ATTACHMENT 11 - Roadside Ditch Conveyance Calculations, David Evans and Associates, Inc.

DAVID EVANS AND ASSOCIATES INC.

MEMORANDUM

Date: April 4, 2019, Updated May 26, 2020

To: Felixberto Palisoc, Cong Ly (WSDOT), Duffy McColloch (WSDOT)

From: Rick Tomkins, PE (DEA)

RE: Roadside Ditch Conveyance Calculations
Lakeside Industries - SR 169 Improvements near MP 19.90

Job No. LKSD0000-0002

cc: Karen Deal (Lakeside Industries)

This memorandum is written in response to WSDOT comments received via email on 3/18/19 related to Lakeside Industries' proposed improvements along SR 169. This memorandum has been updated (red text) to incorporate proposed post-permit approval revisions (elimination of Type 2 catch basin, incorporation of 3-sided bridge at existing culvert ends to facilitate pavement widening).

Background

Lakeside Industries is proposing to construct a new asphalt production facility on their property which lies on the south side of SR 169 near MP 19.90. To facilitate truck traffic entering/leaving the property, an acceleration/declaration lane is proposed along the Lakeside frontage. To accommodate the new lane, the existing shoulder will be widened and improved, and the adjacent roadside drainage ditch will be shifted south.

In addition to draining the south side of the highway, the roadside ditch and two cross-culverts comprise the stormwater receiving system for the Lakeside property. The culverts discharge indirectly to the Cedar River, which lies north of the highway. With development, runoff generated by Lakeside's proposed development will be collected, treated, and fully infiltrated onsite (reducing flows to the cross culverts). Runoff from the added impervious surface area within the right-of-way (due to widening) is also proposed to be directed into / mitigated by the onsite Lakeside facilities. The only proposed impacts to WSDOT facilities are: 1) the insertion of two 3-sided bridges spanning the inlets of both cross culverts to accommodate the additional road width needed for the acceleration/deceleration lane, and 2) relocation / replacement of an existing driveway culvert to accommodate a new Lakeside site entrance.

Segments of 5' wide and 10' wide WSDOT drainage easements exist along portions of the Lakeside frontage. With development, Lakeside will extend/append to the easements, where required, to contain the relocated ditch, culverts, and new guardrail. Maintenance responsibilities will be defined within the easement agreement, as directed by WSDOT.

The following summarizes technical analysis demonstrating that the relocated ditch has sufficient capacity to convey tributary storm flow:

Ditch Conveyance Calculations

Ditch performance was analyzed using several representative cross-sections. Water surface elevations associated with 10-year and 100-year storm flows tributary to each section were compared to the calculated ditch capacity at each section (the capacity of the ditch based on the maximum water surface being below adjacent road subgrade).

MGSFlood software was used to estimate peak 10-year and 100-year flows per acre of pervious and impervious surface at the project location. Modeling gave the following results:

10-Year Flow	**100-Year Flow**
Impervious Area: 0.591 cfs/ac	Impervious Area: 1.057 cfs/ac
Pervious Area: 0.265 cfs/ac	Pervious Area: 0.586 cfs/ac

The *MGSFlood* documentation is attached at the end of this memo.

The pervious and impervious areas tributary to each cross-section were then delineated using AutoCAD and the above results were used to calculate the 10-year tributary flow (Q_{10}) and the 100-year tributary flow (Q_{100}). The tributary areas and representative ditch cross-sections can be seen on the Roadside Ditch Hydrology Exhibit attached at the end of this memo.

Manning's equations for open channel flow and pipe flow were used to determine the capacity of the ditch cross-sections (and in-line culvert). A Manning's Roughness Coefficient of n = 0.09 was used for the open channel flow calculations (n=0.012 was used for the culvert). This was based on *Section IV* in *Appendix 4A Figure 4A-3* of the *2019 WSDOT Hydraulics Manual*.

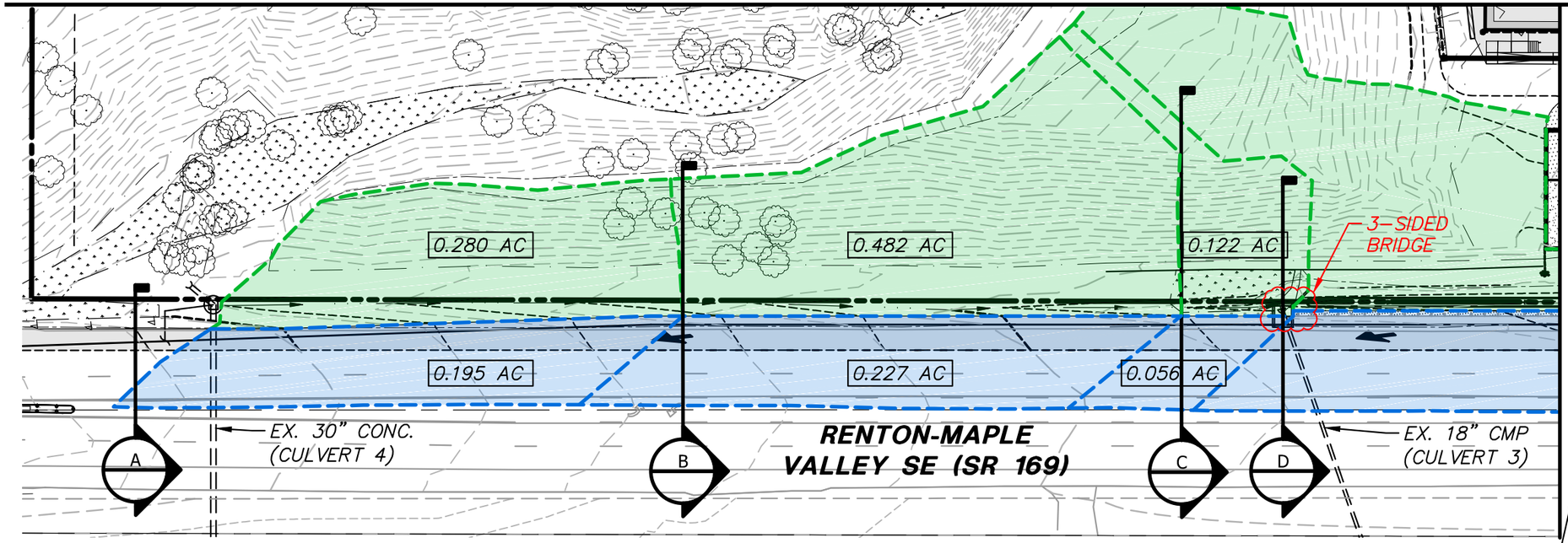
The capacity of each ditch cross-section (Q_{CAP}) was determined based on the distance between the bottom elevation of the adjacent pavement subgrade and the ditch invert, the side slopes, and the longitudinal slope. A conservative longitudinal slope of 0.5% was used for each cross-section, with side slopes ranging from 4:1 to 2:1. The ditch capacity calculations at each section, along with section profiles, are attached at the end of this memo.

Below is a summary of the capacity of the ditch/pipe at each section.

Section	Cross-Section	Q_{10} (cfs)	Q_{100} (cfs)	Q_{CAP} (cfs)	WS Elev @ Q_{10}	Bottom of Subgrade Elev
B	V-Ditch	0.19	0.37	2.18	172.32	172.93
C	V-Ditch	0.45	0.89	0.46	166.72	166.73
D	V-Ditch	0.52	1.02	3.09	165.12	165.79
E	V-Ditch	0.35	0.69	0.46	163.63	163.69
F	Pipe	0.50	1.01	4.90	162.62	162.84
G	V-Ditch	0.81	1.44	7.80	161.16	162.29
H	V-Ditch	0.11	0.21	10.96	159.52	161.31

Conclusion

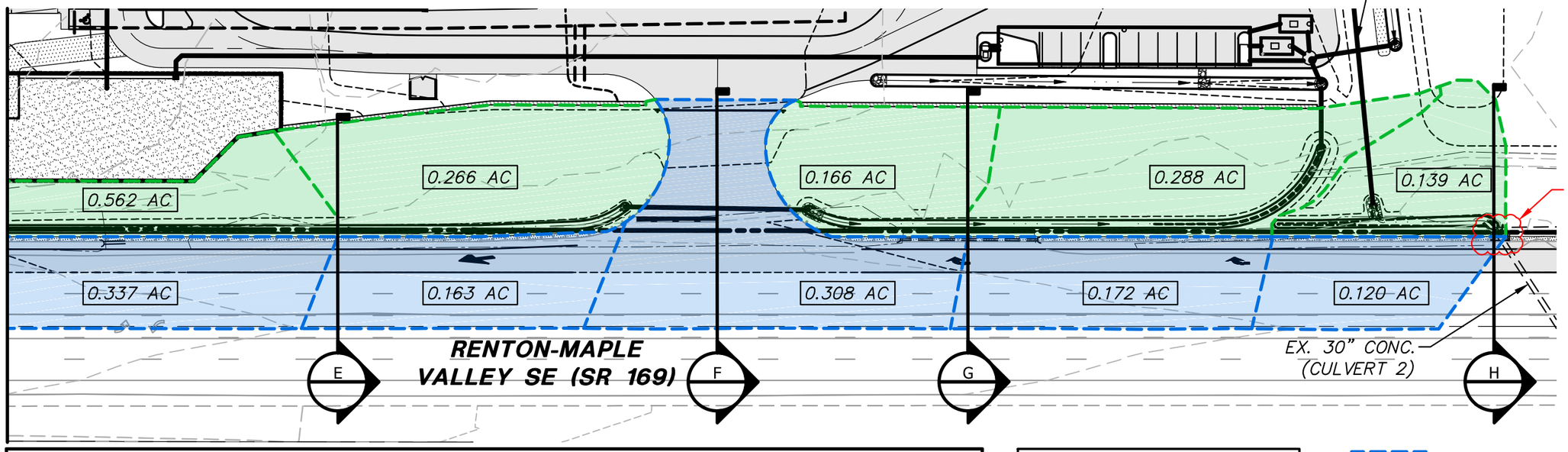
The proposed roadside ditch relocation will not result in any deficiency in conveyance capacity. As demonstrated in the summary table above, each representative cross-section of the proposed ditch has adequate capacity to convey tributary 10-year storm flows without allowing the water surface elevation within the ditch to rise to the point where adjacent pavement subgrade would become saturated.



MATCH LINE, SEE BELOW

SCALE: 1" = 60'

EMERGENCY OVERFLOW FOR ON–SITE INFILTRATION SYSTEM (SYSTEM DESIGNED TO FULLY INFILTRATE Q_{100})



MATCH LINE, SEE ABOVE

ROADSIDE DITCH HYDROLOGY

SECTION	TRIB. PERVIOUS AREA	TRIB. IMPERVIOUS AREA	TYPE	Q_{10}	Q_{100}	Q_{CAP}
B	0.280 AC	0.195 AC	V–DITCH	0.189 CFS	0.370 CFS	2.18 CFS*
C	0.762 AC	0.422 AC	V–DITCH	0.451 CFS	0.893 CFS	0.46 CFS
D	0.884 AC	0.478 AC	V–DITCH	0.517 CFS	1.024 CFS	3.09 CFS
E	0.562 AC	0.337 AC	V–DITCH	0.348 CFS	0.685 CFS	0.46 CFS
F	0.828 AC	0.500 AC	PIPE	0.514 CFS	1.013 CFS	4.90 CFS
G	0.994 AC	0.808 AC	V–DITCH	0.740 CFS	1.436 CFS	7.80 CFS
H	0.139 AC	0.120 AC	V–DITCH	0.108 CFS	0.208 CFS	10.96 CFS

*AT LIMIT OF EASEMENT

FLOW PER ACRE**

10–YEAR FLOW
IMPERVIOUS AREA = 0.591 CFS/AC
PERVIOUS AREA = 0.265 CFS/AC

100–YEAR FLOW
IMPERVIOUS AREA = 1.057 CFS/AC
PERVIOUS AREA = 0.586 CFS/AC

**BASED ON MGSFLOOD MODELING

NOTE: SECTION A IS OUTSIDE OF DITCH IMPACT AREA AND THEREFORE WAS NOT ANALYZED.

IMPERVIOUS TRIBUTARY AREA

PERVIOUS TRIBUTARY AREA

triad
a division of David Evans and Associates, Inc.
20300 Woodinville-Snohomish Rd NE
Suite A • Woodinville, WA 98072
p: 425.415.2000 f: 425.486.5059
w: triadassociates.net

ROADSIDE DITCH HYDROLOGY EXHIBIT

LAKESIDE INDUSTRIES, INC.

MAPLE VALLEY ASPHALT PLANT

18825 RENTON-MAPLE VALLEY SE (SR 169)
KING COUNTY, WASHINGTON

NO.	DATE	REVISION	BY	CK

REVIEWED BY:
DATE:
DESIGNED:
CADD:

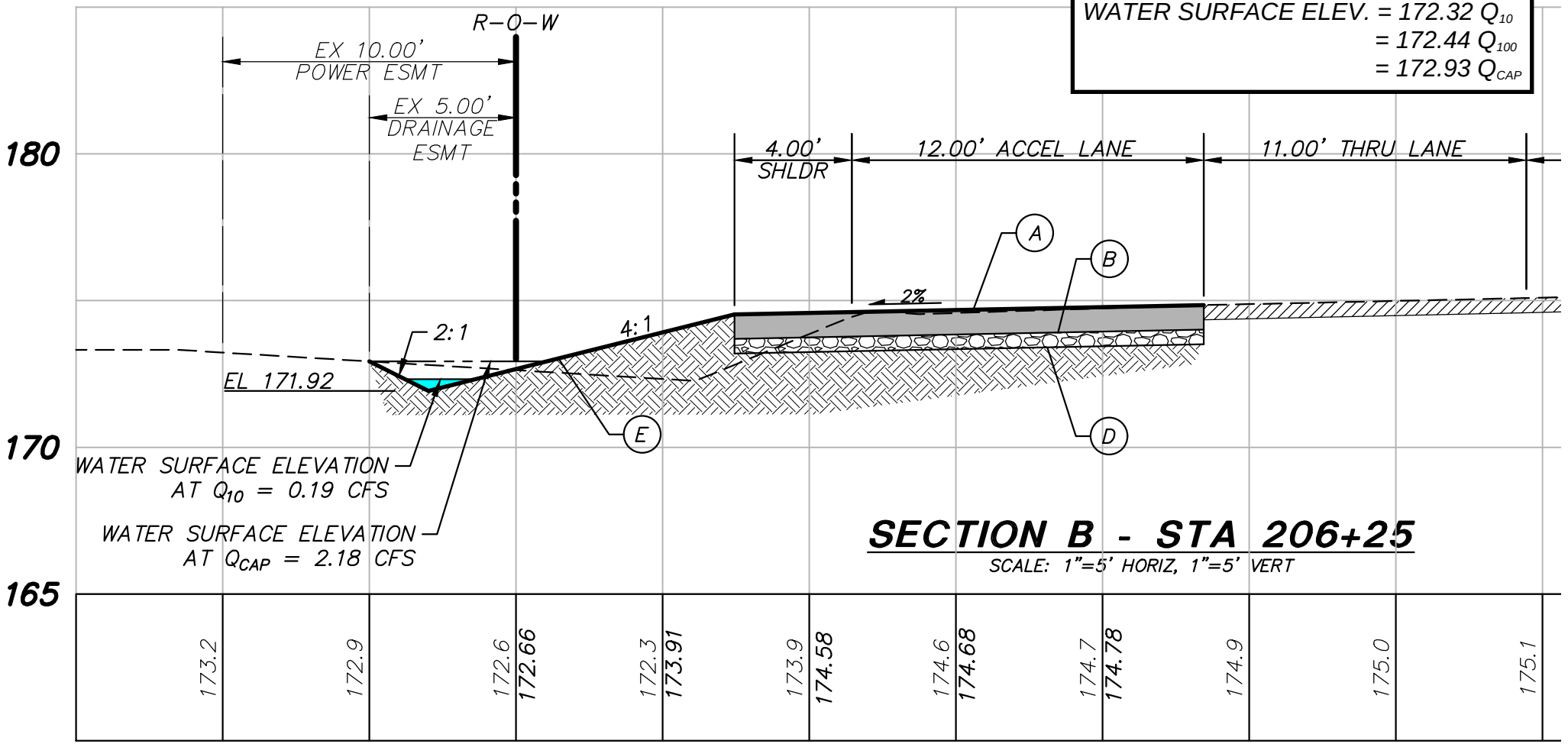
STAMP NOT VALID UNLESS SIGNED AND DATED

FIRST SUBMITTAL DATE: ----
SCALE: HORZ.: 1"=60' VERT.: N/A

PROJECT NO.
LKSD00000002

SHEET NO.
1
OF 1

Plot Date: 5/26/2020 3:10 PM By: Travis Wageman
Save Date: 5/21/2020 8:11 AM By: TJW File: P:\LKSD00000002\04400CAD\EC\Exhibits\Final\2020-05-20 Frontage - Ditch Hydrology\2020-05-20 Frontage Ditch Hydrology Exhibit.dwg



SECTION B - STA 206+25

SCALE: 1"=5' HORIZ, 1"=5' VERT

(A) 10" HMA 1/2" PG 58-22, PER WSDOT SECTIONS 5-04 AND 9-03, ASPHALT COMPACTED TO 95% MAX

(B) 6" MIN CSBC PER WSDOT SECTION 9-03.9(3) COMPACTED TO 95% MODIFIED PROCTOR. CSCC SHALL BE GRADED SMOOTH TO REFLECT FINISHED GRADE

(C) 4" MIN CSTC OVER 12" MIN CSBC COMPACTED TO 95% MODIFIED PROCTOR

(D) COMPACTED SUBGRADE (CUT SECTION) 1' MIN SUB-BASE COMPACTED TO 95% MODIFIED PROCTOR (FILL SECTION)

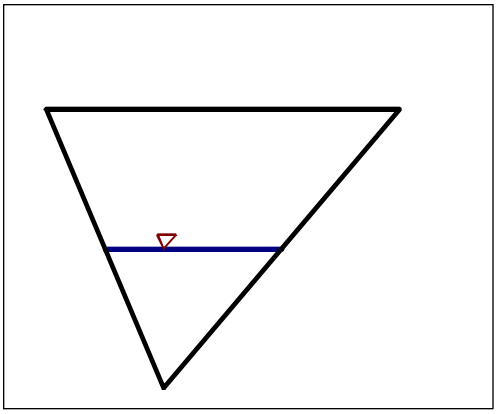
(E) GRASS-LINED DITCH

Q_{CAP} = MAX FLOW TO BE CONVEYED BETWEEN BOTTOM OF SUBGRADE AND DITCH INVERT

Q_{10} = 10 YEAR STORM FLOW TRIBUTARY TO DITCH

Section B - Capacity

	Input	Output	
Q (cfs)	0.00	2.18	
n	0.090	0.090	
B (ft)	0.00	0.00	Trap.
LSSlope (X:1)	2.00	2.00	
RSSlope (X:1)	4.00	4.00	
y (ft)	1.01	1.01	
S (ft/ft)	0.005	0.005	

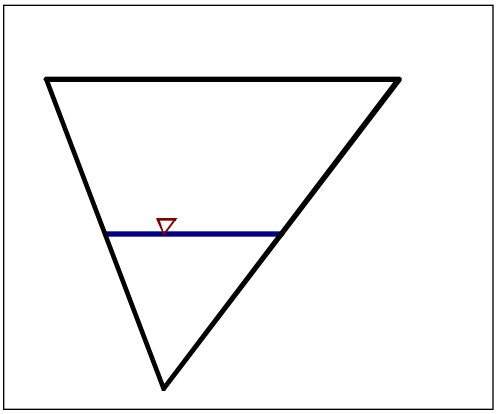


A (sf)	3.060		
Pw (ft)	6.423	**V (ft/s)**	0.712
R (ft)	0.476		

Job: LKSD0000-0002 **Description:** Section B - Capacity
By: TJW **Date:** 5/21/2020

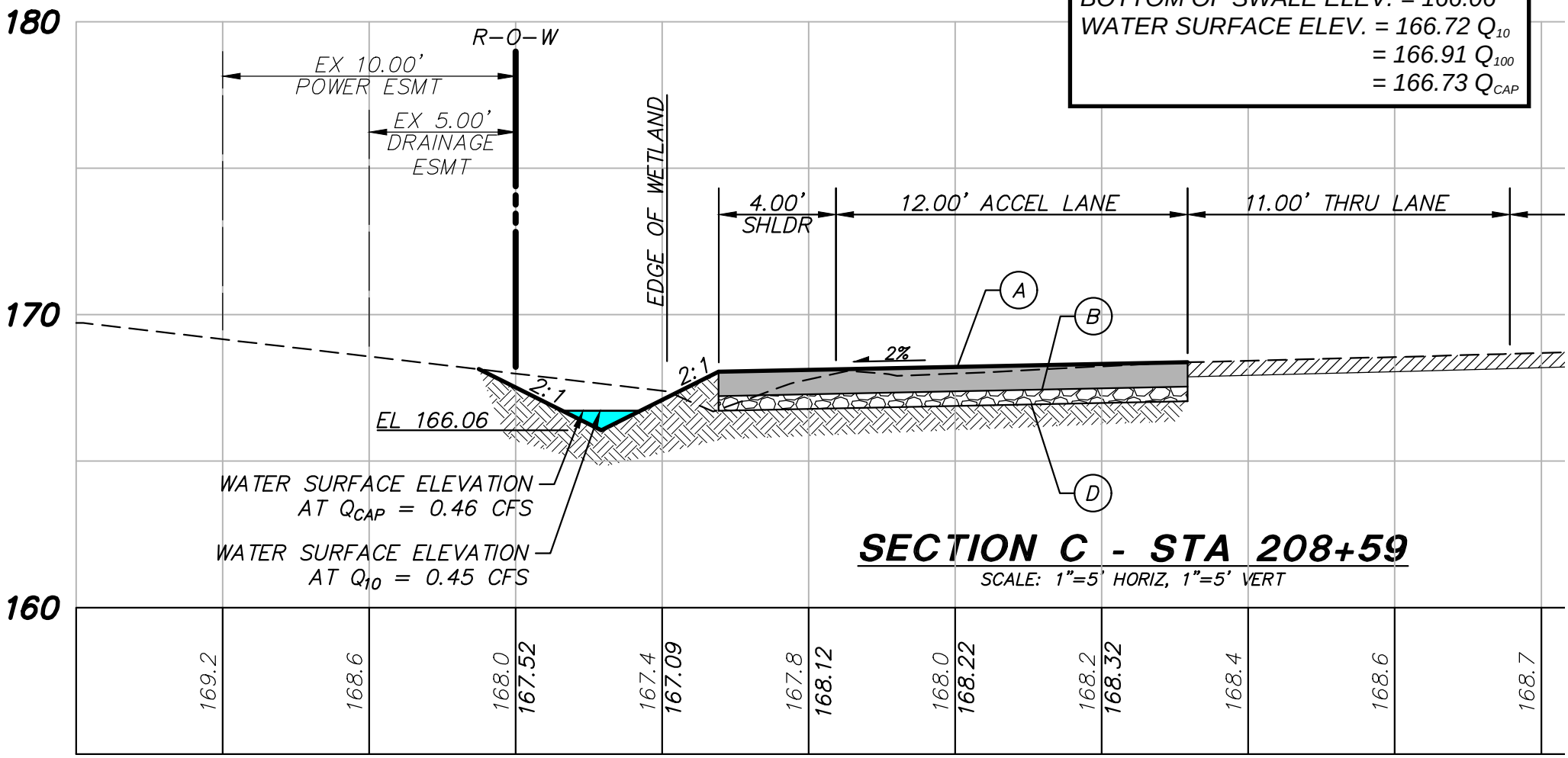
Section B - 10yr

	Input	Output	
Q (cfs)	0.00	0.19	
n	0.090	0.090	
B (ft)	0.00	0.00	Trap.
LSSlope (X:1)	2.00	2.00	
RSSlope (X:1)	4.00	4.00	
y (ft)	0.40	0.40	
S (ft/ft)	0.005	0.005	



A (sf)	0.489		
Pw (ft)	2.568	**V (ft/s)**	0.386
R (ft)	0.190		

Job: LKSD0000-0002 **Description:** Section B - 10-year Depth
By: TJW **Date:** 5/21/2020



SECTION C - STA 208+59

SCALE: 1"=5' HORIZ, 1"=5' VERT

(A) 10" HMA 1/2" PG 58-22, PER WSDOT SECTIONS 5-04 AND 9-03, ASPHALT COMPACTED TO 95% MAX

(B) 6" MIN CSBC PER WSDOT SECTION 9-03.9(3) COMPACTED TO 95% MODIFIED PROCTOR. CSCC SHALL BE GRADED SMOOTH TO REFLECT FINISHED GRADE

(C) 4" MIN CSTC OVER 12" MIN CSBC COMPACTED TO 95% MODIFIED PROCTOR

(D) COMPACTED SUBGRADE (CUT SECTION) 1' MIN SUB-BASE COMPACTED TO 95% MODIFIED PROCTOR (FILL SECTION)

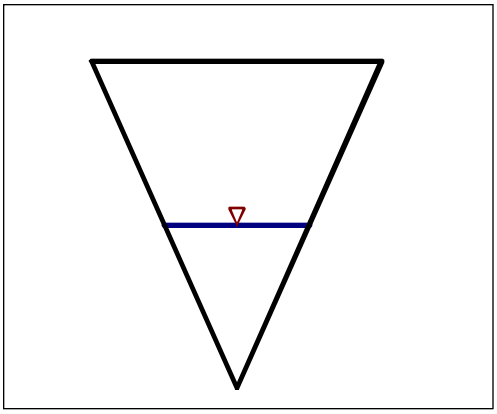
(E) GRASS-LINED DITCH

Q_{CAP} = MAX FLOW TO BE CONVEYED BETWEEN BOTTOM OF SUBGRADE AND DITCH INVERT

Q_{10} = 10 YEAR STORM FLOW TRIBUTARY TO DITCH

Section C - Capacity

	Input	Output	
Q (cfs)	0.00	0.46	
n	0.090	0.090	
B (ft)	0.00	0.00	Trap.
LSSlope (X:1)	2.00	2.00	
RSSlope (X:1)	2.00	2.00	
y (ft)	0.66	0.66	
S (ft/ft)	0.005	0.005	

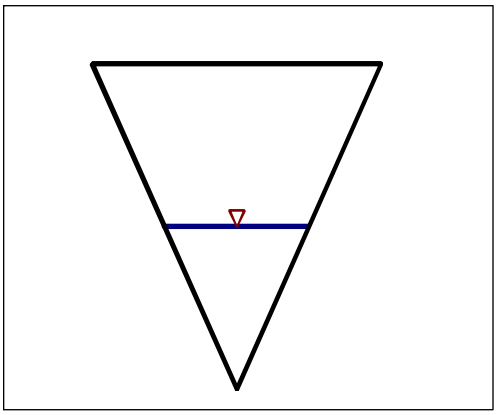


A (sf)	0.882		
Pw (ft)	2.970	**V (ft/s)**	0.520
R (ft)	0.297		

Job: LKSD0000-0002 **Description:** Section C - Capacity
By: TJW **Date:** 5/21/2020

Section C - 10yr

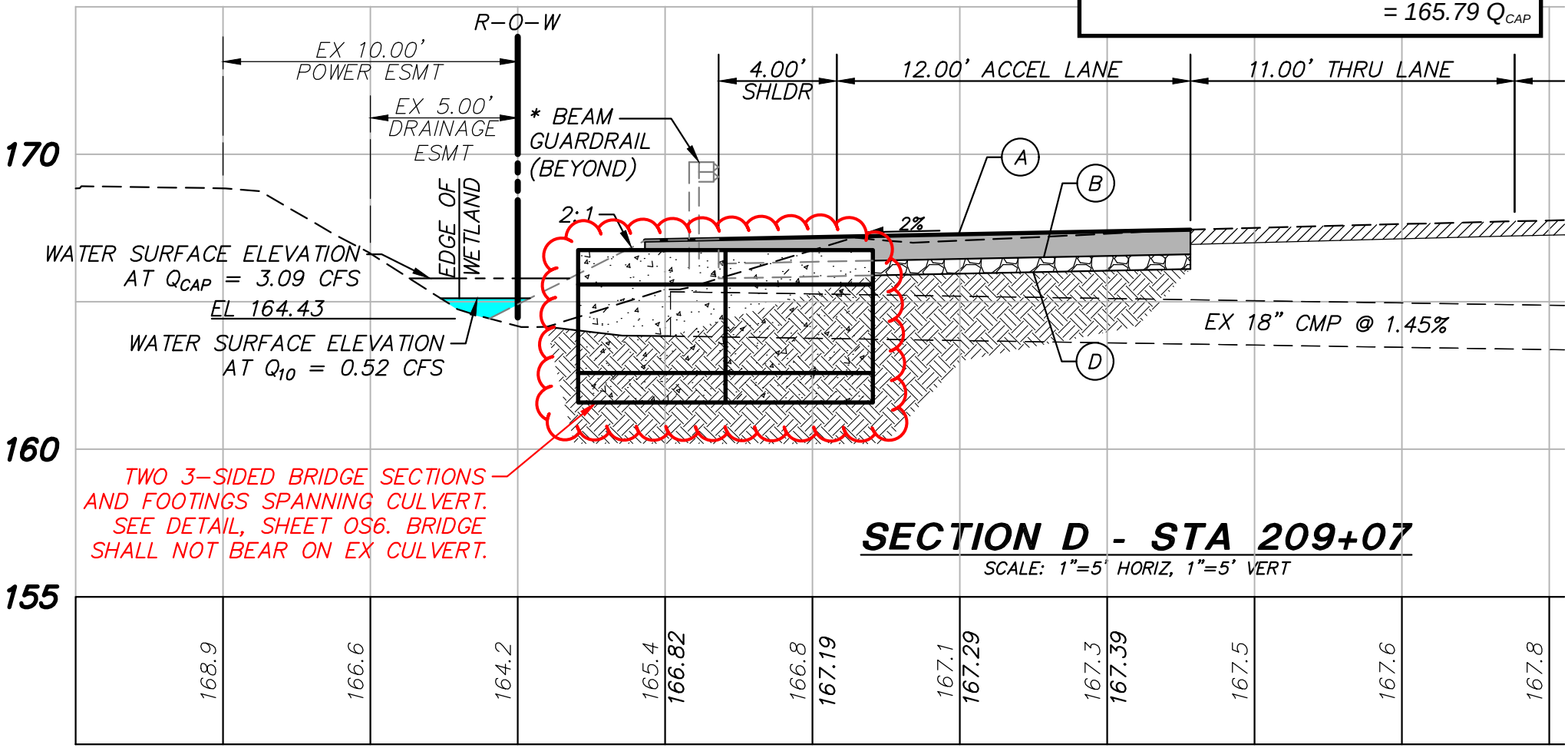
	Input	Output	
Q (cfs)	0.00	0.45	
n	0.090	0.090	
B (ft)	0.00	0.00	Trap.
LSSlope (X:1)	2.00	2.00	
RSSlope (X:1)	2.00	2.00	
y (ft)	0.66	0.66	
S (ft/ft)	0.005	0.005	



A (sf)	0.870		
Pw (ft)	2.950	**V (ft/s)**	0.517
R (ft)	0.295		

Job: LKSD0000-0002 **Description:** Section C - Capacity
By: TJW **Date:** 5/21/2020

BOTTOM OF SWALE ELEV. = 164.43
WATER SURFACE ELEV. = 165.12 Q_{10}
= 165.33 Q_{100}
= 165.79 Q_{CAP}



SECTION D - STA 209+07

SCALE: 1"=5' HORIZ, 1"=5' VERT

168.9	166.6	164.2	165.4	**166.82**	166.8	**167.19**	167.1	**167.29**	167.3	**167.39**	167.5	167.6	167.8

(A) 10" HMA 1/2" PG 58-22, PER WSDOT SECTIONS 5-04 AND 9-03, ASPHALT COMPACTED TO 95% MAX

(B) 6" MIN CSBC PER WSDOT SECTION 9-03.9(3) COMPACTED TO 95% MODIFIED PROCTOR. CSCC SHALL BE GRADED SMOOTH TO REFLECT FINISHED GRADE

(C) 4" MIN CSTC OVER 12" MIN CSBC COMPACTED TO 95% MODIFIED PROCTOR

(D) COMPACTED SUBGRADE (CUT SECTION) 1' MIN SUB-BASE COMPACTED TO 95% MODIFIED PROCTOR (FILL SECTION)

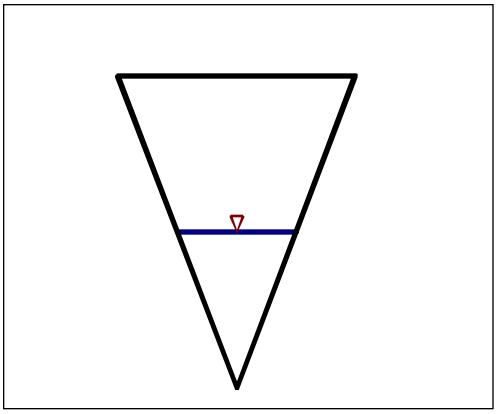
(E) GRASS-LINED DITCH

Q_{CAP} = MAX FLOW TO BE CONVEYED BETWEEN BOTTOM OF SUBGRADE AND DITCH INVERT

Q_{10} = 10 YEAR STORM FLOW TRIBUTARY TO DITCH

Section D - Capacity

	Input	Output	
Q (cfs)	0.00	3.09	
n	0.090	0.090	
B (ft)	0.00	0.00	Trap.
LSSlope (X:1)	2.00	2.00	
RSSlope (X:1)	2.00	2.00	
y (ft)	1.36	1.36	
S (ft/ft)	0.005	0.005	

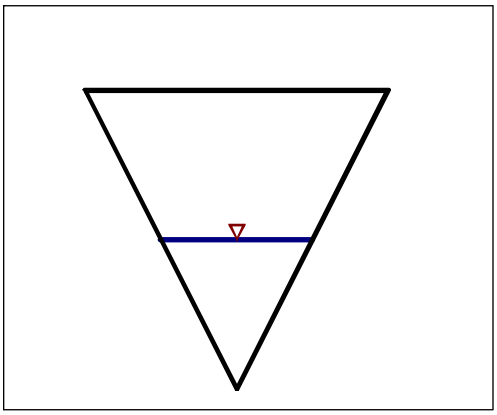


A (sf)	3.688		
Pw (ft)	6.073	**V (ft/s)**	0.837
R (ft)	0.607		

Job: LKSD0000-0002 **Description:** Section D - Capacity
By: TJW **Date:** 5/21/2020

Section D - 10yr

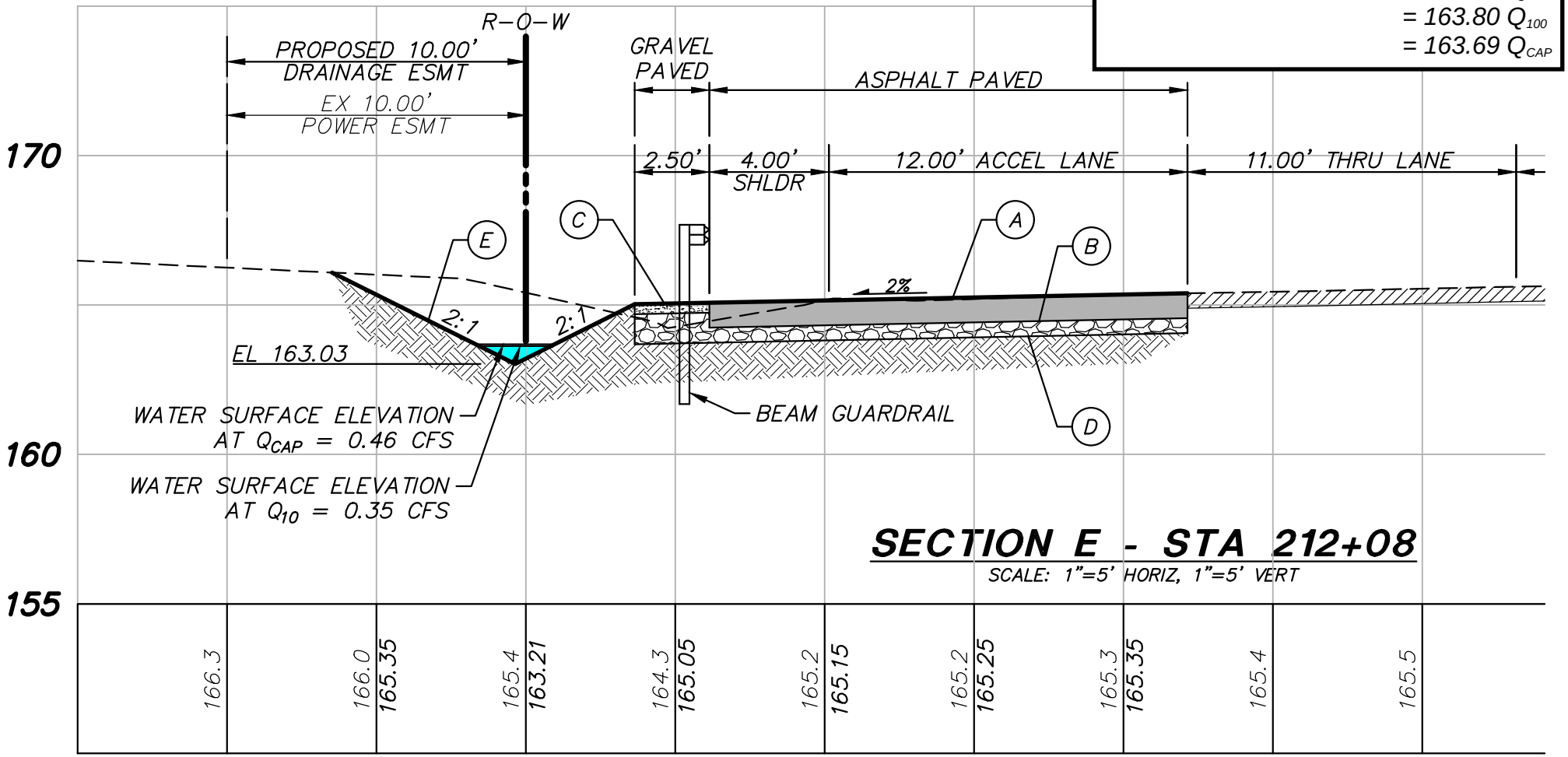
	Input	Output	
Q (cfs)	0.00	0.52	
n	0.090	0.090	
B (ft)	0.00	0.00	Trap.
LSSlope (X:1)	2.00	2.00	
RSSlope (X:1)	2.00	2.00	
y (ft)	0.69	0.69	
S (ft/ft)	0.005	0.005	



A (sf)	0.965		
Pw (ft)	3.107	**V (ft/s)**	0.536
R (ft)	0.311		

Job: LKSD0000-0002 **Description:** Section D - 10-year Depth
By: TJW **Date:** 5/21/2020

BOTTOM OF SWALE ELEV. = 163.03
WATER SURFACE ELEV. = 163.63 Q_{10}
= 163.80 Q_{100}
= 163.69 Q_{CAP}



SECTION E - STA 212+08

SCALE: 1"=5' HORIZ, 1"=5' VERT

(A) 10" HMA 1/2" PG 58-22, PER WSDOT SECTIONS 5-04 AND 9-03, ASPHALT COMPACTED TO 95% MAX

(B) 6" MIN CSBC PER WSDOT SECTION 9-03.9(3) COMPACTED TO 95% MODIFIED PROCTOR. CSCC SHALL BE GRADED SMOOTH TO REFLECT FINISHED GRADE

(C) 4" MIN CSTC OVER 12" MIN CSBC COMPACTED TO 95% MODIFIED PROCTOR

(D) COMPACTED SUBGRADE (CUT SECTION) 1' MIN SUB-BASE COMPACTED TO 95% MODIFIED PROCTOR (FILL SECTION)

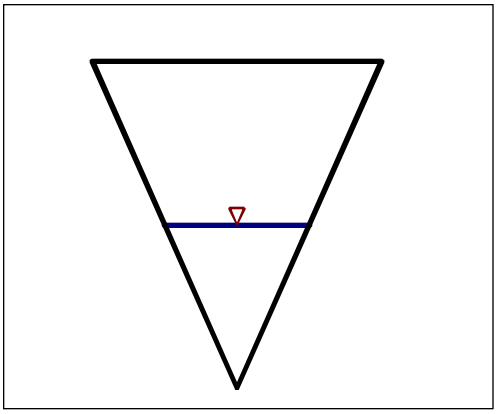
(E) GRASS-LINED DITCH

Q_{CAP} = MAX FLOW TO BE CONVEYED BETWEEN BOTTOM OF SUBGRADE AND DITCH INVERT

Q_{10} = 10 YEAR STORM FLOW TRIBUTARY TO DITCH

Section E - Capacity

	Input	Output	
Q (cfs)	0.00	0.46	
n	0.090	0.090	
B (ft)	0.00	0.00	Trap.
LSSlope (X:1)	2.00	2.00	
RSSlope (X:1)	2.00	2.00	
y (ft)	0.66	0.66	
S (ft/ft)	0.005	0.005	

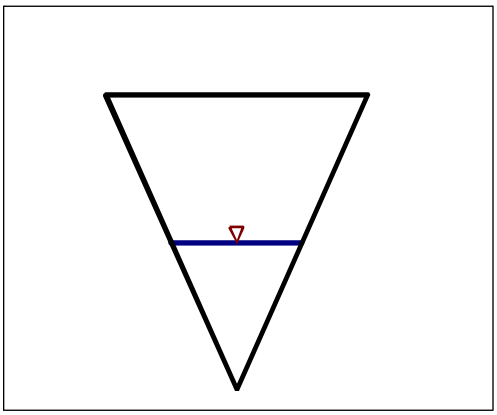


A (sf)	0.879		
Pw (ft)	2.965	**V (ft/s)**	0.519
R (ft)	0.297		

Job: LKSD0000-0002 **Description:** Section E - Capacity
By: TJW **Date:** 5/21/2020

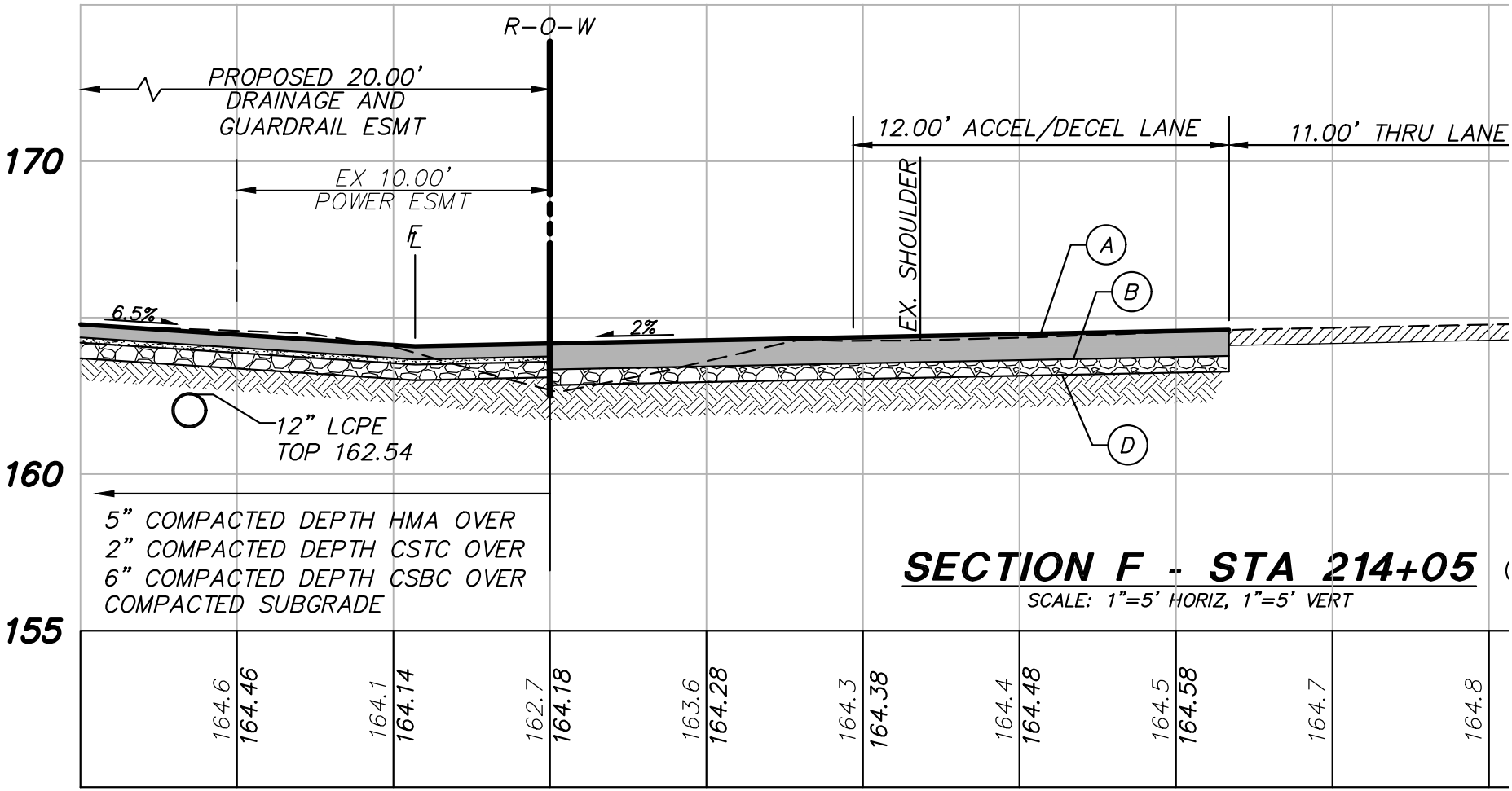
Section E - 10yr

	Input	Output	
Q (cfs)	0.00	0.35	
n	0.090	0.090	
B (ft)	0.00	0.00	Trap.
LSSlope (X:1)	2.00	2.00	
RSSlope (X:1)	2.00	2.00	
y (ft)	0.60	0.60	
S (ft/ft)	0.005	0.005	



A (sf)	0.718		
Pw (ft)	2.679	**V (ft/s)**	0.485
R (ft)	0.268		

Job: LKSD0000-0002 **Description:** Section E - 10-year Depth
By: TJW **Date:** 5/21/2020



SECTION F - STA 214+05

SCALE: 1"=5' HORIZ, 1"=5' VERT

(A) 10" HMA 1/2" PG 58-22, PER WSDOT SECTIONS 5-04 AND 9-03, ASPHALT COMPACTED TO 95% MAX

(B) 6" MIN CSBC PER WSDOT SECTION 9-03.9(3) COMPACTED TO 95% MODIFIED PROCTOR. CSCC SHALL BE GRADED SMOOTH TO REFLECT FINISHED GRADE

(C) 4" MIN CSTC OVER 12" MIN CSBC COMPACTED TO 95% MODIFIED PROCTOR

(D) COMPACTED SUBGRADE (CUT SECTION) 1' MIN SUB-BASE COMPACTED TO 95% MODIFIED PROCTOR (FILL SECTION)

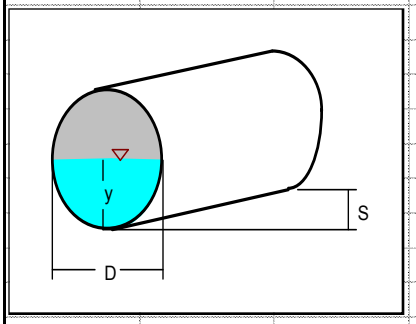
(E) GRASS-LINED DITCH

Q_{CAP} = MAX FLOW TO BE CONVEYED BETWEEN BOTTOM OF SUBGRADE AND DITCH INVERT

Q_{10} = 10 YEAR STORM FLOW TRIBUTARY TO DITCH

Section F - Pipe

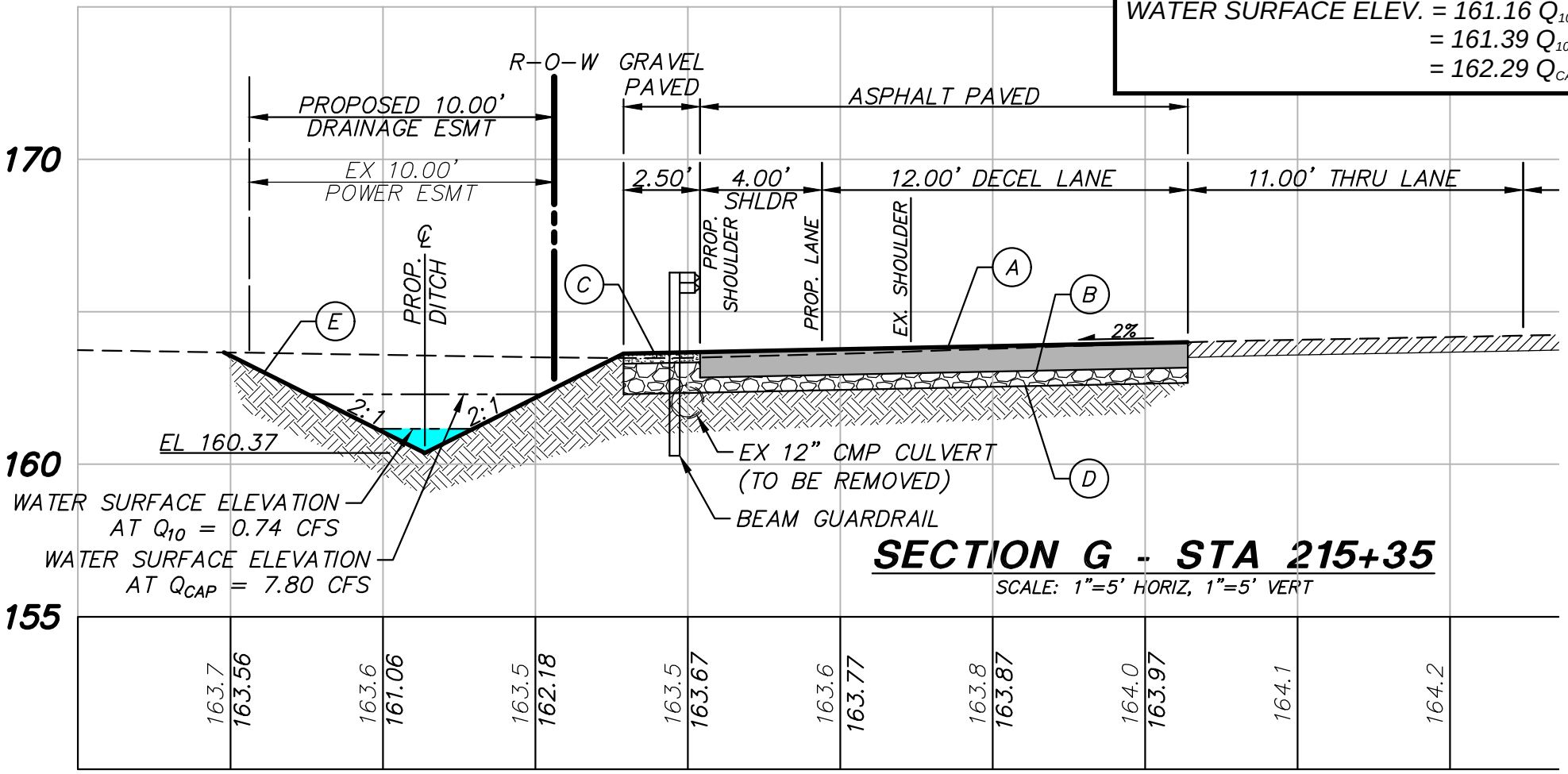
	Input	Output							
Q (cfs)	0.00	4.90							
n	0.012	0.012							
d (ft)	1.00	1.00		1	0	/16	inches		
y (ft)	1.00	1.00							
S (ft/ft)	0.016	0.016							



A (sf)	0.785		
Pw (ft)	3.142	**V (ft/s)**	6.235
R (ft)	0.250		
Critical y (ft) =			
Qmax @ y (ft) =	0.9382		
Vmax @ y (ft) =	0.8128		

Job:	LKSD0000-0002	**Description:**	Section F - Pipe Capacity
By:	TJW	**Date:**	3/28/2019

BOTTOM OF SWALE ELEV. = 160.37
WATER SURFACE ELEV. = 161.16 Q_{10}
= 161.39 Q_{100}
= 162.29 Q_{CAP}



SECTION G - STA 215+35

SCALE: 1"=5' HORIZ, 1"=5' VERT

(A) 10" HMA 1/2" PG 58-22, PER WSDOT SECTIONS 5-04 AND 9-03, ASPHALT COMPACTED TO 95% MAX

(B) 6" MIN CSBC PER WSDOT SECTION 9-03.9(3) COMPACTED TO 95% MODIFIED PROCTOR. CSCC SHALL BE GRADED SMOOTH TO REFLECT FINISHED GRADE

(C) 4" MIN CSTC OVER 12" MIN CSBC COMPACTED TO 95% MODIFIED PROCTOR

(D) COMPACTED SUBGRADE (CUT SECTION) 1' MIN SUB-BASE COMPACTED TO 95% MODIFIED PROCTOR (FILL SECTION)

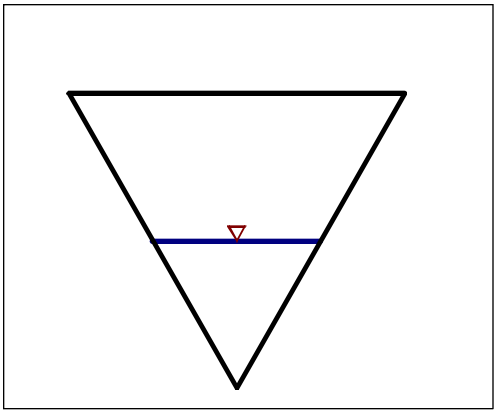
(E) GRASS-LINED DITCH

Q_{CAP} = MAX FLOW TO BE CONVEYED BETWEEN BOTTOM OF SUBGRADE AND DITCH INVERT

Q_{10} = 10 YEAR STORM FLOW TRIBUTARY TO DITCH

Section G - Capacity

	Input	Output	
Q (cfs)	0.00	7.80	
n	0.090	0.090	
B (ft)	0.00	0.00	Trap.
LSSlope (X:1)	2.00	2.00	
RSSlope (X:1)	2.00	2.00	
y (ft)	1.92	1.92	
S (ft/ft)	0.005	0.005	



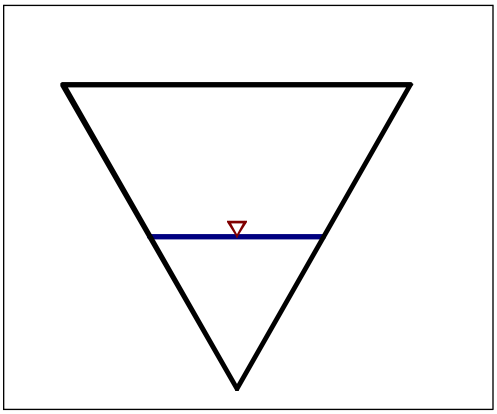
A (sf)	7.388		
Pw (ft)	8.595	**V (ft/s)**	1.055
R (ft)	0.860		

Job: LKSD0000-0002
By: TJW

Description: Section G - Capacity
Date: 5/21/2020

Section G - 10yr

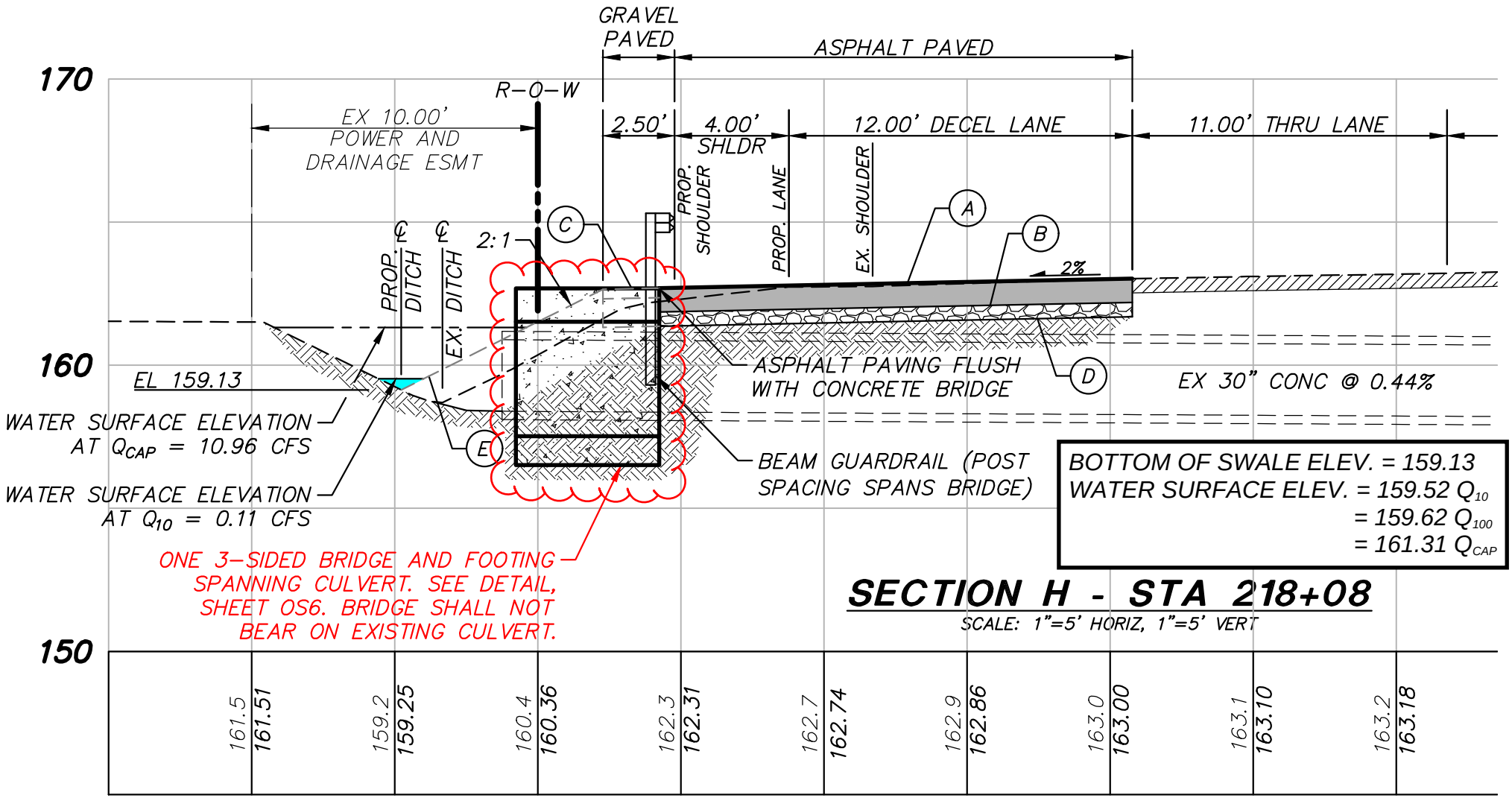
	Input	Output	
Q (cfs)	0.00	0.74	
n	0.090	0.090	
B (ft)	0.00	0.00	Trap.
LSSlope (X:1)	2.00	2.00	
RSSlope (X:1)	2.00	2.00	
y (ft)	0.79	0.79	
S (ft/ft)	0.005	0.005	



A (sf)	1.263		
Pw (ft)	3.554	**V (ft/s)**	0.586
R (ft)	0.355		

Job: LKSD0000-0002
By: TJW

Description: Section G - 10-year Depth
Date: 5/21/2020



BOTTOM OF SWALE ELEV. = 159.13
WATER SURFACE ELEV. = 159.52 Q_{10}
= 159.62 Q_{100}
= 161.31 Q_{CAP}

SECTION H - STA 218+08

SCALE: 1"=5' HORIZ, 1"=5' VERT

(A) 10" HMA 1/2" PG 58–22, PER WSDOT SECTIONS 5–04 AND 9–03, ASPHALT COMPACTED TO 95% MAX

(B) 6" MIN CSBC PER WSDOT SECTION 9–03.9(3) COMPACTED TO 95% MODIFIED PROCTOR. CSCC SHALL BE GRADED SMOOTH TO REFLECT FINISHED GRADE

(C) 4" MIN CSTC OVER 12" MIN CSBC COMPACTED TO 95% MODIFIED PROCTOR

(D) COMPACTED SUBGRADE (CUT SECTION) 1' MIN SUB–BASE COMPACTED TO 95% MODIFIED PROCTOR (FILL SECTION)

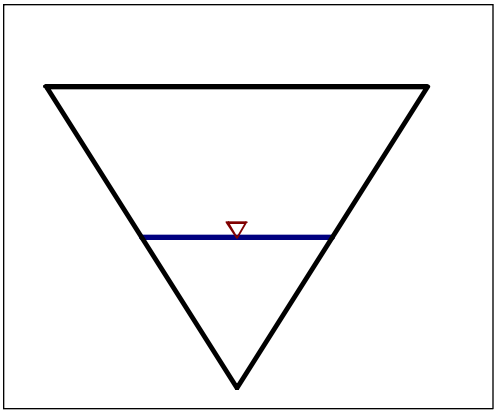
(E) GRASS–LINED DITCH

Q_{CAP} = MAX FLOW TO BE CONVEYED BETWEEN BOTTOM OF SUBGRADE AND DITCH INVERT

Q_{10} = 10 YEAR STORM FLOW TRIBUTARY TO DITCH

Section H - Capacity

	Input	Output	
Q (cfs)	0.00	10.96	
n	0.090	0.090	
B (ft)	0.00	0.00	Trap.
LSSlope (X:1)	2.00	2.00	
RSSlope (X:1)	2.00	2.00	
y (ft)	2.18	2.18	
S (ft/ft)	0.005	0.005	

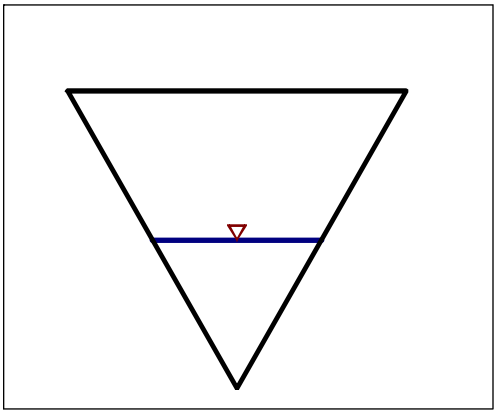


A (sf)	9.540		
Pw (ft)	9.767	**V (ft/s)**	1.149
R (ft)	0.977		

Job: LKSD0000-0002 **Description:** Section H - Capacity
By: TJW **Date:** 5/21/2020

Section H - 10yr

	Input	Output	
Q (cfs)	0.00	0.11	
n	0.090	0.090	
B (ft)	0.00	0.00	Trap.
LSSlope (X:1)	2.00	2.00	
RSSlope (X:1)	2.00	2.00	
y (ft)	0.39	0.39	
S (ft/ft)	0.005	0.005	



A (sf)	0.300		
Pw (ft)	1.733	**V (ft/s)**	0.363
R (ft)	0.173		

Job: LKSD0000-0002 **Description:** Section H - 10-year Depth
By: TJW **Date:** 5/21/2020

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.31
Program License Number: 200410013
Run Date: 03/21/2019 4:03 PM

Input File Name: Lakeside.fld
Project Name: Lakeside
Analysis Title:
Comments:

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Extended Precipitation Timeseries Selected
Climatic Region Number: 14

Full Period of Record Available used for Routing
Precipitation Station : 96004405 Puget East 44 in_5min 10/01/1939-10/01/2097
Evaporation Station : 961044 Puget East 44 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 **********

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

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

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	0.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	1.000
Subbasin Total	1.000

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

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

	-------Area(Acres) --------
Till Forest	0.000
Till Pasture	0.000
Till Grass	1.000
Outwash Forest	0.000
Outwash Pasture	0.000
Outwash Grass	0.000
Wetland	0.000
Green Roof	0.000
User 2	0.000
Impervious	0.000

Subbasin Total 1.000

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

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

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

----------SCENARIO: POSTDEVELOPED
Number of Links: 0

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

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

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

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
Total:	0.000

Total Post Developed Recharge During Simulation

Model Element	Recharge Amount (ac-ft)
Subbasin: Subbasin 1	128.796
Total:	128.796

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 158)
Predeveloped: 0.000 ac-ft/year, Post Developed: 0.815 ac-ft/year

Water Quality Facility Data

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

Number of Links: 0

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

Number of Links: 0

Compliance Point Results

Scenario Predeveloped Compliance Subbasin: Subbasin 1

Scenario Postdeveloped Compliance Subbasin: Subbasin 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	0.388	2-Year	0.114
5-Year	0.508	5-Year	0.188
10-Year	0.591	10-Year	0.265
25-Year	0.712	25-Year	0.371
50-Year	0.863	50-Year	0.497
100-Year	1.057	100-Year	0.586
200-Year	1.105	200-Year	0.617

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

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

Excursion at Predeveloped 50%Q2 (Must be Less Than 0%):	-98.4%	PASS
Maximum Excursion from 50%Q2 to Q2 (Must be Less Than 0%):	-96.4%	PASS
Maximum Excursion from Q2 to Q50 (Must be less than 10%):	-75.0%	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%):	-93.2%	PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):	-94.5%	PASS

MEETS ALL LID DURATION DESIGN CRITERIA: PASS
