a correction factor.

CF v 1.00 CF t 0.50 CF m 0.90 CF = CFv*CFt*CFm 0.45

b. Calculate the "Design Infiltration Rate" below.

Design Infiltration Rate =	1.28	0.45	0.58
	Measured Rate Infiltration (In/hr)	X Correction Factor*	= Design Rate (in/hr)

* A Correction Factor may be used unless a different value is warranted by site conditions, as recommended and documented by a licensed professional.

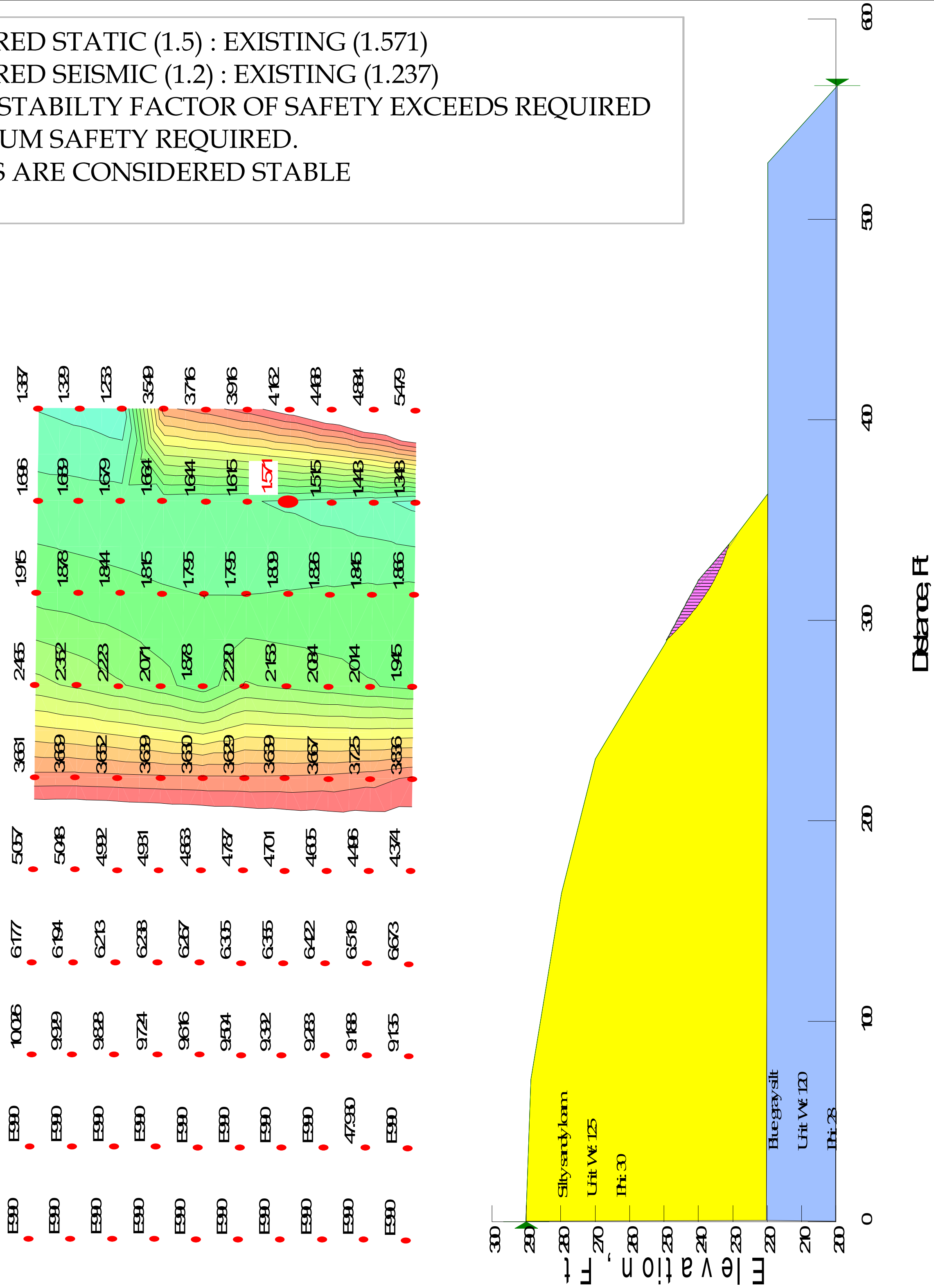
I certify that I have followed the procedure outlined in this document to determine the infiltration BMP infiltration rate.

Date: 2/4/2022

Print Name: Jason Bell

Signature: Jason E. Bell

REQUIRED STATIC (1.5) : EXISTING (1.571)
REQUIRED SEISMIC (1.2) : EXISTING (1.237)
SLOPE STABILTY FACTOR OF SAFETY EXCEEDS REQUIRED MINIMUM SAFETY REQUIRED.
SLOPES ARE CONSIDERED STABLE



Not to Scale

Double Dip, LLC Centralia
1 Duffy Steet
Centralia WA 98531
Parcel: 021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002

SLOPE STABILITY
SECTION A-A, WEST SIDE
STATIC

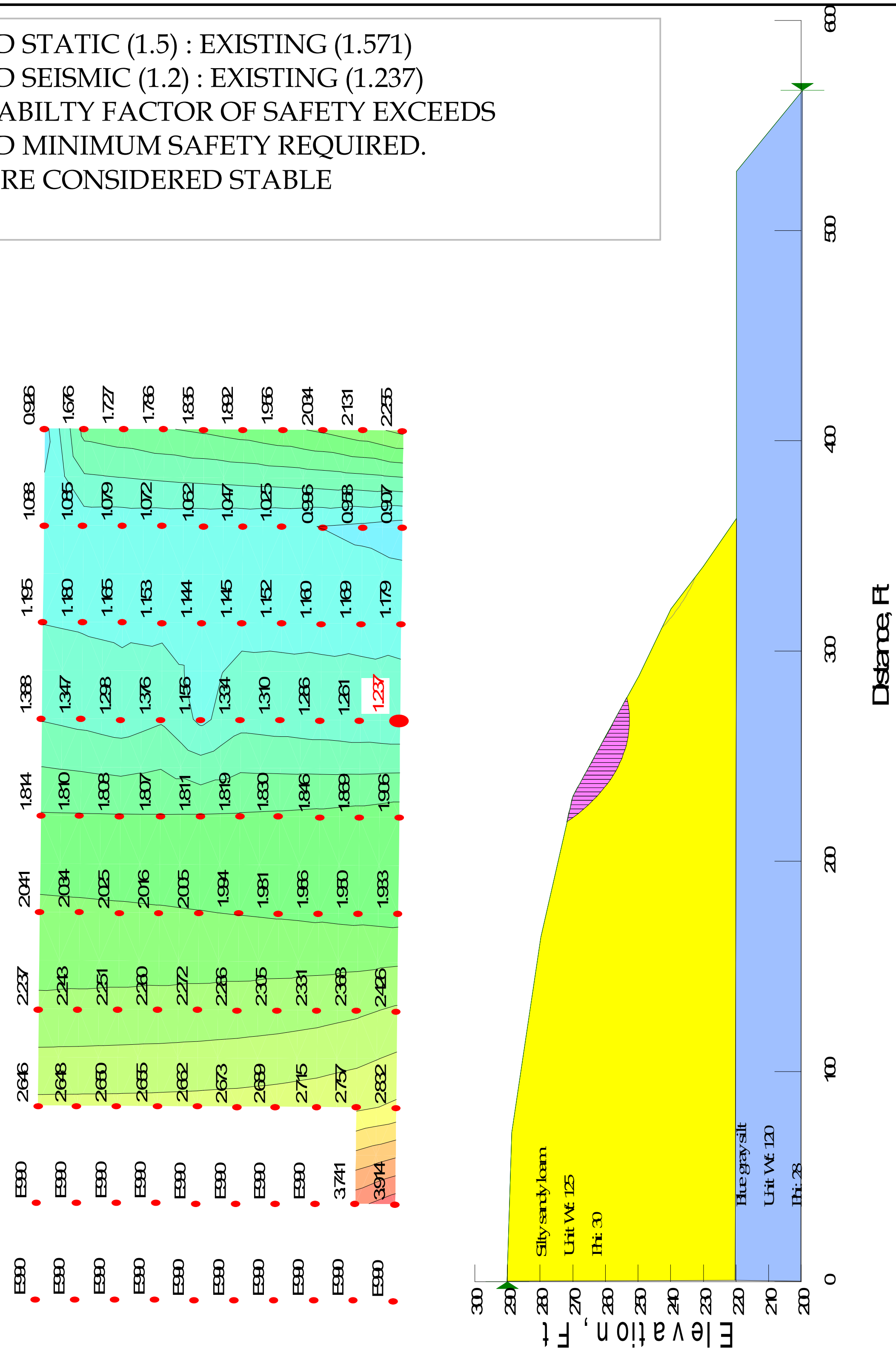
Date: 2022.02.04

Figure A.12.1

File#: 22003

Jason Engineering - (206) 786-8645 - Jason@Jasonengineering.com

REQUIRED STATIC (1.5) : EXISTING (1.571)
REQUIRED SEISMIC (1.2) : EXISTING (1.237)
SLOPE STABILTY FACTOR OF SAFETY EXCEEDS
REQUIRED MINIMUM SAFETY REQUIRED.
SLOPES ARE CONSIDERED STABLE



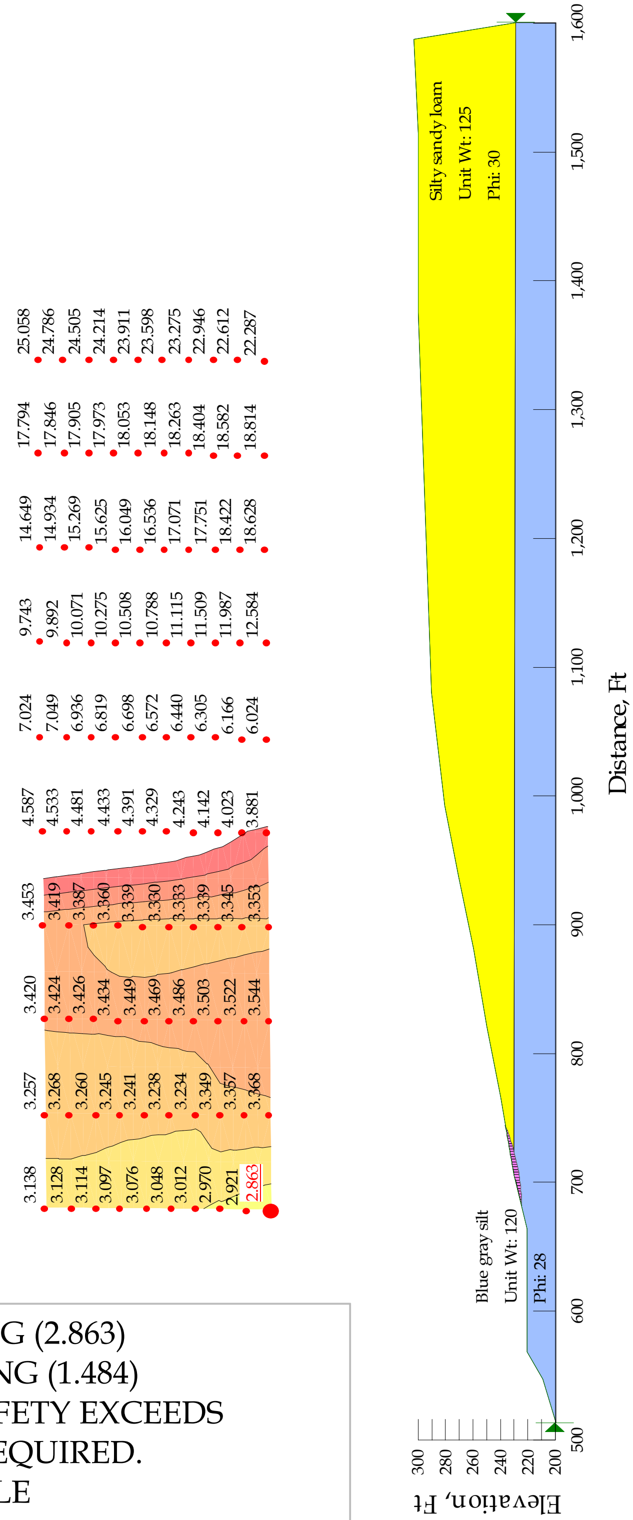
Not to Scale

Double Dip, LLC Centralia
1 Duffy Steet
Centralia WA 98531
Parcel: 021002000000, 003681009000, 021256000000,
1365001003, 1365006070, 1365001002

SLOPE STABILITY
SECTION A-A, WEST SIDE
SEISMIC

Date: 2022.02.04 Figure A.12.2

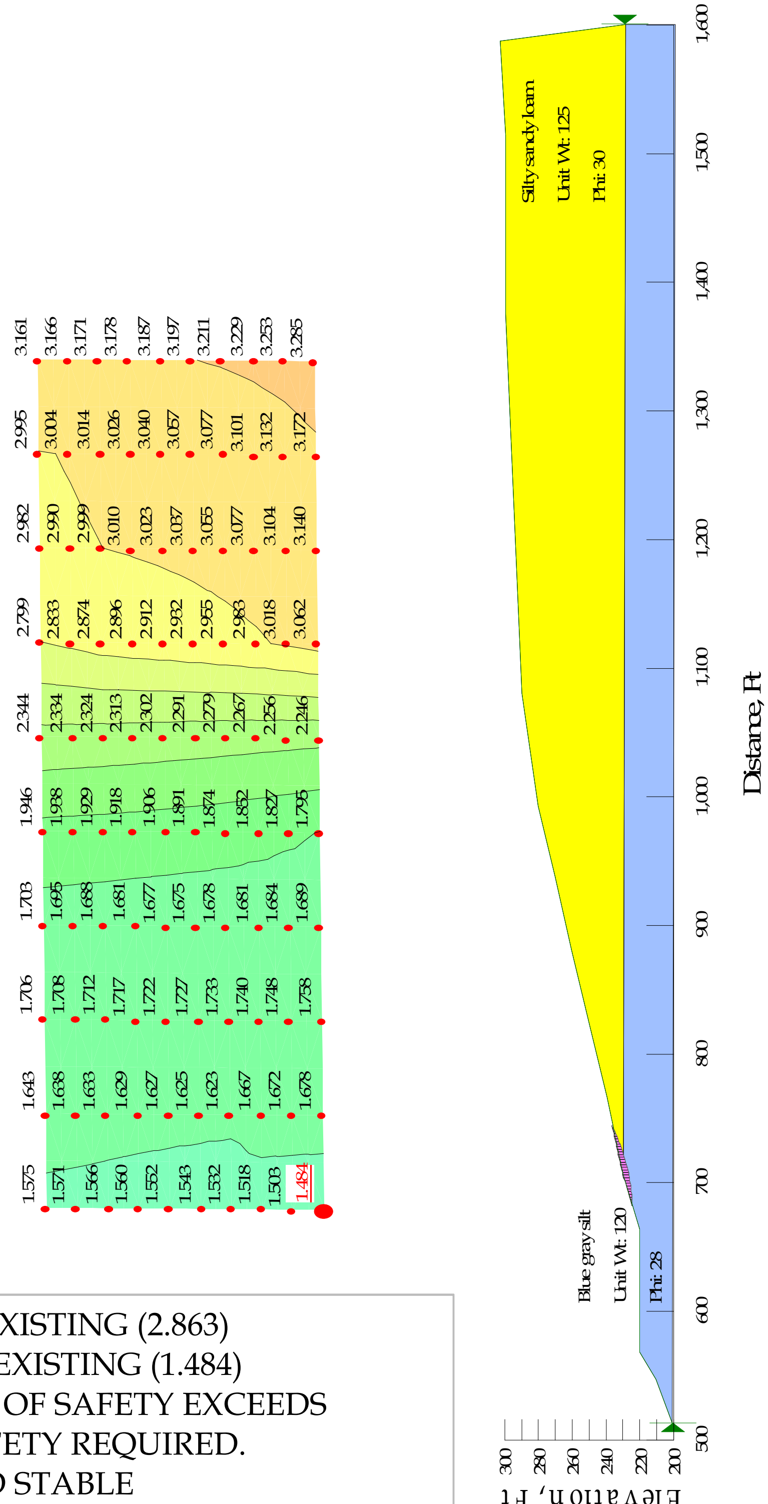
File#: 22003 Jason Engineering - (206) 786-8645 - Jason@Jasonengineering.com



REQUIRED STATIC (1.5) : EXISTING (2.863)
REQUIRED SEISMIC (1.2) : EXISTING (1.484)
SLOPE STABILTY FACTOR OF SAFETY EXCEEDS
REQUIRED MINIMUM SAFETY REQUIRED.
SLOPES ARE CONSIDERED STABLE

Double Dip, LLC Centralia 1 Duffy Steet Centralia WA 98531 Parcel: 021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002	Not to Scale SLOPE STABILITY SECTION A-A, EAST SIDE STATIC Date: 2022.02.04 Figure A.12.3

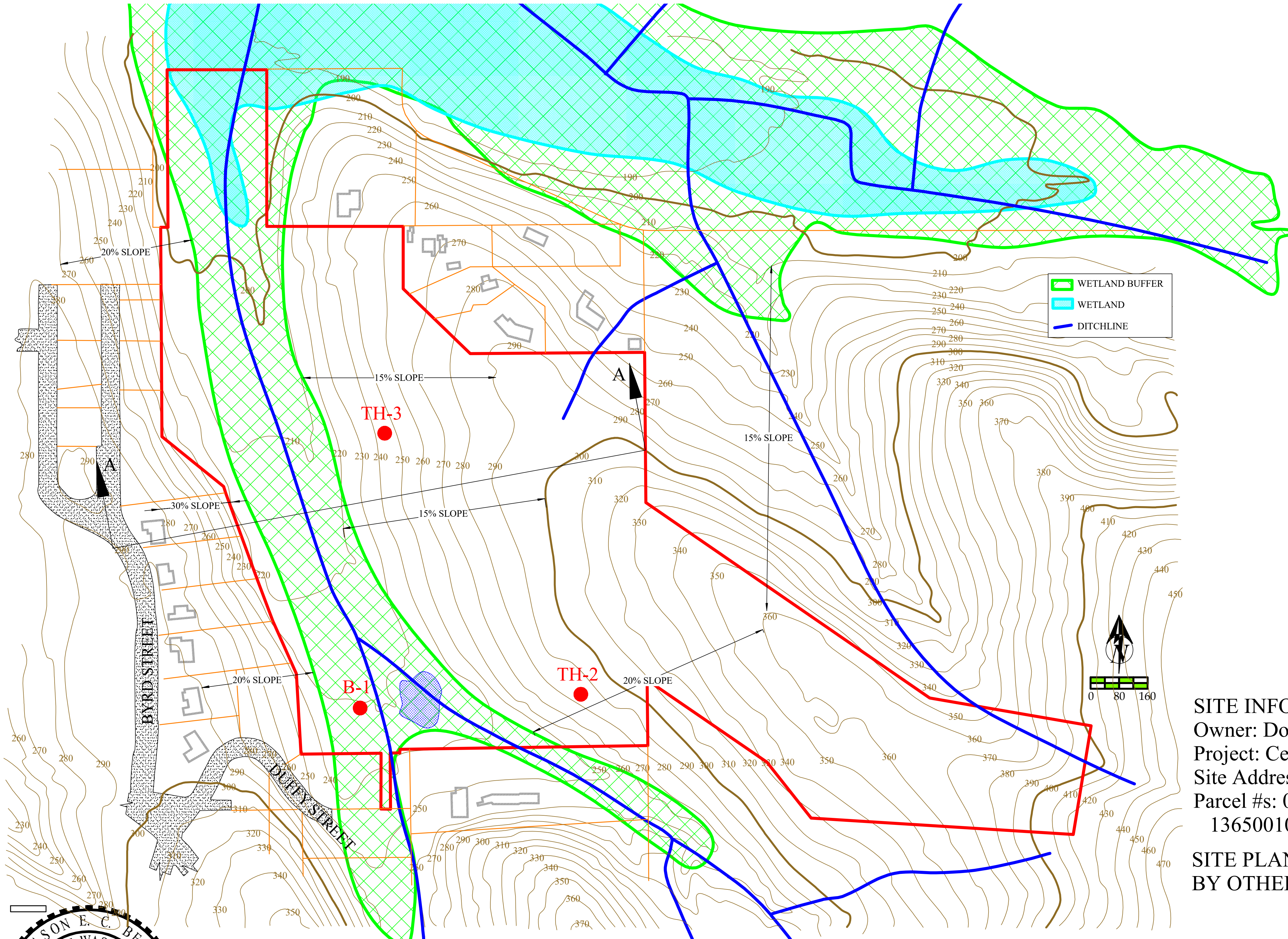
File#: 22003 Jason Engineering - (206) 786-8645 - Jason@Jasonengineering.com



REQUIRED STATIC (1.5) : EXISTING (2.863)
REQUIRED SEISMIC (1.2) : EXISTING (1.484)
SLOPE STABILTY FACTOR OF SAFETY EXCEEDS
REQUIRED MINIMUM SAFETY REQUIRED.
SLOPES ARE CONSIDERED STABLE

Double Dip, LLC Centralia 1 Duffy Steet Centralia WA 98531 Parcel: 021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002	Not to Scale SLOPE STABILITY SECTION A-A, EAST SIDE SEISMIC Date: 2022.02.04 Figure A.12.4

File#: 22003 Jason Engineering - (206) 786-8645 - Jason@Jasonengineering.com



SITE INFO
Owner: Double Dip, LLC
Project: Centralia Development
Site Address: 1 Duffy Steet Centralia WA 98531
Parcel #s: 021002000000, 003681009000, 021256000000, 1365001003, 1365006070, 1365001002

SITE PLAN PROVIDED BY OTHERS

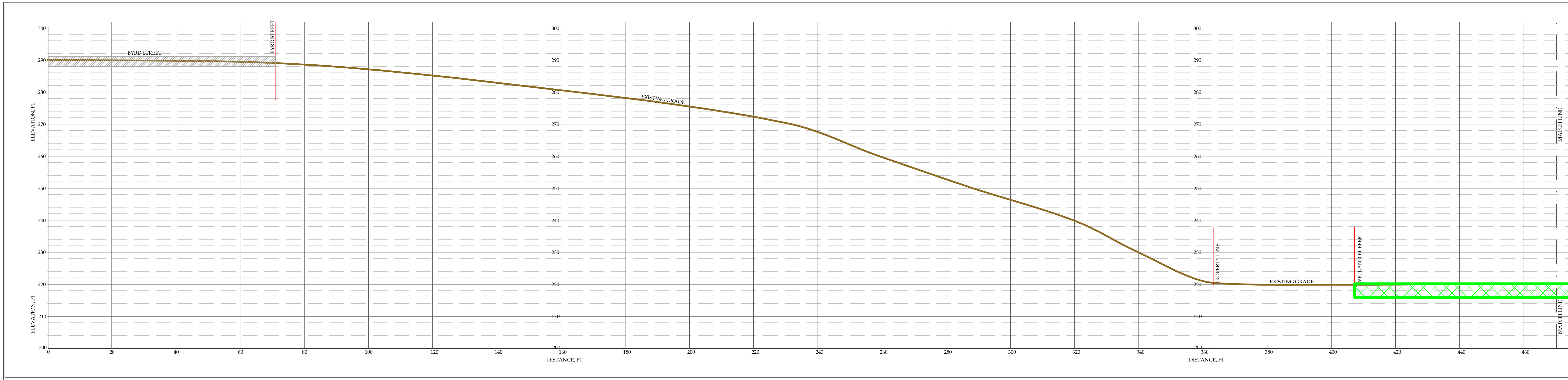
REV	DATE	NOTES

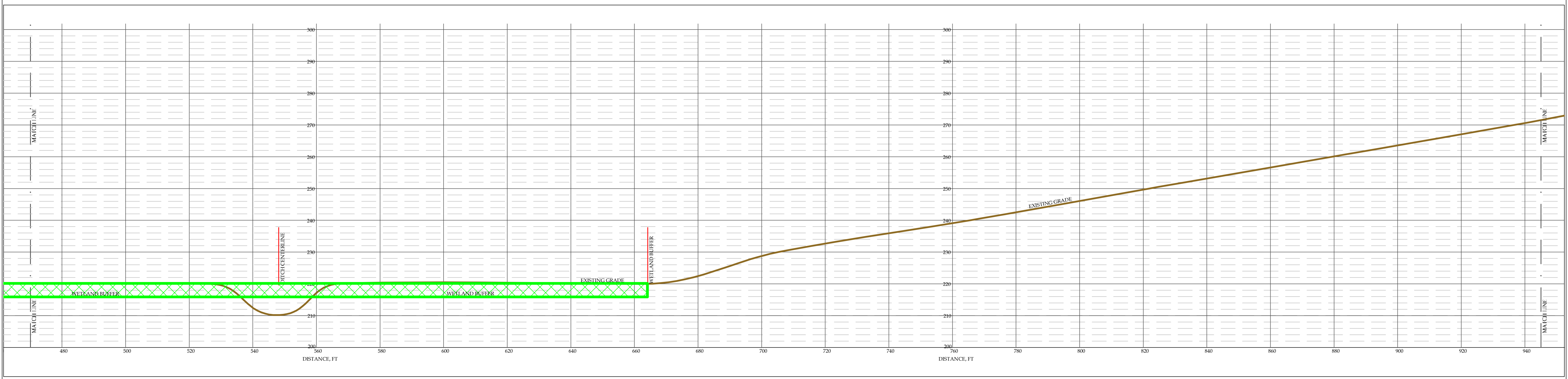
DATE: 2022.02.04
FILE#: 22003
DESIGN: JB
DRAWN: JB

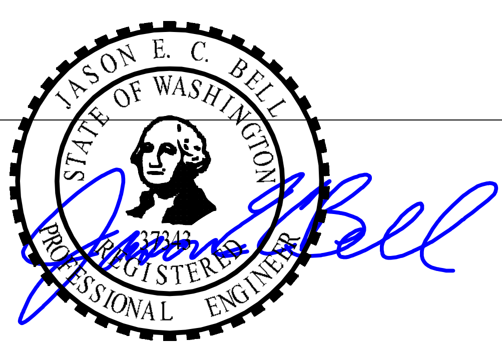
CENTRALIA DEVELOPMENT
1 Duffy Steet
Centralia WA 98531

A.13.1 SITE PLAN
SCALE 1" = 300 FT

Jason Engineering
Geotechnical Engineering
Retaining Wall / Pavement Design
Construction Management
Special Inspection / Material Testing







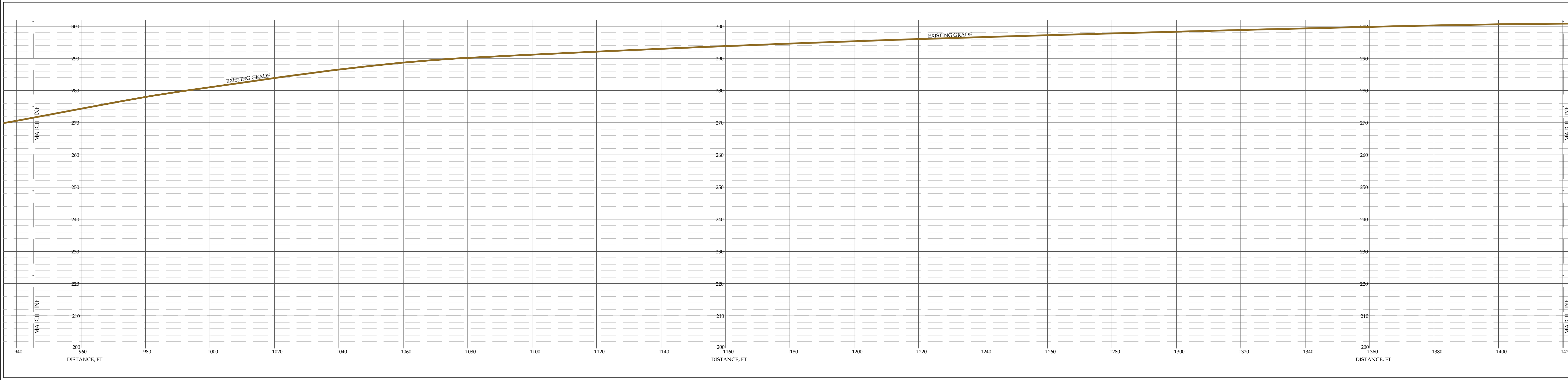
REV	DATE	NOTES

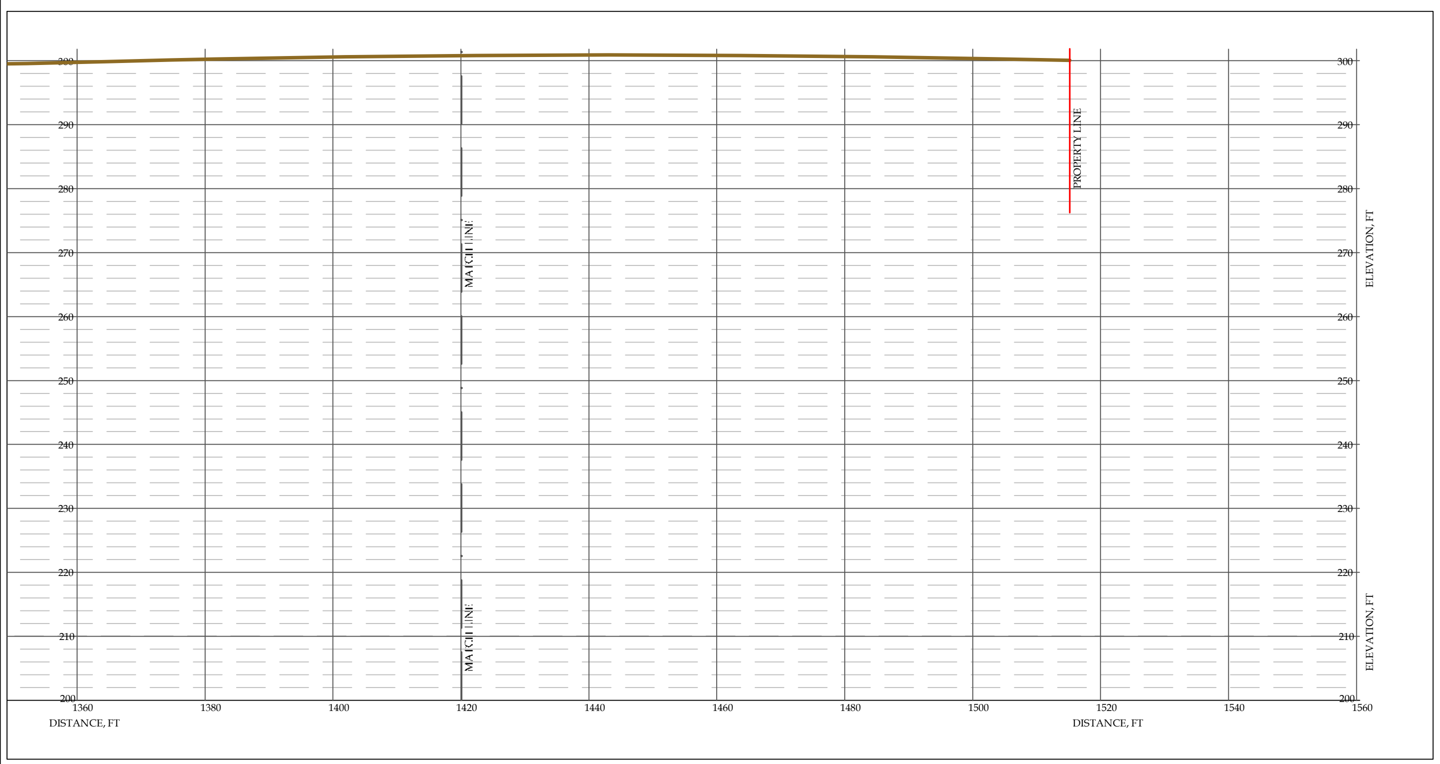
DATE: 2022.02.04
FILE#: 22003
DESIGN: JB
DRAWN: JB

CENTRALIA DEVELOPMENT
1 Duffy Steet
Centralia WA 98531

A.13.2 SECTION A-A
SCALE 1" = 100 FT

Jason Engineering
Geotechnical Engineering
Retaining Wall / Pavement Design
Construction Management
Special Inspection / Material Testing





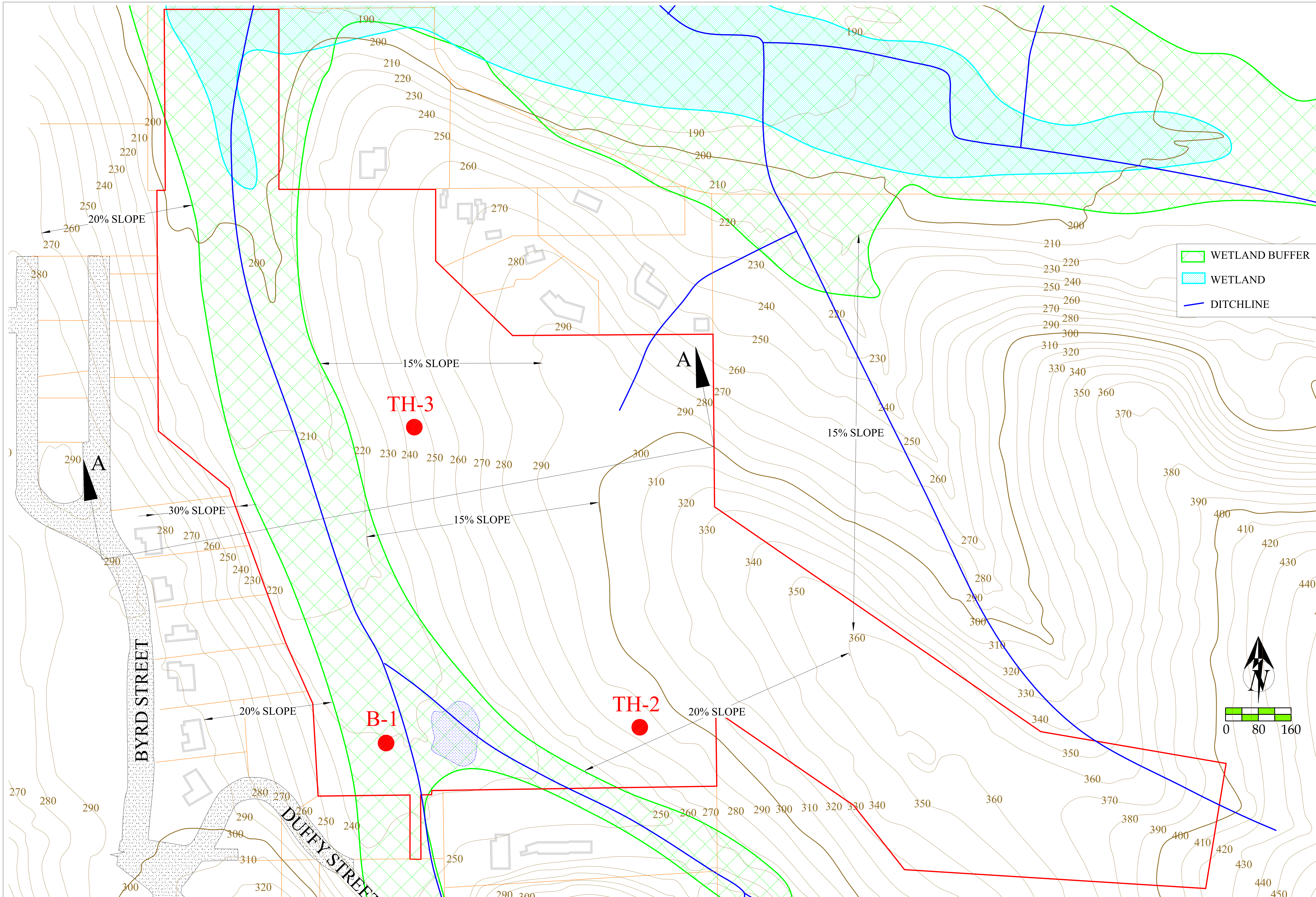
REV	DATE	NOTES

DATE: 2022.02.04
FILE#: 22003
DESIGN: JB
DRAWN: JB

CENTRALIA DEVELOPMENT
1 Duffy Steet
Centralia WA 98531

A.13.3 SECTION A-A
SCALE 1" = 100 FT

Jason Engineering
Geotechnical Engineering
Retaining Wall / Pavement Design
Construction Management
Special Inspection / Material Testing



Jason Engineering
Geotechnical Engineering
Retaining Wall / Pavement Design
Construction Management
Special Inspection / Material Testing

A.13.4 SITE PLAN
SCALE 1" = 100 FT

CENTRALIA DEVELOPMENT
1 Duffy Steet
Centralia WA 98531

DATE: 2022.02.04
FILE#: 22003
DESIGN: JB
DRAWN: JB

REV	DATE	NOTES

Correspondence with Geotechnical Engineer Concerning Underlying Soils

From: jason jasonengineering.com <jason@jasonengineering.com>
Sent: Friday, July 28, 2023 12:03 PM
To: Drew Harris <drewh@momentumcivil.com>
Subject: Re: Centralia Golf Course Project - Upland soil type hydrologic group

Drew
Whole site as Type C/D soils does seem appropriate. I would think to utilize the steam and connect everything to it and make it the natural drainage location.
Place a few walking bridges over it and it's a nice park setting for the houses.

Sent from my T-Mobile 5G Device
Get Outlook for Android

From: Drew Harris <drewh@momentumcivil.com>
Sent: Friday, July 28, 2023 9:54:29 AM
To: jason jasonengineering.com <jason@jasonengineering.com>; Marc Pudists <MarcP@momentumcivil.com>
Cc: Kyle Murphy <kylem@momentumcivil.com>
Subject: RE: Centralia Golf Course Project - Upland soil type hydrologic group

Jason:

One thing we are looking at is the SCS soil mapping that you reference in the report, which differentiates between the “Centralia Loam” on the hillsides and the “Reed Silty Clay Loam” shown in the valley (west side of site). Centralia Loam is described as “Hydrologic Group B,” which has a higher infiltration rate and a VERY low ***runoff*** rate in our models in the pre-developed condition. “Reed Silty Clay Loam” has a hydrologic group D classification.

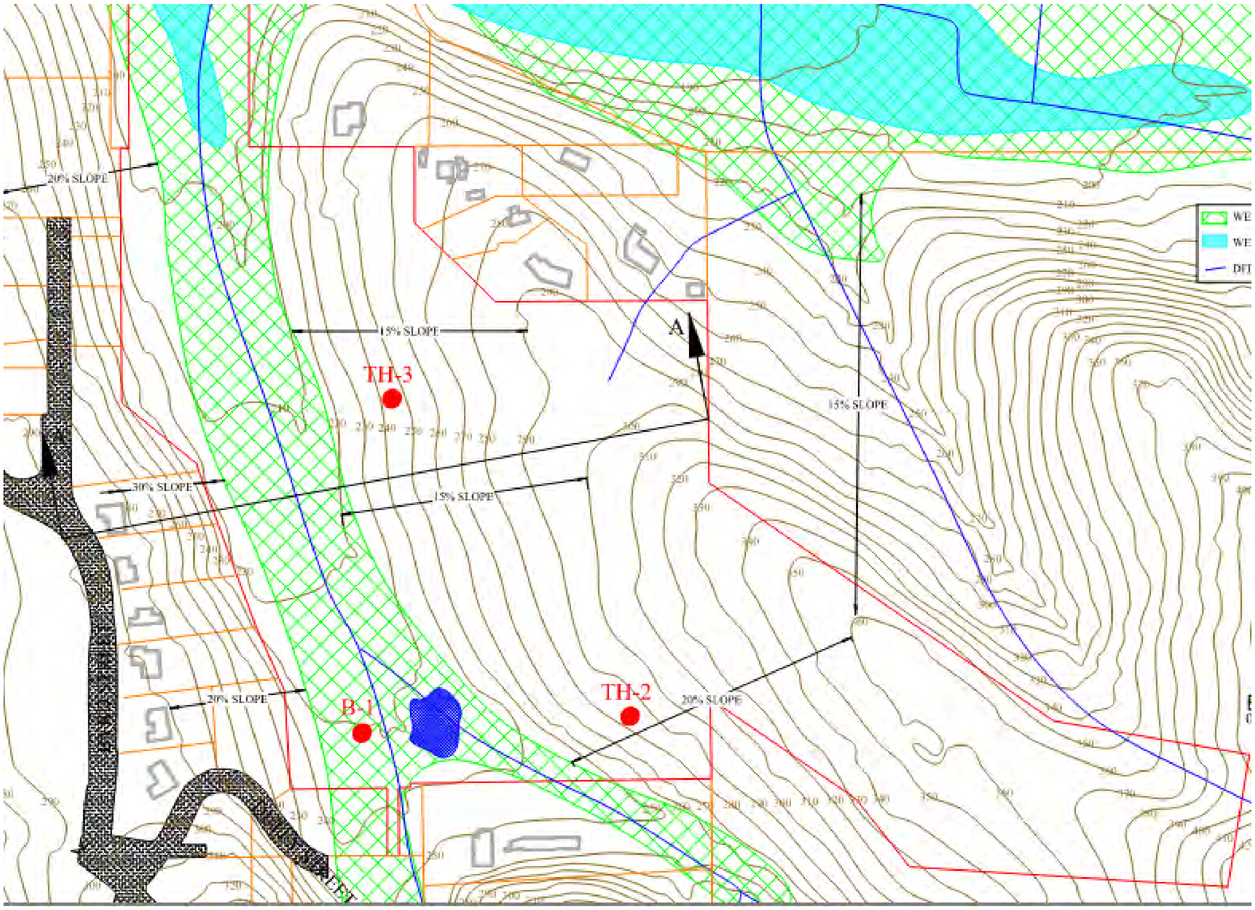
B-1 appears to be within the area mapped as Reed Silty Clay Loam, which may have a lower permeability. If you believe all the soils are relatively similar, with low permeability throughout, do you think it would then be more appropriate to model the existing condition for the whole site as Type C/D soils? This would give us a higher pre-developed release rate, and in this scenario we would try to avoid infiltrating the rooftops under the driveways. Let us know if you think this seems appropriate, and if a call would be easier—feel free to call me directly at (253) 722-6059.

Correspondence with Geotechnical Engineer Concerning Underlying Soils

The geology of the site and surrounding area as taken from the USDA Soil Conservation Service Survey consists of (172) Reed silty clay loam. and (43) and (44) Centralia loam. Reed silty clay loam is very deep, poorly drained soil is on flood plains. Drainage has been altered by tiling. This soil formed in mixed alluvium. The main limitations are the hazard of flooding, the seasonal high water table, shrink-swell potential, and slow permeability. Dikes and channels that have outlets for floodwater can be used to protect buildings from flooding. Permeability of the Reed soil is slow.

Centralia loam. This very deep, well drained soil is on benches, hillsides, and broad ridgetops. It formed in residuum derived dominantly from micaceous marine sandstone. Permeability of the Centralia soil is moderate.

Correspondence with Geotechnical Engineer Concerning Underlying Soils



Drew Harris, P.E.
Principal

Mobile: (253) 722-6059
Direct: (253) 319-1506
Email: drewh@momentumcivil.com

1145 Broadway, Suite 115
Tacoma, WA 98402

www.momentumcivil.com

Appendix H - Wetland, Stream, and Fish and Wildlife Habitat Assessment

[Submitted Under Separate Cover]