



## ***Preliminary Technical Information Report***

*PREPARED FOR:*

Evans Development West, LLC  
PO BOX 1744  
Wenatchee, WA 98807-1744

*PROJECT:*

Spiketon Road Preliminary Plat  
Spiketon Road  
Buckley, WA 98321  
2140645.10

*PREPARED BY:*

Scott T. Kaul, PE, LEED AP  
Project Manager

Jennifer Tetzlaff, PE  
Project Engineer

*REVIEWED BY:*

J. Matthew Weber, PE  
Principal

*DATE:*

February 2016  
Revised May 2016

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5/23/2016



I hereby state that this Preliminary TIR for Spiketon Road Preliminary Plat has been prepared by me or under my supervision, and meets the standard of care and expertise that is usual and customary in this community for professional engineers. I understand that the City of Buckley does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities prepared by me.

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- A-5..... Developed Conditions Map

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- B-2..... WWHM Pond Calculations

## **1.0 Project Overview**

### **1.1 Purpose and Scope**

This report accompanies the preliminary plat application for the Spiketon Road Plat project. This report provides a discussion of the preliminary project assumptions and stormwater concepts.

The project includes a single parcel (0619101076) located within Buckley city limits within the northeast quarter of Section 10 in Township 19 North, Range 6 East, Willamette Meridian in Pierce County, Washington. The site is accessed from Spiketon Road (see Appendix A, Exhibit A-1 for the Vicinity Map).

The project involves the creation of a residential development, including public roads, stormwater management systems, sanitary sewer, water, and other miscellaneous utilities. In order to achieve the proposed design grades, an estimated 25,000 to 40,000 cubic yards of fill material will need to be imported.

The stormwater management design for this project will meet or exceed the requirements of the City of Buckley Storm Drainage Standards. City of Buckley has adopted the Department of Ecology 2005 *Stormwater Management Manual for Western Washington (SMMWW)*, which establishes the methodology and design criteria used for this project.

### **1.2 Existing Conditions**

#### **1.2.1 Existing Cover**

The parcel has a uniform grass cover in the proposed development area. The east end of the parcel, which will be protected, has a mix of trees and groundcover and three identified wetlands (see Appendix A, Exhibit A-2 for the Existing Conditions Map).

#### **1.2.2 Topography and Drainage**

The site is generally flat. A roadside ditch is located along Spiketon Road. The wetland area appears to be tributary to a ditch along Tanner Avenue that drains back to Spiketon Road. The Spiketon Road roadside ditch is relatively flat and connected by a series of 24-inch culverts at driveway crossings.

#### **1.2.3 Soils**

The Natural Resources Conservation Service (NRCS) classifies the onsite soil as Buckley Loam (8A). The soil was formed in the Osceola mudflow under coniferous and deciduous trees. Buckley loam is characterized as level, poorly drained, with high seasonal groundwater. The soil is classified as Type C for stormwater modeling. An NRCS soil map and descriptions are included in Appendix A, Exhibit A-3.

An onsite soil investigation was conducted by ABPB Consulting, LLC. The soils encountered generally match the characteristics of Buckley Loam, as described by NRCS. A copy of the geotechnical report is being submitted under separate cover.

#### **1.2.4 100-Year Flood Analysis**

The project site is not located in a FEMA identified flood hazard area, according to the FEMA Map included in Appendix A, Exhibit A-4.

### **1.3 Post-Development Conditions**

The proposed developed conditions will include public roads, open space, and single-family lots. The current proposed lot count is 63. The project will also include stormwater facilities, sanitary sewer, water, gas, and other miscellaneous utilities. A preliminary plat map has been prepared and is the basis for determining developed basin boundaries and stormwater facility requirements (see Appendix A, Exhibit A-5 for the Developed Conditions Map).

The streets will utilize a standard crown section, in accordance with City of Buckley standards, with a network of catch basins and closed-pipe systems to collect and convey runoff. A combination constructed wetland and detention pond is planned to provide quality and quantity control of stormwater discharge from the project site.

A more detailed discussion of the proposed stormwater management system and developed basin areas is provided in Section 4.0 of this report.

## **2.0 Conditions and Requirements Summary**

### **2.1 MR 1 - Preparation of Stormwater Site Plan**

This report and associated plans have been prepared to satisfy this requirement.

### **2.2 MR 2 - Construction Stormwater Pollution Prevention**

A Construction Stormwater Pollution Prevention Plan (SWPPP) is required for the project and will be prepared during final engineering for construction of this project.

### **2.3 MR 3 – Source Control of Pollution**

The proposed project is required to provide source control of pollution. Following are proposed measures to be implemented as part of the final engineering for the project

- All discharges to the city sewer system (storm or sanitary sewers) require City of Buckley approval.
- All pollutants, including waste materials and demolition debris created onsite during construction, shall be handled and disposed of in a manner that does not cause contamination of surface water.
- Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products, petroleum products, and non-inert wastes present on the site (see Chapter 173-304 WAC for the definition of inert waste).
- Maintenance and repair of heavy equipment and vehicles that may result in discharge or spillage of pollutants to the ground or into surface water runoff must be conducted using spill prevention measures such as drip pans.
- Concrete Handling (BMP C151) and Sawcutting and Surface Pollution Prevention (BMP C152) shall be used to prevent or treat contamination of surface water runoff by pH modifying sources.

The Construction SWPPP will provide additional details on the control of pollution during construction.

## **2.4 MR 4 – Preservation of Natural Drainage Systems and Outfalls**

The only outfall available to this project is the Spiketon Road roadside ditch. The site will continue to discharge to the existing roadside ditch at pre-developed rates using a detention pond and control structure.

## **2.5 MR 5 – Onsite Stormwater Management**

Due to the high groundwater table and poor draining native soils onsite, infiltration of stormwater is not feasible.

## **2.6 MR 6 – Runoff Treatment**

The plat is required to meet basic water quality treatment, in accordance with the 2005 *SMMWW*. A constructed wetland is proposed to meet stormwater treatment requirements.

A more detailed discussion of the proposed stormwater treatment system is provided in Section 4.0 of this report.

## **2.7 MR 7 – Flow Control**

The plat is required to meet flow control standards, in accordance with the 2005 *SMMWW*. A detention pond is proposed to discharge runoff at pre-developed rates.

A more detailed discussion of the proposed stormwater flow control system is provided in Section 4.0 of this report.

## **2.8 MR 8 – Wetlands Protection**

All pollution generating runoff from this development will be directed to a combination construction stormwater wetland and detention pond located adjacent to Spiketon Road. Therefore, water quality degradation of the existing wetlands is not anticipated.

## **2.9 MR 9 – Operations and Maintenance**

The storm drainage system, including catch basins, conveyance pipe, and the stormwater management (water quality and flow control) facility, will be publicly owned and operated by the City of Buckley.

## **2.10 MR 10 – Financial Liability**

Financial guarantees and bonds will be provided by the project, as required by the City of Buckley.

## **3.0 Offsite Analysis**

To our knowledge, there are no capacity or erosion issues along the described downstream drainage system. Peak discharge rates from the development project will match pre-developed conditions to minimize potential impacts to the downstream drainage system.

### 3.1 Downstream Analysis

The plat discharges to the Spiketon Road roadside ditch. The roadside ditch is several feet deep and connected by a series of 24-inch culverts at residential driveways. Runoff from this roadside ditch flows south to Spiketon Ditch stream. Evidence of existing system surcharge or potential flow constrictions was not observed.

### 3.2 Upstream Analysis

There does not appear to be significant upstream or offsite runoff tributary to the development. The existing wetlands are at the upstream end of the basin and discharge to a ditch located along Tanner Avenue that is tributary to the Spiketon Road roadside ditch. Per the critical areas report, "Wetland hydrology for most of the delineated wetlands is supported, for the most part, by shallow groundwater levels, ponding, and interception of precipitation. A stream, Spiketon Ditch, flows offsite to the southeast to which Wetland C appears to drain." Existing hydrology conditions for the wetlands will remain, and wetland flows to Tanner Avenue should be similar in the post-development condition.

## 4.0 Flow Control and Water Quality Facility Analysis and Design

The following sections discuss the conditions assumed and methodology used for stormwater facility sizing. Design analysis and calculations have been completed per the requirements of the 2005 *SMMWW*. The treatment and detention components of this project were sized with the assistance of the Western Washington Hydrology Model (WWHM). The following is a summary of the assumptions made and data used in the conveyance, treatment, and detention calculations. The calculations are also based on soil information from the NRCS Soil Survey of Pierce County Area, Washington.

Methodology: WWHM  
Soils (Soil Group): Buckley Loam (C)

### 4.1 Existing Site Hydrology

The existing ground cover is grass within the development footprint. The wetlands that will remain consist of additional groundcover and trees. The proposed stormwater facility tributary basin is summarized as follows:

**Table 1 – Pre-Development Forested Condition**

Basin Description	Soil Group	Area
Saturated Forest	Type C	14.686 acres

### 4.2 Developed Site Hydrology

The developed site includes public roads, residential roofs, driveways, and lawn areas (see Appendix B, Exhibit B-1 for the Basin Maps). The proposed stormwater facility tributary basin is summarized as follows:

**Table 2 – Post-Development Condition**

Basin Description	Soil Group	Area
Pond	Impervious	0.494 acres
Roads	Impervious	2.632 acres
Sidewalks & Driveways	Impervious	2.184 acres
Roofs	Impervious	4.628 acres
Lawn	Type C	4.749 acres

### **4.3 Flow Control Facility**

The proposed flow control facility will be a detention pond. The detention pond and control structure will be sized to release runoff at pre-developed rates using the flow duration standard, as modeled using WWHM (see Appendix B, Exhibit B-2 for WWHM Pond Calculations). The pond will meet the requirements of the 2005 *SMMWW*.

### **4.4 Water Quality Facility**

The proposed water quality facility will be a constructed stormwater wetland. The wetland geometry and volume will meet the requirements outlined within the 2005 *SMMWW*. The wetland storage will be located beneath the live storage of the detention facility, with a presettling cell at the inlet and a wetland cell at the outlet; see Appendix B, Exhibit B-2 for WWHM Pond Calculations. Constructed wetlands meet the requirements for enhanced stormwater treatment.

## **5.0 Conveyance System Analysis and Design**

The conveyance system, including catch basin spacing and minimum pipe sizes and slopes, will be provided in accordance with City of Buckley Stormwater Standards. The conveyance system will be sized to convey the 25-year storm event.

Detailed conveyance calculations will be provided during final engineering.

## **6.0 Special Reports and Studies**

- Geotechnical Report, prepared by South Sound Geotechnical Consulting, dated November 23, 2015
- Critical Areas Report, prepared by TALASAEA Consultants, Inc, dated September 2015

## **7.0 Other Permits**

A National Pollutant Discharge Elimination System (NPDES) Construction General Permit will be required for the project.

To our knowledge, no other permits are required beyond the City of Buckley site development permit.

## **8.0 Conclusion**

The stormwater management design for this project will meet or exceed the requirements of the Department of Ecology 2005 *Stormwater Management Manual for Western Washington (SMMWW)*.

This analysis is based on data and records either supplied to or obtained by AHBL. These documents are referenced within the text of the analysis. The analysis has been prepared using procedures and practices within the standard accepted practices of the industry.

AHBL, Inc.



Scott T. Kaul, PE, LEED AP  
Project Manager

STK/JT/lsk

February 2016  
Revised May 2016

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# Appendix A

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## Exhibits

- A-1.....Vicinity Map
- A-2.....Existing Conditions Map
- A-3.....Soil Map
- A-4.....FEMA Map
- A-5.....Developed Conditions Map



**VICINITY MAP**

1" = 1/4 MILE (1320')

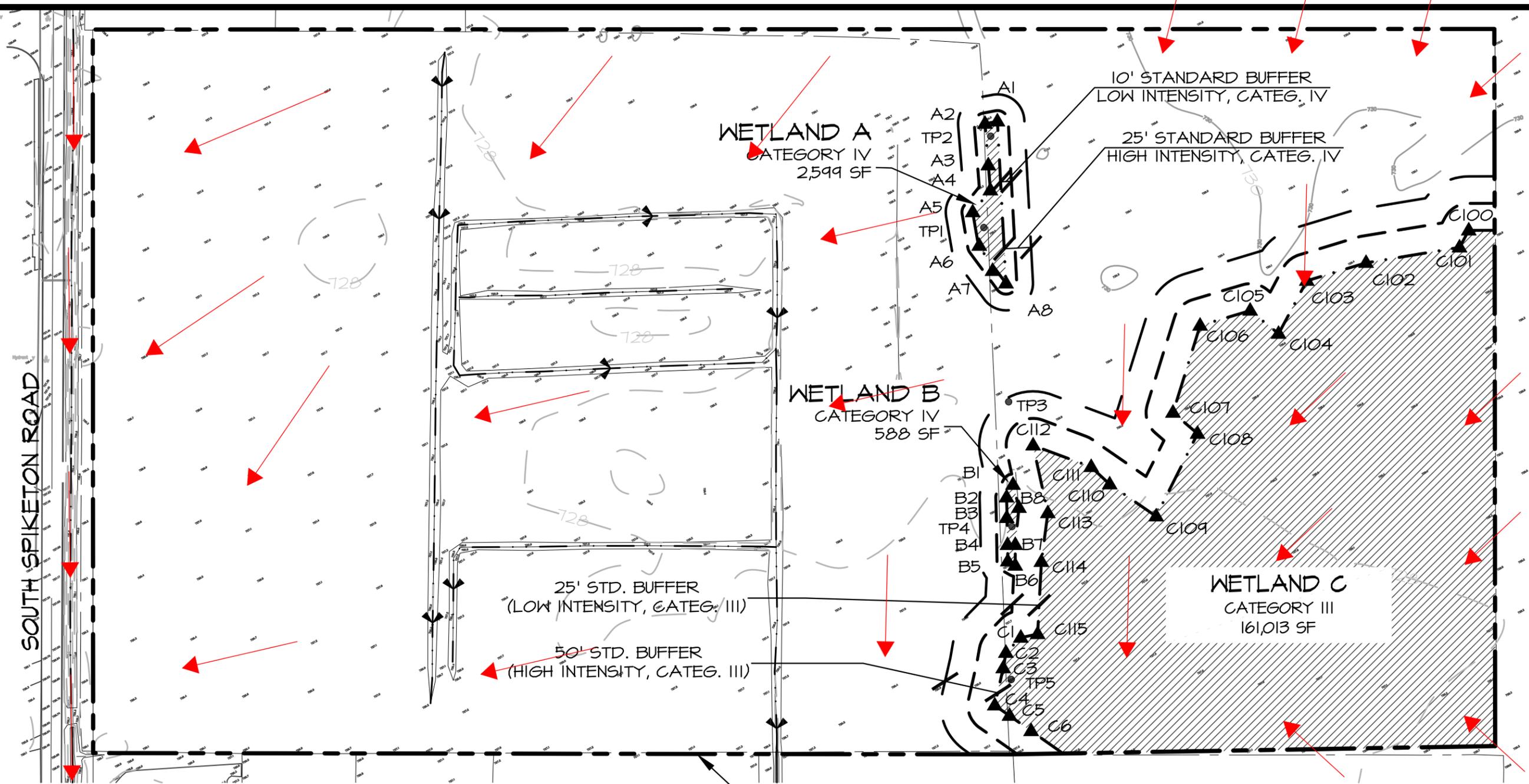


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**SPIKETON ROAD PLAT**

**VICINITY MAP**

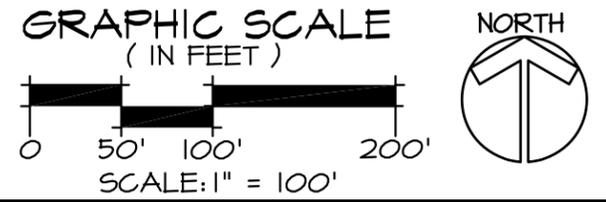
**A-1**



**LEGEND**

- PROPERTY LINE
- EXISTING WETLAND
- WETLAND BUFFER - STANDARD/LOW INTENSITY
- WETLAND BUFFER - STANDARD/HIGH INTENSITY
- DITCH CENTERLINE
- EXISTING CONTOUR
- A-# WETLAND FLAG LOCATION
- TP-# SOIL TEST PIT LOCATION (SAMPLED 6/4/2015)
- DRAINAGE FLOW PATH

PROJECT SITE



**TALASAEA**  
**CONSULTANTS, INC.**  
 Resource & Environmental Planning  
 15020 Bear Creek Road Northeast  
 Woodinville, Washington 98077  
 Bus (425)861-7550 - Fax (425)861-7549

EXISTING CONDITIONS MAP  
 BUCKLEY RESIDENTIAL PROPERTY  
 BUCKLEY, WASHINGTON

DESIGN	DRAWN	PROJECT
	OA	1530
SCALE AS SHOWN		
DATE		
23 SEPT 2015		
REVISED		

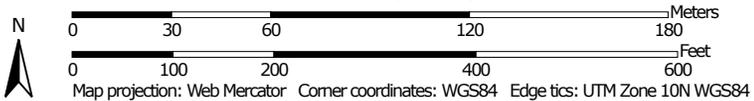
A-2

Z:\DRAWING\1500-1599\TAL1530\Plans\TAL-1530 WP.dwg

Soil Map—Pierce County Area, Washington



Map Scale: 1:2,270 if printed on A landscape (11" x 8.5") sheet.



## 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: <http://websoilsurvey.nrcs.usda.gov>  
 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: Pierce County Area, Washington  
 Survey Area Data: Version 10, Sep 15, 2015

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

Date(s) aerial images were photographed: Aug 1, 2011—Aug 20, 2011

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

Pierce County Area, Washington (WA653)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
8A	Buckley gravelly silt loam, 0 to 3 percent slopes	21.0	100.0%
<b>Totals for Area of Interest</b>		<b>21.0</b>	<b>100.0%</b>

## Pierce County Area, Washington

### 8A—Buckley gravelly silt loam, 0 to 3 percent slopes

#### Map Unit Setting

*National map unit symbol:* 2rtyp

*Elevation:* 390 to 820 feet

*Mean annual precipitation:* 40 to 50 inches

*Mean annual air temperature:* 48 to 52 degrees F

*Frost-free period:* 190 to 205 days

*Farmland classification:* Prime farmland if drained

#### Map Unit Composition

*Buckley and similar soils:* 85 percent

*Minor components:* 15 percent

*Estimates are based on observations, descriptions, and transects of the mapunit.*

#### Description of Buckley

##### Setting

*Landform:* Lahars

*Landform position (three-dimensional):* Dip

*Down-slope shape:* Concave

*Across-slope shape:* Concave

*Parent material:* Mudflow deposits

##### Typical profile

*Ap - 0 to 10 inches:* gravelly silt loam

*A - 10 to 16 inches:* gravelly loam

*Bg - 16 to 38 inches:* gravelly sandy clay loam

*Cd - 38 to 60 inches:* gravelly sandy clay loam

##### Properties and qualities

*Slope:* 0 to 3 percent

*Depth to restrictive feature:* 20 to 39 inches to densic material

*Natural drainage class:* Poorly drained

*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.06 in/hr)

*Depth to water table:* About 0 to 20 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* Low (about 5.1 inches)

##### Interpretive groups

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 5w

*Hydrologic Soil Group:* C/D

*Other vegetative classification:* Wet Soils (G002XF103WA)

## Minor Components

### Alderwood

*Percent of map unit:* 10 percent

*Landform:* Hills, ridges

*Landform position (two-dimensional):* Summit

*Landform position (three-dimensional):* Crest, tal

*Down-slope shape:* Convex, linear

*Across-slope shape:* Convex

### Seattle

*Percent of map unit:* 5 percent

*Landform:* Glacial drainage channels

*Landform position (three-dimensional):* Dip

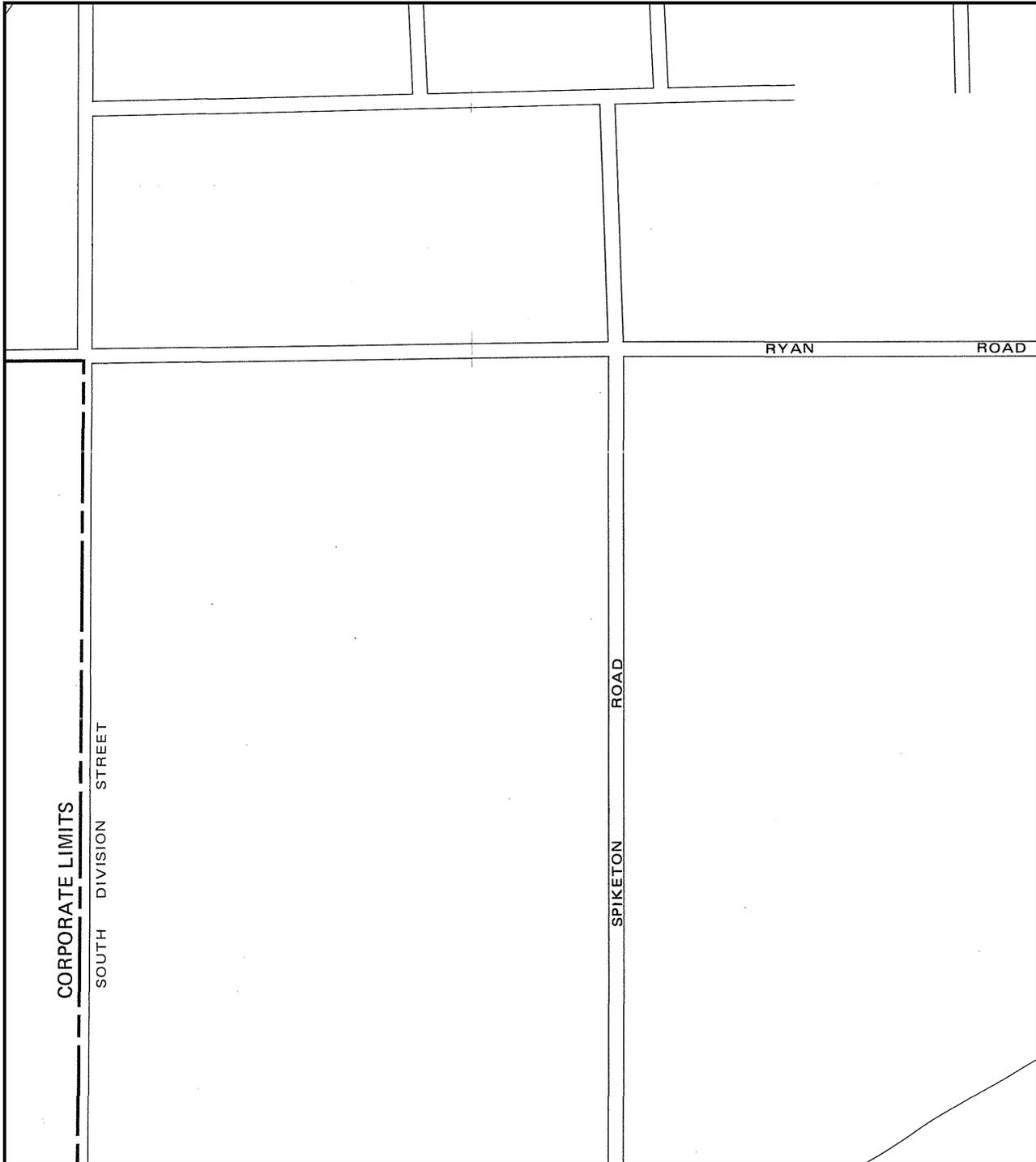
*Down-slope shape:* Concave

*Across-slope shape:* Concave

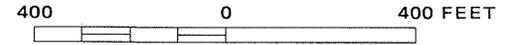
## Data Source Information

Soil Survey Area: Pierce County Area, Washington

Survey Area Data: Version 10, Sep 15, 2015



APPROXIMATE SCALE



NATIONAL FLOOD INSURANCE PROGRAM

**FIRM  
FLOOD INSURANCE RATE MAP**

CITY OF  
**BUCKLEY, WASHINGTON**  
PIERCE COUNTY

ONLY PANEL PRINTED

COMMUNITY-PANEL NUMBER  
530139 0001 B

EFFECTIVE DATE:  
MAY 1, 1980



U.S. DEPARTMENT OF HOUSING  
AND URBAN DEVELOPMENT  
FEDERAL INSURANCE ADMINISTRATION

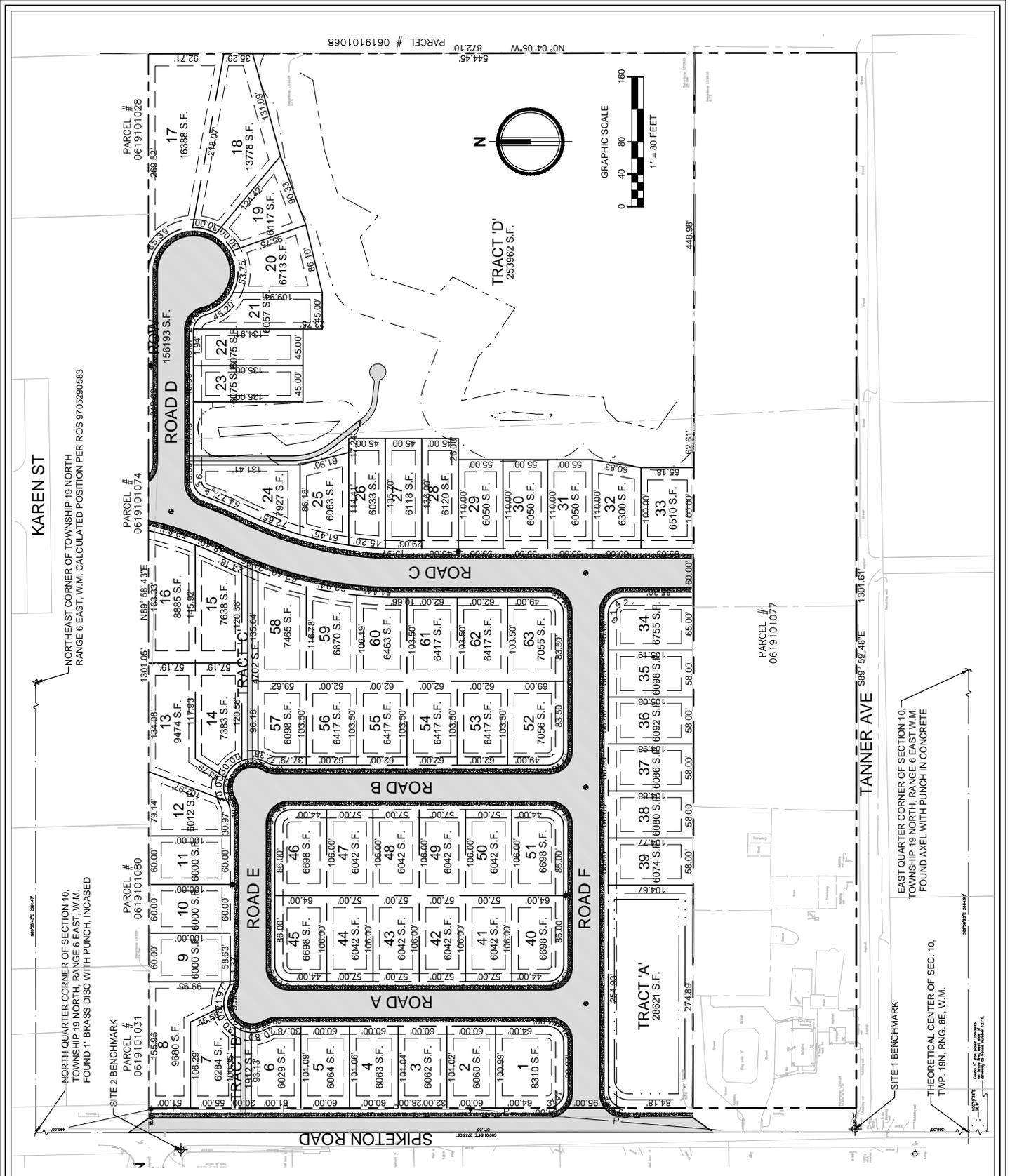
This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at [www.msc.fema.gov](http://www.msc.fema.gov)



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**SPIKETON ROAD PLAT**  
**DEVELOPED CONDITIONS MAP**

**A-5**

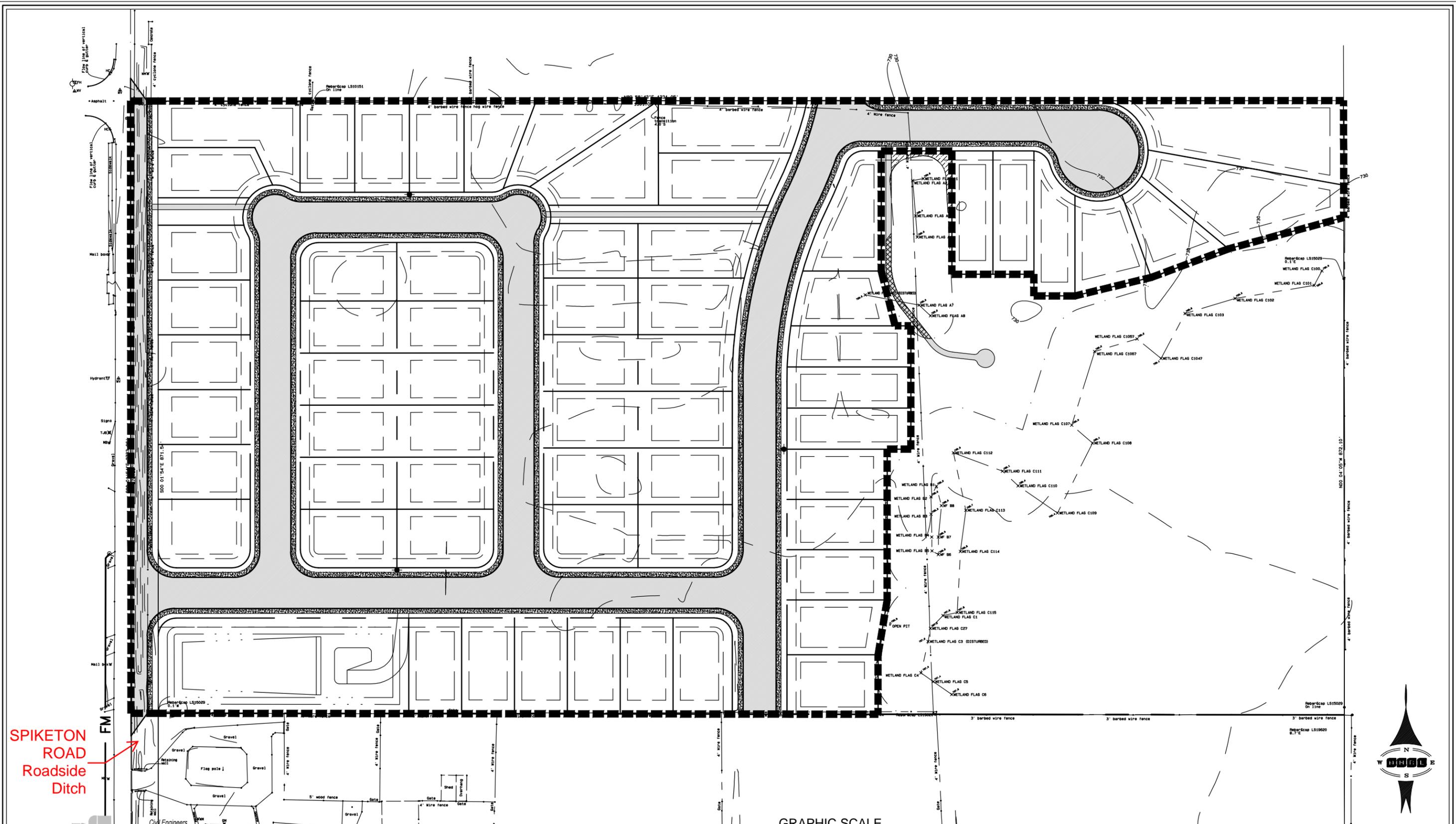


# ***Appendix B***

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## **Hydrologic Analysis**

- B-1.....Basin Maps
- B-2.....WWHM Pond Calculations



SPIKETON ROAD  
Roadside  
Ditch

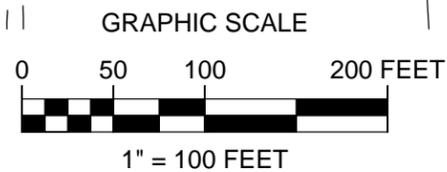
Civil Engineers  
Structural Engineers  
Landscape Architects  
Community Planners  
Land Surveyors  
Neighbors



TACOMA • SEATTLE  
2215 North 30th Street, Suite 300, Tacoma, WA 98403 253.383.2422 TEL  
316 Occidental Avenue South, Suite 320, Seattle, WA 98104 206.267.2425 TEL

**LEGEND:**

■■■■■ BASIN BOUNDARY



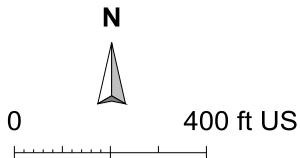
SPIKETON ROAD PLAT  
BASIN MAP

**B-1a**



SPIKETOWN  
ROAD  
Roadside  
Ditch

SPIKETOWN  
DITCH  
Stream



Reference: GIS road, parcel, and watercourse data from Pierce County GIS, 2009. Aerial photograph 19 April 2015 from Google Earth Pro, downloaded 2015.

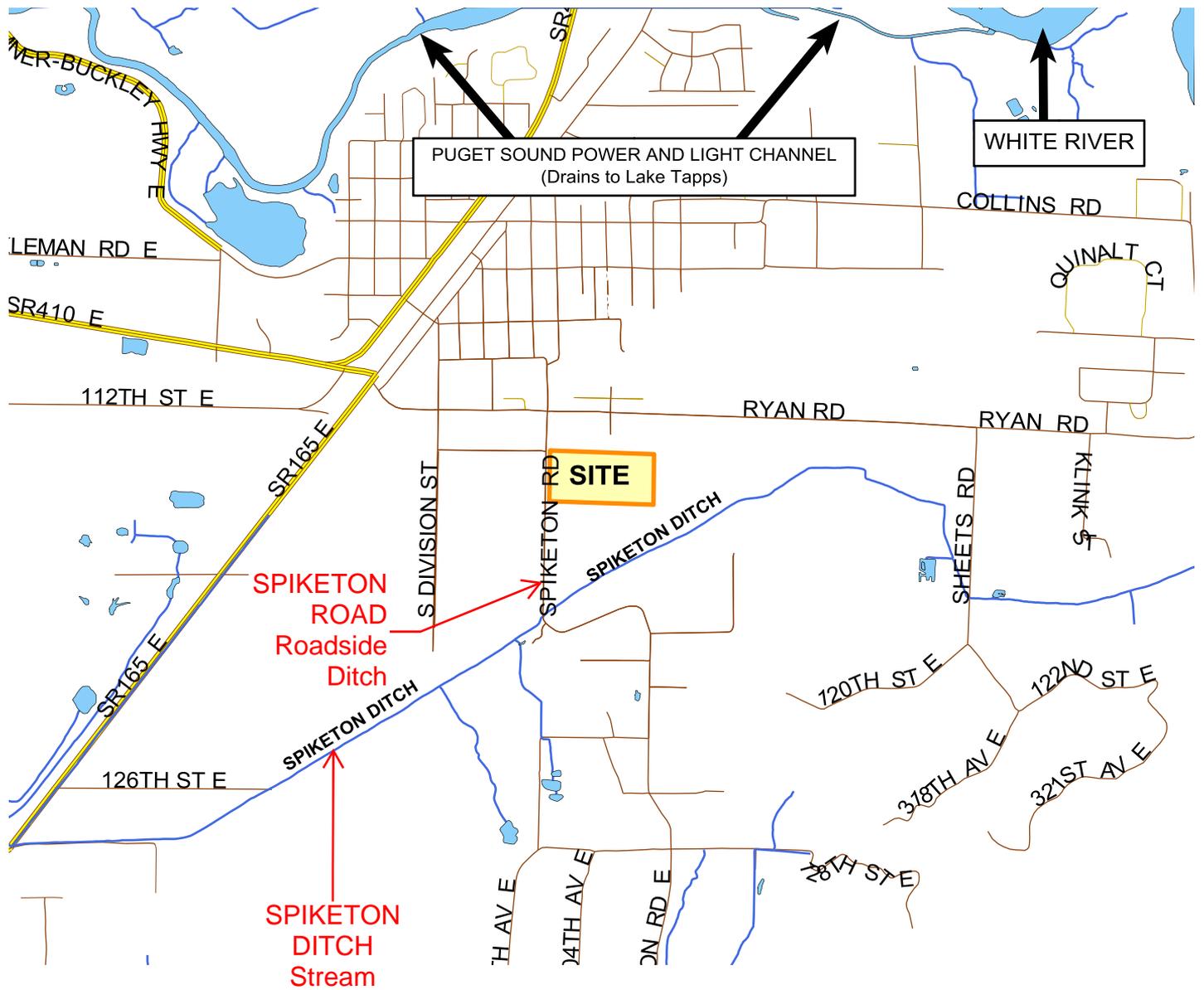


**TALASAEA**  
**CONSULTANTS, INC.**

**Resource & Environmental Planning**

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Woodinville, Washington 98077  
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DESIGN	DRAWN DRT	PROJECT 1530
SCALE 1 in : 400 ft		
DATE 23 SEPT 2015		B-1b
REVISED		



Reference: GIS road, stream, waterbody, and parcel data from Pierce County GIS, 2009.



**TALASAEA**  
**CONSULTANTS, INC.**

**Resource & Environmental Planning**

15020 Bear Creek Road Northeast  
 Woodinville, Washington 98077  
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DESIGN	DRAWN DRT	PROJECT 1530
--------	--------------	-----------------

SCALE  
 1 in : 2000 ft

DATE  
 23 SEPT 2015

REVISED

**B-1c**

2140645		Area Calcs	
JMK			
5/22/2016			
	sf	acres	
Offsite Existing Conditions			
Spiketon Road, Half Street	20,105	0.462	
Onsite Existing Conditions			
Total Parcel including Wetlands	873,565	20.054	
Wetlands Only	166,067	3.812	
Modeled Existing Conditions - routed to pond			
Parcel Area routed to pond	639,726	14.686	SATURATED FOREST
<b>TOTAL</b>	<b>639,726</b>	<b>14.686</b>	

Modeled Developed Conditions - routed to pond			
Proposed Tract A Pond	21,499	0.494	POND
Proposed Tract A pervious	7,122	0.164	LAWN
Proposed Tracts B and C pavement	2,122	0.049	ROAD
Proposed Tracts B and C pervious	5,426	0.125	LAWN
Proposed Road Areas in ROWs	176,298	4.047	
Pavement	112,535	2.583	ROAD 2.632 TOTAL
Curb and Sidewalk	32,114	0.737	SIDEWALK
Remaining Pervious Surface in ROW	31,650	0.727	LAWN
Proposed Lot Areas	427,258	9.809	6,782 sf average lot size
63 lots: 1,000 sf sidewalk area each	63,000	1.446	SIDEWALK 2.184 TOTAL
63 lots: 3,200 sf roof area each	201,600	4.628	ROOF
remaining pervious surface on lots	162,658	3.734	LAWN 4.749 TOTAL
<b>TOTAL</b>	<b>639,726</b>	<b>14.686</b>	<b>TOTAL</b>

2005 DOE SWMM, Volume 3, Section 2.2.2 Assumptions made in creating the WWHM, Development land use data: Streets and sidewalk areas are input separately. Ecology had selected a standard impervious area of 4200 square feet per residential lot, with 1000 square feet of that as driveway, walkways, and patio area, and the remainder as rooftop area.

Onsite Impervious Areas Only			
Pavement	101,868	2.339	
Curb and Sidewalk	26,569	0.610	
63 lots: 1,000 sf sidewalk area each	63,000	1.446	
63 lots: 3,200 sf roof area each	201,600	4.628	
<b>Total</b>	<b>393,037</b>	<b>9.023</b>	

61.44% impervious surfacing onsite



**Name** : Trapezoidal Pond 1  
**Bottom Length:** 129.669394819521ft.  
**Bottom Width:** 129.669394819521ft.  
**Depth :** 5ft.  
**Volume at riser head :** 1.7169ft.  
**Side slope 1:** 1.5 To 1  
**Side slope 2:** 1.5 To 1  
**Side slope 3:** 1.5 To 1  
**Side slope 4:** 1.5 To 1  
**Discharge Structure**  
**Riser Height:** 4 ft.  
**Riser Diameter:** 18 in.  
**NotchType** : Rectangular  
**Notch Width :** 0.380 ft.  
**Notch Height:** 1.374 ft.  
**Orifice 1 Diameter:** 3.97122 in. **Elevation:** 0 ft.  
  
**Element Flows To:**  
**Outlet 1**                      **Outlet 2**

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**Pond Hydraulic Table**

<u>Stage(ft)</u>	<u>Area(acr)</u>	<u>Volume(acr-ft)</u>	<u>Dschrg(cfs)</u>	<u>Infilt(cfs)</u>
0.000	0.386	0.000	0.000	0.000
0.056	0.387	0.021	0.098	0.000
0.111	0.388	0.043	0.138	0.000
0.167	0.389	0.065	0.169	0.000
0.222	0.390	0.086	0.195	0.000
0.278	0.391	0.108	0.218	0.000
0.333	0.392	0.130	0.239	0.000
0.389	0.393	0.151	0.258	0.000
0.444	0.394	0.173	0.276	0.000
0.500	0.395	0.195	0.293	0.000
0.556	0.396	0.217	0.309	0.000
0.611	0.397	0.239	0.324	0.000
0.667	0.398	0.261	0.338	0.000
0.722	0.399	0.283	0.352	0.000
0.778	0.400	0.306	0.365	0.000
0.833	0.401	0.328	0.378	0.000
0.889	0.402	0.350	0.391	0.000
0.944	0.403	0.373	0.403	0.000
1.000	0.404	0.395	0.414	0.000
1.056	0.405	0.417	0.426	0.000
1.111	0.406	0.440	0.437	0.000
1.167	0.407	0.463	0.447	0.000
1.222	0.408	0.485	0.458	0.000
1.278	0.409	0.508	0.468	0.000
1.333	0.410	0.531	0.478	0.000
1.389	0.411	0.554	0.488	0.000
1.444	0.412	0.576	0.498	0.000
1.500	0.413	0.599	0.507	0.000
1.556	0.414	0.622	0.517	0.000
1.611	0.415	0.645	0.526	0.000
1.667	0.416	0.668	0.535	0.000
1.722	0.417	0.692	0.544	0.000
1.778	0.418	0.715	0.552	0.000
1.833	0.419	0.738	0.561	0.000

1.889	0.420	0.761	0.569	0.000
1.944	0.422	0.785	0.578	0.000
2.000	0.423	0.808	0.586	0.000
2.056	0.424	0.832	0.594	0.000
2.111	0.425	0.855	0.602	0.000
2.167	0.426	0.879	0.610	0.000
2.222	0.427	0.903	0.617	0.000
2.278	0.428	0.926	0.625	0.000
2.333	0.429	0.950	0.633	0.000
2.389	0.430	0.974	0.640	0.000
2.444	0.431	0.998	0.648	0.000
2.500	0.432	1.022	0.655	0.000
2.556	0.433	1.046	0.662	0.000
2.611	0.434	1.070	0.669	0.000
2.667	0.435	1.094	0.687	0.000
2.722	0.436	1.118	0.721	0.000
2.778	0.437	1.143	0.763	0.000
2.833	0.438	1.167	0.812	0.000
2.889	0.439	1.191	0.866	0.000
2.944	0.440	1.216	0.924	0.000
3.000	0.441	1.240	0.985	0.000
3.056	0.443	1.265	1.050	0.000
3.111	0.444	1.289	1.117	0.000
3.167	0.445	1.314	1.186	0.000
3.222	0.446	1.339	1.257	0.000
3.278	0.447	1.364	1.329	0.000
3.333	0.448	1.388	1.403	0.000
3.389	0.449	1.413	1.477	0.000
3.444	0.450	1.438	1.552	0.000
3.500	0.451	1.463	1.628	0.000
3.556	0.452	1.488	1.704	0.000
3.611	0.453	1.514	1.781	0.000
3.667	0.454	1.539	1.868	0.000
3.722	0.455	1.564	1.961	0.000
3.778	0.456	1.589	2.057	0.000
3.833	0.458	1.615	2.154	0.000
3.889	0.459	1.640	2.254	0.000
3.944	0.460	1.666	2.355	0.000
4.000	0.461	1.691	2.459	0.000
4.056	0.462	1.717	2.656	0.000
4.111	0.463	1.743	3.012	0.000
4.167	0.464	1.768	3.470	0.000
4.222	0.465	1.794	4.012	0.000
4.278	0.466	1.820	4.626	0.000
4.333	0.467	1.846	5.304	0.000
4.389	0.468	1.872	6.041	0.000
4.444	0.469	1.898	6.832	0.000
4.500	0.471	1.924	7.674	0.000
4.556	0.472	1.950	8.564	0.000
4.611	0.473	1.977	9.499	0.000
4.667	0.474	2.003	10.48	0.000
4.722	0.475	2.029	11.50	0.000
4.778	0.476	2.056	12.56	0.000
4.833	0.477	2.082	13.65	0.000
4.889	0.478	2.109	14.79	0.000
4.944	0.479	2.135	15.96	0.000
5.000	0.480	2.162	17.17	0.000

5.056      0.482      2.189      18.40      0.000

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**MITIGATED LAND USE**

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**ANALYSIS RESULTS**

**Flow Frequency Return Periods for Predeveloped. POC #1**

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	1.308881
5 year	2.763385
10 year	3.729994
25 year	4.832139
50 year	5.541479
100 year	6.15418

**Flow Frequency Return Periods for Mitigated. POC #1**

<u>Return Period</u>	<u>Flow(cfs)</u>
2 year	0.896044
5 year	1.328835
10 year	1.66847
25 year	2.162987
50 year	2.582127
100 year	3.047606

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**Yearly Peaks for Predeveloped and Mitigated. POC #1**

<u>Year</u>	<u>Predeveloped</u>	<u>Mitigated</u>
1949	1.686	0.978
1950	1.994	0.806
1951	3.870	2.152
1952	0.627	0.521
1953	0.633	0.594
1954	1.115	0.662
1955	0.081	0.639
1956	1.986	1.568
1957	1.286	0.629
1958	1.425	0.579
1959	1.231	0.634
1960	3.509	2.796
1961	2.262	1.082
1962	0.337	0.516
1963	2.771	1.408
1964	1.664	0.923
1965	2.438	0.962
1966	2.543	0.549
1967	2.268	0.965
1968	0.646	0.928
1969	1.619	0.648
1970	1.029	0.637
1971	0.933	0.719
1972	1.886	1.174
1973	2.167	0.622
1974	1.549	0.650
1975	1.835	0.923
1976	1.545	0.619

1977	0.632	0.809
1978	1.940	1.115
1979	2.082	0.795
1980	2.286	1.450
1981	1.898	0.712
1982	2.331	1.021
1983	1.107	1.612
1984	0.943	1.353
1985	0.208	0.629
1986	0.363	1.180
1987	2.014	3.319
1988	0.744	0.935
1989	0.709	0.613
1990	1.819	1.330
1991	0.882	1.367
1992	0.438	1.016
1993	1.497	1.375
1994	0.611	0.474
1995	0.005	1.558
1996	1.675	1.104

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**Ranked Yearly Peaks for Predeveloped and Mitigated. POC #1**

<b>Rank</b>	<b>Predeveloped</b>	<b>Mitigated</b>
1	3.8700	3.3192
2	3.5094	2.7963
3	2.7706	2.1517
4	2.5434	1.6121
5	2.4379	1.5683
6	2.3314	1.5577
7	2.2859	1.4502
8	2.2678	1.4078
9	2.2621	1.3753
10	2.1675	1.3666
11	2.0822	1.3532
12	2.0135	1.3303
13	1.9945	1.1795
14	1.9862	1.1740
15	1.9398	1.1150
16	1.8983	1.1039
17	1.8857	1.0821
18	1.8347	1.0211
19	1.8186	1.0157
20	1.6863	0.9783
21	1.6748	0.9645
22	1.6642	0.9622
23	1.6194	0.9353
24	1.5491	0.9285
25	1.5449	0.9233
26	1.4970	0.9228
27	1.4246	0.8094
28	1.2861	0.8063
29	1.2314	0.7953
30	1.1152	0.7191
31	1.1067	0.7117
32	1.0292	0.6624
33	0.9432	0.6503

34	0.9328	0.6475
35	0.8816	0.6395
36	0.7442	0.6368
37	0.7087	0.6336
38	0.6456	0.6292
39	0.6332	0.6286
40	0.6319	0.6223
41	0.6269	0.6192
42	0.6111	0.6133
43	0.4385	0.5940
44	0.3632	0.5786
45	0.3367	0.5492
46	0.2080	0.5210
47	0.0812	0.5163
48	0.0052	0.4738

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**POC #1**

The Facility **PASSED**.

<b>Flow(CFS)</b>	<b>Predev</b>	<b>Dev</b>	<b>Percentage</b>	<b>Pass/Fail</b>
0.6544	812	781	96	Pass
0.7038	701	497	70	Pass
0.7532	616	406	65	Pass
0.8025	553	334	60	Pass
0.8519	493	290	58	Pass
0.9013	433	237	54	Pass
0.9506	391	201	51	Pass
1.0000	349	171	48	Pass
1.0494	306	146	47	Pass
1.0987	263	132	50	Pass
1.1481	233	120	51	Pass
1.1974	213	102	47	Pass
1.2468	184	96	52	Pass
1.2962	158	82	51	Pass
1.3455	144	73	50	Pass
1.3949	125	64	51	Pass
1.4443	110	58	52	Pass
1.4936	92	43	46	Pass
1.5430	84	38	45	Pass
1.5924	71	34	47	Pass
1.6417	66	31	46	Pass
1.6911	56	28	50	Pass
1.7404	54	28	51	Pass
1.7898	49	27	55	Pass
1.8392	43	26	60	Pass
1.8885	40	25	62	Pass
1.9379	37	24	64	Pass
1.9873	31	20	64	Pass
2.0366	27	19	70	Pass
2.0860	25	17	68	Pass
2.1354	24	15	62	Pass
2.1847	23	14	60	Pass
2.2341	21	14	66	Pass
2.2835	17	14	82	Pass
2.3328	13	12	92	Pass

2.3822	11	10	90	Pass
2.4315	11	10	90	Pass
2.4809	9	9	100	Pass
2.5303	8	8	100	Pass
2.5796	7	7	100	Pass
2.6290	7	7	100	Pass
2.6784	6	6	100	Pass
2.7277	6	4	66	Pass
2.7771	5	3	60	Pass
2.8265	5	2	40	Pass
2.8758	5	2	40	Pass
2.9252	4	2	50	Pass
2.9745	4	2	50	Pass
3.0239	4	1	25	Pass
3.0733	3	1	33	Pass
3.1226	3	1	33	Pass
3.1720	3	1	33	Pass
3.2214	3	1	33	Pass
3.2707	3	1	33	Pass
3.3201	3	0	0	Pass
3.3695	2	0	0	Pass
3.4188	2	0	0	Pass
3.4682	2	0	0	Pass
3.5176	1	0	0	Pass
3.5669	1	0	0	Pass
3.6163	1	0	0	Pass
3.6656	1	0	0	Pass
3.7150	1	0	0	Pass
3.7644	1	0	0	Pass
3.8137	1	0	0	Pass
3.8631	1	0	0	Pass
3.9125	0	0	0	Pass
3.9618	0	0	0	Pass
4.0112	0	0	0	Pass
4.0606	0	0	0	Pass
4.1099	0	0	0	Pass
4.1593	0	0	0	Pass
4.2087	0	0	0	Pass
4.2580	0	0	0	Pass
4.3074	0	0	0	Pass
4.3567	0	0	0	Pass
4.4061	0	0	0	Pass
4.4555	0	0	0	Pass
4.5048	0	0	0	Pass
4.5542	0	0	0	Pass
4.6036	0	0	0	Pass
4.6529	0	0	0	Pass
4.7023	0	0	0	Pass
4.7517	0	0	0	Pass
4.8010	0	0	0	Pass
4.8504	0	0	0	Pass
4.8997	0	0	0	Pass
4.9491	0	0	0	Pass
4.9985	0	0	0	Pass
5.0478	0	0	0	Pass
5.0972	0	0	0	Pass
5.1466	0	0	0	Pass

5.1959	0	0	0	Pass
5.2453	0	0	0	Pass
5.2947	0	0	0	Pass
5.3440	0	0	0	Pass
5.3934	0	0	0	Pass
5.4428	0	0	0	Pass
5.4921	0	0	0	Pass
5.5415	0	0	0	Pass

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**Water Quality BMP Flow and Volume for POC 1.**  
**On-line facility volume:** 1.0448 acre-feet  
**On-line facility target flow:** 0.5553 cfs.  
**Adjusted for 15 min:** 0.6041 cfs.  
**Off-line facility target flow:** 0.3493 cfs.  
**Adjusted for 15 min:** 0.3801 cfs.

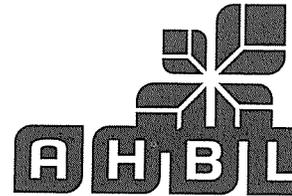
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#### **Perlnd and Implnd Changes**

No changes have been made.

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Project SPIKETON  
 Subject \_\_\_\_\_  
 With/To \_\_\_\_\_  
 Address \_\_\_\_\_  
 Date 05/23/16

Project No. 2140645  
 Phone \_\_\_\_\_  
 Fax # \_\_\_\_\_  
 # Faxed Pages \_\_\_\_\_  
 By RYAN INOUE

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- Memorandum
- Meeting Minutes
- Telephone Memo

- Civil Engineers
- Structural Engineers
- Landscape Architects
- Community Planners
- Land Surveyors

WETLAND SIZING CALCULATIONS PER  
 BMP T10.30 STORMWATER TREATMENT  
 WETLAND OF THE 2005 DOE, VOLUME V

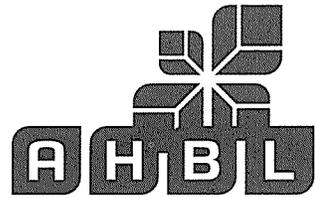
1) WATER QUALITY VOLUME PER WWHM3 = 1.0448 AC-FT  
 = 45,511 CF

2) ASSUME AVERAGE DEPTH OF 3-FT (PER 2005 DOE)  
 STORMWATER WETLAND SURFACE AREA = 45,511 / 3 FT  
 MINIMUM REQUIRED SURFACE AREA = 15,170 SF

3) SURFACE AREA OF CELL #1: PRESETTLING  
 CELL #1 IS APPROXIMATELY 33% OF TOTAL VOLUME  
 45,511 CF (0.33) = 15,019 CF  
 CELL #1 IS 4 FT DEEP PLUS 1-FT OF SEDIMENT STORAGE  
 15,019 CF / 3 FT = 5,006 SF  
 MINIMUM REQUIRED SURFACE AREA = 5,006 SF

4) SURFACE AREA OF CELL #2: WETLAND  
 15,170 SF - 5,006 SF = 10,164 SF  
 MINIMUM REQUIRED SURFACE AREA = 10,164 SF

5) BERM WILL BE 1-FT BELOW THE W.Q. SURFACE  
 OPTION A WILL BE USED: SHALLOW, EVENLY GRADED  
 SLOPE FROM UPSTREAM TO DOWNSTREAM EDGES OF THE  
 WETLAND CELL.



Project \_\_\_\_\_  
Subject \_\_\_\_\_  
With/To \_\_\_\_\_  
Address \_\_\_\_\_  
Date \_\_\_\_\_

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