Ph: 970-871-6772 · Fax: 970-879-8023 · P.O. Box 775966 · Steamboat Springs, Colorado 80477

Draft Drainage Study & Stormwater Quality Plan for Steamboat Airpark Preliminary Plat

Address: TBD

Draft: 4/25/2022
Revised: 6/16/2023

Prepared by: Walter Magill, P.E.
Four Points Surveying & Engineering

P.O. Box 775966
Steamboat Springs, Colorado 80477
(970) 871-6772

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NOTE

City of Steamboat Springs plan review and approval is only for general conformance with City design criteria and City code. The City is not responsible for the accuracy and adequacy of the design, dimensions, and elevations that shall be confirmed and correlated at this job site. The City of Steamboat Springs assumes no responsibility for the completeness or accuracy of this document.

CERTIFICATION

I hereby affirm that this Drainage Report for the (name of project) was prepared by me (or under my direct supervision) for the owners thereof and is, to the best of my knowledge, in accordance with the provisions of the City of Steamboat Springs Storm Drainage Criteria and approved variances. I understand that the City of Steamboat Springs does not and will not assume liability for drainage facilities designed by others.

_____

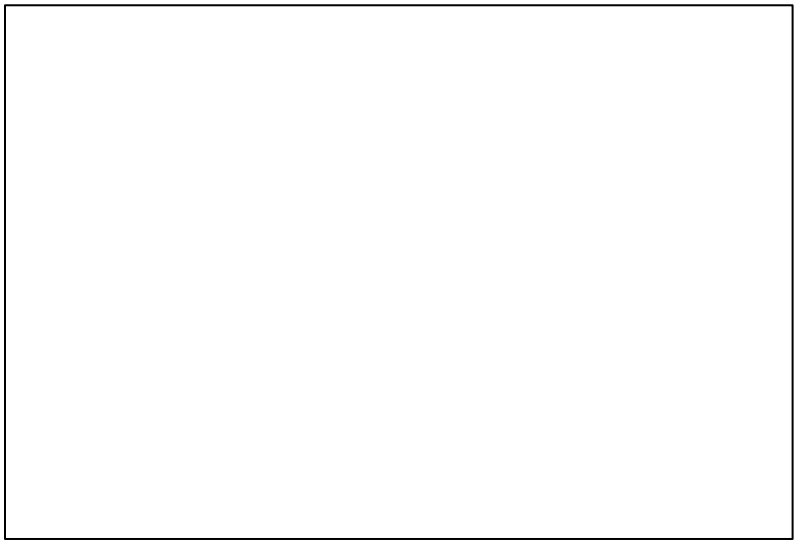
: D O W H U 0 D J L O O, P.E.
State of Colorado No. 00

1.0 Introduction

This report provides a detailed analysis of existing and proposed post-development drainage conditions and proposed water quality facilities at Lot 1 West Acres Ranch Subdivision. The conditional improvements associated with the plat include a 24-foot access road, a detached sidewalk along Gloria Gossard Parkway, earth retainage, and stormwater drainage infrastructure (Project). This report includes all data, engineering methods, assumptions, and calculations used by Four Points Surveying and Engineering (Four Points) to design the stormwater drainage system for the Project. Four Points prepared this report and performed engineering for the Project in accordance with the most recent version of the City of Steamboat Springs Drainage Criteria and Engineering Standards.

A. Location

Figure 1: Site Vicinity Map – Lot 1 West Acres Ranch Subdivision



B. Owner/Developer

Ken Marsh

C. DrainageReports for Adjacent Developments

1. Joe Wiedemeier, P.E. Four Points Surveying and Engineering (March 2020) Final Drainage Study for Overlook Park Subdivision.

D. Stormwater Quality Purpose, Goal, and Special Requirements

The purpose of the stormwater quality plan is to design a conveyance and treatment system that fits with the proposed Project and provides both functionality and aesthetics. The goal is to treat stormwater runoff from the proposed road impervious surfaces per City standards.

2.0 Drainage Criteria and Methodology Used

A. Design Rainfall and Storm Frequency

Design rainfall: NOAA Atlas 14, Volume 8, Version 2 for Steamboat Springs, CO.

- Minor Event (5-year) 24-hour rainfall depth: 1.59 inches
- Major Event (100-year) 24-hour rainfall depth: 2.91 inches

B. Runoff Calculation Methodology

Runoff calculation method: Small basin peak flow runoff was analyzed using the Rational Method, shown in Eq-1.

Rational Method: **Q = CiA** (Eq-1)

Where: Q = runoff, CFS
C = runoff coefficient, dimensionless
i = rainfall intensity, inches per hour
A = basin area, acres

C. Stormwater Quality Design Standard

Proposed permanent stormwater treatment facilities will meet water quality capture volume (WQCV) design standards. WQCV calculations were performed for combined detention pond and sand filter per City drainage engineering standards.

3.0 Existing Conditions

A. Ground Cover, Imperviousness, Topography and Size

- Vacant undeveloped lot with mountainous terrain
- Gloria Gossard Boulevard (Paved Road)
- Rough cut access road and a two-track trail
- Temporary 12”-18” culverts installed on the rough cut road
- 2% imperviousness
- Moderate to steep sloping terrain rugged terrain
- Total lot size: 131.5 acres (Lot 1 and Lot 1 Remainder Parcel)

B. Existing Stormwater Systems

See existing conditions drainage exhibit, DR1, to view the existing conditions and existing drainage basin designations.

- Existing basin (EB) EB1 drains west and into the Overlook Park Subdivision.
- EB2 drains south-southwest and into a ditch and travels west into the Overlook Park Subdivision as concentrated flow. Gloria Gossard Parkway borders the southern portion of the Lot 1/Lot remainder parcel and is public right-of-way. A high point on Gloria Gossard Parkway divides EB2 and EB3.
- EB3 drains to two parallel 30” culverts conveying concentrated flows under Gloria Gossard.
- EB4 drains south and into an existing ditch along Gloria Gossard that flows east into a public storm sewer.
- EB5 drains to an existing cutoff ditch and detention pond that outfalls into the Overlook Park Subdivision.

C. Site Outfall and Ultimate Outfall Locations

EB1, EB2, and EB5 outfall into the Overlook Park Subdivision which feeds into Slate Creek and ultimately the Yampa River. EB3 and EB4 outfall into existing stormwater infrastructure and ultimately the Yampa River.

D. USDA NRCS Soil Type

A USDA NRCS Web Soil Survey was performed to determine basic soil characteristics within the Lot 1. Soil types include:

- Eckmanpark clay ÆHydrologic Soil Group Rating: D
- Eckmanpark clay loam ÆHydrologic Soil Group Rating: D
- Impass silty clay loam ÆHydrologic Soul Group Rating: C

E. Existing Easements

See existing conditions drainage exhibit for existing easement locations. A 40-foot wide construction and slope maintenance easement on the north side of Gloria Gossard.

4.0 Proposed Conditions

A. Proposed Stormwater Systems

See proposed conditions drainage exhibit, DR2. Proposed conditions will maintain historic outfall points but drainage patterns will be changed with the proposed access road, sidewalk, and other drainage improvements. The new sidewalk will increase impervious surface area by 0.80 acres. The new road will increase impervious surface area by 1.40 acres. Drainage infrastructure additions include standard drainage curb and gutter installed along the north side of Gloria Gossard Parkway, 12-foot-wide drainage ditches, culverts (18" and 24" for the Airpark Access Road), stormwater inlets (Denver Type 16), storm sewer piping and pervious sidewalk shoulder and French drains along portions of the proposed 8-foot wide sidewalk that abuts the steep slopes along the north side of Gloria Gossard Blvd.

Design points (DP's) were used to identify the historic and proposed major outfall points identify points where gutter/roadway capacity, drainage ditch capacity, inlet capacity, and culvert capacity were analyzed. Design points are identified on the drainage exhibits, DR1 and DR2.

B. Ground Cover, Imperviousness, Topography and Size

- Total area of development is approximately 6.50 acres.
- Finished ground cover will consist of undeveloped area and paving.
- Runoff from the Airpark Access Road will be collected and routed via drainage ditches to the proposed bypass culverts and inlets feeding into the detention and water quality pond.
- Airpark Access Road Impervious area: 0.75 acres
- Airpark Access Road Impervious area to be treated: 0.60 acres

C. Outlets: Historic and Proposed Flow

Historic outfall points will be maintained under the proposed conditions.

D. Hydraulic Calculations

- Inlet capacity was analyzed using UD-Inlet version 4.05 design spreadsheet.
- Roadway curb and gutter, Storm sewer piping, drainage swales and culvert crossings were analyzed using AutoCAD Hydroflow Express software.

E. Major and Minor Flow Summary Table

Existing and proposed drainage was analyzed by dividing the lot into existing basins (e.g. EB1) for the existing conditions analysis and sub-basins (e.g. SB1) for the proposed conditions analysis. Major and minor flows for each basin are summarized in Table 1, see following page.

Table 1: Major and Minor Flow Summary Table

Basin ID	Area (acres)	Impervious Area (%)	Runoff	
			Q_5 (cfs)	Q_{100} (cfs)
EB1	13.70	2%	3.18	21.73
EB2	24.75	3%	6.40	42.36
EB3	25.75	4%	7.28	46.89
EB4	1.92	12%	1.37	7.24
EB5	2.50	2%	0.91	6.22
SB1	11.50	2%	2.67	18.24
SB2	28.20	2%	6.61	45.13
SB3	12.40	2%	3.42	23.31
SB4	2.00	2%	0.91	6.20
SB5	0.20	100%	0.67	1.56
SB6	0.47	100%	1.57	3.66
SB7	2.78	9%	1.63	9.23
SB8	0.28	2%	0.16	1.10
SB9	4.35	4%	1.63	10.41
SB12	0.65	85%	1.65	4.16
SB13	0.54	96%	1.56	3.71
SB14	0.23	100%	0.77	1.79
SB15	0.47	75%	0.97	2.61
SB16	0.17	100%	0.57	1.33
SB17	0.17	100%	0.57	1.33

F. Proposed Easements

A drainage easement is proposed for the detention pond and sand filter permanent stormwater facility

G. Off Site Flows

No significant off-site flows exist.

H. Impacts to Downstream Properties

There are no anticipated impacts to downstream properties due to the proposed development.

I. Potential Site Contaminants

- Sediment, sand, grit, and salts,
- Vehicular pollutants (Oils, antifreeze, carbon deposits, etc.),

J. On-Site Stormwater Flows

On site flows will originate primarily from the Airpark access road, Gloria Gossard road and, the Gloria Gossard sidewalk and the remaining undisturbed native landscape.

K. Water Quality Design Standard

WQCV for the sand filter in the detention pond.

L. Channels Ditches and Curb and Gutter

Roadside drainage ditches shall convey surface runoff along the Airpark Access Road and Gloria Gossard Parkway. All roadside drainage ditches shall be capable of conveying the major event peak flow rate. The SB2 cutoff shall be capable of conveying the minor event.

Table 2 Ditch Capacity

Design Point #	Minor Storm Flow (cfs)	Major Storm Flow (cfs)	Minor Event Velocity (ft/sec)	Major Event Velocity (ft/sec)
2	6.61	45.13	6.38	N/A

Curb and gutter installations along the northern side of Gloria Gossard Parkway will convey flow into the proposed drainage ditches. Gutter conveyance and associated gutter and roadway capacity were analyzed to ensure street spread flow requirements were met. Flows were calculated using AutoCAD Hydraflow Express for the street hydraulic capacity evaluation. Gloria Gossard road is 32 feet wide, which leaves 8 feet of street spread flow available. This leaves the required 12 feet of lane in each direction open. Design point 5 was evaluated for curb/gutter and roadway capacity with 8 feet of spread flow into the street. All gutters and roadways will effectively convey both the minor and major storm events within the inundation limit and within the required velocity of 8 feet per second or less.

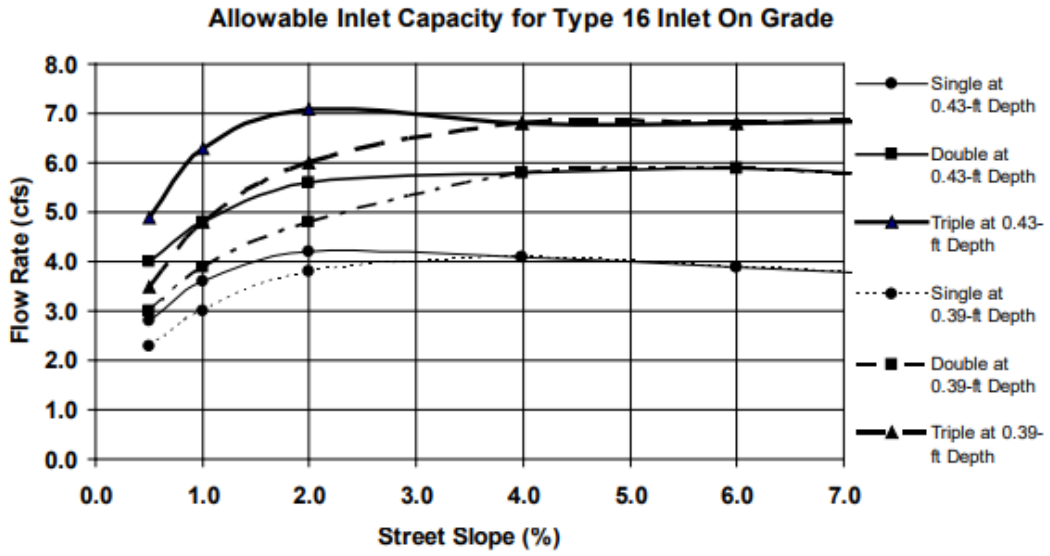
Table 3 Roadway Curb & Gutter Capacity

Design Point #	Roadway/Gutter Capacity (cfs)	Minor Storm Flow (cfs)	Major Storm Flow (cfs)	Major Event Velocity (ft/sec)
5	5.0	1.56	3.71	5.55

M. Inlets

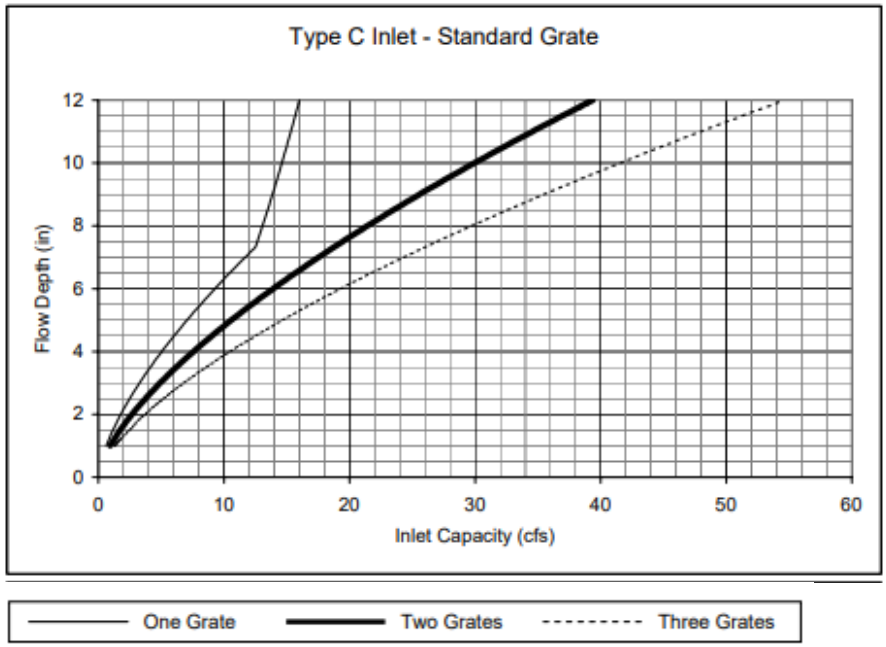
Two Type 16 inlets (see plan for locations) will be installed along Gloria Gossard Parkway. A type C inlet is proposed to be installed at the 30” culvert inlet at Design Point No. 11. Figure 1 Denver Type 16 capacity chart was used to approximate inlet capacity at approximately 5.16 inches of depth. Figure 2 is for a CDOT Type C inlet. The Type 16 inlets will effectively handle the minor and major storm events at a flow depth of 12.0 inches. The Type C inlet will handle the minor event without surcharging, however, surcharging would likely occur with the major event.

Figure 1: Denver Type 16 Inlet Capacity Chart



Source: City and County of Denver Storm Drainage Design and Technical Criteria, January 2006

Figure 2: Denver Type C Inlet Capacity Chart



Source: City and County of Denver Storm Drainage Design and Technical Criteria, January 2006

Table 4 Inlet Capacity

Design Point #	No. of Inlets	Type of Inlet	Inlet Capacity (cfs)	Minor Storm Flow (cfs)	Major Storm Flow (cfs)
7	1	Denver Type 16	4.0	1.44	3.35
11	1	Type C	13.0	3.42	23.31

N. Culverts and Storm Sewers

A culvert for the access road is proposed. It effectively conveys the minor and major storms without surcharging. Capacity was evaluated under a culvert scenario for design points No. 1 and No. 11. At design point No. 11, the major event flow is controlled by the Type-C inlet capacity.

Table 5 Culvert Capacity

Design Point #	Diameter (in)	Flow Regime	Minor Storm Flow (cfs)	Major Storm Flow (cfs)	Major Event Velocity (ft/sec)
7	18”	Inlet Control	2.23	13.67	7.85
8	(2) 30”	Outlet Control	8.53	52.39	5.90
11	30”	Inlet Control	3.40	13.0	8.50

O. Sidewalk Drainage

Portions of sidewalk are proposed to be installed along the steep slopes on the North side of Gloria Gossard. Stormwater runoff from the slopes must be managed to avoid conveyance over the sidewalk surface. As opposed to excavating into the hillside to construct a cutoff ditch, Four Points proposes installing a 6” PVC French along the northern shoulder of the sidewalk from design point No. 6 to design point No. 7 and design point No. 8 to design point No. 9. The French drain is proposed to outfall within the proposed 12-foot roadside ditch, a proposed Denver Type 16 inlet, and the existing dual-culvert crossing extension basin. Cleanouts should be installed every 100-feet to facilitate maintenance. Geotextile fabric should separate the gravel bedding to inhibit vegetation intrusion. The primary concern in this instance is icing from snow melt along the hillside. Therefore it is not anticipated that capacity of the French drain system will need to be very great. 6” PVC capacity calcs were performed for the sidewalk slopes of 4.75% and 7%, the respective slopes for the aforementioned stations. This does not include calculation of the additional flow capacity within the gravel medium of the French drain. The pipe capacity should facilitate the intended use. A large rainfall event may inundate the French drain and overflow into the street but this has been accounted for with the minor and major peak flow inundation determined for street flow.

P. Stormwater Detention

The detention pond is proposed to be constructed to manage the future stormwater for the conceptual Copper Ridge Apartments project. Therefore, it would be oversized for the proposed Airpark access road but the outlet structure would be modified as needed to discharge runoff at historical rates. It’s most practical to design a detention facility for future improvements versus one that just manages flows for the access road.

5.0 Construction Stormwater Management

Temporary erosion and sediment control during construction is the responsibility of the general contractor. This responsibility includes acquisition of any required permits. The contractor and owner shall be required to obtain a state general permit for the discharge of construction site stormwater associated with the approximate 10.0 acres of development. The contractor shall be responsible for obtaining this permit prior to construction.

A detailed stormwater management plan prepared by a Colorado professional engineer shall be required. The stormwater management plan should take into account the changing topography and conditions of the site throughout the construction process. All stormwater control measures shall conform to jurisdictional standards.

6.0 Post Construction Stormwater Management

See Operation and Maintenance Plans provided in the appendices.

7.0 Concluding General Summary

In conclusion, the development of an access road, sidewalk, retaining walls and associated drainage infrastructure along Gloria Gossard Parkway as part of the Steamboat Airpark Preliminary Plat will not substantially impact existing drainage conditions. All proposed drainage infrastructure has been thoroughly evaluated and design of such is within the Steamboat Springs Drainage Criteria standards. Westerly flows off-site are accounted for in the Overlook Park Final Drainage Report.

A. Compliance

The proposed stormwater drainage system complies with City Drainage Criteria.

B. Historic and Proposed Site Flows

Peak proposed flows for design points No. 1 and No. 2 will be about the same as that of historic peak flows. This is due primarily to the decrease in tributary area from the proposed access road. However, flows to design point No. 8 will increase due to the subsequent increase in drainage area. Increased peak flow at design point No. 8 is not substantial however and detention is not required.

C. Proposed New Stormwater System Requirements

The proposed stormwater system shall effectively convey and treat all flows on site with proper installation and maintenance.

8.0 References

Joe Wiedemeier, P.E. Four Points Surveying and Engineering (March 2020) Final Drainage Study for Overlook Park Subdivision.

Urban Drainage and Flood Control District Criteria Manual, 2018.

NOAA Precipitation Frequency Server. NOAA Atlas 14, Volume 8, Version 2. www.NOAA.com

City of Steamboat Springs Engineering Drainage Criteria, Latest Version.

9.0 Appendices

A. Existing Conditions Drainage Exhibit, DR1
B. Proposed Conditions Drainage Exhibit, DR2
C. USDA NRCS Web Soil Survey
D. Basin Runoff Calculations
E. BMP Design Calculations for Sand Filter
F. Channel Flow Calculations (Ditches, curb and gutter, French drains)
G. Inlet Capacity Curves and Calculations
H. Culvert and Storm Sewer Capacity Calculations
I. Standard forms No. 3, 4, & 5
J. Project Design Sheets
K. Detention Pond Design Calculations and O&M Plan

Appendix A: Existing Conditions Drainage Exhibit, DR1

DRAINAGE PLAN LEGEND

- 2' CONTOUR
- 10' CONTOUR
- DRAINAGE BASIN BOUNDARY
- FLOW PATH, SHEET FLOW/OVERLAND FLOW
- FLOW PATH, CONCENTRATED
- DITCH/SWALE CENTERLINE
- DESIGN POINT DESIGNATION
- A: BASIN DESIGNATION
  B: BASIN AREA (ACRES)
  C: % IMPERVIOUS

DESIGN POINTS:

1. EB2 FLOWS CONTINUE INTO OVERLOOK PARK CONSTRUCTION AREA AND FLOW TO THE SEDIMENTATION BASIN DOWNSTREAM.
2. EB3 OUTFALLS FROM (2) PARALLEL 30" CMP CULVERTS CROSSING GLORIA GOSSARD BLVD.

LOT 2
(NOT A PART)

EB1
13.70 2%

LOT 1 WEST ACRES
RANCH SUBD EXEMPTION
OWNER: STEAMBOAT SPRINGS
AIRPARK, LLC

STEAMBOAT AIRPARK

EB2
24.75 3%

EB3
25.75 4%

EB4
1.92 12%

EB5
2.50 2%

ROUGH CUT ROAD

TEMP
18" CULVERT

TEMP
18" CULVERT

TWO TRACK TRAIL

ROUGH CUT ROAD

DITCH

FLOWS TO OVERLOOK PARK SITE AND CONSTRUCTION SEDIMENTATION POND
DRAINAGE AREA: 24.75 AC
HISTORIC FLOW: 5-YR: 6.40 CFS
HISTORIC FLOW: 100-YR: 42.36 CFS

CONSTRUCTION ACCESS ROAD TO OVERLOOK PARK

ROUGH CUT ROAD

EXISTING RIPRAP

DITCH

EXISTING BOULDERS AND SLOPE STABILIZATION

DITCH

GLORIA GOSSARD PARKWAY

DITCH

DITCH

GLORIA GOSSARD PARKWAY

OVERLOOK PARK
CONSTRUCTION SITE

TEMPORARY 6" PVC CULVERT

DITCH

HIGH POINT,
EAST/WEST
FLOW SPLIT

EXISTING 30" DOUBLE HDPE CULVERTS
DRAINAGE AREA: 25.75 AC
HISTORIC FLOW: 5-YR: 7.28 CFS
HISTORIC FLOW: 100-YR: 46.89 CFS

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ROUTT COUNTY PARCEL 7B & 7C

FIVE FORTY SUBDIVISION

STEAMBOAT AIRPORT

LOT 2
(NOT A PART)

EB1
13.74 25

LOT 1 WEST ACRES
RANCH SUBD EXEMPTION
OWNER: STEAMBOAT SPRINGS
AIRPARK, LLC

STEAMBOAT AIRPARK

EB2
24.75 3%

EB1
2.50 12%

EB3
25.75 4%

ROUGH CUT ROAD

TEMP
18" CULVERT

TEMP
18" CULVERT

OVERLOOK PARK

FLOWS TO OVERLOOK PARK SITE AND
CONSTRUCTION SEDIMENTATION POND
DRAINAGE AREA: 24.75 AC
HISTORIC FLOW: 5-YR: 6.40 CFS
HISTORIC FLOW: 100-YR: 42.36 CFS

ROUGH CUT ROAD

DITCH

CONSTRUCTION ACCESS ROAD
TO OVERLOOK PARK

ROUGH CUT ROAD

EXISTING RIPRAP

DITCH

EXISTING BOULDERS AND
SLOPE STABILIZATION

DITCH

TWO TRACK TRAIL

EB4
1.92 12%

DITCH

DITCH

GLORIA GOSSARD PARKWAY

GLORIA GOSSARD PARKWAY

OVERLOOK PARK
CONSTRUCTION SITE

TEMPORARY 6" PVC CULVERT
DITCH

HIGH POINT,
EAST/WEST
FLOW SPLIT

EXISTING 30" DOUBLE HDPE CULVERTS
DRAINAGE AREA: 25.75 AC
HISTORIC FLOW: 5-YR: 7.28 CFS
HISTORIC FLOW: 100-YR: 46.89 CFS

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DRAINAGE PLAN LEGEND

- 2' CONTOUR
- 10' CONTOUR
- DRAINAGE BASIN BOUNDARY
- FLOW PATH, SHEET FLOW/OVERLAND FLOW
- FLOW PATH, CONCENTRATED
- DITCH/SWALE CENTERLINE
- DESIGN POINT DESIGNATION
- A: BASIN DESIGNATION
  B: BASIN AREA (ACRES)
  C: % IMPERVIOUS

DESIGN POINTS:

1. EB2 FLOWS CONTINUE INTO OVERLOOK PARK CONSTRUCTION AREA AND FLOW TO THE SEDIMENTATION BASIN DOWNSTREAM.

2. EB3 OUTFALLS FROM (2) PARALLEL 30" CMP CULVERTS CROSSING GLORIA GOSSARD BLVD.

7+18F>3-

FOUR POINTS SURVEYING ENGINEERING

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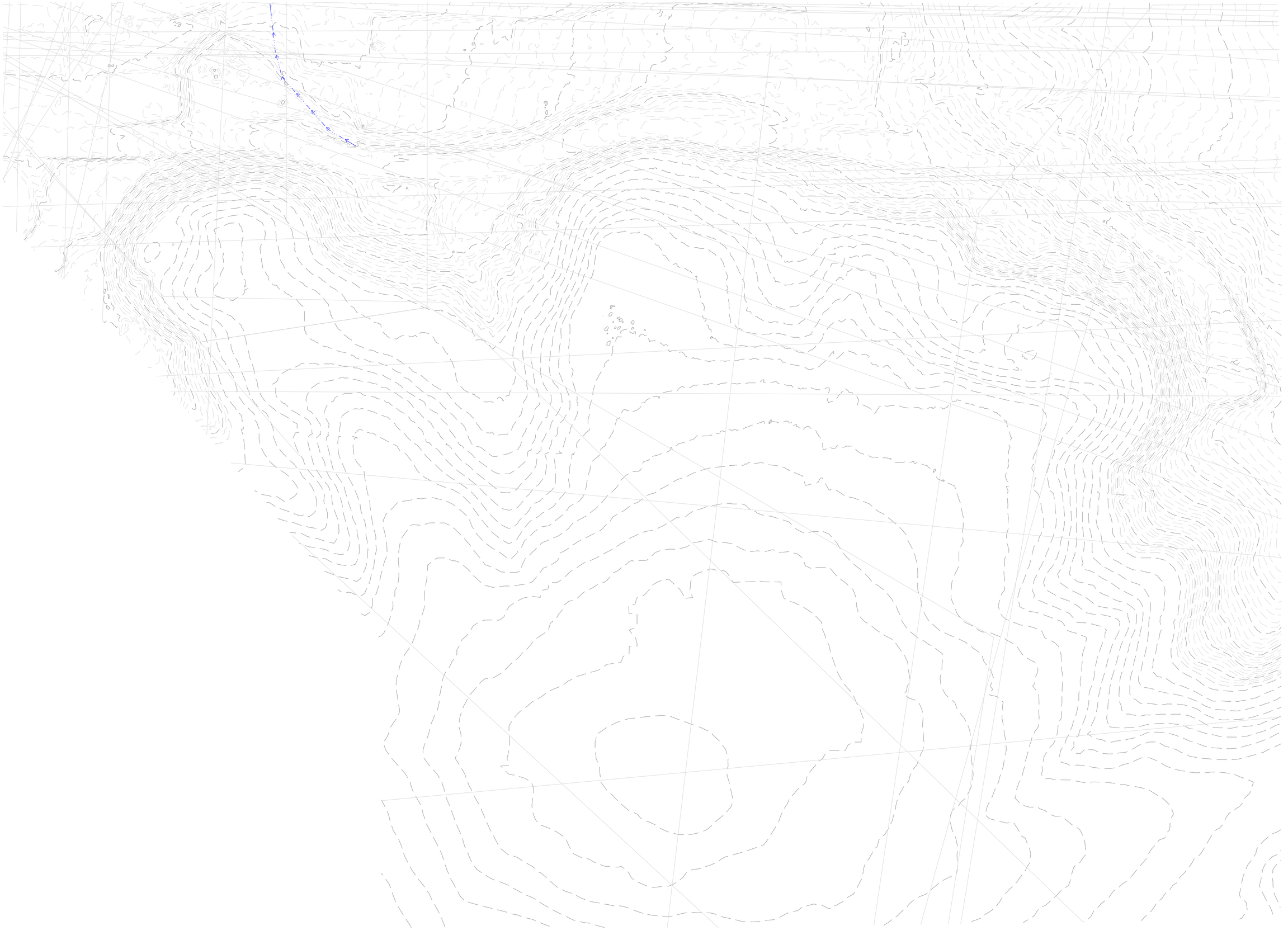
Appendix B: Proposed Conditions Drainage Exhibit, DR2



Appendix C: USDA NRCS Web Soil Survey

8QLWHG 6WDWHV 'HSDUWPHQW RI $JULFXOWXUH

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6WDWH 'HSDUWPHQW RI $JULFXOWXUH DQG)RRG

$JULFXOWXUDO ([SHULPHQW 6WDWLRQV DQG ORFDO SDUWLFLSDQWV

&XVWRP 6RLO 5HVRXUFH 5HSRUW IRU 5RXWW $UHD &RORUDGR %ODQFR DQG 5LR &RQFKLHV

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3HUHQQLDO :DWHU

5RFN 2XWFURS

6DOLQH 6SRW

6DQG\ 6SRW

6HYHUHO\ (URGHG 6SRW

6LQNKROH

6OLGH RU 6OLS

6RGLF 6SRW

6SRLO $UHD

6WRQ\ 6SRW

9HU\ 6WRQ\ 6SRW

:HW 6SRW

2WKHU

6SHFLDO /LQH)HDWXUHV

:DWHU)HDWXUHV

6WUHDPV DQG &DQDOV

7UDQVSRUWDWLRQ

5DLOV

,QWHUVWDWH +LJKZD\V

86 5RXWHV

0DMRU 5RDGV

/RFDO 5RDGV

%DFNJURXQG

$HULDO 3KRWRJUDSK\

0$3 ,1)250$7,21

7KH VRLO VXUYH\V WKDW FRPSULVH \RXU $2, ZHUH PD

:DUQLQJ 6RLO 0DS PD\ QRW EH YDOLG DW WKLV VFDO

(QODUJHPHQW RI PDSV EH\RQG WKH VFDOH RI PDSSLQ
PLVXQGHUVWDQGLQJ RI WKH GHWDLO RI PDSSLQJ DQG
OLQH SODFHPHQW 7KH PDS GR QRW VKRZ WKH VPDO
FRQWUDVWLQJ VRLOV WKDW FRXOG KDYH EHHQ VKRZQ
VFDOH

3OHDVH UHO\ RQ WKH EDU VFDOH RQ HDFK PDS VKHH
PHDVXUHPHQWV

6RXUFH RI 1DWLRQDO 5HVRXUFHV &RQVHUYDWLRQ 6HUY
:HE 6RLO 6XUYH\ 85/
&RRUGLQDWH :HE 0HUFDWRU (36*

0DSV IURP WKH :HE 6RLO 6XUYH\ DUH EDVHG RQ WKH
SURMHFWLRQ ZKLFK SUHVHUYHV GLUHFWLRQ DQG VK
GLVWDQFH DQG DUHD $ SURMHFWLRQ WKDW SUHVHUY
$OEHUV HTXDO DUHD FRQLF SURMHFWLRQ VKRXOG EH
DFFXUDWH FDOFXODWLRQV RI GLVWDQFH RU DUHD DU

7KLV SURGXFW LV JHQHUDWHG IURP WKH 86'$ 15&6 FH
RI WKH YHUVLRQ GDWH V OLVWHG EHORZ

6RLO 6XUYH\ 5HSRUWV $UHD &RORUDGR 3DUWV RI 5LR %
5RXWW &RXQWLHV
6XUYH\ $UHD 9HUVLRQ 6HS

6RLO PDS XQLWV DUH ODEHOHG DV VSDFH DOORZV I
RU ODUJHU

'DWH V DHULDO LPDJHV ZHUH SKRWRJUDSKHG

7KH RUWKRSKRWR RU RWKHU EDVH PDS RQ ZKLFK WKI
FRPSLOHG DQG GLJLWL]HG SUREDEO\ GLIIHUV IURP W

0DS 8QLW /HJHQG

0DS 8QLW 6\PERO	0DS 8QLW 1DPH	$FUHV LQ $2,	3HUFHQW RI $2,
	(FNPDQSDUN FOD\ SHUFHQW VORSHV	WR	
	(FNPDQSDUN FOD\ ORDP SHUFHQW VORSHV	WR	
&	,PSDVV VLOW\ FOD\ SHUFHQW VORSHV	ORDP WR	
7RWDOV IRU $UHD RI ,QWHUHVW			

0DS 8QLW 'HVFULSWLRQV

7KH PDS XQLWV GHOLQHDWHG RQ WKH GHWDLOHG VRLO PDSV LQ
VRLOV RU PLVFHOODQHRXV DUHDV LQ WKH VXUYH\ DUHD 7KH PD
ZLWK WKH PDSV FDQ EH XVHG WR GHWHUPLQH WKH FRPSRVLWLR

$ PDS XQLW GHOLQHDWLRQ RQ D VRLO PDS UHSUHVHQWV DQ DUH
PDMRU NLQGV RI VRLO RU PLVFHOODQHRXV DUHDV $ PDS XQLW
DFFRUGLQJ WR WKH WD[RQRPLF FODVVLILFDWLRQ RI WKH GRPLQ
FODVV WKHUH DUH SUHFLVHO\ GHILQHG OLPLWV IRU WKH SURSHU
ODQGVFDSH KRZHYHU WKH VRLOV DUH QDWXUDO SKHQRPHQD D
FKDUDFWHULVWLF YDULDELOLW\ RI DOO QDWXUDO SKHQRPHQD 7
REVHUYHG SURSHUWLHV PD\ H[WHQG EH\RQG WKH OLPLWV GHILQ
$UHDV RI VRLOV RI D VLQJOH WD[RQRPLF FODVV UDUHO\ LI HYHU
LQFOXGLQJ DUHDV RI RWKHU WD[RQRPLF FODVVHV &RQVHTXHQW
XS RI WKH VRLOV RU PLVFHOODQHRXV DUHDV IRU ZKLFK LW LV Q
FRPSRQHQWV WKDW EHORQJ WR WD[RQRPLF FODVVHV RWKHU WK

0RVW PLQRU VRLOV KDYH SURSHUWLHV VLPLODU WR WKRVH RI W
PDS XQLW DQG WKXV WKH\ GR QRW DIIHFW XVH DQG PDQDJHPHQ
QRQFRQWUDVWLQJ RU VLPLODU FRPSRQHQWV 7KH\ PD\ RU PD\
SDUWLFXODU PDS XQLW GHVFULSWLRQ 2WKHU PLQRU FRPSRQHQ
DQG EHKDYLRUDO FKDUDFWHULVWLFV GLYHUJHQW HQRXJK WR DI
PDQDJHPHQW 7KHVH DUH FDOOHG FRQWUDVWLQJ RU GLVVLPLOD
JHQHUDOO\ DUH LQ VPDOO DUHDV DQG FRXOG QRW EH PDSSHG V
VFDOH XVHG 6RPH VPDOO DUHDV RI VWURQJO\ FRQWUDVWLQJ VI
DUH LGHQWLILHG E\ D VSHFLDO V\PERO RQ WKH PDSV ,I LQFOXG
JLYHQ DUHD WKH FRQWUDVWLQJ PLQRU FRPSRQHQWV DUH LGHQ
GHVFULSWLRQV DORQJ ZLWK VRPH FKDUDFWHULVWLFV RI HDFK
FRPSRQHQWV PD\ QRW KDYH EHHQ REVHUYHG DQG FRQVHTXHQW
PHQWLRQHG LQ WKH GHVFULSWLRQV HVSHFLDOO\ ZKHUH WKH SD
ZDV LPSUDFWLFDO WR PDNH HQRXJK REVHUYDWLRQV WR LGHQWL
PLVFHOODQHRXV DUHDV RQ WKH ODQGVFDSH

7KH SUHVHQFH RI PLQRU FRPSRQHQWV LQ D PDS XQLW LQ QR ZD
XVHIXOQHVV RU DFFXUDF\ RI WKH GDWD 7KH REMHFWLYH RI PDS
SXUH WD[RQRPLF FODVVHV EXW UDWKHU WR VHSDUDWH WKH ODQ

ODQGIRUP VHJPHQWV WKDW KDYH VLPLODU XVH DQG PDQDJHPHQ
GHOLQHDWLRQ RI VXFK VHJPHQWV RQ WKH PDS SURYLGHV VXIILF
GHYHORSPHQW RI UHVRXUFH SODQV ,I LQWHQVLYH XVH RI VPDO
RQVLWH LQYHVWLJDWLRQ LV QHHGHG WR GHILQH DQG ORFDWH W
DUHDV

$Q LGHQWLI\LQJ V\PERO SUHFHGHV WKH PDS XQLW QDPH LQ WKH
(DFK GHVFULSWLRQ LQFOXGHV JHQHUDO IDFWV DERXW WKH XQLV
SURSHUWLHV DQG TXDOLWLHV

6RLOV WKDW KDYH SURILOHV WKDW DUH [DQG [FP WR DOLNH PDNH XS
GLIIHUHQFHV LQ WH[WXUH RI WKH VXUIDFH OD\HU DOO WKH VRL
KRUL]RQV WKDW DUH VLPLODU LQ FRPSRVLWLRQ WKLFNQHVV DQ

6RLOV RI RQH VHULHV FDQ GLIIHU LQ WH[WXUH RI WKH VXUIDFH
VDOLQLW\ GHJUHH RI HURVLRQ DQG RWKHU FKDUDFWHULVWLFV
EDVLV RI VXFK GLIIHUHQFHV DVVRLOSKDVH VRLOV DUH
VKRZQ RQ WKH GHWDLOHG VRLO PDSV DUH SKDVHV RI VRLO VHUL
FRPPRQO\ LQGLFDWHV D IHDWXUH WKDW DIIHFWV XVH RU PDQDJH
VLOW ORDP WR SHUFHQW VORSHV LV D SKDVH RI WKH $OSKD

6RPH PDS XQLWV DUH PDGH XS RI WZR RU PRUH PDMRU VRLOV RU
7KHVH PDS XQLWV DUH FRPSOH[HV DVVRFLDWLRQV RU XQGLIIHU

$ FRPSOH[FRQVLVWV RI WZR RU PRUH VRLOV RU PLVFHOODQHRXV DU
SDWWHUQ RU LQ VXFK VPDOO DUHDV WKDW WKH\ FDQQRW EH VKI
7KH SDWWHUQ DQG SURSRUWLRQ RI WKH VRLOV RU PLVFHOODQH
LQ DOO DUHDV $OSKD %HWD FRPSOH[WR SHUFHQW VORSHV

$QDVVRFLDWLRQ LV PDGH XS RI WZR RU PRUH JHRJUDSKLFDOO\ DVVRFLD
PLVFHOODQHRXV DUHDV WKDW DUH VKRZQ DV RQH XQLW RQ WKH
RU DQWLFLSDWHG XVHV RI WKH PDS XQLWV LQ WKH VXUYH\ DUHD
SUDFWLFDO RU QHFHVVDU\ WR PDS WKH VRLOS RU PLVFHOODQHR
SDWWHUQ DQG UHODWLYH SURSRUWLRQ RI WKH VRLOS RU PLVFH
VLPLODU $OSKD %HWD DVVRFLDWLRQ WR SHUFHQW VORSHV

$QXQGLIIHUHQWLDWHGJURXS RI WZR RU PRUH VRLOS RU PLVFHOOD
WKDW FRXOG EH PDSSHG LQGLYLGXDOO\ EXW DUH PDSSHG DV RQ
LQWHUSUHWDWLRQV FDQ EH PDGH IRU XVH DQG PDQDJHPHQW 7K
RI WKH VRLOS RU PLVFHOODQHRXV DUHDV LQ D PDSSHG DUHD DU
EH PDGH XS RI RQO\ RQH RI WKH PDMRU VRLOS RU PLVFHOODQHR
XS RI DOO RI WKHP $OSKD DQG %HWD VRLOS WR SHUFHQW V

6RPH VXUYH\V LQFOXGH 6XVFHSWLELOLW\ DQG KD]DUGV KDYH OLWWOH RU QR VRL
PDWHULDO DQG VXSSRUW OLWWOH RU QR YHJHWDWLRQ 5RFN RX

5RXWW $UHD &RORUDGR 3DUWV RI 5LR %ODQFR DQ

²(FNPDQSDUN FOD\ WR SHUFHQW VORSHV

0DS 8QLW 6HWWLQJ
1DWLRQDO PDS XNQKLWW V\PERO
(OHYDWLRQWR IHHW
0HDQ DQQXDO SUHFLSLWDWLRQ
0HDQ DQQXDO DLU WHPSHUDWXUH)
)URVW IUHH SHULRG GD\V
)DUPODQG FOD1RWLILFDWLRQ

0DS 8QLW &RPSRVLWLRQ
(FNPDQSDUN DQG VLPLODUFRQWRLOV
(VWLPDWHV DUH EDVHG RQ REVHUYDWLRQV GHVFULSWLRQ

'HVFULSWLRQ RI (FNPDQSDUN

6HWWLQJ
/DQGIRUPV
/DQGIRUP SRVLWLRQ WRSRJUDSKLFSRVLWLRQDO
/DQGIRUP SRVLWLRQ WRSKLGHHVGLRSHQVLRQDO
'RZQ VORSH/LQHEDSH
$FURVV VORSHSHQWKDUSH
3DUHQW P6DWHULDO DOOXYLXP DQG RU FROOXYLXP RYHU UH
VKDOH

7\SLFDO SURILOH
$ WR LQFKHV
%VV WR FLQDFKHV
%VV WR FLQDFKHV
%N WR FLQFKHV
&U WR EHGURFN

3URSHUWLHV DQG TXDOLWLHV
6ORSHWR SHUFHQW
'HSWK WR UHVWULFWLYHOHQHDXWR SDUDOLWKLF EHGURF
'UDLQDJH:HOOGUDLQHG
5XQRII ORZWRPHGLXP
&DSDFLW\ RI WKH PRVW OLPLWLQJ/RZWR WRGWHUDQWHCL\WK
WR LQ KU
'HSWK WR ZDWHUH WDEOH LQFKHV
)UHTXHQF\ RI 1RQHRRGLQJ
)UHTXHQF\ RI 1SRQHGLQJ
&DOFLXP FDUERQDWH PDSHUFHQWHQW
*\SVXP PD[LPXP FRQWHQW
0D[LPXP VDOLQLW\ WR OLJKWO\ VDOLQH WR
$YDLODEOH ZDWHU VXS/RZ\ DEWRXW LQFKHV

,QWHUSUHWLYH JURXSV
/DQG FDSDELOLW\ FODVVLILFDWLRQ LUULJDWHG
/DQG FDSDELOLW\ FODVVLILFDWLRQ QRQLUULJDWHG
+\GURORJLF 6RLO *URXS
(FRORJLFDO 6LWH&2 0RXQWDLQ 6KDOH
+\GULF VRL1RUDWLQJ

²(FNPDQSDUN FOD\ ORDP WR SHUFHQW VORSH

0DS 8QLW 6HWWLQJ
1DWLRQDO PDS XQLW V\PERO
(OHYDWLRQ WR IHHW
0HDQ DQQXDO SUHFLSLWDWLRQ
0HDQ DQQXDO DLU WHPSHUDWXUH)
)URVW IUHH SHULRG GD\V
)DUPODQG FODVVLILFDWLRQ

0DS 8QLW &RPSRVLWLRQ
(FNPDQSDUN DQG VLSPHLOHUV
0LQRU FRPSRQHQW
(VWLPDWHV DUH EDVHG RQ REVHUYDWLRQV GHVFULSWLRQ

'HVFULSWLRQ RI (FNPDQSDUN

6HWWLQJ
/DQGIRUP
/DQGIRUP SRVLWLRQ
/DQGIRUP SRVLWLRQ
'RZQ VORSH/LQH
$FURVV VORSH&RQWRXU
3DUHQW P&RPSOH[LW\ RYHU UHVLGXXP ZHDWKHUHG IURP

7\SLFDO SURILOH
$ WR LQFK\HV RP
%VV WR FLQDFKHV
%N WR FLQFKHV
&U WR EHGURFN

3URSHUWLHV DQG TXDOLWLHV
6ORSHWR SHUFHQW
'HSWK WR UHVWULFWLYH LQFKHV
'UDLQDJH:HWODQGV UDLQHG
5XQRII ²HDV\VKLJK
&DSDFLW\ RI WKH PRVW OLPLWLQJ /RZ\WR WR GWUDQVPLW\WK
WR LQ KU
'HSWK WR ZDWHUH WDEOH LQFKHV
)UHTXHQF\ RI1RQH
)UHTXHQF\ RI1RQH
&DOFLXP FDUERQDWH PDSLHUXFHQW
*\SVXP PD[LPXP FRQWHQW
0D[LPXP VDOLQLW\ WR YHU\ VOLJKWO\ VDOLQH W
$YDLODEOH ZDWHU VXS/RZ\ DEWRXW LQFKHV

,QWHUSUHWLYH JURXSV
/DQG FDSDELOLW\ FODVVLILFDWLRQ LUULJDWHG
/DQG FDSDELOLW\ FODVVLILFDWLRQ QRQLUULJDWHG
+\GURORJLF 6RLO *URXS
(FRORJLFDO 6LWH &ODVVLILFDWLRQ &OD\SDQ

+\GULF VRL1DR UDWLQJ

0LQRU &RPSRQHQWV

5RXWW
3HUFHQW RI PSDHSUXFHLQWW
/DQGIR+ULPOV
/DQGIRUP SRVLWLRQ WWDRNGVLOPRHSQHVLRQDO
/DQGIRUP SRVLWLRQ W6KLGHHVGLRPSHQVLRQDO
'RZQ VORSH/LQHEHH
$FURVV VORSLHQWKDUSH
(FRORJLFDO6LWH&2 $VSHQ :RGODQG
+\GULF VRL1DR UDWLQJ

& ²,PSDVV VLOW\ FOD\ ORDP WR SHUFHQW VORS

0DS 8QLW 6HWWLQJ
1DWLRQDO PDS XQLW V\PERO
(OHYDWLRQWR IHHW
0HDQ DQQXDO SUHFLSLWDQWFKRQV
0HDQ DQQXDO DLU WWHRSHGDWXUHHV)
)URVW IUHH SHULRGD\V
)DUPODQG FODVVLILFDWLRQ UPODQG

0DS 8QLW &RPSRVLWLRQ
,PSDVV DQG VLPLSDUFHQWV
0LQRU FRPSRQHQWV
(VWLPDWHV DUH EDVHG RQ REVHUYDWLRQV GHVFULSWLRQ

'HVFULSWLRQ RI ,PSDVV

6HWWLQJ
/DQGIR+ULPOV
/DQGIRUP SRVLWLRQ WWDRNGVLOPRHSQHVLRQDO
/DQGIRUP SRVLWLRQ W6KLGHHVGLRPSHQVLRQDO
'RZQ VORSH/LQHEHH
$FURVV VORSLHQWKDUSH
3DUHQW P6DWRHSUHL**DO** OXYLXP GHULYHG IURP VDQGVWRQH D

7\SLFDO SURILOH
$ WR LVQLFKWV\ FOD\ ORDP
%VV WR VLLQDFWK\HFOD\
%NVV WR VLLQDWKHFOD\
%N WR VLLQFWKHFOD\
%N WR VLLQFWKHFOD\

3URSHUWLHV DQG TXDOLWLHV
6ORSHWR SHUFHQW
'HSWK WR UHVWULFWLYHKDUGDWXQFHKHV
'UDLQDJH:HOODVGUDLQHG
5XQRII FODVVLX P

&DSDFLW\ RI WKH PRVW OLPLWLQJ 0RDG\HUDWHR0\UDRQ/PLRW
PRGHUDWHO\ KLJK WR LQ KU
'HSWK WR ZDWHUUH WDEOH LQFKHV
)UHTXHQF\ RI 1RRGRR GLQJ
)UHTXHQF\ RI 1SRQGLQJ
&DOFLXP FDUERQDWH PDSLHUXFHHQWWQW
*\SVXP PD[LPXP FRQWHQQW
0D[LPXP VD1RLQVLDWLQH WR YHU\ VOLJKWO\ VDOLQH W
$YDLODEOH ZDWHU VXS-SLQ\K DWERRXWLQFKHVFKHV

,QWHUSUHWLYH JURXSV

/DQG FDSDELOLW\ FODVVLILFDWLRQ LUULJDWHG
/DQG FDSDELOLW\ FODVVLILFDWLRQ QRQLUULJDWHG
+\GURORJLF 6RLO *URXS
(FRORJLFDO 6LWH&2 &OD\SDQ

0LQRU &RPSRQHQWV

*RXUOH\

3HUFHQW RI PDSSHUXQHLQW
/DQGIRUPV
/DQGIRUP SRVLWLRQ WRZRRWGVLOPRHSQHVLRQDO
/DQGIRUP SRVLWLRQ W6KLGHHHVGLRPSHQVLRQDO
'RZQ VORSH&VKDSHY H
$FURVV VORS&HRQFKDYSHH
(FRORJLFDO $V<LW&2 'HHS &OD\ /RDP
+\GULF VRL1RUDWLQJ

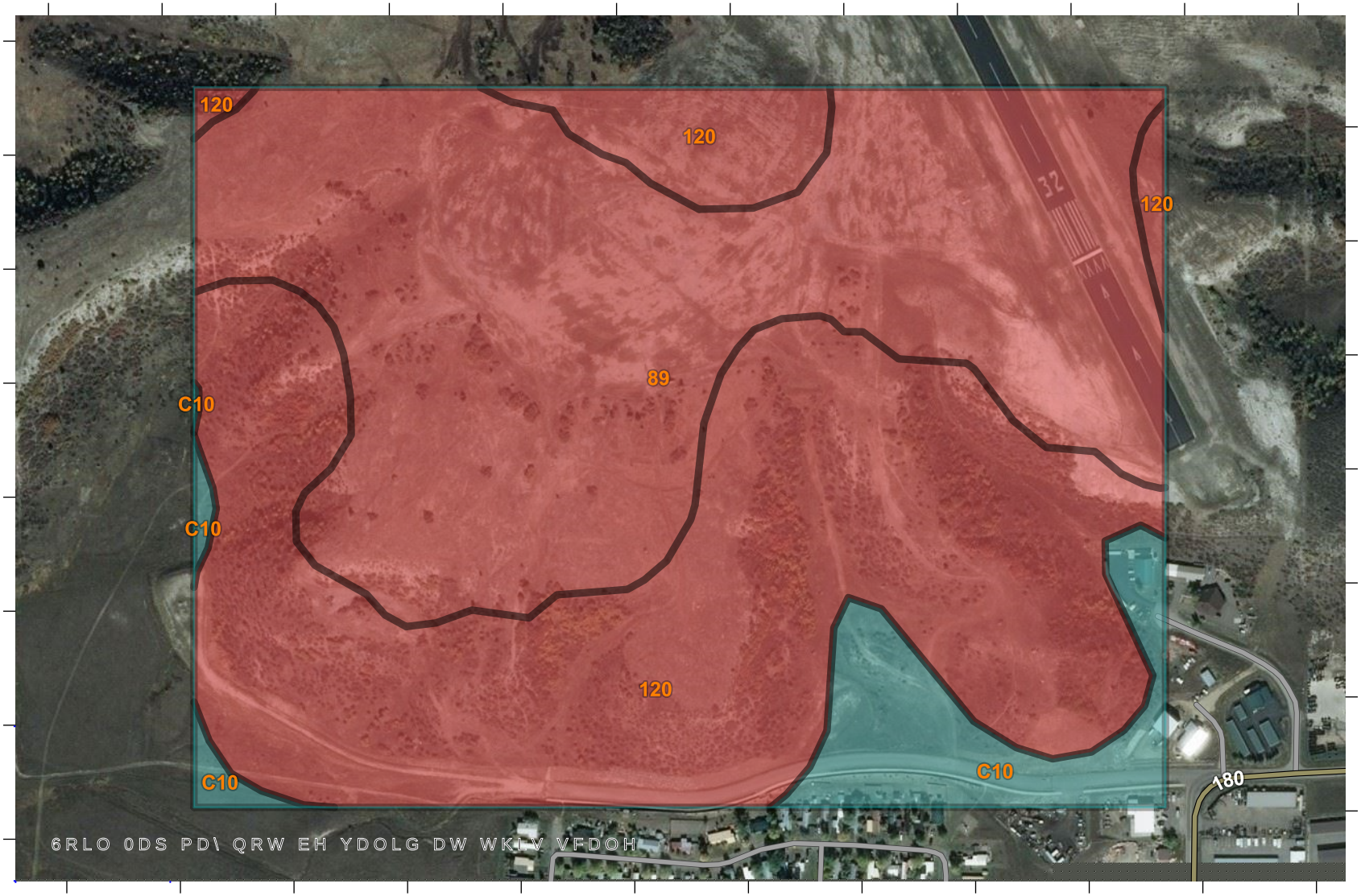
5RXWWVNLQ

3HUFHQW RI PSDHSUXFHLQW
/DQGIRUPV
/DQGIRUP SRVLWLRQ WWDRNGVLOPRHSQHVLRQDO
/DQGIRUP SRVLWLRQ W6KLGHHHVGLRPSHQVLRQDO
'RZQ VORSH/VQHSH
$FURVV VORSLHQWKDSH
(FRORJLFDO $V<LW&2 'HHS &OD\ /RDP
+\GULF VRL1RUDWLQJ

(FNPDQSDUN

3HUFHQW RI PSDHSUXFHLQW
/DQGIRUPV
/DQGIRUP SRVLWLRQ WRZRRWGVLOPRHSQHVLRQDO
/DQGIRUP SRVLWLRQ W6KLGHHHVGLRPSHQVLRQDO
'RZQ VORSH/VQHSH
$FURVV VORS&HRQFKDYSHH
(FRORJLFDO %V<LW&2 &OD\SDQ
+\GULF VRL1RUDWLQJ

&XVWRP 6RLO 5HVRXUFH 5HSRUW
0DS²+\GURORJLF 6RLO *URXS /RW



0DS 6FDOH LI SULQWHG RQ $ ODQGVFDSH [VKHHW

0HWHUV

)HHW

0DS SURMHFWLRQ :HE 0HUFDWRU &RUQHU FRRUGLQDWHV :*6 (GJH WLFV 870 =RQH 1 :*6

0$3 /(*(1'

$UHD RI ,QWHUHVW $2,
$UHD RI ,QWHUHVW $2,

6RLOV
6RLO 5DWLQJ 3RO\JRQV
$
$ '
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'
1RW UDWHG RU QRW DYDLODEOH
6RLO 5DWLQJ /LQHV
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1RW UDWHG RU QRW DYDLODEOH
6RLO 5DWLQJ 3RLQWV
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1RW UDWHG RU QRW DYDLODEOH

:DWHU)HDWXUHV
6WUHDPV DQG &DQDOV
7UDQVSRUWDWLRQ
5DLOV
,QWHUVWDWH +LJKZD\V
86 5RXWHV
0DMRU 5RDGV
/RFDO 5RDGV
%DFNJURXQG
$HULDO 3KRWRJUDSK\

0$3 ,1)250$7,21

7KH VRLO VXUYH\V WKDW FRPSULVH \RXU $2, ZHUH PD

:DUQLQJ 6RLO 0DS PD\ QRW EH YDOLG DW WKLV VFDO
(QODUJHPHQW RI PDSV EH\RQG WKH VFDOH RI PDSSLQ
PLVXQGHUVWDQGLQJ RI WKH GHWDLO RI PDSSLQJ DQG
OLQH SODFHPHQW 7KH PDS GR QRW VKRZ WKH VPDO
FRQWUDVWLQJ VRLOV WKDW FRXOG KDYH EHHQ VKRZQ
VFDOH

3OHDVH UHO\ RQ WKH EDU VFDOH RQ HDFK PDS VKHH
PHDVXUHPHQWV

6RXUFH RI 1DWLRQDO 5HVRXUFHV &RQVHUYDWLRQ 6HUY
:HE 6RLO 6XUYH\ 85/
&RRUGLQDWH :HEVLWH DFFHVV (36*

0DSV IURP WKH :HE 6RLO 6XUYH\ DUH EDVHG RQ WKH
SURMHFWLRQ ZKLFK SUHVHUYHV GLUHFWLRQ DQG VK
GLVWDQFH DQG DUHD $ SURMHFWLRQ WKDW SUHVHUY
$OEHUV HTXDO DUHD FRQLF SURMHFWLRQ VKRXOG EH
DFFXUDWH FDOFXODWLRQV RI GLVWDQFH RU DUHD DU

7KLV SURGXFW LV JHQHUDWHG IURP WKH 86'$ 15&6 FH
RI WKH YHUVLRQ GDWH V OLVWHG EHORZ

6RLO 6XUYH\ 5HSRUW $UHD &RORUDGR 3DUWV RI 5LR %
5RXWW &RXQWLHV
6XUYH\ $UHD 9HUVLRQ 6HS

6RLO PDS XQLWV DUH ODEHOHG DV VSDFH DOORZV I
RU ODUJHU

'DWH V DHULDO LPDJHV ZHUH SKRWRJUDSKHG

7KH RUWKRSKRWR RU RWKHU EDVH PDS RQ ZKLFK WKI
FRPSLOHG DQG GLJLWL]HG SUREDEO\ GLIIHUV IURP W

7DEOH²+\GURORJLF 6RLO *URXS /RW

0DS XQLW V\PERO	0DS XQLW QDPH 5DWLQJ	$FUHV LQ $2,	3HUFHQW RI $2,
	(FNPDQSDUN FOD\ WR SHUFHQW VORSHV		
	(FNPDQSDUN FOD\ ORDP WR SHUFHQW VORSHV		
&	,PSDVV VLOW\ FOD\ ORDP WR SHUFHQW VORSHV		
7RWDOV IRU $UHD RI ,QWHUHVW			

5DWLQJ 2SWLRQV²+\GURORJLF 6RLO *URXS /RW

$JJUHJDWLRQ 0HWKRG &RQGLWLRQDO

&RPSRQHQW 3HUFHQWDJHV 6XPPLHG

7LH EUHDNHU 5XOH

Appendix D: Basin Runoff Calculations

RATIONAL METHOD RUNOFF ANALYSIS

Job #	1670-001	Date:	April 22, 2022
Job Name	Copper Ridge Village	Revised:	
Designed by:	JLW		

Existing Basin 1 (EB1)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION							RESULTS				
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	13.70	2%	C	Surface Imperviousness	0.02	Surface Imperviousness	0.02	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.06	0.7	13.70	0.50
Asphalt Parking & Walkways	0.00	100%		Length, ft	300	Length, ft	300	Length, ft	850	Tc, min	2-YR	0.06	1.0	13.70	0.72
Roof	0.00	90%	P2	Slope, percent	5.0000	Slope, percent	10.0000	Slope, ft/ft	0.2000	5.0	5-YR	0.16	1.4	13.70	3.18
Gravel	0.00	40%	1.4	Runoff Coefficient	0.162	Runoff Coefficient	0.162	Conveyance Coefficient	15	Final	10-YR	0.26	1.8	13.70	6.51
Other	0.00	0%						Velocity, ft/s	6.7	Tc, min	25-YR	0.38	2.3	13.70	12.15
	13.70	2%		Ti, min=	17.1	Ti, min=	13.6	Tt, min=	2.1	32.8	100-YR	0.51	3.1	13.70	21.73

Existing Basin 2 (EB2)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION							RESULTS				
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	24.50	2%	C	Surface Imperviousness	0.02	Surface Imperviousness	0.02	Land Surface	Paved Areas and Shallow Swales	Minimum	1.25 YR	0.06	0.7	24.75	1.10
Asphalt Parking & Walkways	0.25	100%		Length, ft	300	Length, ft	300	Length, ft	2200	Tc, min	2-YR	0.06	1.0	24.75	1.59
Roof	0.00	90%	P2	Slope, percent	10.0000	Slope, percent	20.0000	Slope, ft/ft	0.1000	5.0	5-YR	0.17	1.5	24.75	6.40
Gravel	0.00	0%	1.4	Runoff Coefficient	0.162	Runoff Coefficient	0.162	Conveyance Coefficient	20	Final	10-YR	0.27	1.9	24.75	12.87
Other	0.00	0%						Velocity, ft/s	6.3	Tc, min	25-YR	0.38	2.5	24.75	23.82
	24.75	3%		Ti, min=	13.6	Ti, min=	10.8	Tt, min=	5.8	30.1	100-YR	0.51	3.4	24.75	42.36

Existing Basin 3 (EB3)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION							RESULTS				
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	25.25	2%	C	Surface Imperviousness	0.02	Surface Imperviousness	0.02	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.07	0.8	25.75	1.34
Asphalt Parking & Walkways	0.50	100%		Length, ft	300	Length, ft	300	Length, ft	1200	Tc, min	2-YR	0.07	1.1	25.75	1.93
Roof	0.00	90%	P2	Slope, percent	10.0000	Slope, percent	20.0000	Slope, ft/ft	0.1300	5.0	5-YR	0.18	1.6	25.75	7.28
Gravel	0.00	0%	1.4	Runoff Coefficient	0.162	Runoff Coefficient	0.162	Conveyance Coefficient	15	Final	10-YR	0.27	2.1	25.75	14.42
Other	0.00	0%						Velocity, ft/s	5.4	Tc, min	25-YR	0.39	2.7	25.75	26.49
	25.75	4%		Ti, min=	13.6	Ti, min=	10.8	Tt, min=	3.7	28.0	100-YR	0.51	3.5	25.75	46.89

Existing Basin 4 (EB4)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION							RESULTS				
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	1.72	2%	C	Surface Imperviousness	0.1	Surface Imperviousness	0	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.12	1.5	1.92	0.36
Asphalt Parking & Walkways	0.20	100%		Length, ft	200	Length, ft	0	Length, ft	200	Tc, min	2-YR	0.12	2.2	1.92	0.51
Roof	0.00	90%	P2	Slope, percent	40.0000	Slope, percent	1.0000	Slope, ft/ft	0.0500	5.0	5-YR	0.22	3.2	1.92	1.37
Gravel	0.00	0%	1.4	Runoff Coefficient	0.21	Runoff Coefficient	0.15	Conveyance Coefficient	15	Final	10-YR	0.31	4.1	1.92	2.45
Other	0.00	0%						Velocity, ft/s	3.4	Tc, min	25-YR	0.42	5.3	1.92	4.24
	1.92	12%		Ti, min=	6.6	Ti, min=	0.0	Tt, min=	1.0	7.6	100-YR	0.54	7.0	1.92	7.24

Existing Basin 5 (EB5)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION							RESULTS				
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	2.50	2%	C	Surface Imperviousness	0.02	Surface Imperviousness	0	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.06	1.0	2.50	0.14
Asphalt Parking & Walkways	0.00	100%		Length, ft	300	Length, ft	250	Length, ft	0	Tc, min	2-YR	0.06	1.5	2.50	0.21

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Roof	0.00	90%	P2	Slope, percent	35.0000	Slope, percent	40.0000	Slope, ft/ft	0.0100	5.0	5-YR	0.16	2.2	2.50	0.91
Gravel	0.00	0%	1.4	Runoff Coefficient	0.162	Runoff Coefficient	0.15	Conveyance Coefficient	15	Final	10-YR	0.26	2.8	2.50	1.86
Other	0.00	0%						Velocity, ft/s	1.5	Tc, min	25-YR	0.38	3.7	2.50	3.48
	2.50	2%		Ti, min=	8.9	Ti, min=	7.9	Tt, min=	0.0	16.8	100-YR	0.51	4.9	2.50	6.22

Sub Basin 1 (SB1)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	11.50	2%	C	Surface Imperviousness	0.02	Surface Imperviousness	0.02	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.06	0.7	11.50	0.42
Asphalt Parking & Walkways	0.00	100%		Length, ft	300	Length, ft	300	Length, ft	850	Tc, min	2-YR	0.06	1.0	11.50	0.61
Roof	0.00	90%	P2	Slope, percent	5.0000	Slope, percent	10.0000	Slope, ft/ft	0.2000	5.0	5-YR	0.16	1.4	11.50	2.67
Gravel	0.00	0%	1.4	Runoff Coefficient	0.162	Runoff Coefficient	0.162	Conveyance Coefficient	15	Final	10-YR	0.26	1.8	11.50	5.46
Other	0.00	0%						Velocity, ft/s	6.7	Tc, min	25-YR	0.38	2.3	11.50	10.20
	11.50	2%		Ti, min=	17.1	Ti, min=	13.6	Tt, min=	2.1	32.8	100-YR	0.51	3.1	11.50	18.24

Sub Basin 2 (SB2)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	28.20	2%	C	Surface Imperviousness	0.02	Surface Imperviousness	0.02	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.06	0.7	28.20	1.05
Asphalt Parking & Walkways	0.00	100%		Length, ft	300	Length, ft	300	Length, ft	1725	Tc, min	2-YR	0.06	1.0	28.20	1.50
Roof	0.00	90%	P2	Slope, percent	8.0000	Slope, percent	25.0000	Slope, ft/ft	0.0600	5.0	5-YR	0.16	1.4	28.20	6.61
Gravel	0.00	0%	1.4	Runoff Coefficient	0.162	Runoff Coefficient	0.162	Conveyance Coefficient	15	Final	10-YR	0.26	1.8	28.20	13.52
Other	0.00	0%						Velocity, ft/s	3.7	Tc, min	25-YR	0.38	2.4	28.20	25.24
	28.20	2%		Ti, min=	14.6	Ti, min=	10.0	Tt, min=	7.8	32.4	100-YR	0.51	3.2	28.20	45.13

Sub Basin 3 (SB3)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	12.40	2%	C	Surface Imperviousness	0.02	Surface Imperviousness	0.1	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.06	0.8	12.40	0.54
Asphalt Parking & Walkways	0.00	100%		Length, ft	300	Length, ft	300	Length, ft	850	Tc, min	2-YR	0.06	1.1	12.40	0.78
Roof	0.00	90%	P2	Slope, percent	10.0000	Slope, percent	25.0000	Slope, ft/ft	0.0800	5.0	5-YR	0.16	1.7	12.40	3.42
Gravel	0.00	0%	1.4	Runoff Coefficient	0.162	Runoff Coefficient	0.21	Conveyance Coefficient	15	Final	10-YR	0.26	2.2	12.40	6.98
Other	0.00	0%						Velocity, ft/s	4.2	Tc, min	25-YR	0.38	2.8	12.40	13.04
	12.40	2%		Ti, min=	13.6	Ti, min=	9.5	Tt, min=	3.3	26.4	100-YR	0.51	3.7	12.40	23.31

Sub Basin 4 (SB4)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	2.00	2%	C	Surface Imperviousness	0.02	Surface Imperviousness	0.02	Land Surface	Paved Areas and Shallow Swales	Minimum	1.25 YR	0.06	1.3	2.00	0.14
Asphalt Parking & Walkways	0.00	100%		Length, ft	300	Length, ft	0	Length, ft	200	Tc, min	2-YR	0.06	1.9	2.00	0.21
Roof	0.00	90%	P2	Slope, percent	25.0000	Slope, percent	15.0000	Slope, ft/ft	0.0500	5.0	5-YR	0.16	2.8	2.00	0.91
Gravel	0.00	0%	1.4	Runoff Coefficient	0.162	Runoff Coefficient	0.162	Conveyance Coefficient	20	Final	10-YR	0.26	3.5	2.00	1.86
Other	0.00	0%						Velocity, ft/s	4.5	Tc, min	25-YR	0.38	4.6	2.00	3.47
	2.00	2%		Ti, min=	10.0	Ti, min=	0.0	Tt, min=	0.7	10.7	100-YR	0.51	6.1	2.00	6.20

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Sub Basin 5 (SB5)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION							RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	0.00	2%	C	Surface Imperviousness	1	Surface Imperviousness	0	Land Surface	Paved Areas and Shallow Swales	Minimum	1.25 YR	0.89	1.7	0.20	0.31
Asphalt Parking & Walkways	0.20	100%		Length, ft	20	Length, ft	0	Length, ft	300	Tc, min	2-YR	0.89	2.5	0.20	0.44
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	5.0000	Slope, ft/ft	0.0700	5.0	5-YR	0.90	3.7	0.20	0.67
Gravel	0.00	0%	1.4	Runoff Coefficient	0.9	Runoff Coefficient	0.15	Conveyance Coefficient	20	Final	10-YR	0.92	4.7	0.20	0.87
Other	0.00	0%						Velocity, ft/s	5.3	Tc, min	25-YR	0.94	6.1	0.20	1.14
	0.20	100%		Ti, min=	1.3	Ti, min=	0.0	Tt, min=	0.9	5.0	100-YR	0.96	8.2	0.20	1.56

Sub Basin 6 (SB6)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION							RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	0.00	2%	C	Surface Imperviousness	1	Surface Imperviousness	0.02	Land Surface	Paved Areas and Shallow Swales	Minimum	1.25 YR	0.89	1.7	0.47	0.72
Asphalt Parking & Walkways	0.47	100%		Length, ft	20	Length, ft	0	Length, ft	700	Tc, min	2-YR	0.89	2.5	0.47	1.04
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	35.0000	Slope, ft/ft	0.0600	5.0	5-YR	0.90	3.7	0.47	1.57
Gravel	0.00	0%	1.4	Runoff Coefficient	0.9	Runoff Coefficient	0.162	Conveyance Coefficient	20	Final	10-YR	0.92	4.7	0.47	2.04
Other	0.00	0%						Velocity, ft/s	4.9	Tc, min	25-YR	0.94	6.1	0.47	2.68
	0.47	100%		Ti, min=	1.3	Ti, min=	0.0	Tt, min=	2.4	5.0	100-YR	0.96	8.2	0.47	3.66

Sub Basin 7(SB7)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION							RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	2.58	2%	C	Surface Imperviousness	0.1	Surface Imperviousness	0.05	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.10	1.3	2.78	0.39
Asphalt Parking & Walkways	0.20	100%		Length, ft	225	Length, ft	0	Length, ft	650	Tc, min	2-YR	0.10	1.9	2.78	0.56
Roof	0.00	90%	P2	Slope, percent	35.0000	Slope, percent	20.0000	Slope, ft/ft	0.0700	5.0	5-YR	0.21	2.9	2.78	1.63
Gravel	0.00	0%	1.4	Runoff Coefficient	0.21	Runoff Coefficient	0.18	Conveyance Coefficient	15	Final	10-YR	0.30	3.6	2.78	3.02
Other	0.00	0%						Velocity, ft/s	4.0	Tc, min	25-YR	0.41	4.7	2.78	5.34
	2.78	9%		Ti, min=	7.3	Ti, min=	0.0	Tt, min=	2.7	10.1	100-YR	0.53	6.3	2.78	9.23

Sub Basin 8 (SB8)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION							RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	0.28	2%	C	Surface Imperviousness	0.02	Surface Imperviousness	0.1	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.06	1.7	0.28	0.03
Asphalt Parking & Walkways	0.00	100%		Length, ft	100	Length, ft	0	Length, ft	0	Tc, min	2-YR	0.06	2.4	0.28	0.04
Roof	0.00	90%	P2	Slope, percent	25.0000	Slope, percent	20.0000	Slope, ft/ft	0.0700	5.0	5-YR	0.16	3.5	0.28	0.16
Gravel	0.00	0%	1.4	Runoff Coefficient	0.162	Runoff Coefficient	0.21	Conveyance Coefficient	15	Final	10-YR	0.26	4.5	0.28	0.33
Other	0.00	0%						Velocity, ft/s	4.0	Tc, min	25-YR	0.38	5.8	0.28	0.62
	0.28	2%		Ti, min=	5.8	Ti, min=	0.0	Tt, min=	0.0	5.8	100-YR	0.51	7.8	0.28	1.10

Sub Basin 9 (SB9)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION							RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	4.25	2%	C	Surface Imperviousness	0.02	Surface Imperviousness	0.05	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.07	1.0	4.35	0.31
Asphalt Parking & Walkways	0.10	100%		Length, ft	300	Length, ft	150	Length, ft	100	Tc, min	2-YR	0.07	1.4	4.35	0.44
Roof	0.00	90%	P2	Slope, percent	15.0000	Slope, percent	35.0000	Slope, ft/ft	0.0500	5.0	5-YR	0.18	2.1	4.35	1.63

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Gravel	0.00	0%	1.4	Runoff Coefficient	0.162	Runoff Coefficient	0.18	Conveyance Coefficient	15	Final	10-YR	0.27	2.7	4.35	3.22
Other	0.00	0%						Velocity, ft/s	3.4	Tc, min	25-YR	0.39	3.5	4.35	5.89
	4.35	4%		Ti, min=	11.9	Ti, min=	6.2	Tt, min=	0.5	18.6	100-YR	0.51	4.6	4.35	10.41

Sub Basin 12 (SB12)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	0.10	2%	C	Surface Imperviousness	0.85	Surface Imperviousness	0.02	Land Surface	Paved Areas and Shallow Swales	Minimum	1.25 YR	0.66	1.7	0.65	0.74
Asphalt Parking & Walkways	0.55	100%		Length, ft	20	Length, ft	0	Length, ft	220	Tc, min	2-YR	0.66	2.5	0.65	1.06
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	1.0000	Slope, ft/ft	0.0500	5.0	5-YR	0.68	3.7	0.65	1.65
Gravel	0.00	0%	1.4	Runoff Coefficient	0.68	Runoff Coefficient	0.162	Conveyance Coefficient	20	Final	10-YR	0.71	4.7	0.65	2.19
Other	0.00	0%						Velocity, ft/s	4.5	Tc, min	25-YR	0.75	6.1	0.65	2.97
	0.65	85%		Ti, min=	2.7	Ti, min=	0.0	Tt, min=	0.8	5.0	100-YR	0.78	8.2	0.65	4.16

Sub Basin 13 (SB13)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	0.02	2%	C	Surface Imperviousness	0.95	Surface Imperviousness	0.02	Land Surface	Paved Areas and Shallow Swales	Minimum	1.25 YR	0.82	1.6	0.54	0.72
Asphalt Parking & Walkways	0.52	100%		Length, ft	20	Length, ft	0	Length, ft	750	Tc, min	2-YR	0.82	2.3	0.54	1.03
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	1.0000	Slope, ft/ft	0.0200	5.0	5-YR	0.84	3.5	0.54	1.56
Gravel	0.00	0%	1.4	Runoff Coefficient	0.82	Runoff Coefficient	0.162	Conveyance Coefficient	20	Final	10-YR	0.86	4.4	0.54	2.04
Other	0.00	0%						Velocity, ft/s	2.8	Tc, min	25-YR	0.88	5.7	0.54	2.71
	0.54	96%		Ti, min=	1.8	Ti, min=	0.0	Tt, min=	4.4	6.2	100-YR	0.91	7.6	0.54	3.71

Sub Basin 14 (SB14)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	0.00	2%	C	Surface Imperviousness	1	Surface Imperviousness	0.02	Land Surface	Paved Areas and Shallow Swales	Minimum	1.25 YR	0.89	1.7	0.23	0.35
Asphalt Parking & Walkways	0.23	100%		Length, ft	20	Length, ft	0	Length, ft	320	Tc, min	2-YR	0.89	2.5	0.23	0.51
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	1.0000	Slope, ft/ft	0.0700	5.0	5-YR	0.90	3.7	0.23	0.77
Gravel	0.00	0%	1.4	Runoff Coefficient	0.9	Runoff Coefficient	0.162	Conveyance Coefficient	20	Final	10-YR	0.92	4.7	0.23	1.00
Other	0.00	0%						Velocity, ft/s	5.3	Tc, min	25-YR	0.94	6.1	0.23	1.31
	0.23	100%		Ti, min=	1.3	Ti, min=	0.0	Tt, min=	1.0	5.0	100-YR	0.96	8.2	0.23	1.79

Sub Basin 15 (SB15)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	0.12	2%	C	Surface Imperviousness	0.75	Surface Imperviousness	0.02	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.54	1.7	0.47	0.42
Asphalt Parking & Walkways	0.35	100%		Length, ft	25	Length, ft	0	Length, ft	450	Tc, min	2-YR	0.54	2.4	0.47	0.61
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	1.0000	Slope, ft/ft	0.0700	5.0	5-YR	0.58	3.6	0.47	0.97
Gravel	0.00	0%	1.4	Runoff Coefficient	0.58	Runoff Coefficient	0.162	Conveyance Coefficient	15	Final	10-YR	0.62	4.6	0.47	1.32
Other	0.00	0%						Velocity, ft/s	4.0	Tc, min	25-YR	0.66	5.9	0.47	1.82
	0.47	75%		Ti, min=	3.7	Ti, min=	0.0	Tt, min=	1.9	5.6	100-YR	0.71	7.8	0.47	2.61

Sub Basin 16 (SB16)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	0.00	2%	C	Surface Imperviousness	1	Surface Imperviousness	0.02	Land Surface	Paved Areas and Shallow Swales	Minimum	1.25 YR	0.89	1.7	0.17	0.26
Asphalt Parking & Walkways	0.17	100%		Length, ft	20	Length, ft	0	Length, ft	240	Tc, min	2-YR	0.89	2.5	0.17	0.38
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	1.0000	Slope, ft/ft	0.0700	5.0	5-YR	0.90	3.7	0.17	0.57
Gravel	0.00	0%	1.4	Runoff Coefficient	0.9	Runoff Coefficient	0.162	Conveyance Coefficient	20	Final	10-YR	0.92	4.7	0.17	0.74

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Designed by:	0 ' 0		

Other	0.00	0%					Velocity, ft/s	5.3	Tc, min	25-YR	0.94	6.1	0.17	0.97
	0.17	100%		Ti, min=	1.3	Ti, min=	0.0	Tt, min=	0.8	5.0	100-YR	0.96	8.2	0.17	1.33

Sub Basin 17 (SB17)

BASIN CHARACTERISTICS				TIME OF CONCENTRATION								RESULTS			
	Area, ac	% imp	Soil Type	Overland Flow - Surface Type 1		Overland Flow - Surface Type 2		Channel Flow		Tc, min	Event	C	i, in/hr	A, acres	Q, cfs
Landscape	0.00	2%	C	Surface Imperviousness	1	Surface Imperviousness	0.02	Land Surface	Paved Areas and Shallow Swales	Minimum	1.25 YR	0.89	1.7	0.17	0.26
Asphalt Parking & Walkways	0.17	100%		Length, ft	20	Length, ft	0	Length, ft	240	Tc, min	2-YR	0.89	2.5	0.17	0.38
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	1.0000	Slope, ft/ft	0.0700	5.0	5-YR	0.90	3.7	0.17	0.57
Gravel	0.00	0%	1.4	Runoff Coefficient	0.9	Runoff Coefficient	0.162	Conveyance Coefficient	20	Final	10-YR	0.92	4.7	0.17	0.74
Other	0.00	0%						Velocity, ft/s	5.3	Tc, min	25-YR	0.94	6.1	0.17	0.97
	0.17	100%		Ti, min=	1.3	Ti, min=	0.0	Tt, min=	0.8	5.0	100-YR	0.96	8.2	0.17	1.33

Appendix E: BMP Design Calculations for Sand Filter

Design Procedure Form: Sand Filter (SF)

UD-BMP (Version 3.07, March 2018)

Designer:) 3 6 (
Company: Four Points
Date: April 14, 2021
Project: Copper Ridge
Location: Gloria Gossard Blvd

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of sand filter)	I_a = 44.0 %
B) Tributary Area's Imperviousness Ratio (i = I_a/100)	i = 0.440
C) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time WQCV= 0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)	WQCV = 0.15 watershed inches
D) Contributing Watershed Area (including sand filter area)	Area = 385,000 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume V_{WQCV} = WQCV / 12 * Area	V_{WQCV} = cu ft
F) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.34 in
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume	$V_{WQCV\ OTHER}$ = 3,863 cu ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = cu ft
2. Basin Geometry	
A) WQCV Depth	D_{WQCV} = 4.0 ft
B) Sand Filter Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred). Use "0" if sand filter has vertical walls.	Z = 4.00 ft / ft
C) Minimum Filter Area (Flat Surface Area)	A_{Min} = 2118 sq ft
D) Actual Filter Area	A_{Actual} = 2150 sq ft
E) Volume Provided	V_T = 20700 cu ft
3. Filter Material	Choose One 18" CDOT Class B or C Filter Material Other (Explain):
4. Underdrain System	
A) Are underdrains provided?	Choose One YES NO
B) Underdrain system orifice diameter for 12 hour drain time	
i) Distance From Lowest Elevation of the Storage Volume to the Center of the Orifice	y = 4.0 ft
ii) Volume to Drain in 12 Hours	Vol_{12} = 3,863 cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = 1 1/4 in

Design Procedure Form: Sand Filter (SF)

Designer: 0 ' 0
Company: Four Points
Date: April 14, 2021
Project: Copper Ridge
Location: Gloria Gossard Blvd

5. Impermeable Geomembrane Liner and Geotextile Separator Fabric A) Is an impermeable liner provided due to proximity of structures or groundwater contamination?	Choose One YES NO
6. Inlet / Outlet Works A) Describe the type of energy dissipation at inlet points and means of conveying flows in excess of the WQCV through the outlet	

Notes:

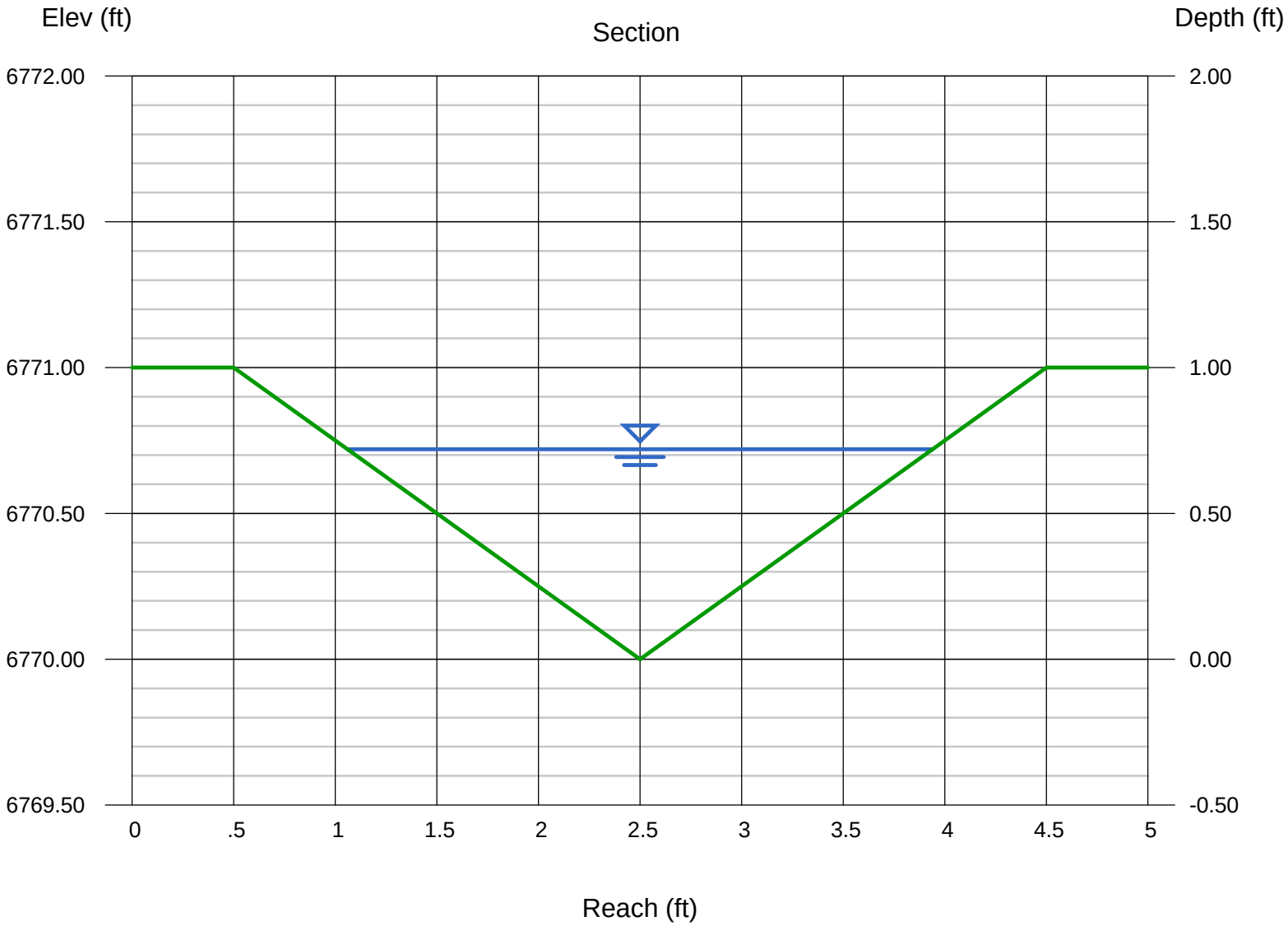
Appendix F: Channel Flow Calculations

Channel Report

Drainage Ditch DP No. 2 - Minor Event - 10% slope

Triangular	
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 6770.00
Slope (%)	= 10.50
N-Value	= 0.035
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 6.61

Highlighted	
Depth (ft)	= 0.72
Q (cfs)	= 6.610
Area (sqft)	= 1.04
Velocity (ft/s)	= 6.38
Wetted Perim (ft)	= 3.22
Crit Depth, Yc (ft)	= 0.93
Top Width (ft)	= 2.88
EGL (ft)	= 1.35



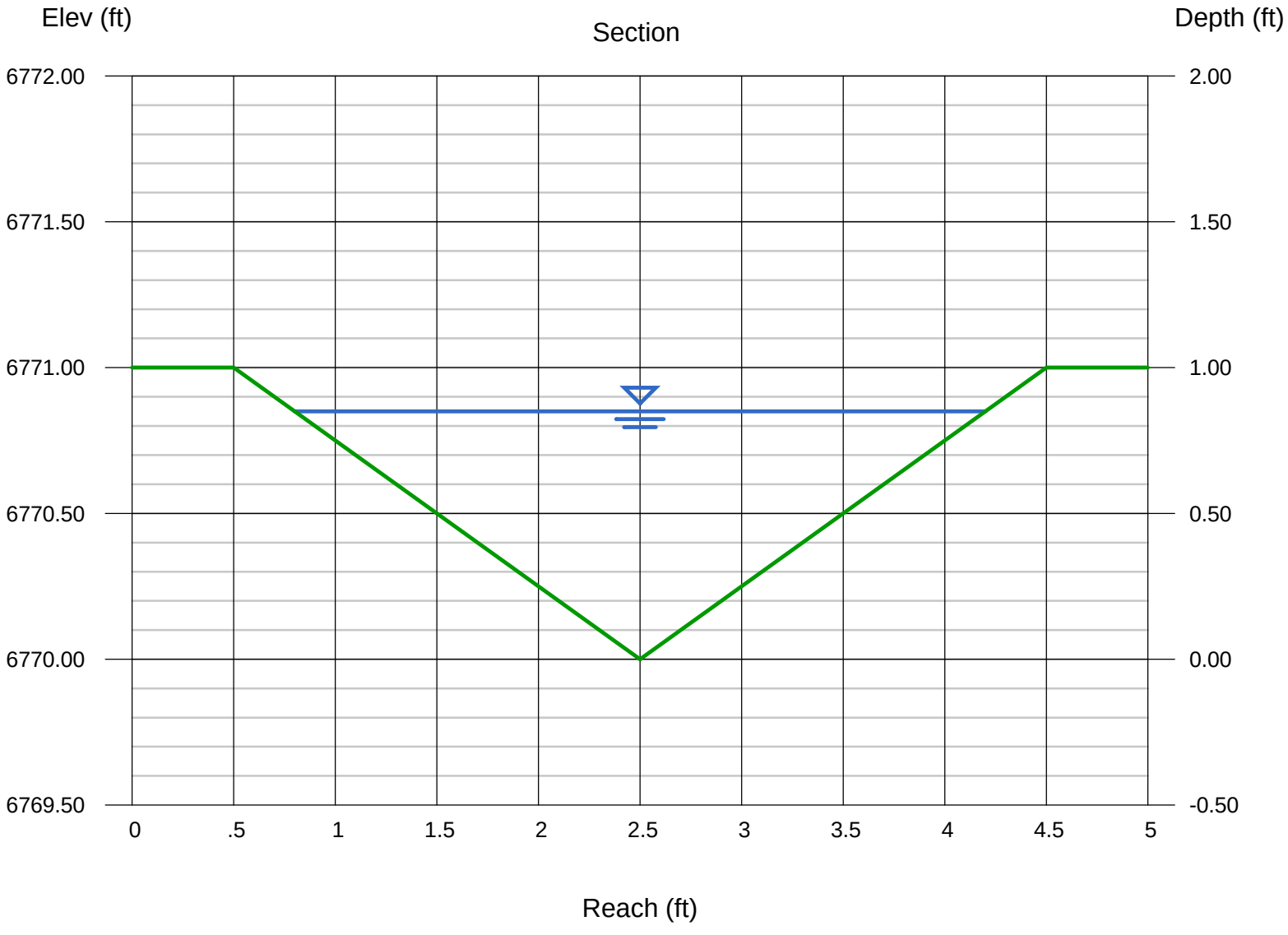
Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 23 2022

Drainage Ditch DP No. 2 - Minor Event

Triangular	
Side Slopes (z:1)	= 2.00, 2.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 6770.00
Slope (%)	= 4.40
N-Value	= 0.035
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 6.61

Highlighted	
Depth (ft)	= 0.85
Q (cfs)	= 6.610
Area (sqft)	= 1.44
Velocity (ft/s)	= 4.57
Wetted Perim (ft)	= 3.80
Crit Depth, Yc (ft)	= 0.93
Top Width (ft)	= 3.40
EGL (ft)	= 1.18



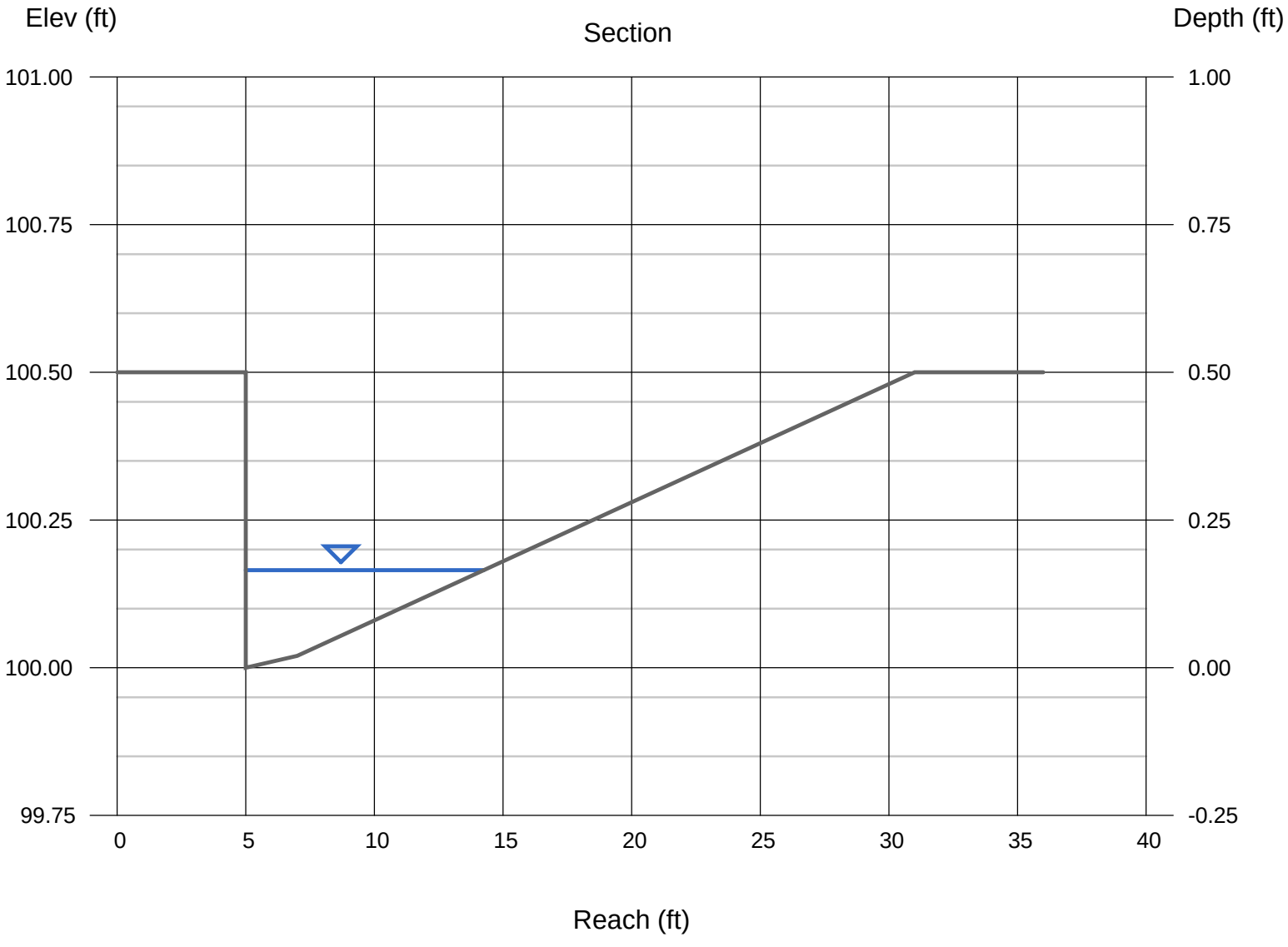
Channel Report

Design Point No. 5 Spread Flow Capacity

Gutter	
Cross Sl, Sx (ft/ft)	= 0.020
Cross Sl, Sw (ft/ft)	= 0.010
Gutter Width (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 5.00
N-Value	= 0.013

Calculations	
Compute by:	Known Q
Known Q (cfs)	= 5.00

Highlighted	
Depth (ft)	= 0.17
Q (cfs)	= 5.000
Area (sqft)	= 0.84
Velocity (ft/s)	= 5.98
Wetted Perim (ft)	= 9.42
Crit Depth, Yc (ft)	= 0.29
Spread Width (ft)	= 9.25
EGL (ft)	= 0.72



Channel Report

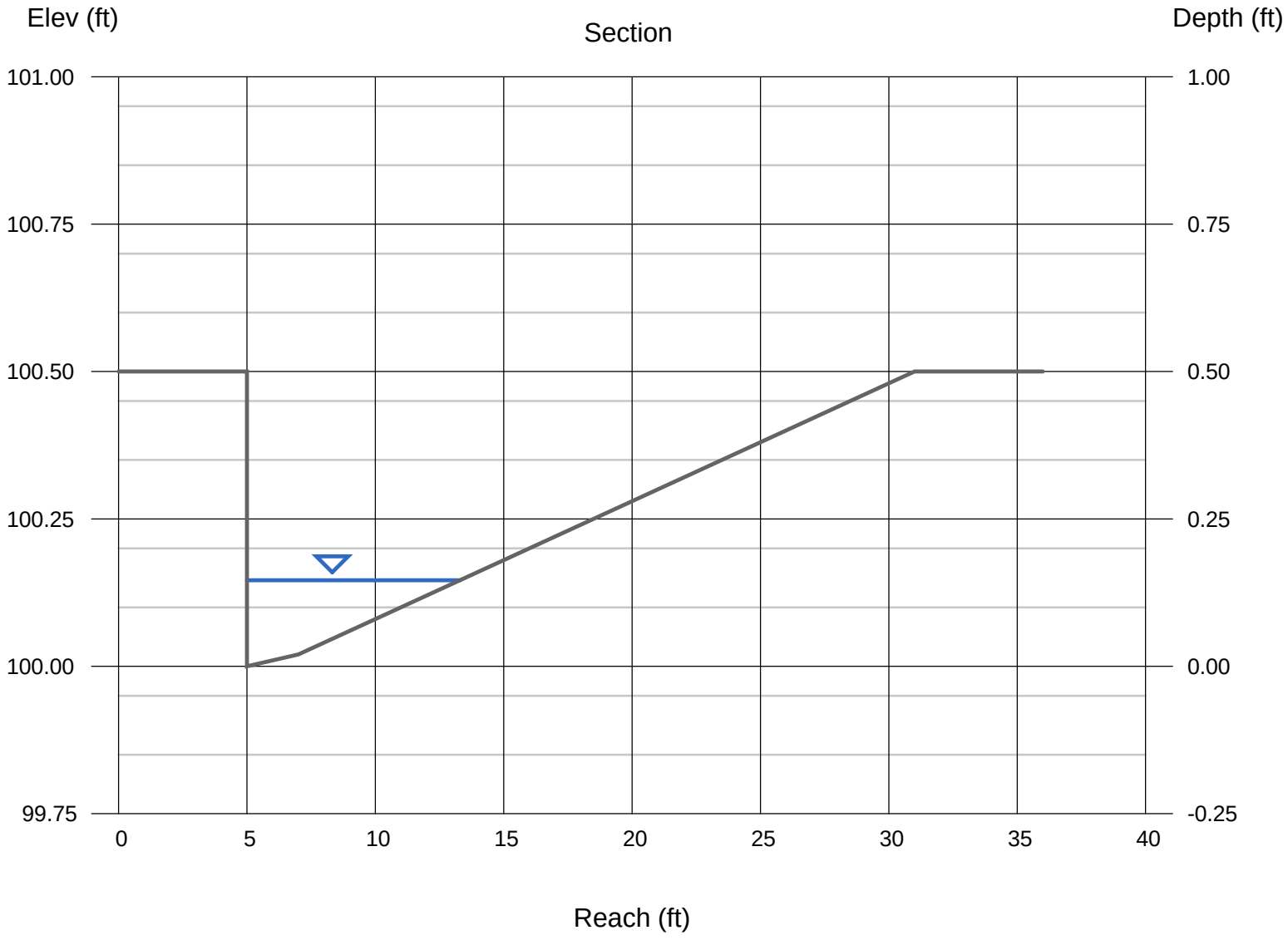
Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 23 2022

Design Point No. 5 Spread Flow Major Event

Gutter	
Cross Sl, Sx (ft/ft)	= 0.020
Cross Sl, Sw (ft/ft)	= 0.010
Gutter Width (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 5.00
N-Value	= 0.013

Calculations	
Compute by:	Known Q
Known Q (cfs)	= 3.71

Highlighted	
Depth (ft)	= 0.15
Q (cfs)	= 3.710
Area (sqft)	= 0.67
Velocity (ft/s)	= 5.55
Wetted Perim (ft)	= 8.45
Crit Depth, Yc (ft)	= 0.25
Spread Width (ft)	= 8.30
EGL (ft)	= 0.62



Channel Report

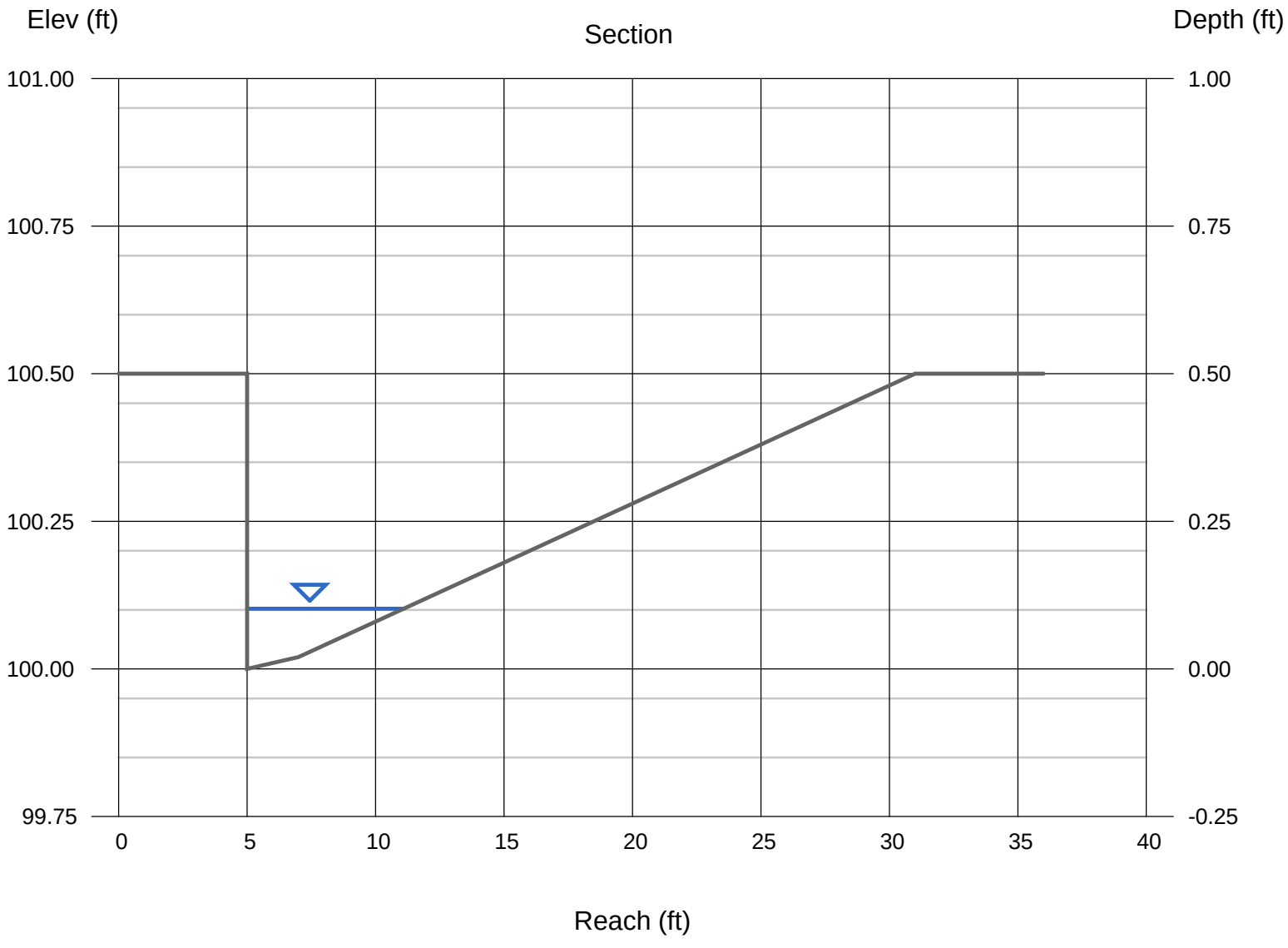
Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Tuesday, Aug 23 2022

Design Point No. 5 Spread Flow Minor Event

Gutter	
Cross Sl, Sx (ft/ft)	= 0.020
Cross Sl, Sw (ft/ft)	= 0.010
Gutter Width (ft)	= 2.00
Invert Elev (ft)	= 100.00
Slope (%)	= 5.00
N-Value	= 0.013

Calculations	
Compute by:	Known Q
Known Q (cfs)	= 1.56

Highlighted	
Depth (ft)	= 0.10
Q (cfs)	= 1.560
Area (sqft)	= 0.35
Velocity (ft/s)	= 4.43
Wetted Perim (ft)	= 6.20
Crit Depth, Yc (ft)	= 0.18
Spread Width (ft)	= 6.10
EGL (ft)	= 0.41



Appendix G: Inlet Capacity Curves

Appendix H: Culvert and Storm Sewer Capacity Calculations

&XOYHUW 5HSRUW

+\GUDIORZ ([SUHVV ([WHQVLRQ IRU $XWRGHVNŠ &LYLO 'Š E\ $XWRGHVN ,QF

LQ %\SDVV &XOYHUW ,QWHULRU &RUUXJDWLRQ 6%

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3LSH /HQJWK IW
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,QYHUW (OHY 8S IW
5LVH LQ
6KDSH &LUFXODU
6SDQ LQ
1R %DUUHOV
Q 9DOXH
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&RHII . 0 F < N

(PEDQNPHQW
7RS (OHYDWLRQ IW
7RS :LGWK IW
&UHVW :LGWK IW

&DOFXODWLRQV
4PLQ FIV
4PD[FIV
7DLOZDWHU (OHY IW

+LJKOLJKWHG
4WRWDO FIV
4SLSH FIV
4RYHUWRS FIV
9HORF Q IW V
3HDN 8S LQOHW WKURDW
+*/ 'Q IW
+*/ 8S IW
+Z (OHY IW
+Z ' IW
)ORZ 5HJLPH ,QOHW

Culvert Report

Gloria Gossard Dual 30-inch Culvert Cro ssing - Major Event for Proposed Conditions

Invert Elev Dn (ft)	=	6749.70
Pipe Length (ft)	=	130.00
Slope (%)	=	0.69
Invert Elev Up (ft)	=	6750.60
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	2
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Mitered to slope (C)
Coeff. K,M,c,Y,k	=	0.021, 1.33, 0.0463, 0.75, 0.7

Embankment		
Top Elevation (ft)	=	6759.00
Top Width (ft)	=	70.00
Crest Width (ft)	=	10.00

Calculations		
Qmin (cfs)	=	52.39
Qmax (cfs)	=	52.39
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted		
Qtotal (cfs)	=	52.39
Qpipe (cfs)	=	52.39
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.90
Veloc Up (ft/s)	=	5.34
HGL Dn (ft)	=	6751.82
HGL Up (ft)	=	6753.68
Hw Elev (ft)	=	6754.43
Hw/D (ft)	=	1.53
Flow Regime	=	Outlet Control

Culvert Report

Culvert - DP No. 7 - Capacity

Invert Elev Dn (ft)	=	6763.50
Pipe Length (ft)	=	55.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	6764.05
Rise (in)	=	18.0
Shape	=	Circular
Span (in)	=	18.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Culvert
Culvert Entrance	=	Smooth tapered inlet throat
Coeff. K,M,c,Y,k	=	0.534, 0.555, 0.0196, 0.9, 0.2

Embankment		
Top Elevation (ft)	=	6768.00
Top Width (ft)	=	32.00
Crest Width (ft)	=	10.00

Calculations		
Qmin (cfs)	=	13.67
Qmax (cfs)	=	13.67
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted		
Qtotal (cfs)	=	13.67
Qpipe (cfs)	=	13.67
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.85
Veloc Up (ft/s)	=	7.74
HGL Dn (ft)	=	6764.94
HGL Up (ft)	=	6765.84
Hw Elev (ft)	=	6766.57
Hw/D (ft)	=	1.68
Flow Regime	=	Inlet Control

Appendix I: Standard forms No. 3, 4, & 5

Standard Form No. 5 Drainage and Stormwater Treatment Scope Approval Form

Prior to starting a development plan and before the first drainage submittal, a Drainage and Stormwater Treatment Scope Approval Form must be submitted for review and signed by the City Engineer. A signed form shall also be included in every drainage submittal as Attachment A. This Scope Approval Form is for City requirements only. Values may be approximate. The City encourages supporting calculations and figures to be attached.

Project Information	
Project name:	West Acres Exemption Plan
Project location:	Lot 1 West Acres Ranch Subdivision Exemption
Developer name/contact info:	Bob Zibell, 785-845-3709
Drainage engineer name/contact info:	Matthew McLeod, PE 248-444-3268
Application Type:	Preliminary Plat
Proposed Land Use:	Subdividing lot for future developments

Project Site Parameters	
Total parcel area (acres):	134
Disturbed area (acres):	~3
Existing impervious area (acres, if applicable):	N/A
Proposed new impervious area (acres):	~1
Proposed total impervious area (acres):	~1
Proposed number of project outfalls:	Two, along the north side of Goria Gossard on each (west and east) end of the project site.
Number of additional parking spaces:	0
Description and site percentage of existing cover/land use(s):	Site is currently vacant with a portion of Gloria Gossard Parkway construction along the front of the lot.
Description and site percentage of proposed cover/land use(s):	Gloria Gossard Parkway will be completed to the west property line adjacent to Overlook Park with new sidewalk installed along the north side. A new public street will be included within the proposed platted ROW through proposed Lot 1 & Lot 2, ending at the remainder parcel for future connection.
Expected maximum proposed conveyance gradient (%):	33-50% on proposed cut and fill slopes
Description of size (acres) and cover/land use(s) of offsite areas draining to the site	Nothing is expected.

Type of Study Required:

- [x] Drainage Letter
- [ ] Final Drainage Study
- [x] Conceptual Drainage Study
- [ ] Stormwater Quality Plan

Required

Hydrologic Evaluation:

- [x] Rational Method
- [ ] CUHP/SWMM
- [ ] HEC-HMS
- [ ] Other_____

Project Drainage	
Number of subbasins to be evaluated:	~9, could increase as development progresses
Presence of pass through flow (circle) Minor flow from adjacent site	YES (NO)
Description of proposed stormwater conveyance on site:	Sheet flow, storm culvert system, curbs, valley pans and ditches will collect flow.
Project includes roadway conveyance as part of design evaluation (circle):	(YES) NO
Description of conveyance of site runoff downstream of site, identify any infrastructure noted in Stormwater Master Plan noted as lacking capacity for minor or major storm event:	There are two 30 inch culverts located near the middle of the site to the south which carry flow through Gloria Gossard road and eventually out to the Yampa River.
Detention expected onsite (circle):	(YES) NO
Presence of Floodway or Floodplain on site (circle):	YES (NO)
Anticipated modification of Floodway or Floodplain proposed (circle):	YES (NO)
Describe culvert or storm sewer conveyance evaluative method:	mannings HW/D

Permanent Stormwater Treatment Facility Design Standard (check all that apply with only one standard per tributary basin)

- [x] WQCV Standard
- [ ] TSS Standard
- [ ] Infiltration Standard
- [ ] Constrained Redevelopment WQCV Standard
- [ ] Constrained Redevelopment TSS Standard
- [ ] Constrained Redevelopment Infiltration Standard
- [ ] Does not Require Permanent Stormwater Treatment (attach Exclusion Tracking Form)

Project Permanent Stormwater Treatment	
Justification of choice of proposed design standard, including how the site meets the constrained redevelopment standard, infiltration test results, etc:	The site is currently vacant so all flow from the proposed public street will need to be treated.
Concept-level permanent stormwater treatment facility design details (type, location of facilities, proprietary structure selection, treatment train concept, etc.):	Water quality porous landscape detention pond will be designed as a part of the drainage study.
Proposed LID measures to reduce runoff volume:	Grass lined water quality swales, reveg
Will treatment evaluation include off-site, pass through flow (circle)	YES (NO)

Approvals

Matthew McLeod, PE Four Points Engineering	3/21/2022	248-444-3268
Prepared By: (Insert drainage engineer name & firm)	Date	Phone number

Approved By:

Printed Name: City Engineer

Date

APPROVED
to be generally in
accordance with
CITY ENGINEERING
STANDARDS

03/28/2022

Standard Form No. 3 – Final Drainage Study Checklist

Instructions:

1. The applicant shall identify with a "check mark" if information is provided with letter. If applicant believes information is not required, indicate with "N/A" and attach separate sheet with explanation.
2. The reviewer will determine if information labeled "N/A" is required and whether additional information must be submitted.

I. General

_____ A. Report typed and legible in 8½" x 11" format.
_____ B. Report bound (comb, spiral, or staple – no notebook).
_____ C. Drawings that are 8½ x 11 or 11 x 17 bound within report, larger drawings (up to 24" x 36) included in a pocket attached to the report. Drawings shall be at an appropriate size and scale to be legible and include project area.

II. Cover

_____ A. Report Type – Final Drainage Study.
_____ B. Project Name, Subdivision, Original Date, Revision Date.
_____ C. Preparer's name, firm, address, phone number.
_____ D. "DRAFT" for 1st submittal and revisions; "FINAL" once approved.

III. Title Sheet

_____ A. Table of Contents
_____ B. Certification, PE Stamp, signature, and date from licensed Colorado PE.
_____ C. Note: City of Steamboat Springs plan review and approval is only for general conformance with City design criteria and the City code. The City is not responsible for the accuracy and adequacy of the design, dimensions, and elevations that shall be confirmed and correlated at the job site. The City of Steamboat Springs assumes no responsibility for the completeness or accuracy of this document.

IV. Introduction

_____ A. Description of site location, size in acres, existing and proposed land use, and any pertinent background info.
_____ B. Reference planning application type and plan set date and preparer.
_____ C. Identify drainage reports for adjacent development.

V. Drainage Criteria and Methodology Used

_____ A. Identify design rainfall and storm frequency.
_____ B. Identify the runoff calculation method used.
_____ C. Identify culvert and storm sewer design methodology.
_____ D. Identify detention discharge and storage methodology.
_____ E. Discuss HEC-HMS methodologies and parameters, if HEC-HMS is used.

VI. Existing Conditions (Pre-Development/Historic)

_____ A. Indicate ground cover, imperviousness, topography, and size of site (acres).
_____ B. Describe existing stormwater system (sizes, materials, etc.).
_____ C. Describe other notable features (canals, major utilities, etc.).
_____ D. Note site outfall locations and ultimate outfall location (typically Yampa River).
_____ E. Note capacity of existing system and identify any constraints.
_____ F. Identify NRCS soil type.
_____ G. Discuss any existing easements.
_____ H. Identify the FEMA Map reviewed, if site is in floodplain/way, and zone designation.

VII. Proposed Conditions

_____ A. Indicate ground cover, imperviousness, topography, and disturbed area (acres).
_____ B. Describe proposed stormwater system (sizes, materials, etc.).
_____ C. Describe proposed outlets and indicate historic and proposed flow for each.
_____ D. Include calculations for all culverts, ditches, ponds, etc. in appendix.
_____ E. Include a summary table for the 5- and 100-year events showing historic flow and proposed flow for total site and each basin.
_____ F. Discuss proposed easements.
_____ G. Describe off-site flows to be passed thru site.
_____ H. Summarize any impacts to downstream properties or indicate none. Reference CLOMR/LOMR and impacts.

I. Detention Ponds.
_____ 1. Indicate pond volume and area (size and depth) requirement.
_____ 2. Indicate release rates.
_____ 3. Discuss outfall design, location, and overflow location.
_____ 4. Discuss maintenance requirements.

J. Curb and Gutter
_____ 1. Indicate gutter capacity.
_____ 2. Indicate curb capacity.
_____ 3. Indicate design velocity
_____ 4. Indicate design depth of flow in street.

K. Culverts
_____ 1. Indicate whether each culvert is under inlet or outlet control.
_____ 2. Show that headwater is less than the maximum allowable.
_____ 3. Indicate design velocity.
_____ 4. Indicate required and provided flow rates.
_____ 5. Discuss whether outlet protection is required and what will be used.

L. Inlets
_____ 1. Indicate inlet capacity.
_____ 2. Indicate the type of inlet(s) used.

M. Channels
_____ 1. Indicate design velocity (and type of dissipation if required).
_____ 2. Indicate required and provided flow capacity.
_____ 3. Show critical cross-section(s) including water surface.

N. Site Discharge
_____ 1. Discuss use and design of detention to ensure discharge is less than or equal to historic flow.
_____ 2. Provide documentation that downstream facilities are adequate and no adverse impacts to downstream property owners (i.e. no rise certification)

VIII. Post Construction Stormwater Management

_____ A. Discuss in general terms which permanent BMP practices will be used to control pollutant and sediment discharge after construction is complete. Exhibit A, Storm Wa Quality Plan shall be attached that will give details (see separate checklist)

IX. Conclusions

_____ A. Provide general summary.
_____ B. Note if site complies with criteria and any variances to criteria.
_____ C. Indicate if peak proposed flow is less than, equal to, or greater than peak historic flow for each outfall, design point, and for the total site.
_____ D. List proposed new stormwater system requirements.

X. References

_____ A. Provide a reference list of all criteria, master plans, drainage reports and technical information used.

XI. Tables

_____ A. Include a copy of all tables prepared for the study.

XII. Figures

_____ A. Vicinity Map.
_____ B. Site Plan (include the horizontal and vertical datum used and all benchmarks).
C. Existing conditions.
X 1. Delineate existing basin boundaries.
X 2. Delineate offsite basins impacting the site.
X 3. Show existing and proposed topography at an interval of at least ft2
X 4. Show existing runoff flow arrows.
X 5. Show existing stormwater features (structures, sizes, materials, etc.).
N/A 6. Show floodplain limits and information.
X 7. For each basin show bubble with basin number, acreage and % impervious.
X 8. For each outlet show bubble with acreage and historic flow and proposed flow or provide information in summary table on figure.
D. Proposed Conditions
_____ 1. Delineate proposed basin boundaries.
_____ 2. Show proposed runoff flow arrows.
_____ 3. Show existing and proposed topography at an interval of at least ft2
_____ 4. For each basin show bubble with basin number, acreage and percent impervious or provide a summary table or figure.
_____ 5. For each outlet show bubble with acreage, historic flow, and proposed flow or provide a summary table or figure.
_____ 6. Show floodplain limits and information.
_____ 7. Show proposed building footprints and FFE for commercial and multi-family
_____ 8. Show property lines and easements (existing and proposed).
_____ 9. Label public and private facilities. A general note can be placed on the plans in lieu of labeling all facilities, if applicable.

XIII. Appendices

_____ A. Runoff Calculations.
_____ B. Culvert Calculations.
_____ C. Pond Calculations.
_____ D. Other Calculations.

Acknowledgements

Standard Form No. 3 was prepared by: Joe Wiedemeier 4-26-2022
Date

Include Attachment A– Scope Approval Form (see Standard Form No. 5)
Include Attachment B– Storm Water Quality Plan (see Standard Form No. 4)

VII F. Easements will be established for all proposed permanent water quality features with the final draft.

Standard Form No. 4 – Stormwater Quality Plan Checklist

This list is not an exhaustive list of every possible item that may be required or requested in a Stormwater Quality Plan but provides a general guideline for preparation of the Stormwater Quality Plan.

Instructions:

1. The applicant shall identify with a "check mark" if information is provided within the Stormwater Quality Plan. If applicant believes information is not required, indicate with "N/A" and attach separate sheet with explanation. If information is included with the associated drainage letter or study, indicated with a "D."
2. The reviewer will determine if information labeled "N/A" is required and whether additional information must be submitted.

I. General

_____ A. Report typed and legible in 8½" x 11" format.
_____ B. Report bound (comb, spiral, or staple – no notebook) and in digital PDF format.
_____ C. Drawings that are 11" x 17" bound within letter, larger drawings (up to 24" x 36") included in a pocket attached to the letter, and a digital PDF copy. Drawings shall at an appropriate size and scale to be legible and include project area.

II. Cover

_____ A. Report Type – Stormwater Quality Plan.
_____ B. Project Name, Subdivision or Development, Original Date, Revision Date.
_____ C. Preparer's name, firm, address, and phone number.
_____ D. "DRAFT" for 1st submittal and revisions; "FINAL" once approved.

III. Title Sheet

_____ A. Table of Contents.
_____ B. Certification, PE Stamp, signature and date from licensed Colorado PE (for Final).
_____ C. Note: City of Steamboat Springs plan review and approval is only for general conformance with City design criteria and City code. The City is not responsible for the accuracy and adequacy of the design, dimensions, and elevations that shall be confirmed and correlated at the job site. The City of Steamboat Springs assumes no responsibility for the completeness or accuracy of this document.

IV. Introduction and Background

_____ A. Description of site location, study limits, size in acres, existing and proposed land use, soil data, permeability of the site, drainage patterns, and any pertinent background info.
_____ B. State purpose and goal of Stormwater Quality Plan and report along with any specific requirements of the desired outcome.
_____ C. List any project stakeholders and/or requestors.
_____ D. Describe the background of the flooding source and any previous studies.

V. Design Criteria and Methodology Used

X A. Identify design rainfall and storm frequency used to design permanent stormwater treatment facilities.

X B Identify the runoff calculation method used to design permanent stormwater treatment facilities.

X C. Identify the standard the design will meet and the means and methodologies by which it will use to meet the standard.

X D. Provide all details supporting the use of the selected design standard.

VI. Proposed Conditions

X A. Identify total site area, total site imperviousness, area to be treated, and impervious area to be treated. Include justification for treating less than the total site area.

X B. Describe potential site contaminant sources including sediment.

X C. Identify source and quantity of on-site and off-site stormwater flows that need to be managed and how they will be managed.

X D. For each permanent treatment facility, identify the design standard, MDCIA level (if applicable), area treated (& percentage of total), imperviousness of area treated, C values of area treated, soil types, and all pertinent data for design.

X E. Volume based facilities: Provide total storage pond volume, WQCV, drain time, release rate, sediment storage, outlet & overflow structures, area and depth of pond, micropool, forebays, etc. (include all calculations in the appendix).

X F. Flow based facilities: Provide design flow rate and all treatment calculations and how flows larger than the water quality design flow rate will be handled. If proprietary facilities are proposed, provide the justification and sizing requirements from manufacturer.

n/a G. If stormwater detention is provided, discuss how water quality is provided within the detention facility. No underground detention is allowed.

VII. Operation and Maintenance Plan Requirements

See template O&M plan and guidance document.

_____ A. Describe general project information, facility description, ROW and access information, vegetation management, hydraulic design parameters, environmental permitting, snow and ice control, and additional pertinent information in the notes.

_____ B. Indicate, describe, and detail the permanent stormwater treatment facilities.

_____ C Include section details where necessary of the permanent treatment facilities.

_____ D. Provide an inspection and maintenance schedule and procedure of permanent treatment facilities and who is responsible for them.

_____ E. Identify design specifications for construction.

Acknowledgements

Standard Form No. 4 prepared by: 0 D W W K H Z _____ 4-26-2022 _____ Date

Include appropriate Project Sheet(s) and Design Checklist(s) (See Section 5.12)
Include this form as part of the Stormwater Quality Plan.

Appendix J: Project Design Sheets

PROJECT SHEET – BASE DESIGN STANDARDS (Site is not constrained)

Complete a Project Sheet for each project that includes Permanent Stormwater Treatment Facilities

SITE INFORMATION

Project Name:	Steamboat Airpark Preliminary Plat	
Project Location:	North of Gloria Gossard Parkway	
Submitted Date:	4/26/2022	Submitted By:
Acreage Disturbed:	3.0 acres	
Existing Imperviousness:	0% (no imperviousness) except for GG paving	New Net Imperviousness:	5%
Review Date:		Reviewed By:

Preparer	City	Requirements
		Design Details are included for all Treatment Facilities
		List or include a description of any source controls or other non-structural practices:

DESIGN STANDARDS

Multiple Design Standards may be used on a site, as necessary, to meet the requirements, but only one Design Standard may be used for each treatment facility's tributary area. Evaluation of suitability of permanent stormwater treatment facilities is based on meeting the specified Design Standard and ease of long-term maintenance. Facilities must be designed in accordance with the most current version of the City's Engineering Standards and Volume 3 of USDCM and meet the specific requirements for each Design Standard used.

1. Indicate below, which Design Standard(s) will be used for the project, and
2. Complete a separate, corresponding Design Standards checklist for each facility (e.g., WQCV)

Design Standard	*Quantity*	*Tributary Area*	*Location/Identifying information*
WQCV	1	3.25 acres	See proposed conditions drainage exhibit DR2, north of GG Blvd
Pollutant Removal			
Runoff Reduction			

DESIGN CHECKLIST – Water Quality Capture Volume (WQCV) Standard

WQCV STANDARD Criteria

Treatment facilities must be designed to provide treatment and/or infiltration of the WQCV for 100% of the site. Under certain conditions, up to 20% of the site may be excluded, not to exceed 1 acre. This may apply if it is not practicable to capture runoff from portions of the site and where it is not practicable to construct a separate treatment facility for those same portions of the site.

Complete checklist if using the WQCV Standard to meet Design Standard requirements.

Project Name: Steamboat Airpark Preliminary Plat			
Preparer	**City**	**Requirements**	
		Facilities provide treatment and/or infiltration of the WQCV for 100% of the site	
		% of site treated: 80%, paved access road	
		Facility Type: Sand Filter	Facility Location: See exhibit DR2
		See Drainage Report section: 4	

If less than 100% of the site is treated, complete the following:

Preparer	**City**	**Requirements**	
		% of site not treated by control measures (not to exceed 20% or 1 acre):	
		%	Size (acres)
		Provide explanation of why the excluded area is impractical to treat: The excluded impervious area not treated is that of the roadway and sidewalk downstream of the inlets leading into the detention and sand filter facility.	
		Provide explanation of why another facility is not practicable for the untreated area: This area is just access road into the lot and will not have very high pollutant loads and it's not economical to install permanent facilities for treatment.	

Appendix K: Detention Design Calculations

Design Procedure Form: 5 Year Detention Pond Calculations

	Designer:	0 ' 0								
	Company:	FOUR POINTS								
	Date:	4/13/2021								
	Project:	Copper Ridge								
	Location:	Gloria Gossard Blvd								
		5 Year Detention Pond								
			Area	8.61	acres					
			Allowable Release Rate Major Storm							
			(0.10 cfs/acre) * A		=	0.861	(from table 5.11.1)			
			C_5	0.59			(from table 5.6.1)			
			i_5	2.3			(from table 5.5.1)			
			Tc (dev)	15.8						
			Equation 5.11.1							
			Volume In							
			V= C*I*A*Tc(dev)*60		11076.21		(from equation 5.11.1)			
					11076	ft^3				
			Equation 5.11.2							
			Volume Out							
			V=Qallow*Tc(ex)*(60)		816.228		(from equation 5.11.2)			
					816	ft^3				
			Pond Volume							
			Volume In - Volume Out							
			10260 ft^3		0.2355	acre-ft				
			Depth	2	ft					
			Area	5129.993	5130	sq-ft				
			Minor Storm Water Surface=		6658	ft				

Design Procedure Form: 100 Year Detention Pond Calculations

	Designer:									
	Company:									
	Date:									
	Project:									
	Location:									
		100 Year Detention Pond								
			Area	8.61	acres					
			Allowable Release Rate Major Storm							
			(0.54 cfs/acre) * A		=	4.6494	(from table 5.11.1)			
			C_{100}	0.59			(from table 5.6.1)			
			i_{100}	5.1			(from table 5.5.1)			
			Tc (dev)	15.8						
			Equation 5.11.1							
			Volume In							
			V= C*I*A*Tc(dev)*60		24560.3		(from equation 5.11.1)			
					24560	ft^3				
			Equation 5.11.2							
			Volume Out							
			V=Qallow*Tc(ex)*(60)		4407.631		(from equation 5.11.2)			
					4408	ft^3				
			Pond Volume							
			Volume In - Volume Out							
			20153	ft^3	0.4626	acre-ft				
			Depth	4	ft					
			Area	5038.167	5038	sq-ft				
			Width	41	ft					
			Length	123	ft					

Discharge Rates for Major and Minor Storms

Designer: 0 ' 0
Company: Four Points
Date: 4/13/2021
Project: Copper R idge V illage
Location:

Oriface Plate Size for Minor Storm

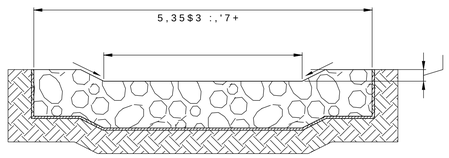
Area of Orifice Plate=	0.081	sq-ft
C_d	0.65	
Diameter of Opening	0.320	ft
	0.59	in
Depth of surface(major)	4.2	ft
Flow line of Orifice Plate	6653.80	

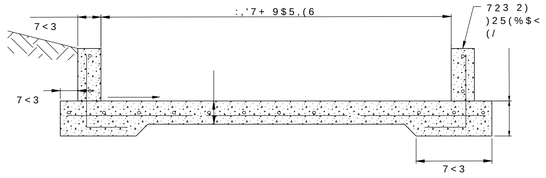
Discharge for Minor Storm Headwater

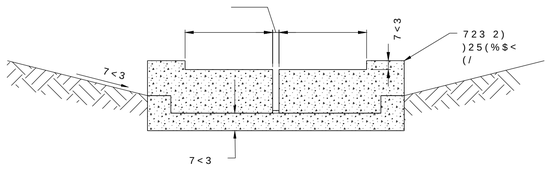
Q=CdA(2gh)^(1/2)	0.86	cfs
Q_{wier}	3.79	cfs

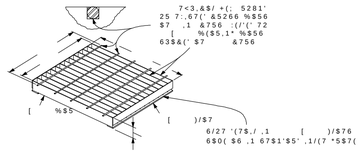
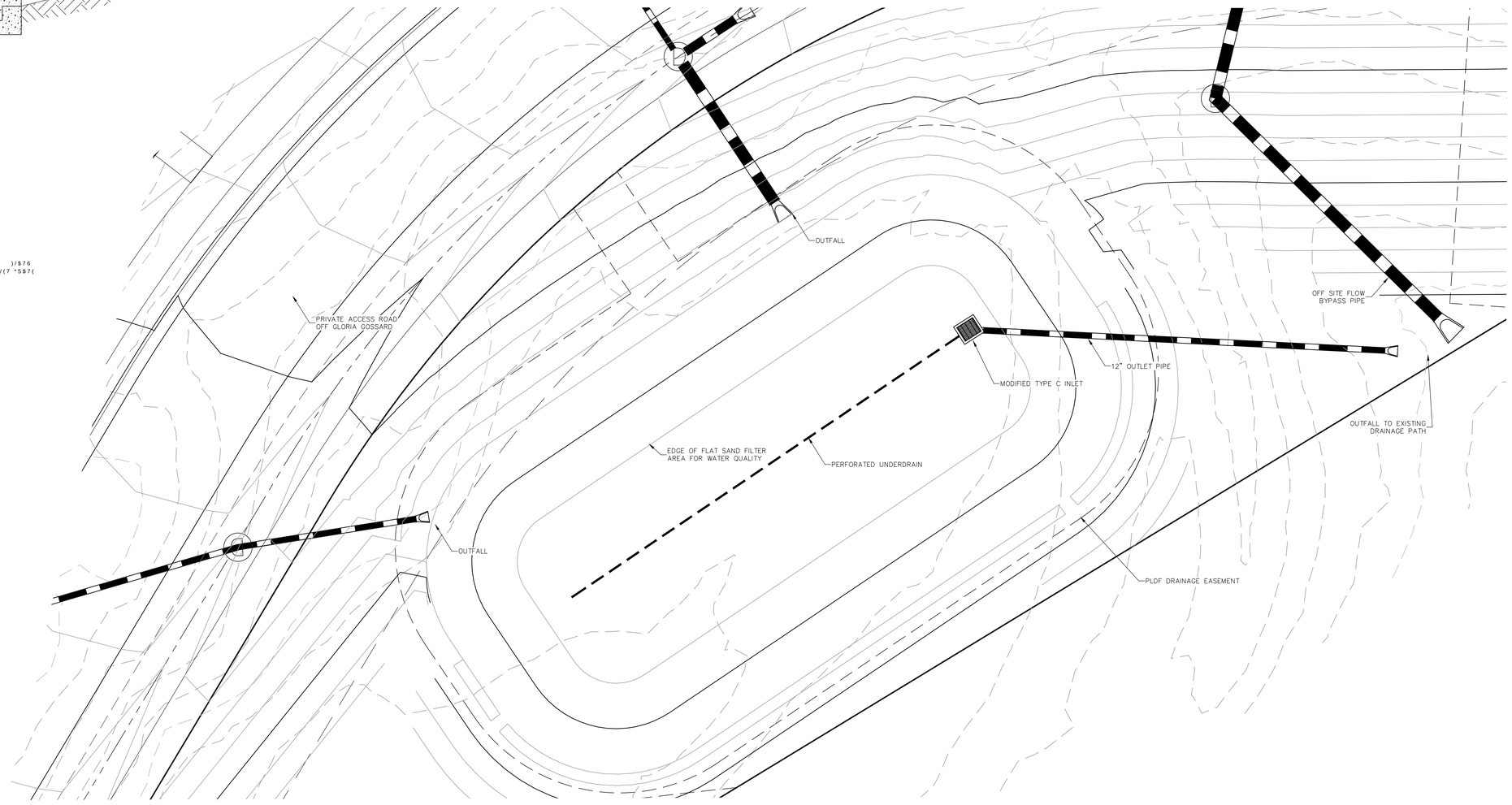
Oriface Plate Size for Major Storm

Area of Orifice Plate=	0.43	sq-ft
Diameter of Opening	0.744	ft
	8.93	in









DETENTION POND CROSS SECTION DETAIL: (1"=20')
(TO BE COM