Technical Memorandum

Date:	Friday, September 24, 2021
Project:	State Avenue Corridor Improvements Project 100th Street to 116th Street
From:	David Kuhns, PE, HDR
Subject:	Storm Drainage Report Addendum

Background

A Final Storm Drainage Report (Report) was prepared by HDR that is dated September 2019 that covers the stormwater requirements for the State Avenue Corridor Improvements Project from 100th Street to 116th Street. The Report includes the Phase 1 project work from 100th Street NE to 104th Street NE, as well as Phase 2 project work from 104th Street NE to 116th Street NE.

Phase 1 project work has been awarded and is currently in construction, while Phase 2 project work is being bid separately. At the time of the drainage report being completed, the Phase 2 project work was completed to a 90 percent level of design.

This technical memorandum (TM) serves as an addendum to the September 2019 Report to provide an overview of the modifications to the Phase 2 design.

Modification Made to Storm Design

There were no significant changes to the threshold discharge areas (TDAs), new/replaced surfaces, and minimum requirements that are provided in the Storm Drainage Report. However, modifications were made to the infiltration galleries as well as the conveyance design.

Infiltration Gallery Modifications

The Phase 2 design included a total of 10 infiltration galleries. This included four smaller infiltration galleries (galleries #3, 4, 5, and 6). These smaller galleries were removed from the design since with the runoff originally tributary to these facilities now conveyed to Infiltration Gallery 2. Infiltration Gallery 2's size was increased to infiltrate the additional area. An updated MGSFlood output for Infiltration Gallery 2 is included as an attachment to this TM

The conveyance system immediately upstream of the infiltration galleries was also modified to accommodate for a 2.3 foot drop required for the pretreatment system. In addition, a new catch basin between the pretreatment system and the infiltration gallery was designed to allow for easier maintenance access to the infiltration gallery and to provide for an additional drop in water surface elevations. The catch basin elevation drop was designed to eliminate tail water on the pretreatment system during the water quality storm event to allow for proper operation of the cartridges.

Conveyance System Modifications

The Phase 2 design used inlet spacing based on using the WSDOT Inlet Spacing spreadsheet to maintain a gutter spread less than 5 feet during a 100-year storm event. However, the City of Marysville Engineer Design and Development Standards (City Standards) does not require a catch basin spacing analysis unless the width of the tributary road surface exceed 35 feet or if the cross slope exceeds 4 percent. When a catch basin spacing analysis is not required, the City Standards call for catch basins to be spaced no greater than 150 feet for grades less than one percent, 200 feet for grades between one and three percent, and 300 feet for grades three percent and greater. Therefore, the design was modified to follow the 150 foot minimum spacing with excess catch basins eliminated.

Because the infiltration galleries were modified to include additional drops to accommodate the required hydraulic drop in the pretreatment system and the drop necessary to avoid a tail water on the StormFilter cartridges during the water quality storm, pipe slopes were modified to keep the infiltration galleries from needing to go significantly deeper.

Previously, the Phase 2 90 percent plans had the shallowest pipe slopes as 0.75 percent. While the City Standards do not include a minimum slope, the WSDOT Hydraulics Manual calls for a minimum slope to maintain a 3 foot per second velocity when the pipe is flowing full. For a 12-inch pipe, this is equal to a slope of 0.44 percent. The revised design uses this standard as the minimum pipe slope as well as doing a conveyance analysis to verify pipe capacities. In the analysis, the total flow to an infiltration gallery was analyzed with a 12-inch pipe at a 0.44 percent slope to see if the minimum pipe size at the minimum slope provided adequate capacity. In locations where this did not provide adequate capacity, a detailed analysis of each pipe segment was completed to determine pipe size and slope that would need to be provided for each segment. A copy of this analysis is included as an attachment to this TM.

Appendix

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Uniform Flow Analysis

City of Marysville State Ave Phase 2
100% Design

100-year Storm Coefficients for Marysville
Per City's SWMMWW Supplemental Manual

m	10.07
n	0.586

Actual Pipe Diameters

Material	Nominal D	Inner D
PVC SDR-35	12	11.78
PVC SDR-35	15	14.426
PVC SDR-35	18	17.629
DI, Class 52	12	12.46
DI, Class 52	14	14.52
DI, Class 52	16	16.6
DI, Class 52	18	18.68

***To use macro to goal seek variable, select cell in Column T and press CTRL+Q to run macro

Upstream Structure ID	Impervious Area (acre)	Impervious Runoff Coefficient C	Pervious Area (acre)	Pervious Runoff Coefficient C	Area Total, A_t (acre)	Composite Runoff Coefficient, C_c	Time of Concentration, T_c (minutes), minimum of 5 minutes	Peak Rainfall Intensity, I_R	Peak Flow from CB, Q (cfs)	Up-stream Pipe Flow (cfs)	Down-stream Pipe Flow, Q	Down-stream Pipe Material	Pipe Manning's N	Pipe Diam. (inch)	Pipe Slope (%)	Pipe Slope (ft/ft)	Calculated Flow, Q_{calc} for Mannings	Q - Q_{calc} (goal seek to zero)	Flow depth, y (inch), goal seek variable	θ	Area, A (sq.ft.)	Hydraulic Radius, R (ft)	Flow Depth / Pipe Diam. (%)	Goal Seek Complete?
Calculation of Slope Required for Last Pipe																								
Flow to Gallery 2																								
CB 111	0.105	0.9	0	0.25	0.1047	0.9	5	3.9213269	0.36953	0	0.36952835	PVC	0.013	11.78	0.44	0.0044	0.37016382	-0.000635476	3.23	2.2035	0.1683	0.1556043	27.4%	Solved
CB 106	0.104	0.9	0	0.25	0.1038	0.9	5	3.9213269	0.36637	0.3695	0.73589695	PVC	0.013	11.78	0.44	0.0044	0.73590122	-4.2746E-06	4.63	2.7103	0.27611	0.2075595	39.3%	Solved
CB 110	0.124	0.9	0	0.25	0.124	0.9	5	3.9213269	0.43758	0	0.43758443	PVC	0.013	11.78	0.44	0.0044	0.43787211	-0.000287675	3.52	2.3127	0.18978	0.1671855	29.9%	Solved
CB 109	0.035	0.9	0	0.25	0.0353	0.9	5	3.9213269	0.12469	0.4376	0.56227291	PVC	0.013	11.78	0.44	0.0044	0.56233239	-5.94809E-05	4.01	2.4913	0.22717	0.1857789	34.0%	Solved
CB 108	0.018	0.9	0	0.25	0.0177	0.9	5	3.9213269	0.0623	0.5623	0.62457663	PVC	0.013	11.78	0.44	0.0044	0.62460152	-2.48905E-05	4.24	2.5731	0.2451	0.1940658	36.0%	Solved
CB 104	0.019	0.9	0	0.25	0.019	0.9	5	3.9213269	0.067	1.3605	1.42747642	PVC	0.013	11.78	0.44	0.0044	1.42799207	-0.000515651	6.80	3.4527	0.45278	0.2671759	57.7%	Solved
CB 105	0.111	0.9	0	0.25	0.111	0.9	5	3.9213269	0.39181	1.8419	2.23369799	PVC	0.013	11.78	0.55	0.0055	2.23373618	-3.81916E-05	8.62	4.1062	0.59363	0.2945357	73.2%	Solved
CB 103	0.117	0.9	0	0.25	0.1174	0.9	5	3.9213269	0.41441	0	0.41441296	PVC	0.013	11.78	2	0.02	0.41450038	-8.74251E-05	2.34	1.8468	0.10656	0.1175573	19.8%	Solved
CB 102	0.106	0.9	0	0.25	0.1055	0.9	5	3.9213269	0.37236	2.2337	2.606062	PVC	0.013	11.78	0.6	0.006	2.60583543	0.000226567	9.54	4.4796	0.65682	0.2987244	81.0%	Solved
CB 101	0.125	0.9	0	0.25	0.1248	0.9	5	3.9213269	0.44058	2.2337	2.67428013	PVC	0.013	11.78	0.6	0.006	2.6734596	0.000820527	9.82	4.604	0.67434	0.298409	83.4%	Solved
Flow to Gallery 7	0.520	0.9	0	0.25	0.5202	0.9	5	3.9213269	1.83597	0	1.83597497	PVC	0.013	11.78	0.44	0.0044	1.83666059	-0.000685615	8.07	3.9016	0.55298	0.2887529	68.5%	Solved
Flow to Gallery 8	0.523	0.9	0	0.25	0.5234	0.9	5	3.9213269	1.84716	0	1.84715562	PVC	0.013	11.78	0.44	0.0044	1.84740899	-0.000253373	8.11	3.9145	0.55565	0.2891925	68.8%	Solved
Flow to Gallery 9	0.536	0.9	0	0.25	0.5363	0.9	5	3.9213269	1.89261	0	1.89260736	PVC	0.013	11.78	0.44	0.0044	1.89283483	-0.00022747	8.26	3.9701	0.56699	0.2909694	70.1%	Solved
Flow to Gallery 10 from the south	0.641	0.9	0	0.25	0.6407	0.9	5	3.9213269	2.26133	0	2.26132552	PVC	0.013	11.78	0.44	0.0044	2.26129556	2.99514E-05	9.68	4.5408	0.66567	0.2986699	82.2%	Solved
Flow to Gallery 10 from the north																								
CB 158	0.067	0.9	0	0.25	0.0672	0.9	5	3.9213269	0.23706	0	0.23706203	PVC	0.013	11.78	0.44	0.0044	0.23713612	-7.40808E-05	2.58	1.9478	0.12263	0.1282706	21.9%	Solved
CB 156	0.164	0.9	0	0.25	0.1638	0.9	5	3.9213269	0.57807	0.2371	0.81513368	PVC	0.013	11.78	0.44	0.0044	0.81490187	0.000231802	4.90	2.8024	0.29748	0.2162751	41.6%	Solved
CB 154	0.206	0.9	0	0.25	0.2065	0.9	5	3.9213269	0.72877	0.8151	1.54390094	PVC	0.013	11.78	0.44	0.0044	1.54391411	-1.31694E-05	7.16	3.5745	0.48112	0.2742209	60.7%	Solved
CB 152	0.212	0.9	0	0.25	0.2121	0.9	5	3.9213269	0.7487	1.5439	2.29259891	PVC	0.013	11.78	0.44	0.0044	2.2918578	0.00074111	9.84	4.6098	0.67511	0.2983749	83.5%	Solved
CB 150	0.181	0.9	0	0.25	0.1806	0.9	5	3.9213269	0.6373	2.2926	2.92989555	PVC	0.013	14.426	0.44	0.0044	2.92923565	0.000659901	9.38	3.7513	0.78112	0.3464186	65.0%	Solved
CB 148	0.192	0.9	0	0.25	0.1919	0.9	5	3.9213269	0.67716	2.9299	3.60705361	PVC	0.013	14.426	0.5	0.005	3.60704002	1.35888E-05	10.44	4.0704	0.88	0.3596766	72.4%	Solved
CB 146 (to Pretreatment MH)	0.208	0.9	0	0.25	0.2081	0.9	5	3.9213269	0.73452	5.8684	6.60289874	PVC	0.013	17.629	0.63	0.0063	6.60291562	-1.68745E-05	12.31	3.9582	1.26444	0.4348963	69.9%	Solved
Flow to Gallery 11	0.417	0.9	0	0.25	0.4165	0.9	5	3.9213269	1.46993	0	1.46993045	PVC	0.013	11.78	0.44	0.0044	1.46993394	-3.48986E-06	6.93	3.4965	0.46305	0.2698085	58.8%	Solved

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MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.54
Program License Number: 200510004
Project Simulation Performed on: 09/21/2021 1:44 PM
Report Generation Date: 09/21/2021 1:44 PM

Input File Name: COM State Ave 90 Per_Infiltration Gallery 02.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)	1.000	1.000
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	1.000	1.000

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

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

	-------Area (Acres) --------
Till Forest	1.000
Subbasin Total	1.000

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

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

	-------Area (Acres) --------
Impervious	1.000
Subbasin Total	1.000

********** 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)	: 70.00
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 PerInd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	172.429
Total:	172.429

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	0.000
Link: Infiltration Gallery	448.334
Total:	448.334

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 1.091 ac-ft/year, Post Developed: 2.838 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): 448.35
Inflow Volume Including PPT-Evap (ac-ft): 448.35
Total Runoff Infiltrated (ac-ft): 448.33, 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
Volume Lost to ET (ac-ft): 0.00
Percent Treated (Infiltrated+Filtered+ET)/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	2.131E-02	2-Year	0.000
5-Year	3.473E-02	5-Year	0.000
10-Year	4.680E-02	10-Year	0.000
25-Year	5.933E-02	25-Year	0.000
50-Year	7.572E-02	50-Year	0.000
100-Year	8.205E-02	100-Year	0.000
200-Year	0.128	200-Year	9.099E-02
500-Year	0.189	500-Year	0.214

** 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%):	-19.7%	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
