State Avenue Corridor Improvements Project
100th Street to 116th Street
Storm Drainage Report

September 2019

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100th Street to 116th Street
Storm Drainage Report

September 2019

Prepared by:

HDR Engineering, Inc.
929 108th Avenue NE, Suite 1300
Bellevue, WA 98004
425.450.6200
www.hdrinc.com

Prepared for:

City of Marysville
1049 State Avenue
Marysville, WA 98270
360.651.5000
www.marysvillewa.gov

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Certificate of Engineer

The report and data contained in this report for **the City of Marysville State Avenue Corridor Improvements project** were prepared under the supervision and direction of the undersigned, whose seal, a nal engineer licensed to practice as such, is affixed below.

Brian Ward, P.E.
Stormwater Engineer
HDR Engineering, Inc.

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1.0 Introduction

1.1 Background

The City of Marysville has maintained a long-term vision to improve the State Avenue Corridor to a 5-lane Principal Arterial section. State Avenue between 100th Street NE and 116th Street NE represents the final segment to be widened to the proposed build out.

State Avenue is the primary north-south spine of the City of Marysville's transportation network carrying traffic between the Downtown core and Smokey Point area. The corridor, running parallel to Interstate 5, provides local access to and from the freeway, and adjacent commercial and residential areas. The current section is defined as a rural 3-lane asphalt roadway with 6 to 8-foot wide shoulders. The corridor crosses Quilceda Creek atop a 25-foot high earthen embankment with vegetated steep slopes. Adjacent properties currently utilize the public right-of-way outside the roadway limits for parking and lawn areas.

1.2 Project Overview

The State Avenue Corridor Improvement Project is located in Marysville, Washington, along State Avenue from 100th Street NE to 116th Street NE, as shown in Figure 1.

This project proposes to widen State Avenue from 3-lanes to 5-lanes and will include curb, gutter and sidewalk, as well as street lighting to improve traffic and pedestrian safety along the corridor. The project includes utility modifications to the sewer line to correct a deficient segment of pipe, stormwater drainage design and upgrade, water main abandonment and replacement, and coordination with franchise utilities to relocate facilities and underground where possible. The existing box culvert spanning Quilceda Creek will be replaced with a five-lane bridge. To accomplish these improvements, right-of-way (ROW) will be acquired.

The project will be constructed in two phases. Phase I extends from 100th Street NE to 104th Place NE. Construction for Phase I is anticipated to start in April 2019. Phase II extends from 104th Place NE to 116th Street NE. Construction for Phase II is anticipated to start in November 2020.

FIGURE 1
PROJECT VICINITY

CITY OF MARYSVILLE: STATE AVENUE IMPROVEMENT PROJECT

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1.3 Design Standards and Requirements

The proposed project will be constructed within the City of Marysville and is subjected to the Marysville Municipal Code. The City requires all projects to be designed in accordance with the following requirements:

Washington State Department of Ecology 2012 Stormwater Management Manual for Western Washington, as amended in December 2014 (2014 Ecology Manual), per Municipal Code Chapter 14.15

City of Marysville amendment to the Ecology Manual, per Municipal Code Chapter 14.15

City of Marysville Engineering Design and Development Standards, 2016

1.4 Purpose of this Report

The intent of this report is to provide permit support related to the storm drainage design for the State Avenue Corridor Improvement project by documenting the proposed permanent stormwater management best management practices (BMPs).

The remainder of the report describes the existing and proposed site conditions, the proposed permanent stormwater management plan, conveyance and off-site capacity analysis, operations and maintenance, and construction stormwater pollution prevention plan (CSWPPP).

2.0 Existing Conditions

A majority of the proposed improvements are located within the existing 100th Street NE ROW with a few areas extending into parcels that will be acquired by the City. The existing surface coverage includes a 3-lane asphalt roadway with 6 to 8-foot wide paved shoulders. There is sidewalk on the east side of the street, between 113th Place NE and 116th Street NE. The land surface coverage outside the formal roadway consist of grass and a few minor landscaped areas.

2.1 Drainage Patterns

The City of Marysville State Avenue project encompasses approximately ten acres. In the existing conditions, stormwater generated by the project site either infiltrates or is conveyed and discharged to Quilceda Creek. There are two discharge locations, which combine within one-quarter mile downstream; therefore, the project site is made up of one threshold discharge area (TDA). Quilceda Creek is within the Snoqualmie-Snohomish River Basin and generally flows from the northeast to the southwest for approximately five miles where it ultimately discharges to Possession Sound.

2.2 Stormwater Conveyance System

The existing stormwater runoff flows from the site as natural overland flow and sheet flow to the formal roadway drainage system. The State Avenue roadway is crowned and sloped north to south. Existing drainage infrastructure consists of closed conveyance systems that are made up of catch basins and pipes, and infiltration systems. To the west of State Avenue, between 104th Street NE and 113th Street NE, there is no formal conveyance system. The runoff flows to the grass area between the roadway and the railroad tracks and infiltrates. The following provides a summary of the drainage system and how it serves the project area:

- Stormwater runoff from the west end of 100th Street NE and the portion of State Avenue south of Quilceda Creek is conveyed north through an existing pipe system that discharges to Quilceda Creek.
- Stormwater runoff from the portion of State Avenue directly north of Quilceda Creek is collected by catch basins along the east side of State Avenue, conveyed south, and discharges directly to Quilceda Creek.
- There is an existing water quality facility in the Northwest Biscotti parking lot (parcel 01107400000100/01107400000200) that treats runoff from the parking lot prior to infiltrating onsite.
- Stormwater runoff from the eastern portion of State Avenue at the intersection of 104th Place NE is collected by an existing catch basin on the north side of 104th Place NE. During a site visit, pipes connecting to the catch basin from the east and west were observed; however, the end locations of these respective pipes could not be found and appear to remain underground. The City confirmed these pipes convey the stormwater to an infiltration system similar to City of Marysville Standard Plan 4-040-005. This situation was observed at several intersections along State Avenue.
- Stormwater runoff from the eastern portion of State Avenue between 106th Place NE and 105th Place NE is collected by existing catch basins along State Avenue on the

north and south sides of 105th Place NE. The City confirmed the pipes connected to the east and west of these catch basins convey the stormwater to infiltration systems similar to City of Marysville Standard Plan 4-040-005.

- Stormwater runoff from the eastern portion of State Avenue between 108th Place NE and 106th Place NE is collected by catch basins on the north and south sides of 106th Place NE. The City confirmed the pipes connected to the east and west of these catch basins convey the stormwater to infiltration systems similar to City of Marysville Standard Plan 4-040-005.
- Stormwater runoff from the eastern portion of State Avenue between 109th Place NE and 108th Place NE are collected by existing catch basins along State Avenue on the north and south sides of 108th Place NE. The City confirmed the pipes connected to the east and west of these catch basins convey the stormwater to infiltration systems similar to City of Marysville Standard Plan 4-040-005.
- Stormwater runoff from the eastern portion of State Avenue at the intersection of 109th Place NE is collected by catch basins on the south side of 109th Place NE. The City confirmed the pipes connected to the east and west of this catch basins convey the stormwater to an infiltration system similar to City of Marysville Standard Plan 4-040-005.
- Stormwater runoff from the western half of State Avenue, from 113th Place NE to 116th Place NE, sheet flows and is collected to the west of the roadway. The runoff north of the commercial driveway between 113th Place NE and 116th Place NE is conveyed north, beyond the project limits. The flow south of the commercial driveway is conveyed across State Avenue to existing catch basins on the east side of State Avenue that collect the runoff from the east side of the roadway in this area. The runoff is routed through two existing swales in the commercial parking lot that discharge to the roadway drainage system that continue east down 113th Place NE.

The existing system can be depicted in Figures 2A through 2C.

2.3 Soils and Groundwater

Shannon and Wilson, Inc. conducted geotechnical analysis of the existing site conditions to support the design and construction of the project. The analysis included review of available subsurface information, field investigation, and laboratory testing. The full geotechnical report has been submitted as a separate document (Shannon and Wilson, Inc. 2017).

Soil samples taken from nine borings, designated B-1-17 through B-9-17, were collected along the alignment at depths ranging from 20 to 110 feet below ground surface. Two hand borings, designated HA-1-17 and HA-2-17, were also completed at depths ranging from 7 to 14 feet below ground surface. Loose, brown, Poorly Graded sand and loose to medium dense, brown, Poorly Graded sand was found in the first 4 to 7 feet below ground surface in borings B-1-17 and B-2-17. Medium dense, Poorly Graded Sand to Poorly Graded Sand with Silt and medium dense, Poorly Graded Sand to Poorly Graded Sand with Silt were found in the first 4 to 12 feet below ground surface in Borings B-3-17 and B-4-17. B-5-17 found Poorly Graded Gravel with Sand and Loose, brown Silty Sand within the first 4.5 feet below ground surface. The first 23

feet below ground surface in B-6-7 consisted of medium dense, Poorly Graded Sand to Poorly Graded Sand with Silt. Poorly Graded Gravel with Sand and very loose, Silty Sand to Poorly Graded sand was found within the first 7.5 feet in B-7-17, B-8-17, and B-9-17.

Groundwater depths were estimated in each borehole and groundwater monitoring wells were installed in four borings. Groundwater was observed at depths between 14.5 to 31.6 feet below the ground surface. These measurements were obtained during the summer months, when groundwater levels are typically lowest. Shannon and Wilson, Inc. will continue to monitor groundwater levels and provide updated values.

Long-term infiltration rates were estimated using the soil grain size analysis method in accordance with the 2014 Ecology Manual. From Shannon and Wilson's experience, the 2014 Ecology method may over estimate infiltration rates. As an alternative, the correlation based on D10 from the 2005 Stormwater Management in Western Washington Manual (2005 Ecology Manual) was also analyzed. Long-term infiltration rates for both methods are presented below in Table 1. The design values for application to design infiltration facilities were selected in consultation with HDR, accounting for the variation at boring locations and variation between the two methods (Shannon and Wilson, Inc. 2017). Table 1 can also be found in the full geotechnical report.

Table 1: Summary of Estimated and Design Long-Term Infiltration Rates

Boring	Sample Number	Sample Depth (feet)	2014 Ecology Manual Infiltration Rate (inches/hour)	2005 Ecology Manual Infiltration Rate (inches/hour)	Design Infiltration Rate (inches/hour)
B-1-17	S-2	5.0	9.6	4.1	5.0
	S-4	10.0	5.1	3.2	
	S-5	12.5	7.5	2.9	
B-2-17	S-2	5.0	12.4	5.3	4.0
	S-3	7.5	4.8	1.2	
	S-4	10.0	4.1	1.5	
B-4-17	S-2	5.0	5.1	1.9	4.0
	S-3	7.5	3.1	1.0	
	S-4	10.0	3.9	1.4	

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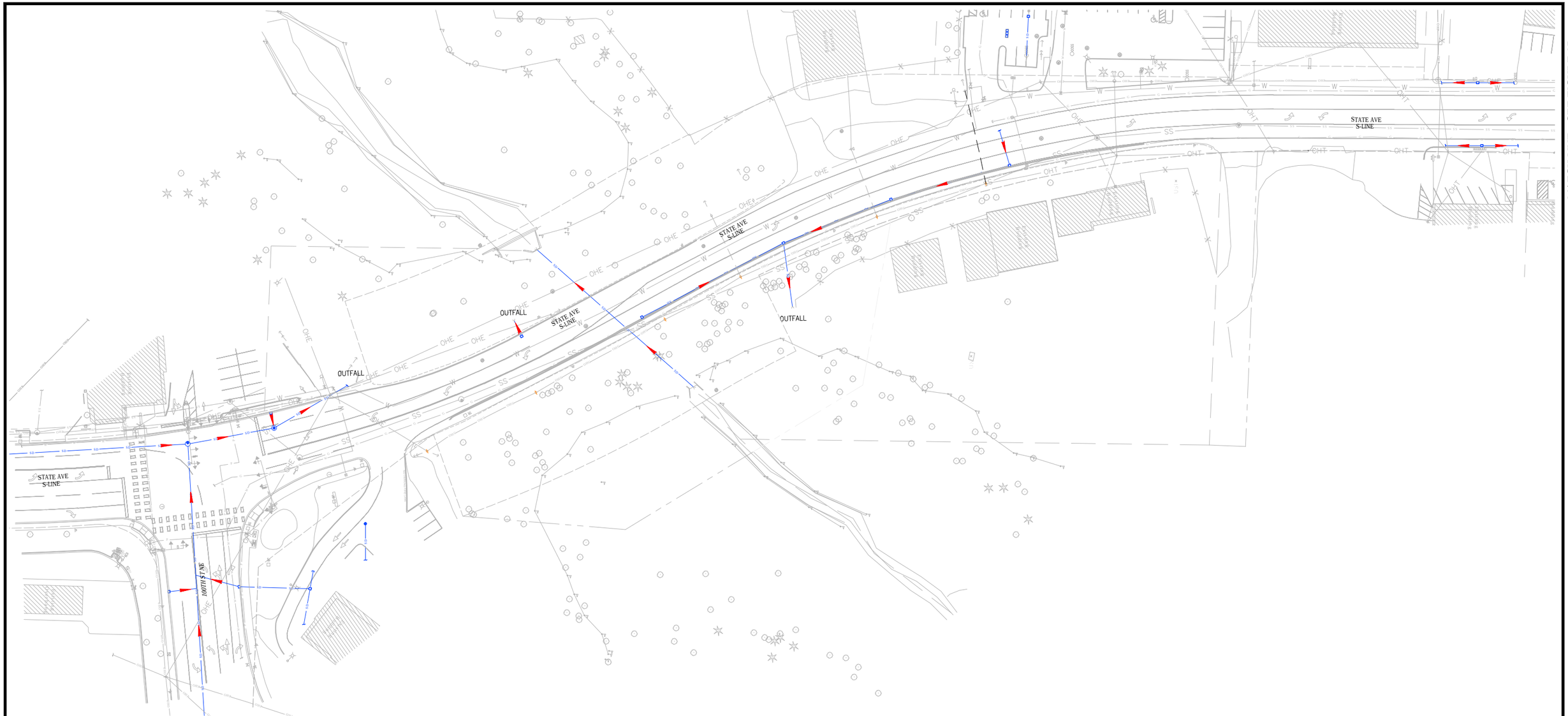


MATCH LINE - SEE FIGURE 2B

LEGEND

- EXISTING RIGHT-OF-WAY
- PROPERTY LINE
- EXISTING STORM DRAIN PIPE
- EXISTING STORM DRAIN STRUCTURES
- FLOW ARROW

N

HORZ SCALE: 20' 0' 20' 40' IN FEET

LINE IS 1 INCH
AT FULL SIZE
(IF NOT 1" - SCALE ACCORDINGLY)

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT
(100TH STREET NE TO 116TH STREET NE)

EXISTING CONDITIONS

FIGURE 2A

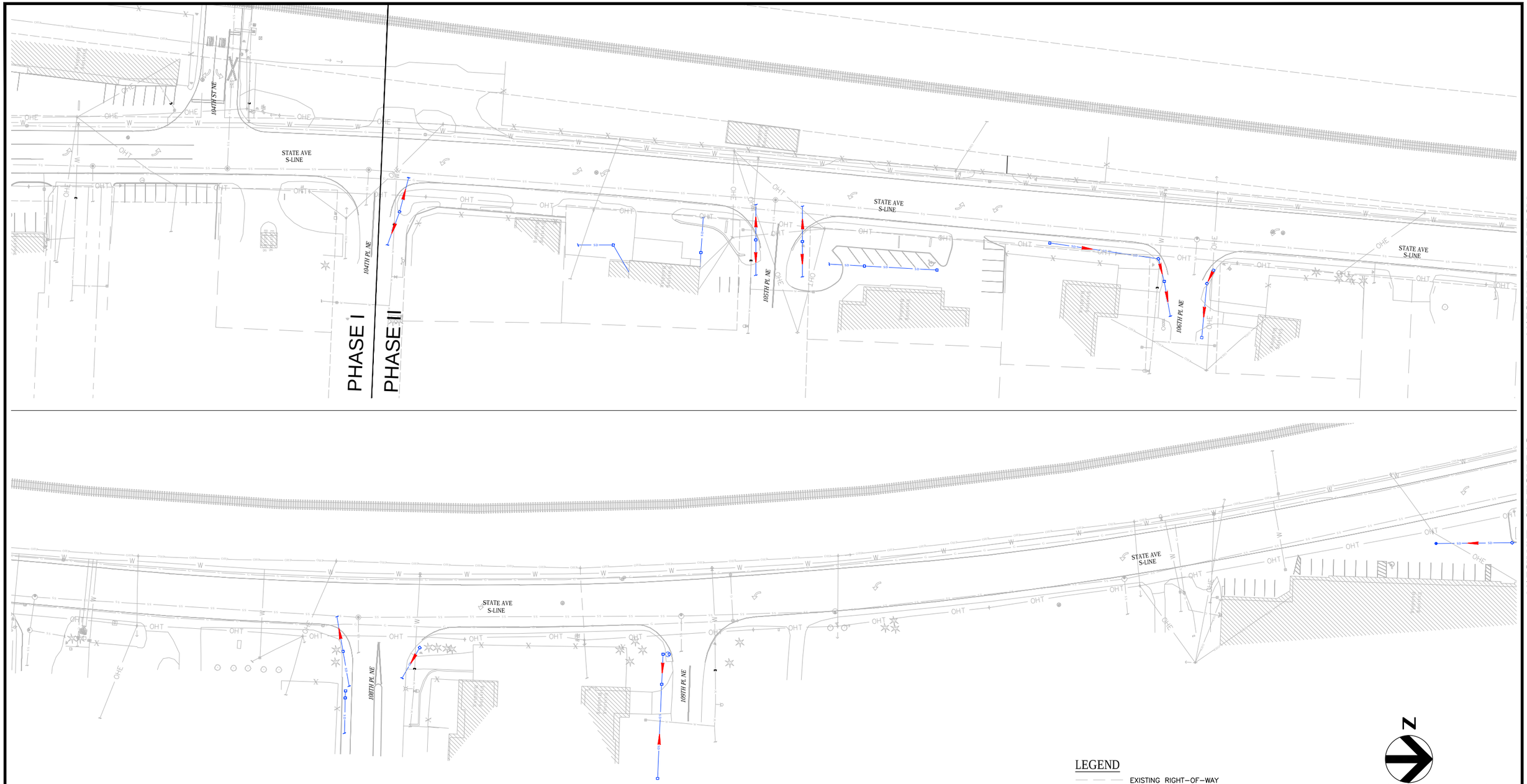
NOT FOR CONSTRUCTION

MATCH LINE - SEE FIGURE 2A

MATCH LINE - SEE BELOW

MATCH LINE - SEE ABOVE

MATCH LINE - SEE FIGURE 2C



LEGEND

- EXISTING RIGHT–OF–WAY
- PROPERTY LINE
- SD — EXISTING STORM DRAIN PIPE
- EXISTING STORM DRAIN STRUCTURES
- FLOW ARROW

N

HORZ SCALE: 20' 0' 20' 40' IN FEET

CITY OF Marysville WASHINGTON

HDR

LINE IS 1 INCH AT FULL SIZE
(IF NOT 1" - SCALE ACCORDINGLY)

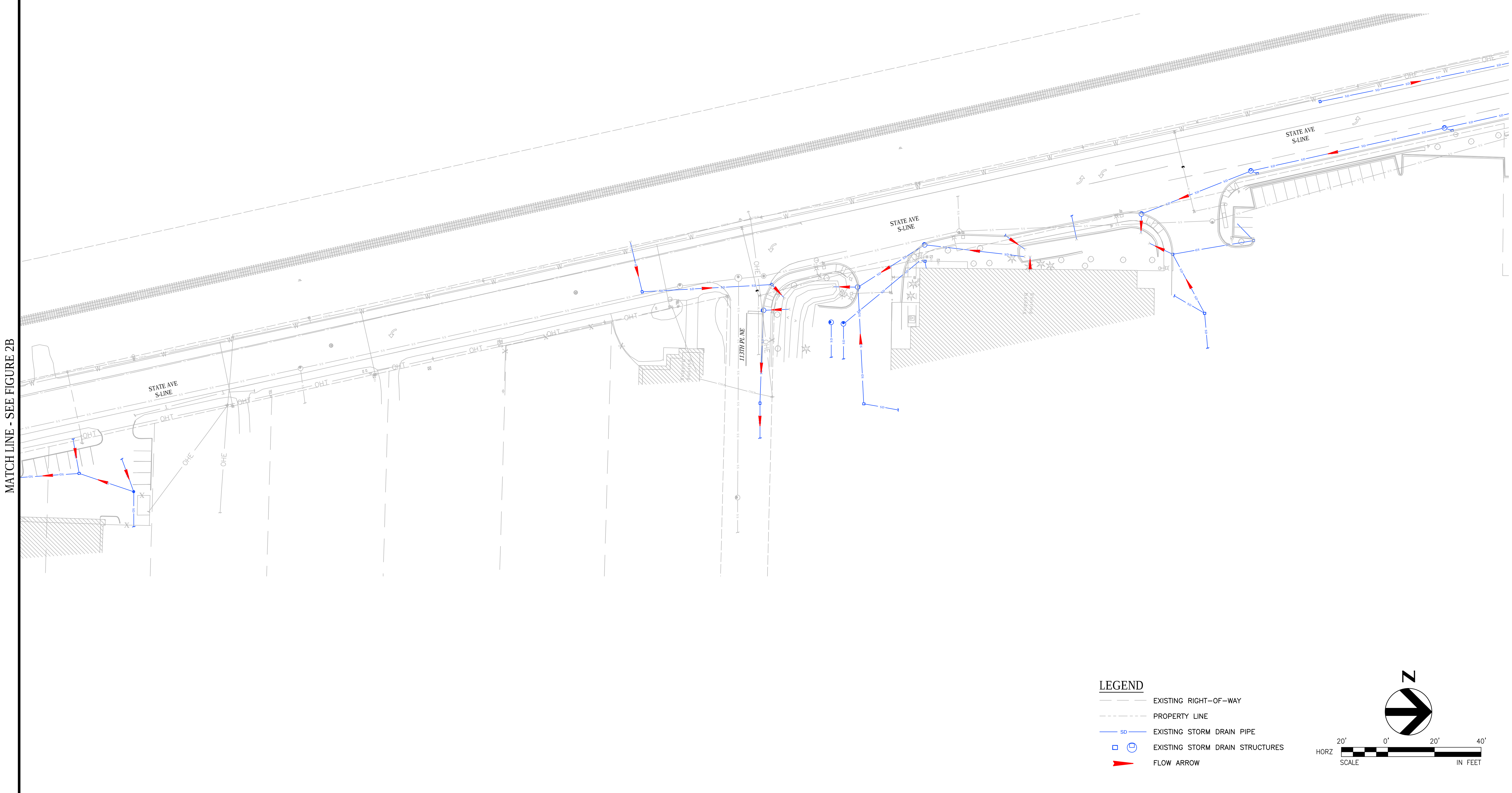
CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT (100TH STREET NE TO 116TH STREET NE)

EXISTING CONDITIONS

FIGURE 2B

NOT FOR CONSTRUCTION



LINE IS 1 INCH AT FULL SIZE (IF NOT 1" - SCALE ACCORDINGLY)

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT (100TH STREET NE TO 116TH STREET NE)

EXISTING CONDITIONS

FIGURE 2C

3.0 Proposed Conditions

The following section provides a brief description of the proposed project layout based on the design, which was submitted as a separate document.

3.1 Site Layout

The State Avenue Corridor Improvement Project proposes to widen State Avenue from 3-lanes to 5-lanes and will include, curb, gutter and sidewalk. Street lighting will be provided to improve traffic safety along the corridor. The existing box culvert will be replaced with a five-lane bridge. Most of the existing drainage system will be removed, as indicated in the design plans.

The proposed permanent stormwater management design includes the following:

Phase I

- One infiltration facility with pre-treatment that will provide flow control.
- A wetpond that will provide water quality treatment for the entire corridor even though it does not accept runoff from the Phase II roadway area.
- New conveyance systems that will collect and convey stormwater from the proposed improvements and minor offsite flow to the proposed infiltration facility and wetpond.

Phase II

- Ten infiltration facilities with pre-treatment that will provided flow control.
- New conveyance systems that will collect and convey stormwater from the proposed improvements and minor offsite flow to the proposed infiltration facilities.

Proposed conditions are depicted in Figures 3A through 3C.

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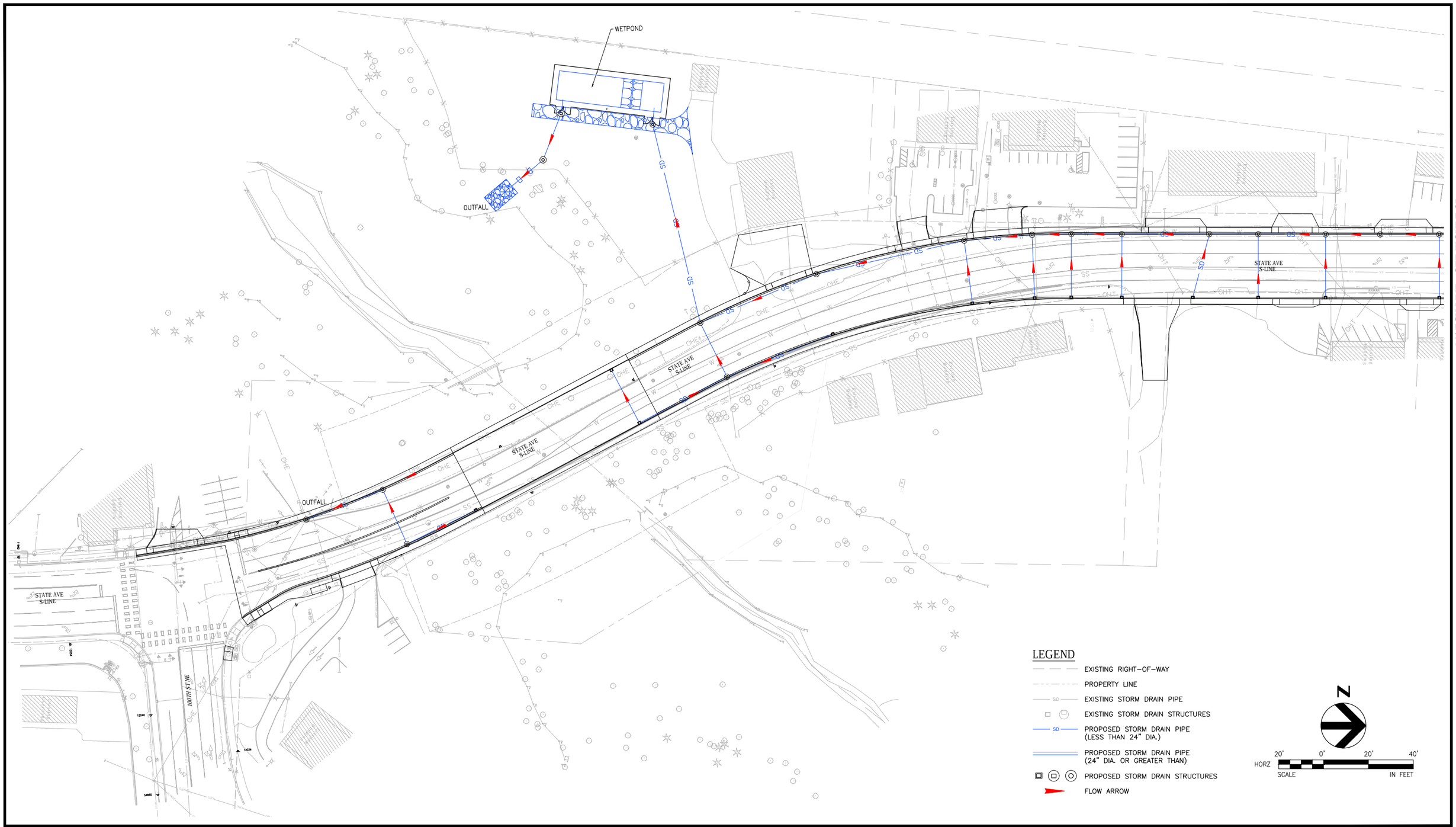

MATCH LINE - SEE FIGURE 3B

LEGEND

- EXISTING RIGHT-OF-WAY
- PROPERTY LINE
- EXISTING STORM DRAIN PIPE
- EXISTING STORM DRAIN STRUCTURES
- PROPOSED STORM DRAIN PIPE (LESS THAN 24" DIA.)
- PROPOSED STORM DRAIN PIPE (24" DIA. OR GREATER THAN)
- PROPOSED STORM DRAIN STRUCTURES
- FLOW ARROW

N

HORZ SCALE: 20' 0' 20' 40' IN FEET

LINE IS 1 INCH AT FULL SIZE
(IF NOT 1" - SCALE ACCORDINGLY)

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT
(100TH STREET NE TO 116TH STREET NE)

PROPOSED CONDITIONS

FIGURE 3A

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MATCH LINE - SEE FIGURE 3A

MATCH LINE - SEE FIGURE 3C

MATCH LINE - SEE ABOVE

INFILTRATION GALLERY 1
INFILTRATION GALLERY 2
INFILTRATION GALLERY 3
INFILTRATION GALLERY 4
INFILTRATION GALLERY 5
INFILTRATION GALLERY 6
INFILTRATION GALLERY 7
INFILTRATION GALLERY 8
INFILTRATION GALLERY 9
INFILTRATION GALLERY 10

PHASE I
PHASE II

104TH ST NE
104TH PL NE
105TH PL NE
107TH PL NE
108TH PL NE
109TH PL NE

STATE AVE S-LINE

SEQUOIA PLACE CONDOMINIUM
WILHELMI DALE E
WILHELMI DANA
VAZQUEZ ALFONSO
SMITH MICHAEL K & BILLIE B
MORENO ALFONSO M
WILEY FLORENCE M
MICKELSON ELMER & VAL
PAYNE R GREGORY

LEGEND

- EXISTING RIGHT-OF-WAY
- PROPERTY LINE
- EXISTING STORM DRAIN PIPE
- EXISTING STORM DRAIN STRUCTURES
- PROPOSED STORM DRAIN PIPE (LESS THAN 24" DIA.)
- PROPOSED STORM DRAIN PIPE (24" DIA. OR GREATER THAN)
- PROPOSED STORM DRAIN STRUCTURES
- FLOW ARROW

N

HORZ SCALE 20' 0' 20' 40' IN FEET

LINE IS 1 INCH AT FULL SIZE
(IF NOT 1" - SCALE ACCORDINGLY)

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT
(100TH STREET NE TO 116TH STREET NE)

PROPOSED CONDITIONS

FIGURE 3B

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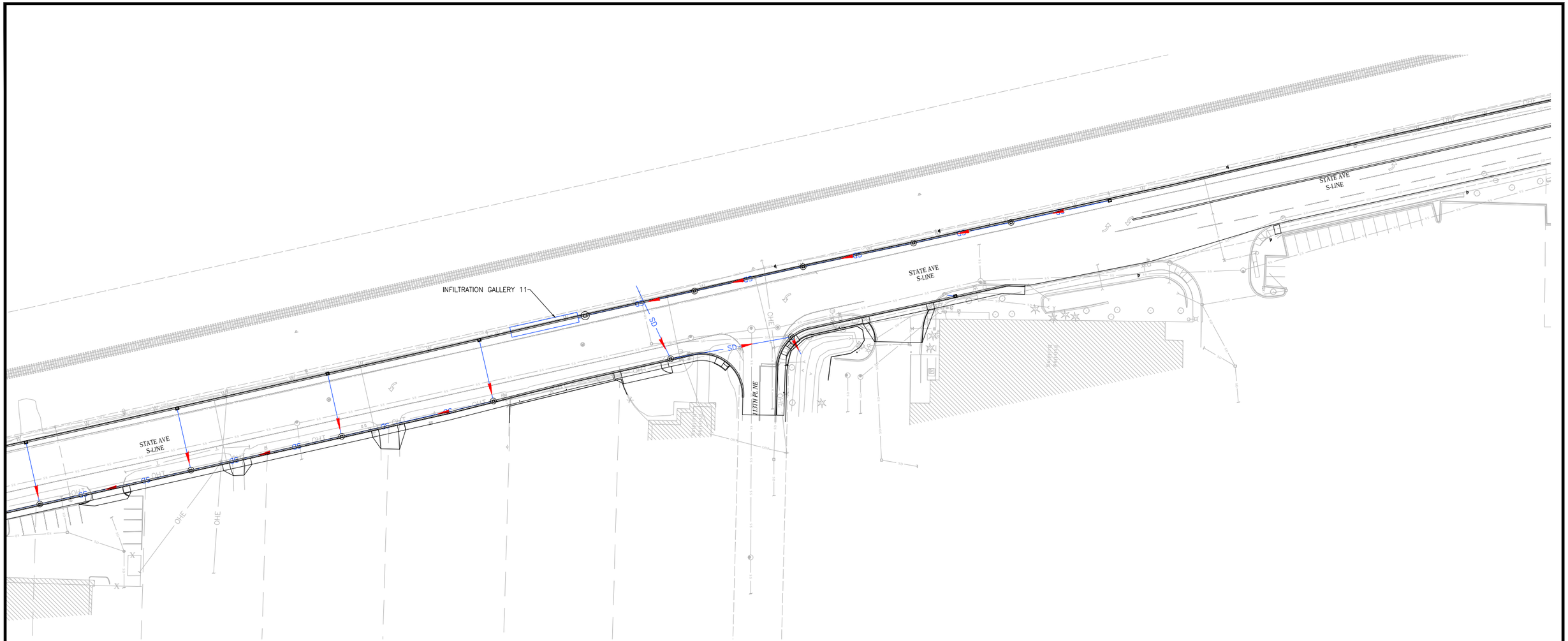
MATCH LINE - SEE FIGURE 3B



LEGEND

- EXISTING RIGHT-OF-WAY
- PROPERTY LINE
- EXISTING STORM DRAIN PIPE
- EXISTING STORM DRAIN STRUCTURES
- PROPOSED STORM DRAIN PIPE (LESS THAN 24" DIA.)
- PROPOSED STORM DRAIN PIPE (24" DIA. OR GREATER THAN)
- PROPOSED STORM DRAIN STRUCTURES
- FLOW ARROW

N

HORZ SCALE: 20' 0' 20' 40' IN FEET

LINE IS 1 INCH AT FULL SIZE
(IF NOT 1" - SCALE ACCORDINGLY)

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT
(100TH STREET NE TO 116TH STREET NE)

PROPOSED CONDITIONS

FIGURE 3C

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4.0 Permanent Stormwater Management Plan

This section provides a description of the TDA delineation, minimum requirement applicability, performance goals and standards, and proposed permanent stormwater BMPs.

4.1 Threshold Discharge Area Delineation

The TDA delineation was conducted in accordance with the 2014 Ecology Manual and used to assess the minimum requirement applicability. The project is made up of only one TDA located in the Snoqualmie-Snohomish River Basin that ultimately discharges to Possession Sound.

A summary of the existing and proposed land coverage conditions for Phase 1, Phase 2, and the total TDA are provided in Tables 2 through 4.

Table 2: New and Replaced Surfaces for Phase 1

Surface Type	Areas (Square Feet)			
	Non-Pollution Generating Impervious Surface	Pollution Generating Impervious Surface	Pervious Surface	Total
Existing	6,821	99,600	68,116	174,536
New	5,791	23,331	0	29,122
Replaced	7,846	50,480	0	58,326
Unchanged	87,087			
New + Replaced Impervious	13,638	73,811	0	87,449
Total New Impervious Surface	29,122			
Total Replaced Impervious Surface	58,326			

Table 3: New and Replaced Surfaces for Phase 2

Surface Type	Areas (Square Feet)			
	Non-Pollution Generating Impervious Surface	Pollution Generating Impervious Surface	Pervious Surface	Total
Existing	4,347	205,195	58,141	267,683
New	14,984	25,741	929	41,655
Replaced	4,859	39,518	3,058	47,436
Unchanged	178,593			
New + Replaced Impervious	19,844	65,259	3,988	89,091
Total New Impervious Surface	40,725			
Total Replaced Impervious Surface	44,377			

Table 4: Total New and Replaced Surfaces

Surface Type	Areas (Square Feet)			
	Non-Pollution Generating Impervious Surface	Pollution Generating Impervious Surface	Pervious Surface	Total
Existing	11,168	304,795	126,256	442,219
New	20,776	49,072	929	70,777
Replaced	12,706	89,998	3,058	105,762
Unchanged	265,680			
New + Replaced Impervious	33,482	139,070	3,988	176,539
Total New Impervious Surface	69,848			
Total Replaced Impervious Surface	102,704			

Existing and proposed land cover is depicted in Figures 4A through 4C.

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NOT FOR CONSTRUCTION

EXISTING LAND COVER

EXISTING CONDITIONS LEGEND:

- NON POLLUTION–GENERATING IMPERVIOUS SURFACE
- POLLUTION–GENERATING IMPERVIOUS SURFACE
- PERVIOUS SURFACE

N

HORZ SCALE 20' 0' 20' 40' IN FEET

CITY OF Marysville WASHINGTON

HDR

LINE IS 1 INCH AT FULL SIZE
(IF NOT 1" - SCALE ACCORDINGLY)

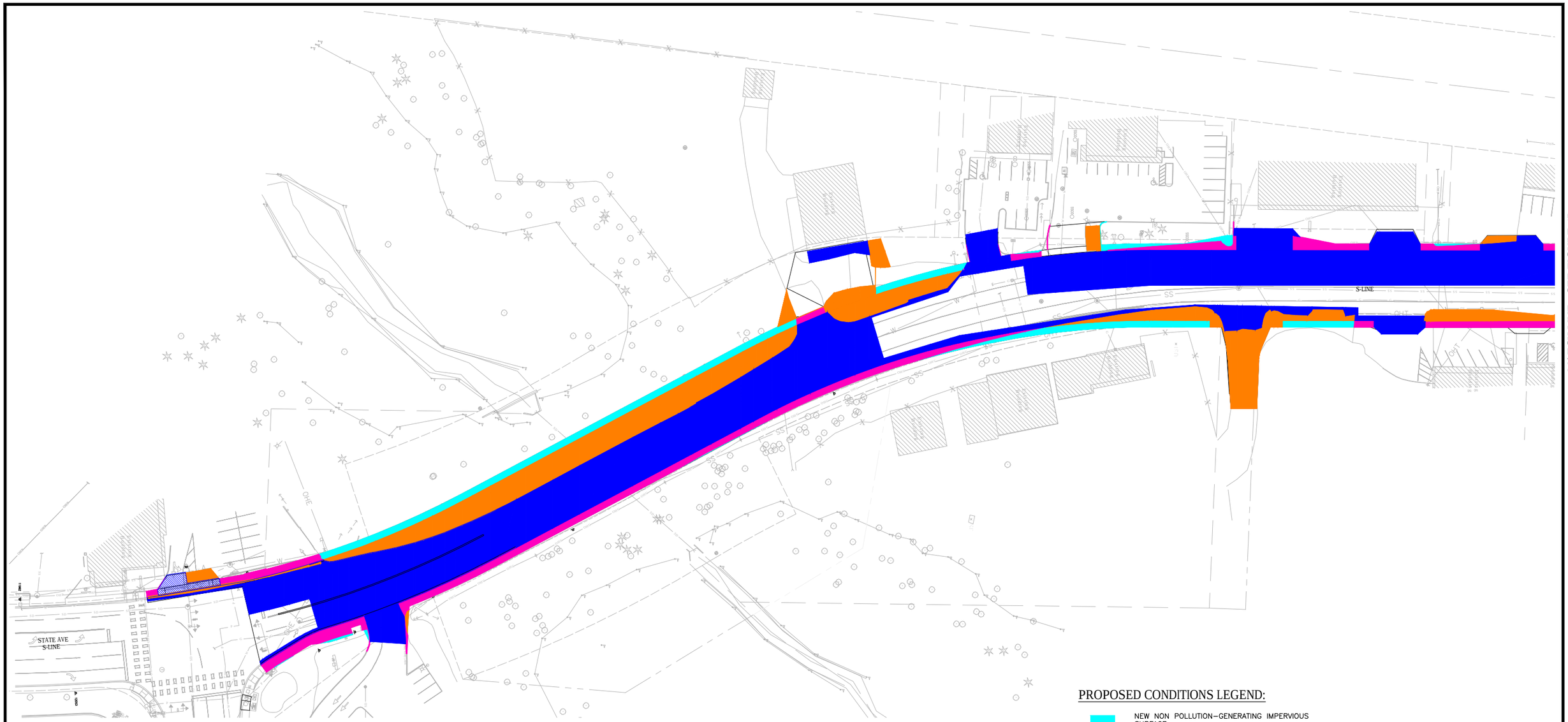
CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT
(100TH STREET NE TO 116TH STREET NE)

LAND COVER

FIGURE 4A

NOT FOR CONSTRUCTION



MATCH LINE - SEE FIGURE 4B

PROPOSED LAND COVER

PROPOSED CONDITIONS LEGEND:

- NEW NON POLLUTION–GENERATING IMPERVIOUS SURFACE
- NEW POLLUTION–GENERATING IMPERVIOUS SURFACE
- NEW PERVIOUS SURFACE
- REPLACED NON POLLUTION–GENERATING IMPERVIOUS SURFACE
- REPLACED POLLUTION–GENERATING IMPERVIOUS SURFACE
- REPLACED PERVIOUS SURFACE

N

HORZ SCALE: 20' 0' 20' 40' IN FEET

LINE IS 1 INCH AT FULL SIZE
(IF NOT 1" - SCALE ACCORDINGLY)

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT
(100TH STREET NE TO 116TH STREET NE)

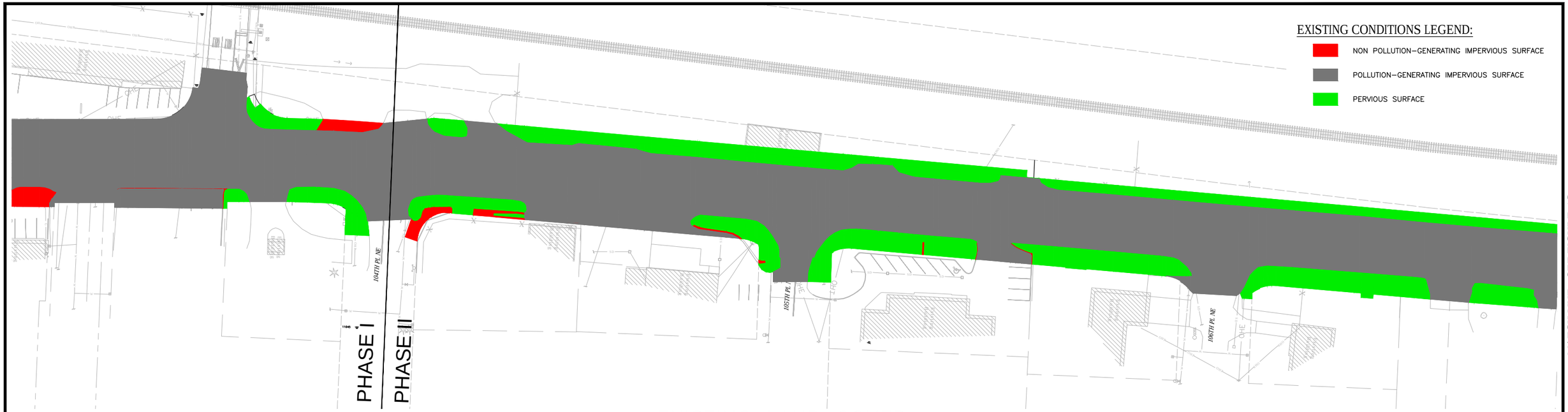
LAND COVER

FIGURE 4A–2

NOT FOR CONSTRUCTION

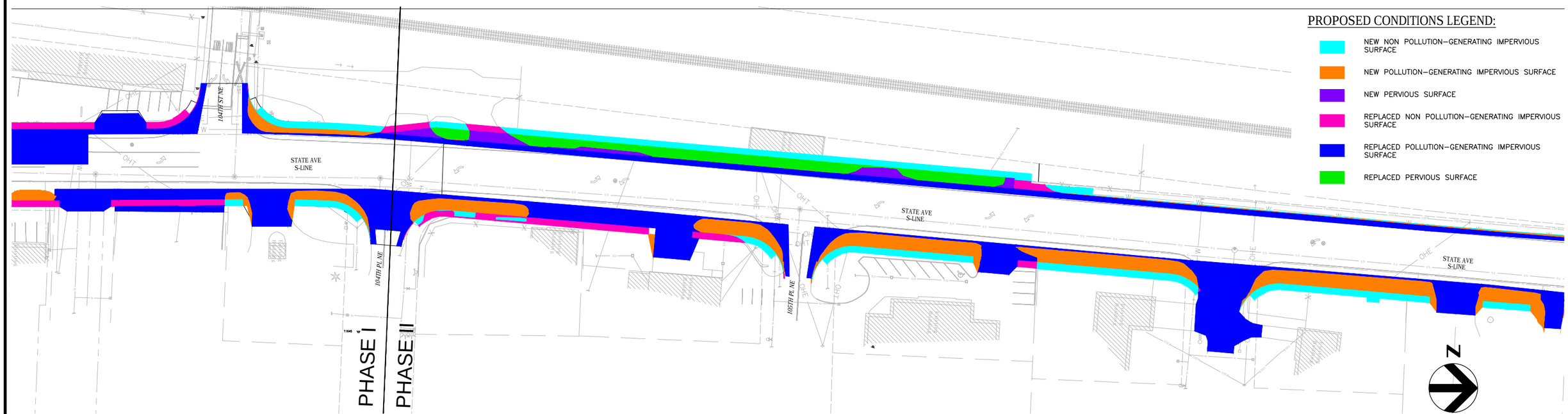
MATCH LINE - SEE FIGURE 4A

MATCH LINE - SEE FIGURE 4C



EXISTING LAND COVER

MATCH LINE - SEE FIGURE 4A-2



PROPOSED LAND COVER

CITY OF Marysville WASHINGTON

HDR

LINE IS 1 INCH AT FULL SIZE
(IF NOT 1" - SCALE ACCORDINGLY)

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT
(100TH STREET NE TO 116TH STREET NE)

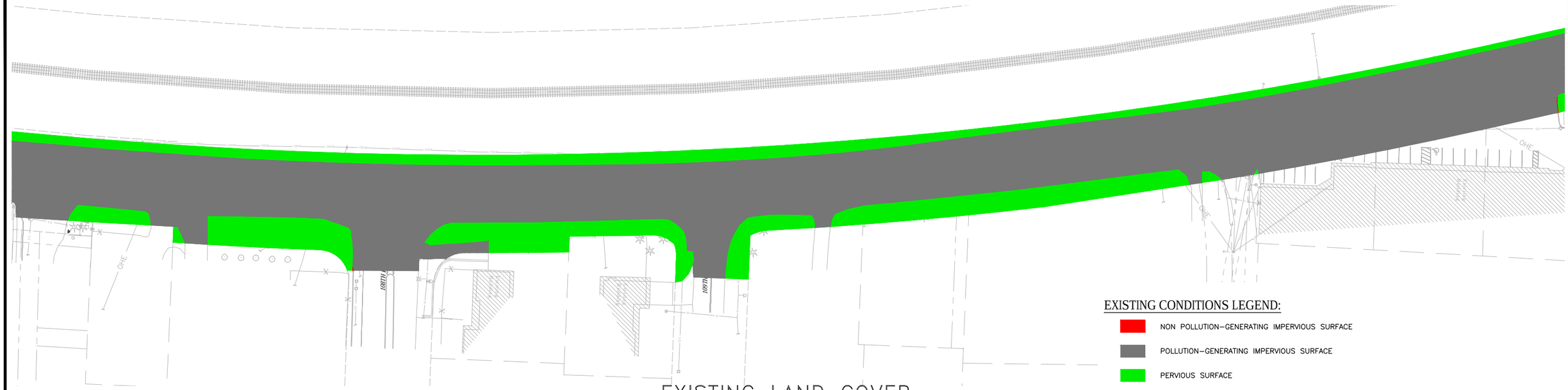
LAND COVER

FIGURE 4B

NOT FOR CONSTRUCTION

MATCH LINE - SEE FIGURE 4B

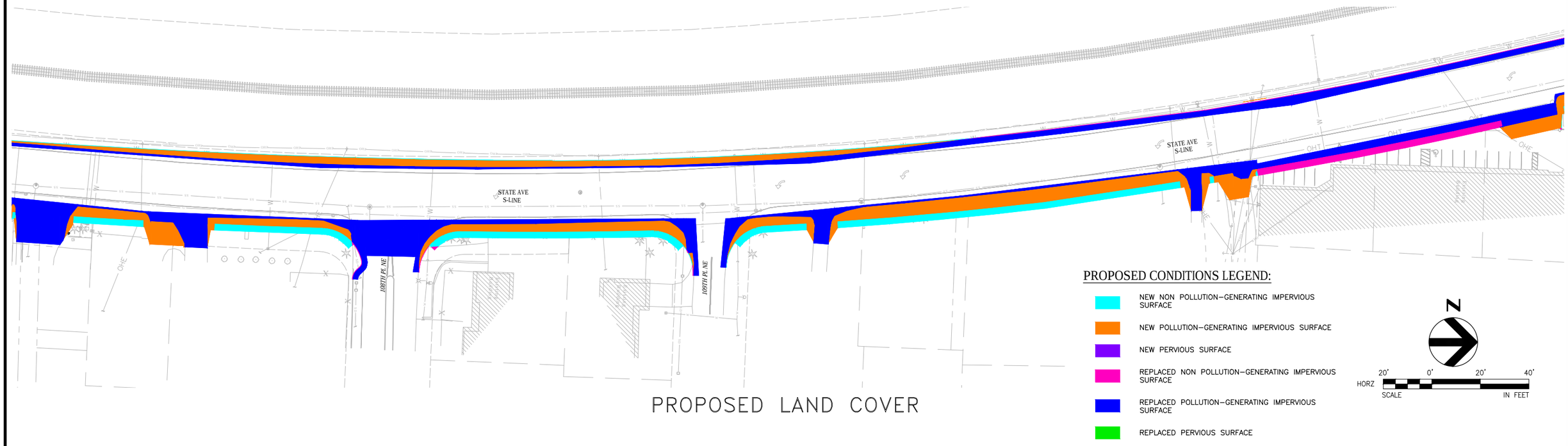
MATCH LINE - SEE FIGURE 4D



EXISTING LAND COVER

MATCH LINE - SEE FIGURE 4B

MATCH LINE - SEE FIGURE 4D



PROPOSED LAND COVER

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT
(100TH STREET NE TO 116TH STREET NE)

LAND COVER

LINE IS 1 INCH
AT FULL SIZE
(IF NOT 1" - SCALE ACCORDINGLY)

FIGURE
4C

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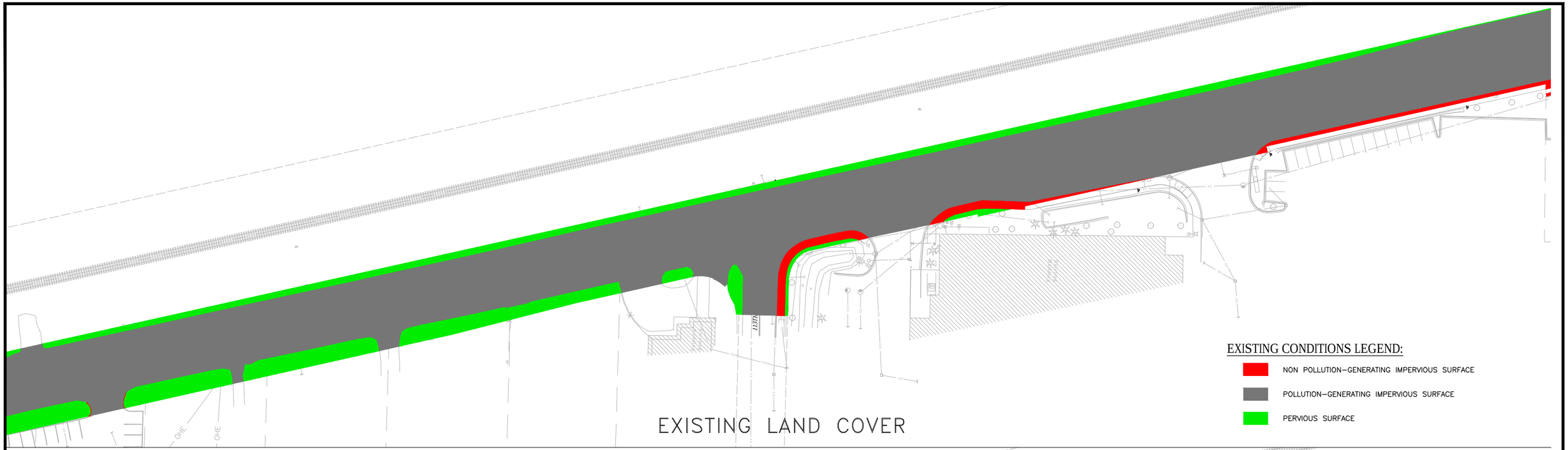
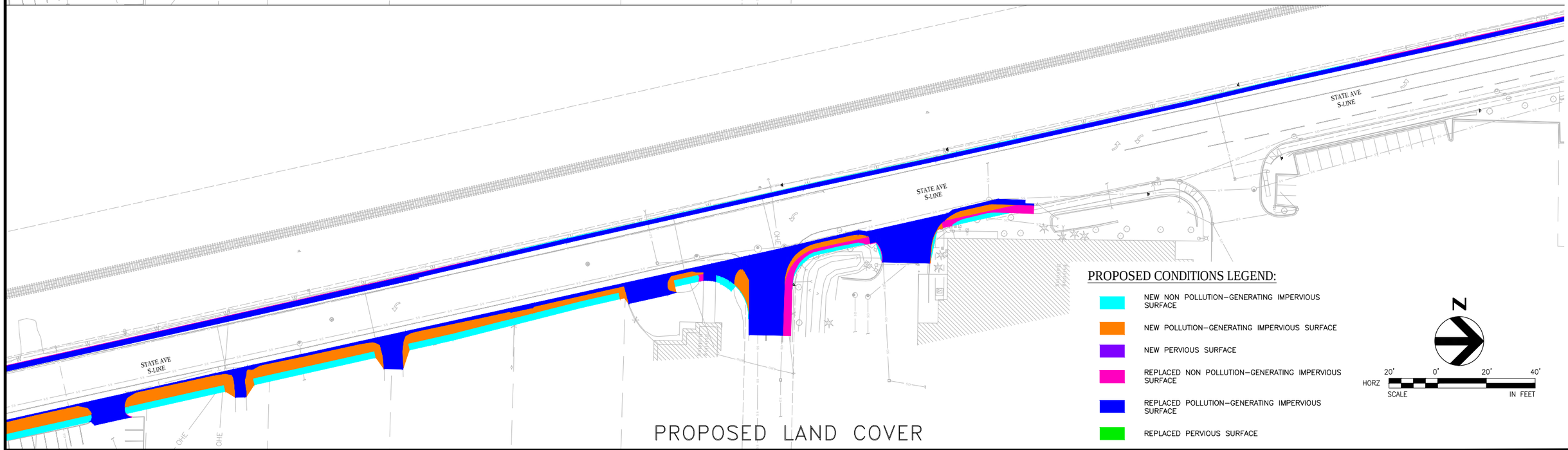
MATCH LINE - SEE FIGURE 4C



EXISTING LAND COVER

MATCH LINE - SEE FIGURE 4C



PROPOSED LAND COVER

CITY OF Marysville WASHINGTON

HDR

LINE IS 1 INCH
AT FULL SIZE
(IF NOT 1" - SCALE ACCORDINGLY)

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT
(100TH STREET NE TO 116TH STREET NE)

LAND COVER

FIGURE 4D

4.2 Minimum Requirement Applicability

The minimum requirements (MRs) are evaluated based on the assessment of the changes in land coverage and land disturbing activity provided in Table 2 above. The table provides the total amount of new and replaced impervious surfaces and converted pervious surfaces for the project. “Replaced impervious surface” is defined as the removal and replacement of impervious surfaces down to the foundation for structures, or the removal down to bare soil, or base course, and replacement of the surfaces. “Converted pervious surface” is defined as the conversion of existing pervious surface to a pervious surface that would increase the stormwater runoff characteristics of the surface (i.e., converting forest to pasture, pasture to landscape, etc.).

Based on the criteria provided in the 2014 Ecology Manual, this project is classified as “redevelopment” because the site has greater than 35 percent of existing impervious coverage.

Further, because the project results in 2,000 square feet, or more, of new plus replaced hard surface area; Minimum Requirements 1 through 5 apply to the new and replaced hard surfaces and land disturbing areas. Minimum Requirements 1—5 are:

Minimum Requirement 1 - Preparation of Stormwater Site Plans. All projects meeting the thresholds in Section 4.1 shall prepare a Stormwater Site Plan for review. Stormwater Site Plans shall use site-appropriate development principles, as required and encouraged City of Marysville Codes, to retain native vegetation and minimize impervious surfaces to the extent feasible.

Minimum Requirement 2: Construction Pollution Prevention. Since site disturbance is greater than 2,000 SF, a construction stormwater pollution prevention plan (CSWPP) will be prepared to prevent erosion and discharge of sediment and other pollutants into the storm drainage system on the site.

Minimum Requirement 3 - Source Control of Pollution. All known, available and reasonable Source Control BMPs shall be applied to all projects. Source Control BMPs shall be selected, designed, and maintained according to the DOE Manual. These BMPs are described in Section 2.1.9 of the CSWPPP.

Minimum Requirement 4 - Preservation of Natural Drainage Systems and Outfalls. Natural drainage patterns shall be maintained and discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and down-gradient properties. All outfalls require energy dissipation.

Minimum Requirement 5 - On-site Stormwater Management. Projects shall employ On-site stormwater Management BMPs in accordance with the following projects thresholds, standards, and lists to infiltrate, disperse, and retain stormwater runoff on-site to the extent feasible without causing flooding or erosion impacts.

Because the project is a road related project and results in more than 5,000 square feet of new hard surfaces, but does not add 50 percent more to the existing hard surfaces within the project limits, Minimum Requirements 6 through 9 apply to new hard surfaces and converted vegetation areas, but not to the replaced hard surfaces.

Minimum Requirements 6—9, applicable only to the new hard surface areas, are:

Minimum Requirement #6: Runoff Treatment. The following require construction of stormwater treatment facilities:

- Projects in which the total of, pollution-generating hard surface (PGHS) is 5,000 square feet or more in a threshold discharge area of the project, or
- Projects in which the total of pollution-generating pervious surfaces (PGPS) – not including permeable pavements – is three-quarters (3/4) of an acre or more in a threshold discharge area, and from which there will be a surface discharge in a natural or man-made conveyance system from the site.

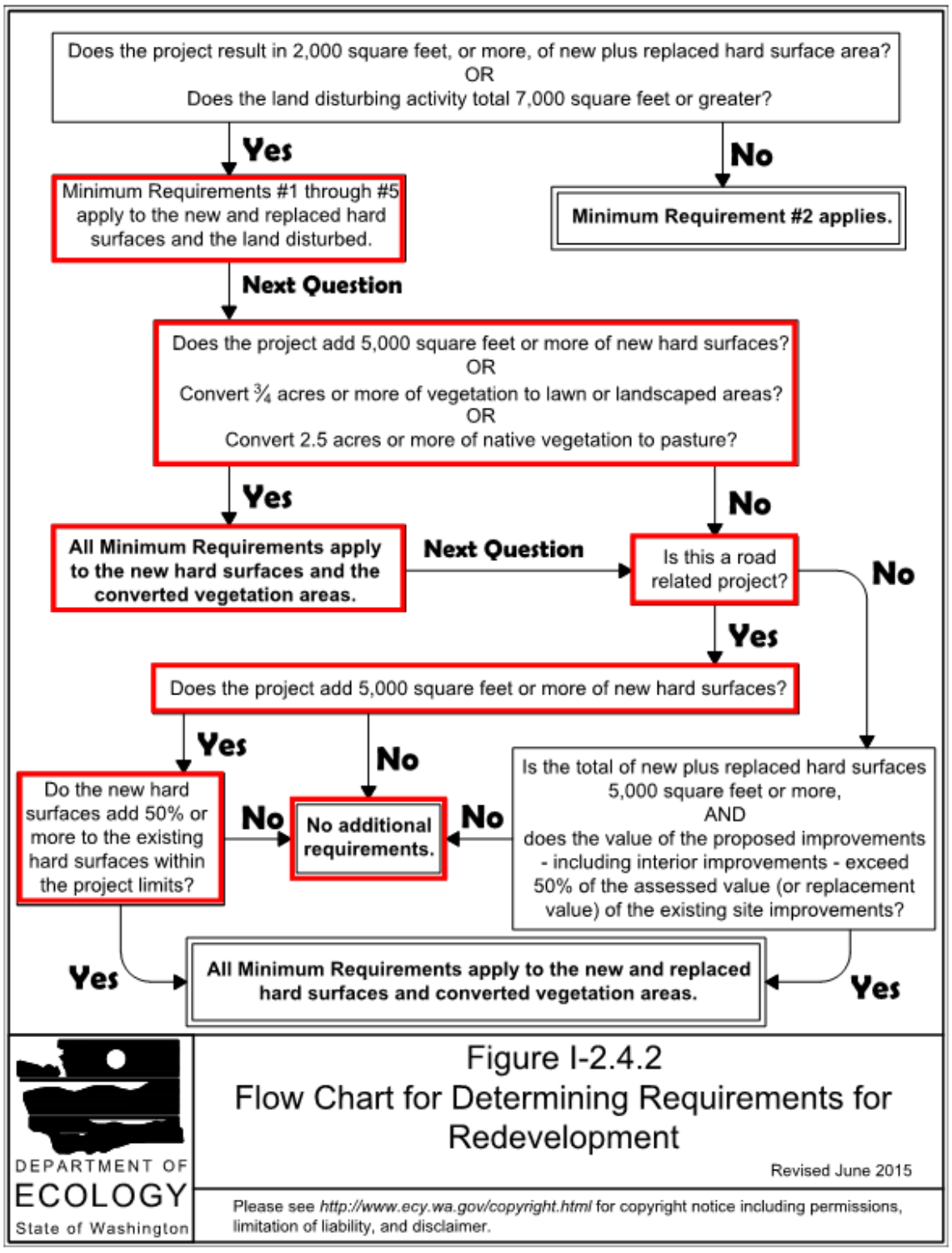
Minimum Requirement #7: Flow Control. Projects must provide flow control to reduce the impacts of stormwater runoff from hard surfaces and land cover conversions. The requirement below applies to projects that discharge stormwater directly, or indirectly through a conveyance system, into a fresh waterbody.

Minimum Requirement #8: Wetlands Protection. All projects whose stormwater discharges into a wetland, either directly or indirectly through a conveyance system must provide wetlands protection. Before discharging to Quilceda Creek, the stormwater generated by the project at the south end of the project must flow through a Category II wetland; therefore protection must be employed to ensure the wetlands receive the same level of protection as any other waters of the state. The thresholds identified in MR 6 and MR 7 shall also be applied to determine the applicability of this requirement to discharges to wetlands.

Minimum Requirement #9: Operation and Maintenance. An operation and maintenance manual that is consistent with the provisions in Volume V shall be provided for proposed stormwater facilities and BMPs, and the party (or parties) responsible for maintenance and operation shall be identified. At private facilities, a copy of the operation and maintenance manual shall be retained on-site or within reasonable access to the site, and shall be transferred with the property to the new owner. For public facilities, a copy of the operation and maintenance manual shall be retained in the appropriate department. A log of maintenance activity that indicates what actions were taken shall be kept and be available for inspection by the local government.

Referring to Table 2, the project will add approximately 0.48 acres of new non-pollution generating impervious surface and 1.13 acres of new pollution generating impervious surface, for a total of 1.61 acres of new impervious surface. The flow chart used to assess the MRs for redevelopment roadway-related projects (Figure I-2.4.2 in the 2014 Ecology Manual) is provided in Figure 5 below.

Figure 5: Minimum Requirements Flow Chart



4.3 Performance Goals and Standards

This section summarizes the performance goals and standards for MR 5: On-Site Stormwater Management, MR 6: Runoff Treatment, and MR 7: Flow Control that were used to evaluate the permanent stormwater management BMPs, which are based on the 2014 Ecology Manual and described in the following sections.

4.3.1 MR 5 (On-Site Stormwater Management)

Given that TDA 1 triggers MR 5, the drainage design must meet the on-site stormwater management requirements for projects classified as Redevelopment within the Urban Growth Area (UGA), see Section I-2.5.5 in the 2014 Ecology Manual. Accordingly, the project is required to meet the Low Impact Development Performance Standard and T5.13: Post Construction Soil Quality and Depth; or List #2. The Low Impact Development Performance Standard requires stormwater discharge to match developed discharge durations to pre-developed durations for the range of pre-developed discharge rates from 8 percent of the 2-year peak flow to 50 percent of the 2-year peak flow. List #2 BMPs are listed below in order of precedence:

Lawn and Landscape:

- Post-Construction Soil Quality and Depth in accordance with BMP T5.13: Post-Construction Soil Quality and Depth

Roofs:

- Full Dispersion in accordance with BMP T5.30: Fill Dispersion, or Downspout Full Infiltration Systems in accordance with BMP T5.10A: Downspout Full Infiltration
- Bioretention facilities that have a minimum horizontally projected surface area below the overflow which is at least five percent of the total surface area draining to it
- Downspout Dispersion Systems in accordance with BMP T5.10B: Downspout Dispersion Systems
- Perforated Stub-Out Connections in accordance with BMP T5.10C: Perforated Stub-out Connections

Other Hard Surfaces:

- Full Dispersion in accordance with BMP T5.30: Full Dispersion
- Permeable Pavement in accordance with BMP T5.15: Permeable Pavements
- Bioretention BMPs that have a minimum horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it
- Sheet Flow Dispersion in accordance with BMP T5.12: Sheet Flow Dispersion, or Concentrated Flow Dispersion in accordance with BMP T5.11: Concentrated Flow Dispersion

4.3.2 MR 6 (Runoff Treatment)

Water quality BMPs designed to meet MR 6 must be sized in accordance with the criteria set forth in Volume V of the 2014 Ecology Manual. The criteria require water quality BMPs preceding detention, or when detention is not required, to treat the flow rate at or below which 91 percent of the runoff volume, as estimated by an approved continuous runoff model. For this project, MGSFlood (version 4.46), which is an approved continuous simulation model, was used to size the water quality BMPs. An extended precipitation time series for Puget Sound East region with a mean annual precipitation of 40 inches and a 15-minute computational time step was used.

According to Marysville Municipal Code Section 14.15.040, Enhanced Treatment is required for High annual daily traffic (AADT) roads as follows: Fully controlled and partially controlled limited access highways with AADT count of 15,000 or more and all other roads with an AADT of 7,500 or greater. State Avenue has an Average Daily Traffic (ADT) count of less than 7,500; therefore the project is required to provide basic level treatment (80 percent removal of total suspended solids) for all new and replaced PGIS prior to discharging to leaving the site.

4.3.3 MR 7 (Flow Control)

Flow control facilities designed to meet MR 7 must be sized using an approved continuous hydrologic model to achieve the Standard Flow Control Requirement in accordance with Volume 1 Section I-2.5.7 of the 2014 Ecology Manual. The Standard states that stormwater discharges from the site shall match developed discharge durations to pre-developed durations for the range of discharge rates from 50 percent of the two-year peak flow, up to the full 50-year flow. The pre-developed conditions were assessed based on forested land cover.

The MGSFlood continuous simulation model was used with an extended precipitation time series for Puget Sound East with a mean annual precipitation of 40 inches and a 15-minute computational time step.

4.3.4 MR 8 (Wetlands Protection)

Projects shall comply with Guide Sheets #1 through #3 in Appendix 1-D: Guidelines for Wetlands when Managing Stormwater, in Chapter I Section 2.5.8 in the 2014 Ecology Manual. The hydraulic analysis shall use the exiting land cover condition to determine the existing hydrologic conditions unless directed otherwise by a regulatory agency with jurisdiction.

Proposed Permanent Stormwater Best Management Practices

This section provides a detailed description of the proposed permanent stormwater BMPs (i.e., on-site stormwater management, runoff treatment, and flow control) that have been incorporated in the design to manage the stormwater runoff from the site and satisfy the MRs based on the performance goals and standards discussed above.

4.4.1 On-Site Stormwater Management Evaluation and Selection

The proposed BMPs from List #2 used to satisfy MR 5 are described below.

Lawn and Landscape:

- Post-Construction Soil Quality and Depth – This BMP will be used to the extent feasible in accordance with BMP T5.13: Post-Construction Soil Quality and Depth.

Roofs: There are no roofs associated with this project; therefore, BMPs intended for stormwater runoff from roofs will not be implemented.

Other Hard Surfaces:

- Full Dispersion - This BMP is not feasible because there is not adequate space to meet the 100-foot minimum vegetated flow path requirements on this site.
- Permeable Pavement – This BMP is not feasible due to ROW constraints.
- Bioretention - This BMP is not feasible because there is not adequate space for bioretention due to the existing developed condition of the project.
- Sheet Flow Dispersion - This BMP is not feasible because there is not adequate space to meet the 100-foot minimum vegetated flow path requirements on this site.

As an alternative, the proposed drainage design includes infiltration galleries along the corridor, where feasible. The infiltration galleries manage the stormwater runoff on-site, near the runoff generating surfaces to reduce the amount of disruption of the natural hydrologic characteristics of the site. The project analyzed multiple types of infiltration options for treating stormwater. The Phase II project includes infiltration galleries to treat 100% of the water through infiltration. The Phase I project, however, only utilizes one infiltration gallery and is not able to utilize infiltration galleries or other types of infiltration further south on the Phase I project. The reason for not being able to use infiltration galleries is twofold. One is that the surrounding properties are often just below the roadway elevation. Infiltrating water via permeable sidewalks would risk water moving through the granular subgrade material and onto the private properties. This is not acceptable from a ROW viewpoint. The option to utilize more infiltration galleries was also explored but was not carried forward due to ROW constraints. The galleries need space for maintenance access and placing them in the roadway was decided to not be an option due to access restrictions. Further to the south around the bridge and creek area, infiltration is not possible via either method due to the characteristics of the creek and the steep embankments on either side. Thus, a cast in place settling wetpond was selected for stormwater treatment.

4.4.2 Runoff Treatment

TDA 1 triggers MR 6 and is therefore required to provide basic treatment of the stormwater runoff from all the new PGIS, approximately 49,072 square feet. A wetpond will be used to meet the requirements for basic treatment. This facility will be constructed on the City owned parcel north of Quilceda Creek, west of State Avenue. Specific design parameters for the wetpond are discussed in more detail in Section 4.5. The wetpond will be constructed as a part of Phase I.

Pretreatment will be provided before each of the infiltration facilities to reduce maintenance and increase the lifespan of the systems.

4.4.3 Flow Control Facilities

TDA 1 is required to provide flow control to meet the Standard Flow Control Requirements, which require the discharges from the site to match developed discharge durations to pre-developed durations for the range of discharge rates, from 50 percent of the two-year peak flow up to the full 50-year flow. Meeting the flow control requirements reduces the impacts of stormwater runoff from all new impervious surfaces prior to discharging to the downstream system.

Flow control is required for approximately 69,848 square feet and will be provided by infiltration galleries constructed along the State Avenue corridor. One infiltration gallery will be installed as a part of Phase I and ten additional infiltration galleries will be installed as a part of Phase II. Stormwater runoff in excess of a 50-year recurrence interval event that does not infiltrate will sheet flow into the roadway drainage system and into the succeeding downstream infiltration gallery. In the extreme event that multiple facilities no longer infiltrate, the stormwater runoff will be routed through the roadway drainage system that conveys runoff through the wetpond overflow structure and discharged to Quilceda Creek.

The design parameters used to size the infiltration galleries are discussed in more detail in Section 4.5.

4.4.4 Wetlands Protection

A portion of stormwater runoff from the project site flows through a Category II wetland before discharging to Quilceda Creek; therefore, the project shall comply with Guide Sheets #1 through #3 in Appendix 1-D: Guidelines for Wetlands when Managing Stormwater, in Chapter I Section 2.5.8 in the 2014 Ecology Manual.

- Guide Sheet 1: Criteria that excludes wetlands from serving as a treatment or flow control BMP/Facility – The wetland will not serve as a treatment or flow control BMP/facility; therefore Guide Sheet 1 does not apply to the project.
- Guide Sheet 2: Criteria for including wetlands as a treatment or flow control BMP/facility – The wetland will not be physically or hydrologically altered to meet the requirements of a treatment or flow control BMP/facility; therefore, Guide Sheet 2 does not apply to the project.
- Guide Sheet 3: Wetland protection guidelines
    - Guide Sheet 3A: General guidelines for protecting functions and values of wetlands – The project will follow the general guidelines of Guide Sheet 3A. An engineered energy dissipator will be constructed to diffuse the flow before entering the wetland. The areas of native vegetation will be maintained, while soil compaction and introduction of exotic plant species will be avoided.
    - Guide Sheet 3B: Protecting wetlands from impacts of changes in water flows – The project must satisfy one of two criteria: 1) total volume of water into a wetland during a single precipitation event should not be more than 20% higher or lower than the pre-project volumes, or 2) total volume of water into a wetland on a monthly basis should not be more than 15% higher or lower than pre-project

volumes. As illustrated in the Wetpond Wetland Analysis MGSflood output file (Appendix B), criteria 1 and 2 shall be satisfied.

- Guide Sheet 3C: Guidelines for protecting wetlands from pollutants – Guidelines in Guide Sheet 3C will be followed by implementing basic water quality treatment and an engineered energy dissipator and outfall protection and the proposed outfall.

4.5 Sizing and Performance Evaluations

4.5.1 Wetpond

The proposed wetpond was sized to provide basic water quality for TDA 1 in order to meet the performance requirements discussed in Section 4.3.

The tributary area to the wetpond is approximately 78,331 square feet (1.80 acres), which exceeds the required area of 49,072 (1.13 acres) to satisfy MR 6. Modeling this area in MGSFlood produced a required wetpond volume of 7,973 cubic feet. Model inputs are presented below in Table 5.

Table 5: Wetpond Sizing Modeling Parameters

Modeling Scenario	Tributary Area (Acres/Square Feet)			
	Till Forest	Till Grass	Impervious	Total
Pre-Developed	1.80/78,331	0	0	1.80/78,331
Developed	0	0	1.80/78,331	1.80/78,331

In accordance with Volume V, Section 10 of the 2014 Ecology Manual, the wetpond was sized with two cells separated by a berm submerged one-foot below the water quality water surface. The design water quality water surface provides a live storage depth of four feet, the required minimum pool depth. One foot of sediment storage and one foot of freeboard were provided, producing a total pond depth of seven feet. The dimensions of the two pond cells and total provided volume are shown below in Table 6. The Tributary Areas Map and MGSFlood modeling report are provided in Appendix A and Appendix B, respectively.

Table 6: Wetpond Dimensions and Volume

Cell 1				Required Volume (cf)
Length (ft)	Width (ft)	Live Storage Depth (ft)	Volume (cf)	7,973
19	26	4	1,976	
Cell 2				**Total Volume Provided (cf)**
Length (ft)	Width (ft)	Live Storage Depth (ft)	Volume (cf)	8,008
58	26	4	6,032	

4.5.2 Infiltration Galleries

Eleven infiltration galleries were sized to provide flow control for TDA 1 in order to meet the performance requirements discussed in Section 4.3. The infiltration galleries are comprised of a hallow chamber surrounded by aggregate stone with 40 percent porosity. The foundation stone and chamber are separated by a woven geotextile layer. The infiltration galleries were modeled in MGSFlood with an infiltration rate of four inches per hour based on the geotechnical recommendations as discussed in Section 2.3. The modeling results indicate that all elven infiltration galleries will infiltrate 100 percent of the stormwater runoff from the associated contributing areas. The infiltration gallery modeling parameters and required storage volumes are provided in Table 7. The Tributary Areas Map and MGSFlood modeling report are provided in Appendix A and Appendix C, respectively.

Table 7: Infiltration Gallery Modeling Parameters and Required Storage Volume

Infiltration Gallery	Tributary Area (acres)			Required Storage Volume (cf)	Percent Infiltrated
	Till Forest	Till Grass	Impervious		
1	0	0	0.50	1667	100
2	0	0	0.60	1995	100
3	0	0	0.10	265	100
4	0	0	0.10	265	100
5	0	0	0.10	265	100
6	0	0	0.10	265	100
7	0	0	0.45	1503	100
8	0	0	0.58	1940	100
9	0	0	0.60	2282	100
10	0	0	1.90	2676	100
11	0	0	0.45	1503	100

Flow control will be provided for approximately 238,709 square feet (5.48 acres), which exceeds the required area of 69,848 square feet to satisfy MR 7. Pretreatment will be provided before each of the infiltration facilities to reduce maintenance and increase the lifespan of the systems.

Conveyance System Analysis

A hydrologic and hydraulic evaluation of the proposed conveyance system was conducted to verify that the proposed system design was in compliance with the 2016 City of Marysville Engineering Design and Development Standards. Specifically, these standards require that stormwater conveyance systems on a major stream or creek as determined by the Public Works Director or Designee be designed to safely collect and convey the runoff generated from the 100-year recurrence interval storm. The project is along Quilceda Creek and will therefore be designed to these standards. The conveyance system was evaluated using Washington State Department of Transportation (WSDOT) Storm Drain Design worksheet.

The analysis includes the mainline conveyance pipes and structures within the system. Lateral structures and crossings were not included. Instead, the assumption that the flow for the run enters the storm drainage at the upstream end of the run being analyzed was used to produce conservative results. The analysis was split into nine segments, extending from 113th Place NE to Quilceda Creek. The specific model boundaries are shown in figures provided in Appendix D.

4.6.1 Hydrology

The WSDOT Storm Drain Design worksheet uses the rational method, as described in the WSDOT Hydraulics Manual. Selection of the input data utilized for the application of this worksheet is discussed below.

Necessary inputs for the Storm Drain Design worksheet include drainage area, runoff coefficient, time of concentration, and contributing inflow, and the 'm' and 'n' dimensionless coefficients used to calculate rainfall intensity. Subbasin drainage areas were delineated for both the project area and the off-site area observed to contribute flows to the proposed conveyance system. Subbasin boundaries were established based on review of the available topographic data provided by the survey. The runoff coefficient was selected from Figure 2-5.2 in the WSDOT Hydraulics Manual. A value of 0.9 corresponding to pavement and roof land cover was selected for all runs, as the contributing areas are all impervious. The minimum required time of concentration, five minutes, and no contributing flow were selected to provide conservative results. Instead, it was assumed the flow enters the run at the upstream end of the run being analyzed. Coefficients 'm' and 'n' were selected from Figure 2-5.4A in the WSDOT Hydraulics Manual. 10.07 (m) and 0.586 (n) for the 100-year recurrence for the City of Everett were chosen because Everett is the largest city near Marysville containing coefficients provided in the manual. With these parameters, the worksheet calculated rainfall intensity, runoff, and total flow. Results are provided in Appendix D.

4.6.2 Hydraulics

As discussed previously, all main conveyance system elements were analyzed within the hydraulic component of the worksheet. Input data for pipes consisted of diameter, upstream invert elevation, downstream invert elevation, and length. The worksheet calculated slope with the invert elevation and length. Input data for structures consisted of ground (rim) elevation. All data described above was extracted from the design drawings.

Hydraulic analysis in the worksheet used Manning's roughness, n, value of 0.011 for pipes of polyvinyl chloride (PVC). These values were derived from Appendix 4-1 Manning's Roughness Coefficients (n), provided in the WSDOT Hydraulics Manual.

All structures were spaced according to the spacing requirements provided in Chapter 4 of the 2016 City of Marysville Engineering Design and Development Standards and with a gutter spread less than five feet, calculated using the WSDOT Inlet Spacing spreadsheet.

4.6.3 Results and Conclusions

Based on the results, it is concluded that the proposed 12-inch and 18-inch conveyance system has adequate capacity to accommodate the stormwater runoff from a 100-year recurrence interval event as required by the City. Results of the spreadsheet are provided in Appendix D.

5.0 Off-Site Capacity Analysis

The proposed drainage system discharges to Quilceda Creek in a similar manner as the existing system. Water quality treatment, flow control, and outfall protection are being provided as a part of the project to ensure the proposed system will not negatively impact the creek. The proposed facilities have been designed so conveyance capacity issues, localized flooding, upland erosion impacts and stream channel erosion should not occur.

6.0 Operations and Maintenance Manual

All inspection, maintenance, and operations shall be completed in accordance with City ordinances and codes, and in accordance with the 2014 Ecology Manual. Maintenance and operations practices for the BMP's prescribed in this report can be found in Appendix E.

7.0 Construction Stormwater Pollution Prevention Plan

Formal CSWPPPs for Phase 1 and Phase 2 have been prepared and submitted as separate documents. Temporary erosion and sediment control (TESC) plans are included in the plans.

8.0 References

City of Marysville 2016. City of Marysville Engineering Design and Development Standards. December 2016.

Ecology 2014. Washington Department of Ecology (Ecology), 2014. *Stormwater Management Manual for Western Washington*, *as Amended in December 2014,* Volumes I – V, Final. December 2014.

Shannon and Wilson, Inc. 2017. Geotechnical Engineering Report City of Marysville State Avenue Corridor Widening Project. November 2017.

Washington State Department of Transportation 2017. *Hydraulics Manual.* March 2017.

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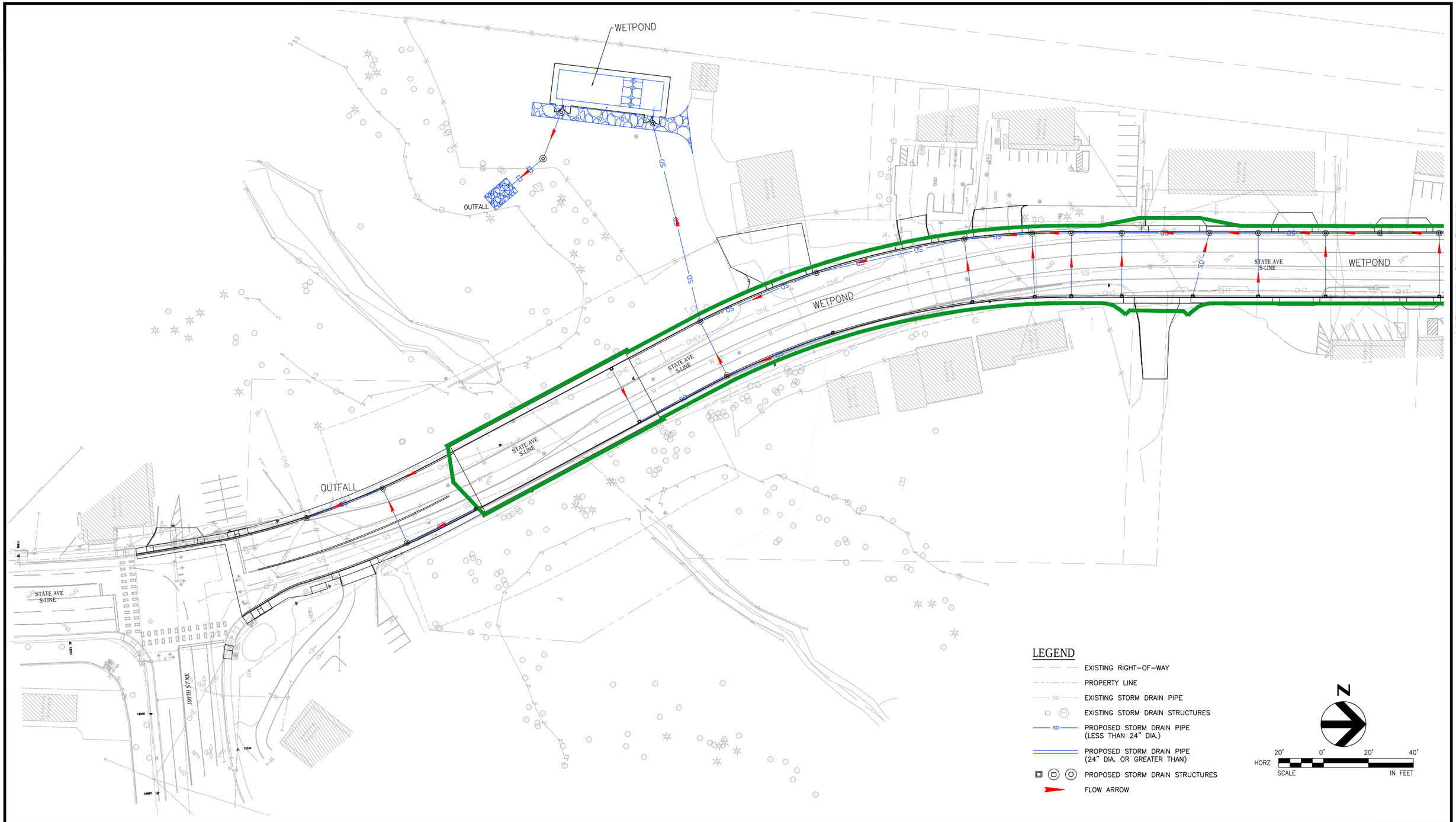
APPENDIX A

TRIBUTARY AREAS MAP FOR FLOW CONTROL AND WATER QUALITY TREATMENT FACILITIES

NOT FOR CONSTRUCTION



MATCH LINE - SEE FIGURE B

LEGEND

- EXISTING RIGHT-OF-WAY
- PROPERTY LINE
- EXISTING STORM DRAIN PIPE
- EXISTING STORM DRAIN STRUCTURES
- PROPOSED STORM DRAIN PIPE (LESS THAN 24" DIA.)
- PROPOSED STORM DRAIN PIPE (24" DIA. OR GREATER THAN)
- PROPOSED STORM DRAIN STRUCTURES
- FLOW ARROW

N

HORZ SCALE: 20' 0' 20' 40' IN FEET

CITY OF Marysville WASHINGTON

HDR

LINE IS 1 INCH AT FULL SIZE
(IF NOT 1"- SCALE ACCORDINGLY)

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT (100TH STREET NE TO 116TH STREET NE)

TRIBUTARY AREAS MAP

A

NOT FOR CONSTRUCTION

MATCH LINE - SEE FIGURE A

MATCH LINE - SEE ABOVE

MATCH LINE - SEE FIGURE C

INFILTRATION GALLERY 1
INFILTRATION GALLERY 2
INFILTRATION GALLERY 3
INFILTRATION GALLERY 4
INFILTRATION GALLERY 5
INFILTRATION GALLERY 6
INFILTRATION GALLERY 7
INFILTRATION GALLERY 8
INFILTRATION GALLERY 9
INFILTRATION GALLERY 10
WETPOND
STATE AVE S-LINE
104TH ST NE
104TH PL NE
107TH PL NE
108TH PL NE
109TH PL NE
110TH PL NE
SEQUOIA PLACE CONDOMINIUM
WILHELMI DALE E
WILHELMI DANA
VAZQUEZ ALFONSO
SMITH MICHAEL K & BILLIE B
MORENO ALFONSO M
WILEY FLORENCE M
MICKELSON ELMER & VAL
PAYNE R GREGORY

LEGEND

- EXISTING RIGHT-OF-WAY
- PROPERTY LINE
- SD — EXISTING STORM DRAIN PIPE
- EXISTING STORM DRAIN STRUCTURES
- SD — PROPOSED STORM DRAIN PIPE (LESS THAN 24" DIA.)
- PROPOSED STORM DRAIN PIPE (24" DIA. OR GREATER THAN)
- PROPOSED STORM DRAIN STRUCTURES
- FLOW ARROW

N

HORZ SCALE: 20' 0' 20' 40' IN FEET

CITY OF Marysville WASHINGTON

HDR

LINE IS 1 INCH AT FULL SIZE
(IF NOT 1" - SCALE ACCORDINGLY)

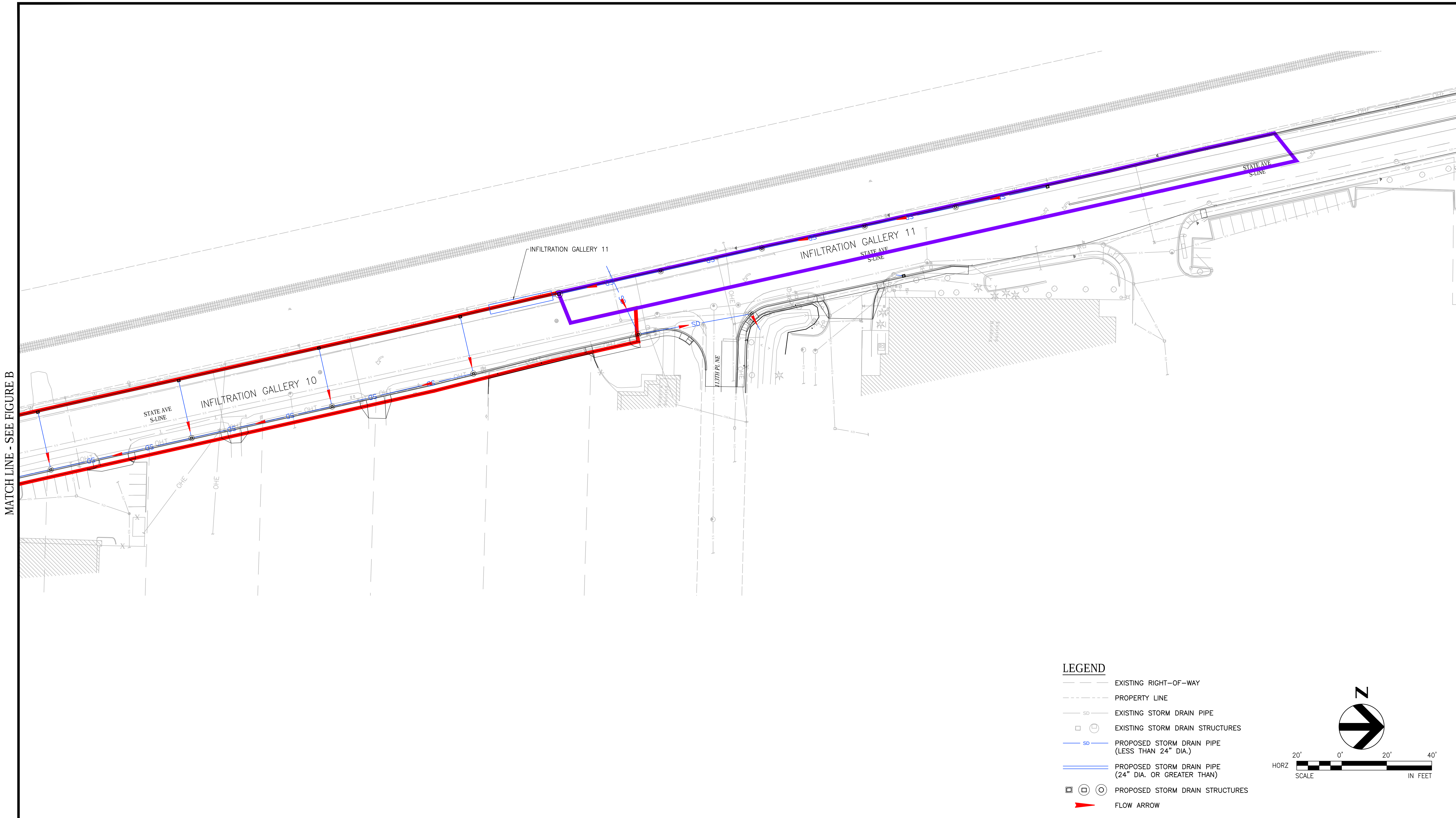
CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT
(100TH STREET NE TO 116TH STREET NE)

TRIBUTARY AREAS MAP

B

NOT FOR CONSTRUCTION



CITY OF Marysville WASHINGTON

HDR

LINE IS 1 INCH AT FULL SIZE (IF NOT 1" - SCALE ACCORDINGLY)

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT (100TH STREET NE TO 116TH STREET NE)

TRIBUTARY AREAS MAP

C

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APPENDIX B
WETPOND MGSFLOOD REPORT

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.46
Program License Number: 200510004
Project Simulation Performed on: 08/28/2018 9:14 PM
Report Generation Date: 08/28/2018 9:15 PM

Input File Name: 180706_COM State Ave_Wetpond_V2.fld
Project Name: Marysville State Ave
Analysis Title: Wetpond 60%
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	1.800	1.800
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	1.800	1.800

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	1.800
Subbasin Total	1.800

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	1.800
Subbasin Total	1.800

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Wetpond
Link Type: Structure
Downstream Link: None

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	105.00
Max Pond Elevation (ft)	:	105.50
Storage Depth (ft)	:	5.00
Pond Bottom Length (ft)	:	170.0
Pond Bottom Width (ft)	:	54.0
Pond Side Slopes (ft/ft)	:	L1= 0.00 L2= 0.00 W1= 0.00 W2= 0.00
Bottom Area (sq-ft)	:	9180.
Area at Riser Crest El (sq-ft)	:	9,180.
(acres)	:	0.211
Volume at Riser Crest (cu-ft)	:	45,900.
(ac-ft)	:	1.054
Area at Max Elevation (sq-ft)	:	9180.
(acres)	:	0.211
Vol at Max Elevation (cu-ft)	:	50,490.
(ac-ft)	:	1.159

Massmann Infiltration Option Used

Hydraulic Conductivity (in/hr)	: 0.00
Depth to Water Table (ft)	: 100.00
Bio-Fouling Potential	: Low
Maintenance	: Average or Better

Riser Geometry

Riser Structure Type	: Circular
Riser Diameter (in)	: 18.00
Common Length (ft)	: 0.020
Riser Crest Elevation	: 105.00 ft

Hydraulic Structure Geometry

Number of Devices: 2

---Device Number 1 ---
Device Type : Circular Orifice
Control Elevation (ft) : 100.00
Diameter (in) : 0.64
Orientation : Horizontal
Elbow : No

--- Device Number 2 ---
Device Type : Vertical Rectangular Orifice
Control Elevation (ft) : 102.96
Length (in) : 0.17
Height (in) : 24.53
Orientation : Vertical
Elbow : No

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

********** Link: Wetpond ********** Link WSEL Stats
WSEL Frequency Data(ft)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	WSEL Peak (ft)
1.05-Year	101.638
1.11-Year	101.841
1.25-Year	102.112
2.00-Year	102.698
3.33-Year	103.209
5-Year	103.570
10-Year	104.010
25-Year	104.327
50-Year	104.481
100-Year	104.580

**********Groundwater Recharge Summary **********
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Model Element	Total Predeveloped Recharge During Simulation Recharge Amount (ac-ft)

Subbasin: Subbasin 1	310.372
Total:	310.372

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	0.000
Link: Wetpond	0.000
Total:	0.000

Total Predevelopment Recharge is Greater than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 1.964 ac-ft/year, Post Developed: 0.000 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Wetpond **********

Basic Wet Pond Volume (91% Exceedance): 7973. cu-ft
Computed Large Wet Pond Volume, 1.5*Basic Volume: 11959. cu-ft

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 807.03
Inflow Volume Including PPT-Evap (ac-ft): 807.03
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 806.81
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: Wetpond

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)

2-Year	3.836E-02	2-Year	1.779E-02
5-Year	6.251E-02	5-Year	3.846E-02
10-Year	8.423E-02	10-Year	6.239E-02
25-Year	0.107	25-Year	8.283E-02
50-Year	0.136	50-Year	9.370E-02
100-Year	0.148	100-Year	0.101
200-Year	0.230	200-Year	0.102

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-23.8%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-14.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	5.1%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	8.2%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

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APPENDIX C

INFILTRATION FACILITY MGSFLOOD REPORT

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.46
Program License Number: 200510004
Project Simulation Performed on: 08/27/2018 9:41 PM
Report Generation Date: 08/27/2018 9:43 PM

Input File Name: COM State Ave 90 Per_Infiltration Gallery 01.fld
Project Name: Marysville State Ave
Analysis Title: Infiltration Gallery 1
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.500	0.500
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.500	0.500

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	0.500
Subbasin Total	0.500

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	0.500
Subbasin Total	0.500

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Infiltration Gallery 1
Link Type: Infiltration Trench
Downstream Link: None

Trench Type	:	Trench on Embankment Sideslope
Trench Length (ft)	:	61.00
Trench Width (ft)	:	8.42
Trench Depth (ft)	:	5.50
Trench Bottom Elev (ft)	:	100.00
Trench Rockfill Porosity (%)	:	59.00

Constant Infiltration Option Used
Infiltration Rate (in/hr): 4.00

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

**********Groundwater Recharge Summary **********
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Model Element	Total Predeveloped Recharge During Simulation Recharge Amount (ac-ft)
Subbasin: Subbasin 1	86.214

Total:	86.214

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	0.000
Link: Infiltration Gallery	224.174
Total:	224.174

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.546 ac-ft/year, Post Developed: 1.419 ac-ft/year

*************Water Quality Facility Data **************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Infiltration Gallery 1 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 224.17
Inflow Volume Including PPT-Evap (ac-ft): 224.17
Total Runoff Infiltrated (ac-ft): 224.17, 100.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 0.01
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: Infiltration Gallery 1

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.065E-02	2-Year	0.000
5-Year	1.737E-02	5-Year	0.000
10-Year	2.340E-02	10-Year	0.000
25-Year	2.967E-02	25-Year	0.000
50-Year	3.786E-02	50-Year	0.000

100-Year	4.103E-02	100-Year	5.790E-02
200-Year	6.386E-02	200-Year	6.142E-02

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-100.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-99.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-15.8%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

****** LID Duration Performance ******

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-100.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-100.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.46
Program License Number: 200510004
Project Simulation Performed on: 08/27/2018 9:47 PM
Report Generation Date: 08/27/2018 9:47 PM

Input File Name: COM State Ave 90 Per_Infiltration Gallery 02.fld
Project Name: Marysville State Ave
Analysis Title: Infiltration Gallery 2
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.600	0.600
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.600	0.600

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	0.600
Subbasin Total	0.600

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	0.600
Subbasin Total	0.600

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Infiltration Gallery 2
Link Type: Infiltration Trench
Downstream Link: None

Trench Type	:	Trench on Embankment Sideslope
Trench Length (ft)	:	73.00
Trench Width (ft)	:	8.42
Trench Depth (ft)	:	5.50
Trench Bottom Elev (ft)	:	100.00
Trench Rockfill Porosity (%)	:	59.00

Constant Infiltration Option Used
Infiltration Rate (in/hr): 4.00

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

**********Groundwater Recharge Summary **********
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Model Element	Total Predeveloped Recharge During Simulation Recharge Amount (ac-ft)
Subbasin: Subbasin 1	103.457

Total:	103.457

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	0.000
Link: Infiltration Gallery	269.009
Total:	269.009

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.655 ac-ft/year, Post Developed: 1.703 ac-ft/year

*************Water Quality Facility Data **************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Infiltration Gallery 2 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 269.01
Inflow Volume Including PPT-Evap (ac-ft): 269.01
Total Runoff Infiltrated (ac-ft): 269.01, 100.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 0.01
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: Infiltration Gallery 2

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.279E-02	2-Year	0.000
5-Year	2.084E-02	5-Year	0.000
10-Year	2.808E-02	10-Year	0.000
25-Year	3.560E-02	25-Year	0.000
50-Year	4.543E-02	50-Year	0.000

100-Year	4.923E-02	100-Year	6.983E-02
200-Year	7.663E-02	200-Year	7.702E-02

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-100.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-99.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-9.5%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

****** LID Duration Performance ******

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-100.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-100.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.46
Program License Number: 200510004
Project Simulation Performed on: 08/27/2018 9:54 PM
Report Generation Date: 08/27/2018 9:54 PM

Input File Name: COM State Ave 90 Per_Infiltration Gallery 03_06.fld
Project Name: Marysville State Ave
Analysis Title: Infiltration Galleries 3, 4 ,5, and 6
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.100	0.100
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.100	0.100

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	0.100
Subbasin Total	0.100

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	0.100
Subbasin Total	0.100

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Infiltration Galleries 3,4,5,6
Link Type: Infiltration Trench
Downstream Link: None

Trench Type	:	Trench on Embankment Sideslope
Trench Length (ft)	:	20.00
Trench Width (ft)	:	6.25
Trench Depth (ft)	:	3.75
Trench Bottom Elev (ft)	:	100.00
Trench Rockfill Porosity (%)	:	57.00

Constant Infiltration Option Used
Infiltration Rate (in/hr): 4.00

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

**********Groundwater Recharge Summary **********
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

	Total Predeveloped Recharge During Simulation
Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	17.243

Total:	17.243

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	0.000
Link: Infiltration Galleri	44.835
Total:	44.835

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.109 ac-ft/year, Post Developed: 0.284 ac-ft/year

*************Water Quality Facility Data **************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Infiltration Galleries 3,4,5,6 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 44.83
Inflow Volume Including PPT-Evap (ac-ft): 44.83
Total Runoff Infiltrated (ac-ft): 44.83, 100.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 0.00
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: Infiltration Galleries 3,4,5,6

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	2.131E-03	2-Year	0.000
5-Year	3.473E-03	5-Year	0.000
10-Year	4.680E-03	10-Year	0.000
25-Year	5.933E-03	25-Year	0.000
50-Year	7.572E-03	50-Year	0.000

100-Year	8.205E-03	100-Year	9.283E-03
200-Year	1.277E-02	200-Year	2.655E-02

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-100.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-99.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-15.8%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

****** LID Duration Performance ******

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-100.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-100.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.46
Program License Number: 200510004
Project Simulation Performed on: 08/27/2018 9:59 PM
Report Generation Date: 08/27/2018 9:59 PM

Input File Name: COM State Ave 90 Per_Infiltration Gallery 07.fld
Project Name: Marysville State Ave
Analysis Title: Infiltration Gallery 7
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.450	0.450
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.450	0.450

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	0.450
Subbasin Total	0.450

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	0.450
Subbasin Total	0.450

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Infiltration Gallery 7
Link Type: Infiltration Trench
Downstream Link: None

Trench Type	:	Trench on Embankment Sideslope
Trench Length (ft)	:	55.00
Trench Width (ft)	:	8.42
Trench Depth (ft)	:	5.50
Trench Bottom Elev (ft)	:	100.00
Trench Rockfill Porosity (%)	:	59.00

Constant Infiltration Option Used
Infiltration Rate (in/hr): 4.00

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

************Groundwater Recharge Summary **************
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Model Element	Total Predeveloped Recharge During Simulation Recharge Amount (ac-ft)
Subbasin: Subbasin 1	77.593

Total:	77.593

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	0.000
Link: Infiltration Gallery	201.757
Total:	201.757

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.491 ac-ft/year, Post Developed: 1.277 ac-ft/year

*************Water Quality Facility Data **************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Infiltration Gallery 7 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 201.76
Inflow Volume Including PPT-Evap (ac-ft): 201.76
Total Runoff Infiltrated (ac-ft): 201.76, 100.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 0.01
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: Infiltration Gallery 7

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	9.589E-03	2-Year	0.000
5-Year	1.563E-02	5-Year	0.000
10-Year	2.106E-02	10-Year	0.000
25-Year	2.670E-02	25-Year	0.000
50-Year	3.407E-02	50-Year	0.000

100-Year	3.692E-02	100-Year	6.724E-03
200-Year	5.747E-02	200-Year	3.775E-02

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-100.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-99.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-31.6%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

****** LID Duration Performance ******

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-100.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-100.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.46
Program License Number: 200510004
Project Simulation Performed on: 08/27/2018 10:02 PM
Report Generation Date: 08/27/2018 10:02 PM

Input File Name: COM State Ave 90 Per_Infiltration Gallery 08.fld
Project Name: Marysville State Ave
Analysis Title: Infiltration Gallery 8
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.580	0.580
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.580	0.580

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------
-------Area (Acres) --------
Till Forest 0.580

Subbasin Total 0.580

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	0.580
Subbasin Total	0.580

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Infiltration Gallery 8
Link Type: Infiltration Trench
Downstream Link: None

Trench Type	: Trench on Embankment Sideslope
Trench Length (ft)	: 71.00
Trench Width (ft)	: 8.42
Trench Depth (ft)	: 5.50
Trench Bottom Elev (ft)	: 100.00
Trench Rockfill Porosity (%)	: 59.00

Constant Infiltration Option Used
Infiltration Rate (in/hr): 4.00

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

**********Groundwater Recharge Summary **********
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

	Total Predeveloped Recharge During Simulation
Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	100.009

Total:	100.009

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	0.000
Link: Infiltration Gallery	260.042
Total:	260.042

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.633 ac-ft/year, Post Developed: 1.646 ac-ft/year

*************Water Quality Facility Data **************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Infiltration Gallery 8 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 260.04
Inflow Volume Including PPT-Evap (ac-ft): 260.04
Total Runoff Infiltrated (ac-ft): 260.04, 100.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 0.01
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: Infiltration Gallery 8

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.236E-02	2-Year	0.000
5-Year	2.014E-02	5-Year	0.000
10-Year	2.714E-02	10-Year	0.000
25-Year	3.441E-02	25-Year	0.000
50-Year	4.392E-02	50-Year	0.000

100-Year	4.759E-02	100-Year	0.000
200-Year	7.407E-02	200-Year	4.553E-02

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-100.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-99.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-31.6%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

****** LID Duration Performance ******

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-100.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-100.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.46
Program License Number: 200510004
Project Simulation Performed on: 08/27/2018 10:04 PM
Report Generation Date: 08/27/2018 10:04 PM

Input File Name: COM State Ave 90 Per_Infiltration Gallery 09.fld
Project Name: Marysville State Ave
Analysis Title: Infiltration Gallery 9
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.600	0.600
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.600	0.600

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	0.600
Subbasin Total	0.600

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	0.600
Subbasin Total	0.600

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Infiltration Gallery 9
Link Type: Infiltration Trench
Downstream Link: None

Trench Type	:	Trench on Embankment Sideslope
Trench Length (ft)	:	44.00
Trench Width (ft)	:	15.58
Trench Depth (ft)	:	5.50
Trench Bottom Elev (ft)	:	100.00
Trench Rockfill Porosity (%)	:	61.00

Constant Infiltration Option Used
Infiltration Rate (in/hr): 4.00

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

**********Groundwater Recharge Summary **********
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

	Total Predeveloped Recharge During Simulation
Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	103.457

Total:	103.457

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	0.000
Link: Infiltration Gallery	269.009
Total:	269.009

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.655 ac-ft/year, Post Developed: 1.703 ac-ft/year

*************Water Quality Facility Data **************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Infiltration Gallery 9 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 269.01
Inflow Volume Including PPT-Evap (ac-ft): 269.01
Total Runoff Infiltrated (ac-ft): 269.01, 100.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 0.01
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: Infiltration Gallery 9

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	1.279E-02	2-Year	0.000
5-Year	2.084E-02	5-Year	0.000
10-Year	2.808E-02	10-Year	0.000
25-Year	3.560E-02	25-Year	0.000
50-Year	4.543E-02	50-Year	0.000

100-Year	4.923E-02	100-Year	0.000
200-Year	7.663E-02	200-Year	5.765E-02

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-100.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-100.0%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-38.3%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

****** LID Duration Performance ******

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-100.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-100.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.46
Program License Number: 200510004
Project Simulation Performed on: 08/27/2018 10:19 PM
Report Generation Date: 08/27/2018 10:19 PM

Input File Name: COM State Ave 90 Per_Infiltration Gallery 10.fld
Project Name: Marysville State Ave
Analysis Title: Infiltration Gallery 10
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	1.900	1.900
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	1.900	1.900

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	1.900
Subbasin Total	1.900

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	1.900
Subbasin Total	1.900

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Infiltration Gallery 10
Link Type: Infiltration Trench
Downstream Link: None

Trench Type	:	Trench on Embankment Sideslope
Trench Length (ft)	:	121.00
Trench Width (ft)	:	15.58
Trench Depth (ft)	:	5.50
Trench Bottom Elev (ft)	:	100.00
Trench Rockfill Porosity (%)	:	61.00

Constant Infiltration Option Used
Infiltration Rate (in/hr): 5.00

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

**********Groundwater Recharge Summary **********
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Model Element	Total Predeveloped Recharge During Simulation Recharge Amount (ac-ft)
Subbasin: Subbasin 1	327.615

Total:	327.615

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	0.000
Link: Infiltration Gallery	851.862
Total:	851.862

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 2.074 ac-ft/year, Post Developed: 5.392 ac-ft/year

*************Water Quality Facility Data **************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Infiltration Gallery 10 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 851.86
Inflow Volume Including PPT-Evap (ac-ft): 851.86
Total Runoff Infiltrated (ac-ft): 851.86, 100.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 0.03
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: Infiltration Gallery 10

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	4.049E-02	2-Year	0.000
5-Year	6.599E-02	5-Year	0.000
10-Year	8.891E-02	10-Year	0.000
25-Year	0.113	25-Year	0.000
50-Year	0.144	50-Year	1.595E-02

100-Year	0.156	100-Year	0.265
200-Year	0.243	200-Year	0.290

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-100.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-99.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-1.2%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

****** LID Duration Performance ******

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-100.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-100.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.46
Program License Number: 200510004
Project Simulation Performed on: 08/27/2018 10:30 PM
Report Generation Date: 08/27/2018 10:30 PM

Input File Name: COM State Ave 90 Per_Infiltration Gallery 11.fld
Project Name: Marysville State Ave
Analysis Title: Infiltration Gallery 11
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.450	0.450
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.450	0.450

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Till Forest	0.450
Subbasin Total	0.450

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	0.450
Subbasin Total	0.450

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 0

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 1

Link Name: Infiltration Gallery 11
Link Type: Infiltration Trench
Downstream Link: None

Trench Type	:	Trench on Embankment Sideslope
Trench Length (ft)	:	55.00
Trench Width (ft)	:	8.42
Trench Depth (ft)	:	5.50
Trench Bottom Elev (ft)	:	100.00
Trench Rockfill Porosity (%)	:	59.00

Constant Infiltration Option Used
Infiltration Rate (in/hr): 4.00

**********FLOOD FREQUENCY AND DURATION STATISTICS**********

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 1

**********Groundwater Recharge Summary **********
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Model Element	Total Predeveloped Recharge During Simulation Recharge Amount (ac-ft)
Subbasin: Subbasin 1	77.593

Total:	77.593

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	0.000
Link: Infiltration Gallery	201.757
Total:	201.757

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.491 ac-ft/year, Post Developed: 1.277 ac-ft/year

*************Water Quality Facility Data **************

----------SCENARIO: PREDEVELOPED

Number of Links: 0

----------SCENARIO: POSTDEVELOPED

Number of Links: 1

********** Link: Infiltration Gallery 11 **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 201.76
Inflow Volume Including PPT-Evap (ac-ft): 201.76
Total Runoff Infiltrated (ac-ft): 201.76, 100.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 0.01
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%

*************Compliance Point Results ***************

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Link: Infiltration Gallery 11

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	9.589E-03	2-Year	0.000
5-Year	1.563E-02	5-Year	0.000
10-Year	2.106E-02	10-Year	0.000
25-Year	2.670E-02	25-Year	0.000
50-Year	3.407E-02	50-Year	0.000

100-Year	3.692E-02	100-Year	6.724E-03
200-Year	5.747E-02	200-Year	3.775E-02

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******

Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%):	-100.0%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%):	-99.9%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-31.6%	PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%):	0.0%	PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

****** LID Duration Performance ******

Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):	-100.0%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-100.0%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.46
Program License Number: 200510004
Project Simulation Performed on: 10/09/2019 11:34 AM
Report Generation Date: 10/09/2019 11:35 AM

Input File Name: State_Ave_20191009.fld
Project Name: Marysville State Ave
Analysis Title: Wetpond Wetland Analysis
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 60

Extended Precipitation Time Series Selected
Climatic Region Number: 15

Full Period of Record Available used for Routing
Precipitation Station : 96004005 Puget East 40 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961040 Puget East 40 in MAP
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 1
HSPF Parameter Region Name : USGS Default

********** Default HSPF Parameters Used (Not Modified by User) **********

********** WATERSHED DEFINITION **********

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	1.800	1.800
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	1.800	1.800

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	1.800
Subbasin Total	1.800

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1

---------- Subbasin : Subbasin 1 ----------

	-------Area (Acres) --------
Impervious	1.800
Subbasin Total	1.800

********** **LINK DATA** **********

----------SCENARIO: PREDEVELOPED
Number of Links: 1

Link Name: Pre-Developed Outflow
Link Type: Copy
Downstream Link: None

********** **LINK DATA** **********

----------SCENARIO: POSTDEVELOPED
Number of Links: 2

Link Name: New Structure Lnk1
Link Type: Structure
Downstream Link Name: Post-Developed Outflow

Prismatic Pond Option Used

Pond Floor Elevation (ft)	:	100.00
Riser Crest Elevation (ft)	:	103.25
Max Pond Elevation (ft)	:	103.75
Storage Depth (ft)	:	3.25
Pond Bottom Length (ft)	:	61.0
Pond Bottom Width (ft)	:	8.4
Pond Side Slopes (ft/ft)	:	L1= 3.00 L2= 3.00 W1= 3.00 W2= 3.00
Bottom Area (sq-ft)	:	514.
Area at Riser Crest El (sq-ft)	:	2,248.
(acres)	:	0.052
Volume at Riser Crest (cu-ft)	:	4,281.
(ac-ft)	:	0.098
Area at Max Elevation (sq-ft)	:	2582.
(acres)	:	0.059
Vol at Max Elevation (cu-ft)	:	5,487.
(ac-ft)	:	0.126

Massmann Infiltration Option Used

Hydraulic Conductivity (in/hr)	: 0.00
Depth to Water Table (ft)	: 100.00
Bio-Fouling Potential	: Low
Maintenance	: Average or Better

Riser Geometry
Riser Structure Type : Circular
Riser Diameter (in) : 24.00
Common Length (ft) : 0.000
Riser Crest Elevation : 103.25 ft

Hydraulic Structure Geometry

Number of Devices: 0

Link Name: Post-Developed Outflow
Link Type: Copy
Downstream Link: None

**************************FLOOD FREQUENCY AND DURATION STATISTICS*********************

----------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 1

----------SCENARIO: POSTDEVELOPED
Number of Subbasins: 1
Number of Links: 2

*************Groundwater Recharge Summary **************
Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: Subbasin 1		0.000
Link:	Pre-Developed Outflo	0.000
Total:		0.000

Total Post Developed Recharge During Simulation

Model Element		Recharge Amount (ac-ft)
Subbasin: Subbasin 1		0.000
Link:	New Structure Lnk1	Not Computed
Link:	Post-Developed Outfl	0.000
Total:		0.000

Total Predevelopment Recharge Equals Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.000 ac-ft/year, Post Developed: 0.000 ac-ft/year

*************Water Quality Facility Data ***************

----------SCENARIO: PREDEVELOPED

Number of Links: 1

********** Link: Pre-Developed Outflow **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 794.95
Inflow Volume Including PPT-Evap (ac-ft): 794.95
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 794.95
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

----------SCENARIO: POSTDEVELOPED

Number of Links: 2

********** Link: Post-Developed Outflow **********

Infiltration/Filtration Statistics----------
Inflow Volume (ac-ft): 799.11
Inflow Volume Including PPT-Evap (ac-ft): 799.11
Total Runoff Infiltrated (ac-ft): 0.00, 0.00%
Total Runoff Filtered (ac-ft): 0.00, 0.00%
Primary Outflow To Downstream System (ac-ft): 799.11
Secondary Outflow To Downstream System (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

*************Compliance Point Results **************

Scenario Predeveloped Compliance Link: Pre-Developed Outflow
Scenario Postdeveloped Compliance Link: Post-Developed Outflow

***** Point of Compliance Flow Frequency Data *****
Recurrence Interval Computed Using Gringorten Plotting Position

Predevelopment Runoff		Postdevelopment Runoff	
Tr (Years)	Discharge (cfs)	Tr (Years)	Discharge (cfs)
2-Year	0.501	2-Year	0.483
5-Year	0.638	5-Year	0.612
10-Year	0.718	10-Year	0.680
25-Year	0.839	25-Year	0.805
50-Year	0.933	50-Year	0.883
100-Year	1.052	100-Year	0.996
200-Year	1.113	200-Year	1.089

** Record too Short to Compute Peak Discharge for These Recurrence Intervals

****** Flow Duration Performance ******
Excursion at Predeveloped 50%Q2 (Must be Less Than or Equal to 0%): -5.4% PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than or Equal to 0%): -5.4% PASS

Maximum Excursion from Q2 to Q50 (Must be less than 10%): 0.0% PASS
Percent Excursion from Q2 to Q50 (Must be less than 50%): 0.0% PASS

MEETS ALL FLOW DURATION DESIGN CRITERIA: PASS

*************Wetland Hydrologic Loading Analysis Results **************

Predeveloped Wetland Location: Pre-Developed Outflow, Outflow
Postdeveloped Wetland Location: Post-Developed Outflow, Outflow

***********Mean Daily Wetland Inflow (cfs) *************
Must be within 20% for each Day

Month	Predeveloped	Postdeveloped	Percent Difference
Oct-01	5.203E-03	5.223E-03	0.37%
Oct-02	3.889E-03	3.905E-03	0.39%
Oct-03	5.466E-03	5.480E-03	0.27%
Oct-04	6.625E-03	6.662E-03	0.55%
Oct-05	4.888E-03	4.907E-03	0.39%
Oct-06	8.833E-03	8.898E-03	0.74%
Oct-07	6.290E-03	6.330E-03	0.64%
Oct-08	6.241E-03	6.272E-03	0.50%
Oct-09	7.973E-03	8.012E-03	0.49%
Oct-10	7.305E-03	7.316E-03	0.15%
Oct-11	6.274E-03	6.328E-03	0.86%
Oct-12	6.875E-03	6.855E-03	-0.29%
Oct-13	6.532E-03	6.619E-03	1.33%
Oct-14	7.144E-03	7.177E-03	0.46%
Oct-15	5.268E-03	5.292E-03	0.46%
Oct-16	4.442E-03	4.459E-03	0.39%
Oct-17	8.092E-03	8.120E-03	0.33%
Oct-18	7.742E-03	7.763E-03	0.27%
Oct-19	8.283E-03	8.339E-03	0.68%
Oct-20	1.077E-02	1.062E-02	-1.37%
Oct-21	1.065E-02	1.067E-02	0.24%
Oct-22	1.063E-02	1.069E-02	0.57%
Oct-23	1.057E-02	1.065E-02	0.73%
Oct-24	8.611E-03	8.669E-03	0.67%
Oct-25	9.369E-03	9.402E-03	0.35%
Oct-26	1.095E-02	1.099E-02	0.37%
Oct-27	1.256E-02	1.249E-02	-0.52%
Oct-28	9.609E-03	9.671E-03	0.64%
Oct-29	1.063E-02	1.068E-02	0.48%
Oct-30	8.455E-03	8.535E-03	0.95%
Oct-31	1.276E-02	1.278E-02	0.16%
Nov-01	9.348E-03	9.422E-03	0.79%
Nov-02	8.404E-03	8.416E-03	0.15%
Nov-03	1.374E-02	1.376E-02	0.12%
Nov-04	1.262E-02	1.276E-02	1.13%
Nov-05	8.011E-03	8.053E-03	0.53%
Nov-06	9.193E-03	9.192E-03	-0.02%
Nov-07	1.044E-02	1.051E-02	0.70%
Nov-08	9.143E-03	9.170E-03	0.30%

Nov-09	1.286E-02	1.290E-02	0.35%
Nov-10	1.287E-02	1.293E-02	0.51%
Nov-11	1.357E-02	1.363E-02	0.42%
Nov-12	9.712E-03	9.776E-03	0.65%
Nov-13	1.304E-02	1.308E-02	0.32%
Nov-14	1.121E-02	1.128E-02	0.64%
Nov-15	1.125E-02	1.128E-02	0.30%
Nov-16	1.314E-02	1.319E-02	0.39%
Nov-17	1.368E-02	1.377E-02	0.65%
Nov-18	1.166E-02	1.171E-02	0.37%
Nov-19	1.586E-02	1.590E-02	0.29%
Nov-20	1.176E-02	1.182E-02	0.55%
Nov-21	1.289E-02	1.294E-02	0.34%
Nov-22	1.097E-02	1.104E-02	0.61%
Nov-23	1.741E-02	1.744E-02	0.20%
Nov-24	1.775E-02	1.782E-02	0.39%
Nov-25	1.541E-02	1.550E-02	0.57%
Nov-26	1.212E-02	1.217E-02	0.39%
Nov-27	1.376E-02	1.386E-02	0.73%
Nov-28	9.351E-03	9.367E-03	0.17%
Nov-29	1.232E-02	1.239E-02	0.56%
Nov-30	1.465E-02	1.466E-02	0.06%
Dec-01	1.308E-02	1.315E-02	0.52%
Dec-02	1.459E-02	1.470E-02	0.71%
Dec-03	1.591E-02	1.591E-02	0.01%
Dec-04	1.419E-02	1.429E-02	0.75%
Dec-05	1.344E-02	1.345E-02	0.11%
Dec-06	1.322E-02	1.330E-02	0.61%
Dec-07	1.217E-02	1.225E-02	0.64%
Dec-08	1.082E-02	1.088E-02	0.55%
Dec-09	1.055E-02	1.056E-02	0.13%
Dec-10	1.352E-02	1.361E-02	0.61%
Dec-11	1.182E-02	1.186E-02	0.28%
Dec-12	1.079E-02	1.087E-02	0.80%
Dec-13	1.031E-02	1.035E-02	0.37%
Dec-14	1.096E-02	1.100E-02	0.33%
Dec-15	1.291E-02	1.298E-02	0.51%
Dec-16	1.042E-02	1.045E-02	0.29%
Dec-17	1.097E-02	1.104E-02	0.60%
Dec-18	1.019E-02	1.022E-02	0.25%
Dec-19	1.095E-02	1.099E-02	0.36%
Dec-20	1.401E-02	1.407E-02	0.48%
Dec-21	1.329E-02	1.337E-02	0.58%
Dec-22	9.407E-03	9.475E-03	0.72%
Dec-23	1.049E-02	1.049E-02	0.05%
Dec-24	9.565E-03	9.644E-03	0.83%
Dec-25	1.008E-02	1.008E-02	0.00%
Dec-26	1.276E-02	1.278E-02	0.16%
Dec-27	1.099E-02	1.107E-02	0.73%
Dec-28	8.106E-03	8.136E-03	0.37%
Dec-29	1.331E-02	1.335E-02	0.31%
Dec-30	1.100E-02	1.105E-02	0.50%
Dec-31	7.708E-03	7.726E-03	0.23%
Jan-01	1.004E-02	1.010E-02	0.51%
Jan-02	1.210E-02	1.217E-02	0.57%
Jan-03	9.769E-03	9.777E-03	0.08%

Jan-04	9.973E-03	1.006E-02	0.86%
Jan-05	9.280E-03	9.312E-03	0.35%
Jan-06	1.030E-02	1.030E-02	-0.01%
Jan-07	9.997E-03	1.006E-02	0.67%
Jan-08	9.011E-03	9.055E-03	0.50%
Jan-09	1.096E-02	1.101E-02	0.40%
Jan-10	1.166E-02	1.172E-02	0.54%
Jan-11	9.174E-03	9.185E-03	0.11%
Jan-12	1.079E-02	1.080E-02	0.18%
Jan-13	1.109E-02	1.117E-02	0.71%
Jan-14	1.464E-02	1.468E-02	0.26%
Jan-15	1.310E-02	1.317E-02	0.55%
Jan-16	1.082E-02	1.089E-02	0.66%
Jan-17	1.085E-02	1.089E-02	0.41%
Jan-18	1.147E-02	1.152E-02	0.42%
Jan-19	1.171E-02	1.176E-02	0.47%
Jan-20	1.049E-02	1.053E-02	0.41%
Jan-21	7.471E-03	7.512E-03	0.55%
Jan-22	9.570E-03	9.591E-03	0.22%
Jan-23	1.314E-02	1.316E-02	0.12%
Jan-24	1.069E-02	1.080E-02	0.96%
Jan-25	8.977E-03	9.019E-03	0.46%
Jan-26	8.889E-03	8.913E-03	0.27%
Jan-27	1.134E-02	1.139E-02	0.37%
Jan-28	7.548E-03	7.610E-03	0.83%
Jan-29	8.770E-03	8.779E-03	0.11%
Jan-30	8.248E-03	8.319E-03	0.86%
Jan-31	1.237E-02	1.239E-02	0.16%
Feb-01	1.112E-02	1.118E-02	0.52%
Feb-02	1.017E-02	1.023E-02	0.60%
Feb-03	8.178E-03	8.219E-03	0.50%
Feb-04	8.361E-03	8.431E-03	0.84%
Feb-05	9.201E-03	9.186E-03	-0.16%
Feb-06	1.190E-02	1.196E-02	0.55%
Feb-07	9.521E-03	9.571E-03	0.52%
Feb-08	1.116E-02	1.122E-02	0.47%
Feb-09	9.913E-03	9.960E-03	0.47%
Feb-10	9.066E-03	9.134E-03	0.75%
Feb-11	8.598E-03	8.594E-03	-0.05%
Feb-12	1.295E-02	1.297E-02	0.17%
Feb-13	1.233E-02	1.241E-02	0.60%
Feb-14	9.839E-03	9.874E-03	0.35%
Feb-15	1.163E-02	1.164E-02	0.11%
Feb-16	1.318E-02	1.326E-02	0.58%
Feb-17	1.562E-02	1.569E-02	0.42%
Feb-18	1.424E-02	1.429E-02	0.38%
Feb-19	1.220E-02	1.230E-02	0.85%
Feb-20	8.447E-03	8.476E-03	0.35%
Feb-21	8.969E-03	9.022E-03	0.59%
Feb-22	7.823E-03	7.863E-03	0.52%
Feb-23	7.770E-03	7.813E-03	0.55%
Feb-24	1.168E-02	1.173E-02	0.37%
Feb-25	1.082E-02	1.086E-02	0.36%
Feb-26	9.653E-03	9.708E-03	0.56%
Feb-27	1.027E-02	1.032E-02	0.55%
Feb-28	1.024E-02	1.028E-02	0.43%

Mar-01	9.984E-03	1.003E-02	0.50%
Mar-02	8.625E-03	8.658E-03	0.39%
Mar-03	1.194E-02	1.198E-02	0.37%
Mar-04	1.013E-02	1.018E-02	0.53%
Mar-05	1.052E-02	1.058E-02	0.58%
Mar-06	5.385E-03	5.407E-03	0.41%
Mar-07	7.925E-03	7.958E-03	0.42%
Mar-08	1.021E-02	1.023E-02	0.26%
Mar-09	1.249E-02	1.254E-02	0.44%
Mar-10	8.925E-03	8.996E-03	0.80%
Mar-11	8.380E-03	8.430E-03	0.59%
Mar-12	1.120E-02	1.127E-02	0.61%
Mar-13	8.183E-03	8.214E-03	0.38%
Mar-14	8.909E-03	8.972E-03	0.71%
Mar-15	8.866E-03	8.912E-03	0.52%
Mar-16	7.243E-03	7.291E-03	0.67%
Mar-17	8.941E-03	8.994E-03	0.59%
Mar-18	8.155E-03	8.194E-03	0.48%
Mar-19	6.953E-03	6.993E-03	0.58%
Mar-20	7.643E-03	7.679E-03	0.47%
Mar-21	6.887E-03	6.919E-03	0.47%
Mar-22	1.106E-02	1.110E-02	0.40%
Mar-23	1.079E-02	1.083E-02	0.39%
Mar-24	8.367E-03	8.427E-03	0.71%
Mar-25	8.000E-03	8.048E-03	0.60%
Mar-26	8.610E-03	8.658E-03	0.56%
Mar-27	7.674E-03	7.682E-03	0.11%
Mar-28	8.163E-03	8.193E-03	0.37%
Mar-29	1.061E-02	1.068E-02	0.66%
Mar-30	9.189E-03	9.258E-03	0.75%
Mar-31	8.261E-03	8.306E-03	0.54%
Apr-01	6.412E-03	6.494E-03	1.28%
Apr-02	5.761E-03	5.782E-03	0.36%
Apr-03	5.006E-03	5.022E-03	0.34%
Apr-04	7.814E-03	7.826E-03	0.16%
Apr-05	8.319E-03	8.389E-03	0.84%
Apr-06	6.820E-03	6.867E-03	0.69%
Apr-07	5.505E-03	5.511E-03	0.10%
Apr-08	8.754E-03	8.787E-03	0.38%
Apr-09	8.644E-03	8.720E-03	0.88%
Apr-10	6.311E-03	6.333E-03	0.34%
Apr-11	8.289E-03	8.347E-03	0.70%
Apr-12	7.104E-03	7.141E-03	0.52%
Apr-13	5.313E-03	5.351E-03	0.73%
Apr-14	5.801E-03	5.837E-03	0.62%
Apr-15	4.495E-03	4.504E-03	0.21%
Apr-16	6.222E-03	6.276E-03	0.87%
Apr-17	5.694E-03	5.762E-03	1.20%
Apr-18	3.511E-03	3.502E-03	-0.28%
Apr-19	8.854E-03	8.855E-03	0.01%
Apr-20	6.806E-03	6.904E-03	1.43%
Apr-21	4.119E-03	4.154E-03	0.83%
Apr-22	6.920E-03	6.890E-03	-0.43%
Apr-23	8.696E-03	8.792E-03	1.10%
Apr-24	5.925E-03	5.984E-03	1.00%
Apr-25	3.844E-03	3.877E-03	0.88%

Apr-26	4.016E-03	4.022E-03	0.13%
Apr-27	6.811E-03	6.849E-03	0.56%
Apr-28	5.575E-03	5.590E-03	0.26%
Apr-29	5.176E-03	5.230E-03	1.04%
Apr-30	6.226E-03	6.263E-03	0.59%
May-01	7.003E-03	7.012E-03	0.12%
May-02	5.471E-03	5.533E-03	1.14%
May-03	5.984E-03	6.047E-03	1.06%
May-04	3.778E-03	3.805E-03	0.70%
May-05	6.621E-03	6.628E-03	0.10%
May-06	5.334E-03	5.410E-03	1.44%
May-07	4.296E-03	4.332E-03	0.83%
May-08	3.872E-03	3.920E-03	1.22%
May-09	2.619E-03	2.628E-03	0.35%
May-10	3.204E-03	3.206E-03	0.07%
May-11	4.628E-03	4.685E-03	1.24%
May-12	4.679E-03	4.694E-03	0.31%
May-13	4.048E-03	4.120E-03	1.79%
May-14	4.171E-03	4.213E-03	1.03%
May-15	4.293E-03	4.323E-03	0.70%
May-16	4.487E-03	4.506E-03	0.44%
May-17	5.087E-03	5.126E-03	0.75%
May-18	2.877E-03	2.939E-03	2.15%
May-19	4.559E-03	4.550E-03	-0.21%
May-20	3.717E-03	3.778E-03	1.65%
May-21	2.974E-03	3.002E-03	0.92%
May-22	4.035E-03	4.081E-03	1.14%
May-23	4.048E-03	4.082E-03	0.83%
May-24	3.829E-03	3.841E-03	0.32%
May-25	3.766E-03	3.813E-03	1.25%
May-26	5.498E-03	5.530E-03	0.57%
May-27	4.034E-03	4.055E-03	0.50%
May-28	3.544E-03	3.590E-03	1.28%
May-29	4.243E-03	4.268E-03	0.60%
May-30	4.429E-03	4.432E-03	0.07%
May-31	6.228E-03	6.281E-03	0.85%
Jun-01	4.077E-03	4.119E-03	1.02%
Jun-02	2.484E-03	2.519E-03	1.40%
Jun-03	3.411E-03	3.423E-03	0.36%
Jun-04	4.968E-03	5.024E-03	1.14%
Jun-05	2.824E-03	2.866E-03	1.50%
Jun-06	5.270E-03	5.269E-03	-0.02%
Jun-07	3.651E-03	3.708E-03	1.55%
Jun-08	3.065E-03	3.097E-03	1.04%
Jun-09	4.222E-03	4.211E-03	-0.25%
Jun-10	4.768E-03	4.835E-03	1.40%
Jun-11	3.348E-03	3.376E-03	0.82%
Jun-12	3.243E-03	3.249E-03	0.19%
Jun-13	3.212E-03	3.259E-03	1.46%
Jun-14	4.290E-03	4.324E-03	0.78%
Jun-15	2.312E-03	2.347E-03	1.54%
Jun-16	3.889E-03	3.893E-03	0.10%
Jun-17	3.448E-03	3.523E-03	2.16%
Jun-18	2.601E-03	2.637E-03	1.36%
Jun-19	1.880E-03	1.894E-03	0.73%
Jun-20	2.992E-03	3.014E-03	0.74%

Jun-21	2.319E-03	2.340E-03	0.91%
Jun-22	2.436E-03	2.444E-03	0.32%
Jun-23	2.679E-03	2.721E-03	1.56%
Jun-24	5.238E-03	5.247E-03	0.18%
Jun-25	2.445E-03	2.494E-03	2.00%
Jun-26	2.559E-03	2.575E-03	0.64%
Jun-27	2.132E-03	2.150E-03	0.88%
Jun-28	3.586E-03	3.603E-03	0.50%
Jun-29	5.019E-03	5.110E-03	1.82%
Jun-30	1.702E-03	1.714E-03	0.71%
Jul-01	2.999E-03	3.038E-03	1.30%
Jul-02	1.731E-03	1.743E-03	0.74%
Jul-03	2.631E-03	2.646E-03	0.57%
Jul-04	1.791E-03	1.815E-03	1.33%
Jul-05	4.032E-03	4.049E-03	0.43%
Jul-06	8.846E-04	9.239E-04	4.44%
Jul-07	1.396E-03	1.412E-03	1.17%
Jul-08	3.625E-03	3.651E-03	0.72%
Jul-09	2.592E-03	2.624E-03	1.24%
Jul-10	2.093E-03	2.110E-03	0.83%
Jul-11	1.994E-03	2.016E-03	1.09%
Jul-12	2.268E-03	2.317E-03	2.16%
Jul-13	1.028E-03	1.054E-03	2.56%
Jul-14	1.335E-03	1.349E-03	1.05%
Jul-15	1.456E-03	1.490E-03	2.31%
Jul-16	2.891E-03	2.887E-03	-0.15%
Jul-17	2.212E-03	2.258E-03	2.07%
Jul-18	1.432E-03	1.438E-03	0.36%
Jul-19	1.364E-03	1.400E-03	2.65%
Jul-20	9.442E-04	9.575E-04	1.41%
Jul-21	1.395E-03	1.406E-03	0.80%
Jul-22	5.210E-04	5.474E-04	5.07%
Jul-23	1.636E-04	1.794E-04	9.68%
Jul-24	3.306E-04	3.599E-04	8.85%
Jul-25	9.651E-04	9.755E-04	1.08%
Jul-26	2.344E-03	2.373E-03	1.22%
Jul-27	1.171E-03	1.203E-03	2.71%
Jul-28	8.315E-04	8.609E-04	3.53%
Jul-29	4.393E-04	4.705E-04	7.09%
Jul-30	3.016E-04	3.178E-04	5.37%
Jul-31	3.016E-04	3.217E-04	6.67%
Aug-01	3.926E-04	3.989E-04	1.60%
Aug-02	1.502E-03	1.515E-03	0.90%
Aug-03	1.351E-03	1.375E-03	1.81%
Aug-04	1.449E-03	1.461E-03	0.81%
Aug-05	6.129E-04	6.538E-04	6.66%
Aug-06	1.452E-03	1.464E-03	0.78%
Aug-07	2.440E-03	2.455E-03	0.64%
Aug-08	6.693E-04	7.145E-04	6.75%
Aug-09	8.161E-04	8.385E-04	2.75%
Aug-10	4.495E-04	4.712E-04	4.84%
Aug-11	7.618E-04	7.703E-04	1.11%
Aug-12	1.625E-03	1.643E-03	1.07%
Aug-13	1.191E-03	1.217E-03	2.23%
Aug-14	2.370E-03	2.335E-03	-1.47%
Aug-15	2.490E-03	2.505E-03	0.58%

Aug-16	2.024E-03	2.039E-03	0.71%
Aug-17	1.812E-03	1.833E-03	1.17%
Aug-18	1.922E-03	1.937E-03	0.74%
Aug-19	2.146E-03	2.177E-03	1.45%
Aug-20	1.371E-03	1.391E-03	1.43%
Aug-21	2.050E-03	2.064E-03	0.69%
Aug-22	1.626E-03	1.629E-03	0.21%
Aug-23	4.116E-03	4.136E-03	0.49%
Aug-24	3.077E-03	3.113E-03	1.16%
Aug-25	2.814E-03	2.840E-03	0.95%
Aug-26	2.662E-03	2.691E-03	1.06%
Aug-27	3.761E-03	3.741E-03	-0.51%
Aug-28	3.272E-03	3.267E-03	-0.16%
Aug-29	3.871E-03	3.880E-03	0.23%
Aug-30	3.245E-03	3.279E-03	1.07%
Aug-31	2.169E-03	2.156E-03	-0.62%
Sep-01	5.403E-03	5.407E-03	0.07%
Sep-02	3.847E-03	3.894E-03	1.24%
Sep-03	3.166E-03	3.169E-03	0.09%
Sep-04	3.294E-03	3.308E-03	0.44%
Sep-05	3.071E-03	3.097E-03	0.84%
Sep-06	3.046E-03	3.080E-03	1.09%
Sep-07	1.731E-03	1.768E-03	2.13%
Sep-08	2.966E-03	2.930E-03	-1.22%
Sep-09	4.099E-03	4.123E-03	0.60%
Sep-10	3.922E-03	3.946E-03	0.62%
Sep-11	2.526E-03	2.575E-03	1.91%
Sep-12	1.226E-03	1.238E-03	0.96%
Sep-13	3.674E-03	3.632E-03	-1.15%
Sep-14	4.888E-03	4.912E-03	0.49%
Sep-15	5.375E-03	5.397E-03	0.41%
Sep-16	4.686E-03	4.729E-03	0.91%
Sep-17	6.384E-03	6.410E-03	0.40%
Sep-18	4.374E-03	4.323E-03	-1.17%
Sep-19	5.898E-03	5.941E-03	0.73%
Sep-20	4.521E-03	4.569E-03	1.05%
Sep-21	3.477E-03	3.542E-03	1.87%
Sep-22	5.028E-03	5.060E-03	0.62%
Sep-23	5.076E-03	5.131E-03	1.07%
Sep-24	4.353E-03	4.390E-03	0.84%
Sep-25	2.623E-03	2.656E-03	1.27%
Sep-26	5.438E-03	5.449E-03	0.20%
Sep-27	4.329E-03	4.367E-03	0.87%
Sep-28	5.575E-03	5.640E-03	1.17%
Sep-29	3.152E-03	3.180E-03	0.89%
Sep-30	5.011E-03	5.060E-03	0.97%

**********Mean Monthly Wetland Inflow (cfs) **********

Must be within 15% for each Month

Month	Predeveloped	Postdeveloped	Percent Difference
Oct	8.029E-03	8.064E-03	0.44%
Nov	1.227E-02	1.233E-02	0.46%
Dec	1.165E-02	1.170E-02	0.45%
Jan	1.047E-02	1.052E-02	0.46%
Feb	1.053E-02	1.058E-02	0.49%

Mar	8.973E-03	9.025E-03	0.58%
Apr	6.291E-03	6.332E-03	0.66%
May	4.431E-03	4.465E-03	0.78%
Jun	3.335E-03	3.365E-03	0.89%
Jul	1.596E-03	1.618E-03	1.41%
Aug	1.984E-03	1.999E-03	0.72%
Sep	4.072E-03	4.096E-03	0.60%

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APPENDIX D
CONVEYANCE ANALYSIS

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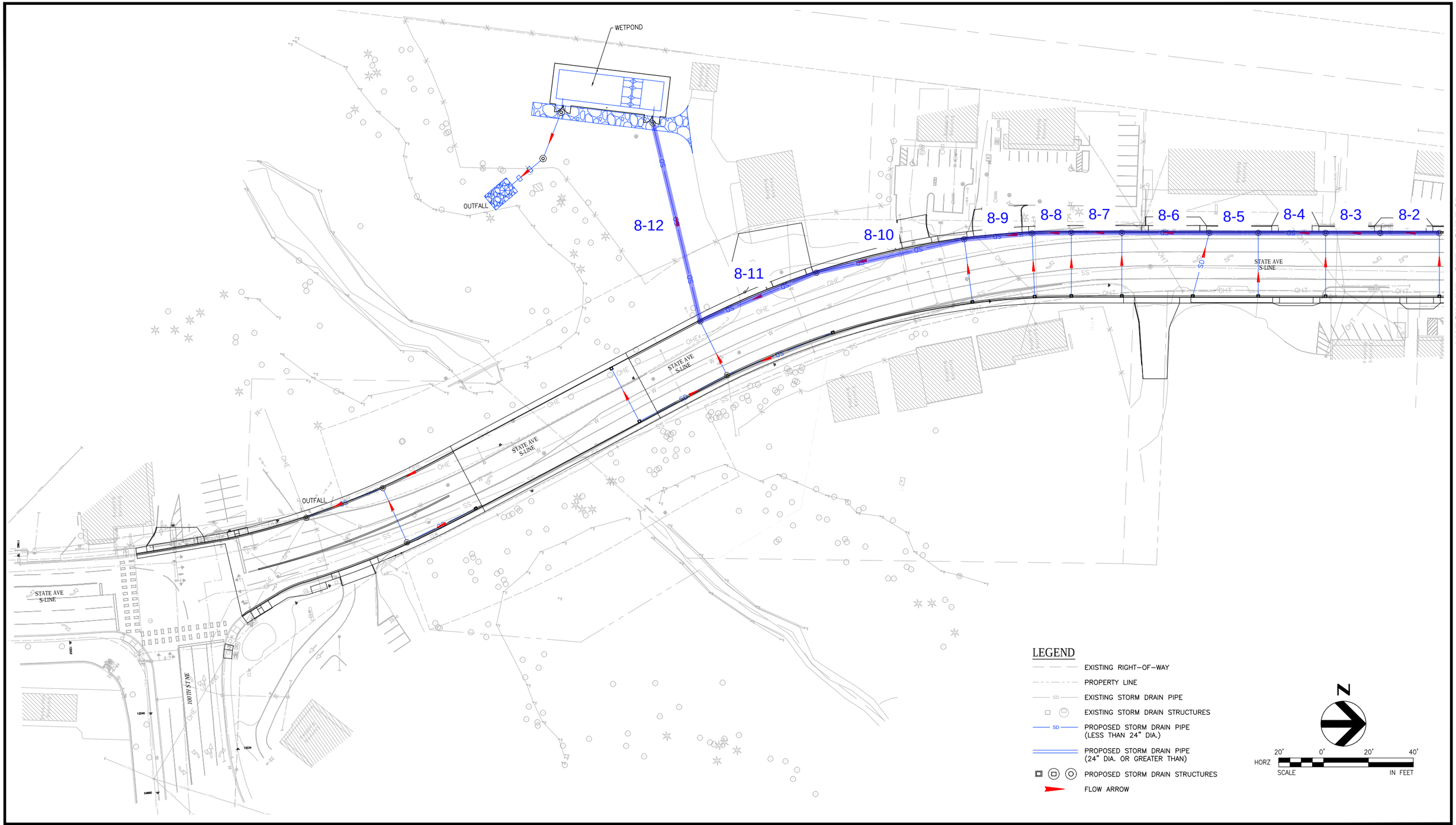

MATCH LINE - SEE FIGURE 3B

LEGEND

- EXISTING RIGHT-OF-WAY
- PROPERTY LINE
- EXISTING STORM DRAIN PIPE
- EXISTING STORM DRAIN STRUCTURES
- PROPOSED STORM DRAIN PIPE (LESS THAN 24" DIA.)
- PROPOSED STORM DRAIN PIPE (24" DIA. OR GREATER THAN)
- PROPOSED STORM DRAIN STRUCTURES
- FLOW ARROW

N

HORZ SCALE: 20' 0' 20' 40' IN FEET

LINE IS 1 INCH AT FULL SIZE
(IF NOT 1" - SCALE ACCORDINGLY)

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT
(100TH STREET NE TO 116TH STREET NE)

CONVEYANCE ANALYSIS MAP

A

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MATCH LINE - SEE FIGURE 3A

MATCH LINE - SEE FIGURE 3C

MATCH LINE - SEE ABOVE

INFILTRATION GALLERY 1
INFILTRATION GALLERY 2
INFILTRATION GALLERY 3
INFILTRATION GALLERY 4
INFILTRATION GALLERY 5
INFILTRATION GALLERY 6
INFILTRATION GALLERY 7
INFILTRATION GALLERY 8
INFILTRATION GALLERY 9
INFILTRATION GALLERY 10

8-1
7-1
7-2
7-3
6-7
6-6
6-5
6-4
6-3
6-2
6-1
5-5
5-4
5-3
5-2
5-1
4-3
4-2
4-1
3-3
3-2
3-1
2-1
2-2
2-3
2-4
1-6
1-5
1-4

PHASE I
PHASE II

STATE AVE S-LINE
104TH PL NE
105TH PL NE
107TH PL NE
108TH PL NE
109TH PL NE

SEQUOIA PLACE CONDOMINIUM
WILHELMI DANA
VAZQUEZ ALFONSO
SMITH MICHAEL K & BILLIE B
MORENO ALFONSO M
WILEY FLORENCE M
MICKELSON ELMER & VAL
PAYNE R GREGORY

LEGEND

- EXISTING RIGHT-OF-WAY
- PROPERTY LINE
- EXISTING STORM DRAIN PIPE
- EXISTING STORM DRAIN STRUCTURES
- PROPOSED STORM DRAIN PIPE (LESS THAN 24" DIA.)
- PROPOSED STORM DRAIN PIPE (24" DIA. OR GREATER THAN)
- PROPOSED STORM DRAIN STRUCTURES
- FLOW ARROW

N

HORZ SCALE 20' 0' 20' 40' IN FEET

LINE IS 1 INCH AT FULL SIZE
(IF NOT 1" - SCALE ACCORDINGLY)

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT (100TH STREET NE TO 116TH STREET NE)

CONVEYANCE ANALYSIS MAP

B

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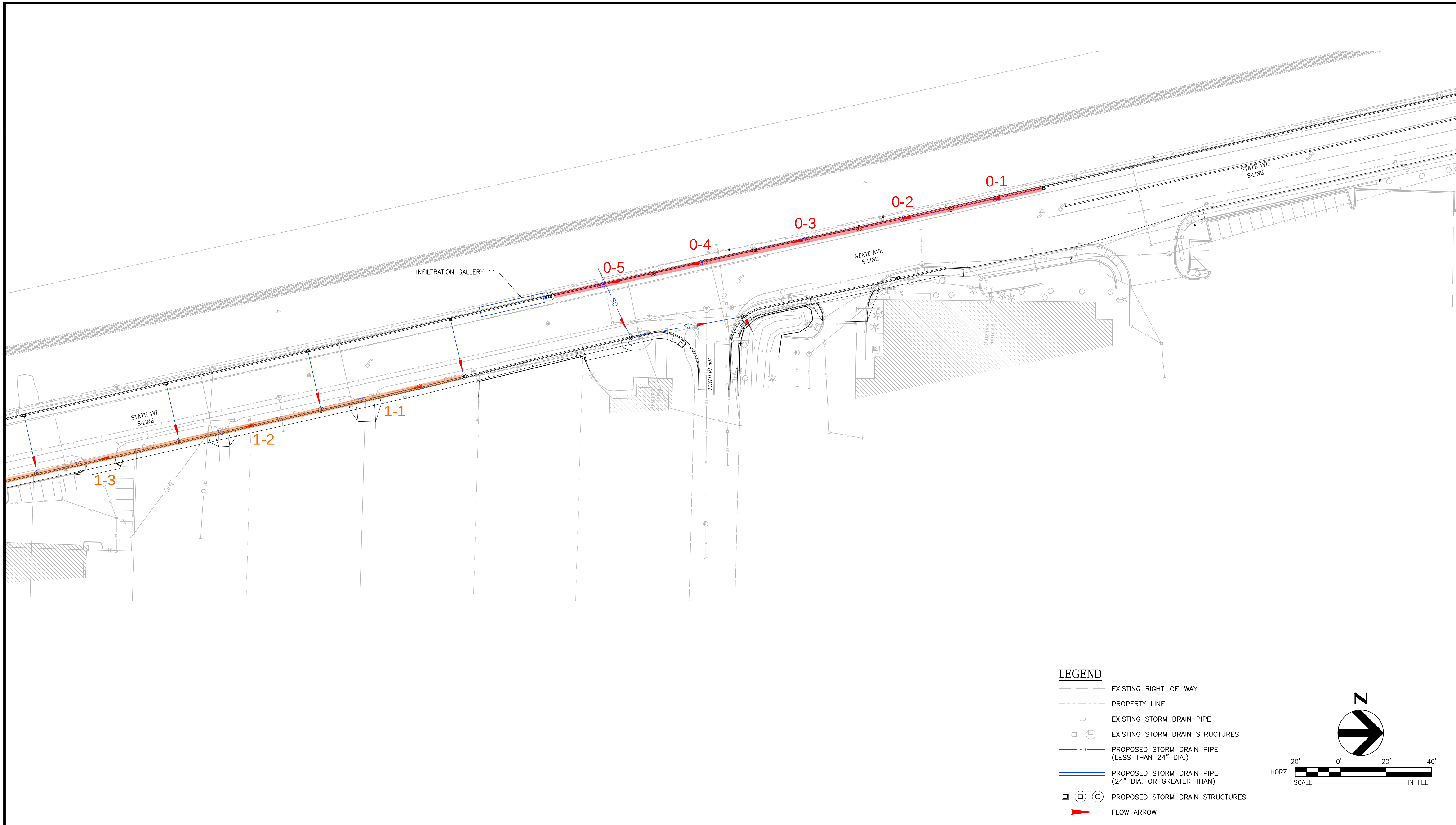

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CITY OF Marysville WASHINGTON

HDR

LINE IS 1 INCH AT FULL SIZE (IF NOT 1" - SCALE ACCORDINGLY)

CITY OF MARYSVILLE

STATE AVENUE CORRIDOR WIDENING PROJECT (100TH STREET NE TO 116TH STREET NE)

CONVEYANCE ANALYSIS MAP

C

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APPENDIX E
OPPERATIONS AND MAINTENANCE MANUAL

City of Marysville State Avenue Corridor Improvements Project

Operations and Maintenance Manual

This Operations and Maintenance (O&M) manual provides detailed guidelines for inspecting, operating, and maintaining the stormwater conveyance facilities and on-site stormwater management, flow control, and water quality treatment Best Management Practices (BMPs) for this project. Table E-1 summarizes the facilities and BMPs included and the source of the detailed O&M guidelines presented below.

Table E-1: Summary of O&M guidelines and information sources

Facility/BMP	Source of Information
Wetpond	The Washington State Department of Ecology's Stormwater Management Manual for Western Washington, as Amended in 2014
Control Structure	
Catch Basins	
Energy Dissipator	
Infiltration Gallery	StormTech

Table V-A.11: Maintenance Standards - Wetponds

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Water level	First cell is empty, doesn't hold water.	Line the first cell to maintain at least 4 feet of water. Although the second cell may drain, the first cell must remain full to control turbulence of the incoming flow and reduce sediment resuspension.

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Trash and Debris	Accumulation that exceeds 1 CF per 1000-SF of pond area.	Trash and debris removed from pond.
	Inlet/Outlet Pipe	Inlet/Outlet pipe clogged with sediment and/or debris material.	No clogging or blockage in the inlet and outlet piping.
	Sediment Accumulation in Pond Bottom	Sediment accumulations in pond bottom that exceeds the depth of sediment zone plus 6-inches, usually in the first cell.	Sediment removed from pond bottom.
	Oil Sheen on Water	Prevalent and visible oil sheen.	Oil removed from water using oil-absorbent pads or vactor truck. Source of oil located and corrected. If chronic low levels of oil persist, plant wetland plants such as Juncus effusus (soft rush) which can uptake small concentrations of oil.
	Erosion	Erosion of the pond's side slopes and/or scouring of the pond bottom, that exceeds 6-inches, or where continued erosion is prevalent.	Slopes stabilized using proper erosion control measures and repair methods.

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Settlement of Pond Dike/Berm	Any part of these components that has settled 4-inches or lower than the design elevation, or inspector determines dike/berm is unsound.	Dike/berm is repaired to specifications.
	Internal Berm	Berm dividing cells should be level.	Berm surface is leveled so that water flows evenly over entire length of berm.
	Overflow Spillway	Rock is missing and soil is exposed at top of spillway or outside slope.	Rocks replaced to specifications.

Table V-A.12: Maintenance Standards - Wetvaults

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash/Debris Accumulation	Trash and debris accumulated in vault, pipe or inlet/outlet (includes floatables and non-floatables).	Remove trash and debris from vault.
	Sediment Accumulation in Vault	Sediment accumulation in vault bottom exceeds the depth of the sediment zone plus 6-inches.	Remove sediment from vault.
	Damaged Pipes	Inlet/outlet piping damaged or broken and in need of repair.	Pipe repaired and/or replaced.

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Access Cover Damaged/Not Working	Cover cannot be opened or removed, especially by one person.	Pipe repaired or replaced to proper working specifications.
	Ventilation	Ventilation area blocked or plugged.	Blocking material removed or cleared from ventilation area. A specified % of the vault surface area must provide ventilation to the vault interior (see design specifications).
	Vault Structure Damage - Includes Cracks in Walls Bottom, Damage to Frame and/or Top Slab	Maintenance/inspection personnel determine that the vault is not structurally sound. Cracks wider than 1/2-inch at the joint of any inlet/outlet pipe or evidence of soil particles entering through the cracks.	Vault replaced or repairs made so that vault meets design specifications and is structurally sound. Vault repaired so that no cracks exist wider than 1/4-inch at the joint of the inlet/outlet pipe.
	Baffles	Baffles corroding, cracking, warping and/or showing signs of failure as determined by maintenance/inspection staff.	Baffles repaired or replaced to specifications.
	Access Ladder Damage	Ladder is corroded or deteriorated, not functioning properly, not attached to structure wall, missing rungs, has cracks and/or misaligned. Confined space warning sign missing.	Ladder replaced or repaired to specifications, and is safe to use as determined by inspection personnel. Replace sign warning of confined space entry requirements. Ladder and entry notification complies with OSHA standards.

Table V-A.4: Maintenance Standards - Control Structure/Flow Restrictor

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Structural Damage	Structure is not securely attached to manhole wall. Structure is not in upright position (allow up to 10% from plumb). Connections to outlet pipe are not watertight and show signs of rust. Any holes - other than designed holes - in the structure.	Structure securely attached to wall and outlet pipe. Structure in correct position. Connections to outlet pipe are water tight; structure repaired or replaced and works as designed. Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing. Gate cannot be moved up and down by one maintenance person. Chain/rod leading to gate is missing or damaged. Gate is rusted over 50% of its surface area.	Gate is watertight and works as designed. Gate moves up and down easily and is watertight. Chain is in place and works as designed. Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.
Manhole	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)	See Table V-A.3: Maintenance Standards - Closed Detention Systems (Tanks/Vaults)
Catch Basin	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

Table V-A.5: Maintenance Standards - Catch Basins

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%. Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe. Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height. Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No Trash or debris located immediately in front of catch basin or on grate opening. No trash or debris in the catch basin. Inlet and outlet pipes free of trash or debris. No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe.	No sediment in the catch basin

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch. (Intent is to make sure no material is running into basin). Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Top slab is free of holes and cracks. Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound. Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Basin replaced or repaired to design standards. Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening. Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation blocking opening to basin. No vegetation or root growth present.
	Contamination and Pollution	See Table V-A.1: Maintenance Standards - Detention Ponds	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.

Maintenance Component	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is performed
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.

Table V-A.6: Maintenance Standards - Debris Barriers (e.g., Trash Racks)

Maintenance Components	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier cleared to design flow capacity.
Metal	Damaged/ Missing Bars.	Bars are bent out of shape more than 3 inches. Bars are missing or entire barrier missing. Bars are loose and rust is causing 50% deterioration to any part of barrier.	Bars in place with no bends more than 3/4 inch. Bars in place according to design. Barrier replaced or repaired to design standards.
	Inlet/Outlet Pipe	Debris barrier missing or not attached to pipe	Barrier firmly attached to pipe

Table V-A.7: Maintenance Standards - Energy Dissipators

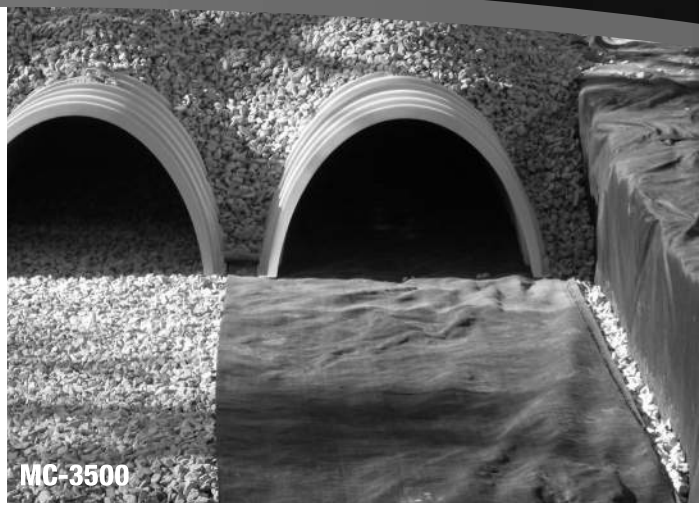
Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
External:			
Rock Pad	Missing or Moved Rock	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil.	Rock pad replaced to design standards.
	Erosion	Soil erosion in or adjacent to rock pad.	Rock pad replaced to design standards.
Dispersion Trench	Pipe Plugged with Sediment	Accumulated sediment that exceeds 20% of the design depth.	Pipe cleaned/flushed so that it matches design.
	Not Discharging Water Properly	Visual evidence of water discharging at concentrated points along trench (normal condition is a "sheet flow"□ of water along trench). Intent is to prevent erosion damage.	Trench redesigned or rebuilt to standards.
	Perforations Plugged.	Over 1/2 of perforations in pipe are plugged with debris and sediment.	Perforated pipe cleaned or replaced.

Maintenance Components	Defect	Conditions When Maintenance is Needed	Results Expected When Maintenance is Performed
	Water Flows Out Top of "Distributor" Catch Basin.	Maintenance person observes or receives credible report of water flowing out during any storm less than the design storm or its causing or appears likely to cause damage.	Facility rebuilt or redesigned to standards.
	Receiving Area Over-Saturated	Water in receiving area is causing or has potential of causing landslide problems.	No danger of landslides.
Internal:			
Manhole/Chamber	Worn or Damaged Post, Baffles, Side of Chamber	Structure dissipating flow deteriorates to 1/2 of original size or any concentrated worn spot exceeding one square foot which would make structure unsound.	Structure replaced to design standards.
	Other Defects	See Table V-A.5: Maintenance Standards - Catch Basins	See Table V-A.5: Maintenance Standards - Catch Basins

StormTech®
Detention • Retention • Water Quality
An ADS company

Isolator® Row O&M Manual


SC-740


MC-3500


MC-4500

*THE MOST **ADVANCED** NAME IN WATER MANAGEMENT SOLUTIONS™*

ADS®

THE ISOLATOR® ROW

INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a technique to inexpensively enhance Total Suspended Solids (TSS) and Total Phosphorus (TP) removal with easy access for inspection and maintenance.

THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-160, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The woven geotextile provides a media for stormwater filtration, a durable surface for maintenance, prevents scour of the underlying stone and remains intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the SC-160, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

The Isolator Row is typically designed to capture the “first flush” and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole provides access to the Isolator Row and typically includes a high flow weir. When flow rates or volumes exceed the Isolator Row weir capacity the water will flow over the weir and discharge through a manifold to the other chambers.

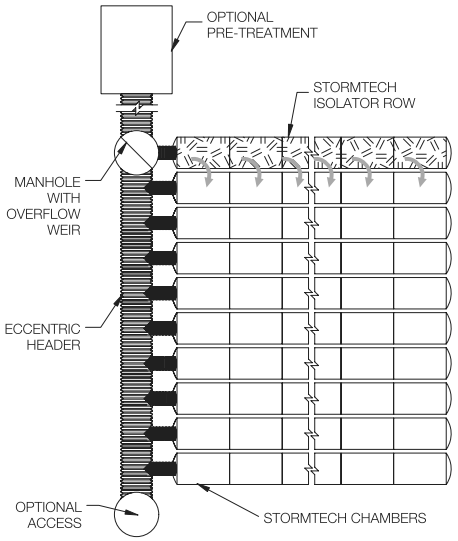
Another acceptable design uses one open grate inlet structure. Using a “high/low” design (low invert elevation on the Isolator Row and a higher invert elevation on the manifold) an open grate structure can provide the advantages of the Isolator Row by creating a differential between the Isolator Row and manifold thus allowing for settlement in the Isolator Row.

The Isolator Row may be part of a treatment train system. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

StormTech Isolator Row with Overflow Spillway (not to scale)



ISOLATOR ROW INSPECTION/MAINTENANCE

INSPECTION

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

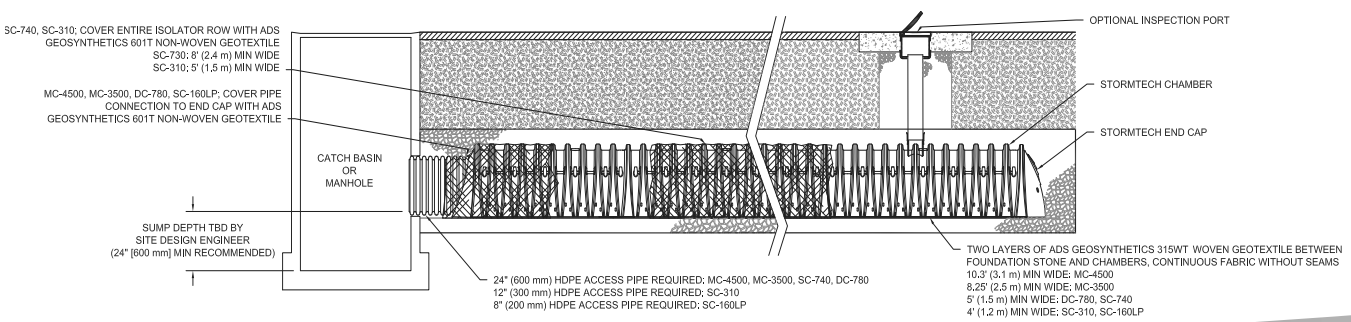
MAINTENANCE

The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

Note: Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-4500 chamber models and is not required over the entire Isolator Row.



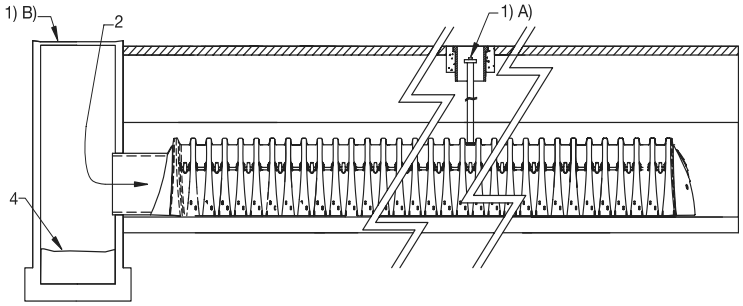
ISOLATOR ROW STEP BY STEP MAINTENANCE PROCEDURES

STEP 1
Inspect Isolator Row for sediment.
- A) Inspection ports (if present)
  - i. Remove lid from floor box frame
  - ii. Remove cap from inspection riser
  - iii. Using a flashlight and stadia rod,measure depth of sediment and record results on maintenance log.
  - iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.
- B) All Isolator Rows
  - i. Remove cover from manhole at upstream end of Isolator Row
  - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2. If not, proceed to Step 3.

STEP 2
Clean out Isolator Row using the JetVac process.
- A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

STEP 3
Replace all caps, lids and covers, record observations and actions.

STEP 4
Inspect & clean catch basins and manholes upstream of the StormTech system.



SAMPLE MAINTENANCE LOG

Date	Stadia Rod Readings		Sediment Depth (1)–(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

StormTech Detention • Retention • Water Quality
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Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com