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

Draft Drainage Study & Stormwater Quality Plan for Lot 1 Indian Meadows Development Plan

Address: TBD

Draft: 3/24/2022
Final:

Prepared by: Joe Wiedemeier, P.E.
Four Points Surveying & Engineering

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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.

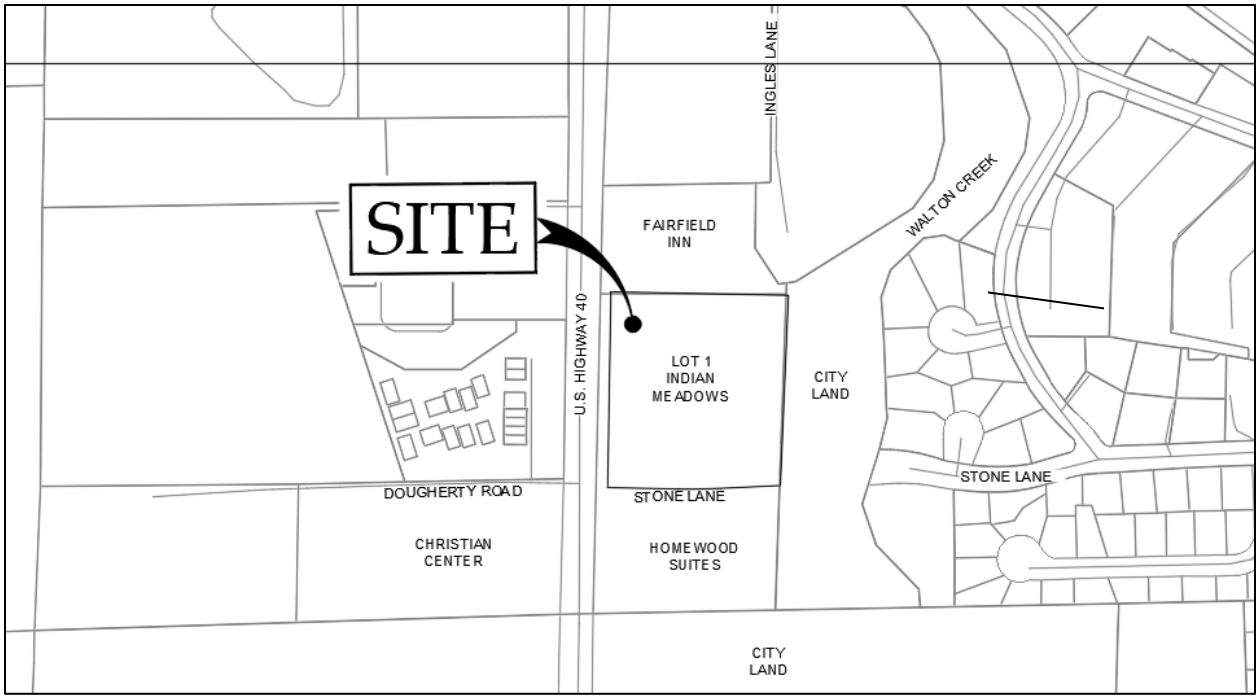
_____
Joe Wiedemeier, P.E.
State of Colorado No. 0054959
Date:_____

1.0 Introduction

This report provides a detailed analysis of existing and proposed post-development drainage conditions and proposed water quality facilities for the proposed development at Lot 1 Indian Meadows. 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: Vicinity Map – Lot 1 Indian Meadows



B. Owner/Developer

Gray Stone, LLC

C. Drainage Reports for Adjacent Developments

Homewood Suites Hotel Final Drainage Study Report, March 2006. Owen Consulting Group, Inc. Larry C. Owen, P.E.

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 developed impervious areas 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: $\mathbf{Q = CiA}$ (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 total suspended solids (TSS) design standards. TSS calculations were performed for grass lined water quality swales per City drainage engineering standards.

3.0 Existing Conditions

A. Ground Cover, Imperviousness, Topography and Size

- Vacant Lot with bare ground, native grasses, and wetlands vegetation
- 24-foot-wide paved vehicle access and 8-foot-wide pedestrian sidewalk to Fairfield Inn
- 5-10% imperviousness
- Flat to gentle sloping terrain, 5% slopes max
- Total lot size: 3.875 acres

B. Existing Stormwater Systems

Refer to the existing conditions drainage exhibit and existing drainage basin designations. Drainage from EB1 (the portion of the lot to be developed) generally sheet flows west to east across Lot 1. A low spot in the northeast corner appears to be the only defined outfall point. Wetlands are present along much of the eastern property line. No stormwater infrastructure is located within EB1. EB2 generally sheet flows east to west and into the US 40 roadside ditch and wetlands. Flows between EB1 and EB2 are generally split by the existing Fairfield Inn access road. EB3 primarily consists of the Stone Lane right-of-way. Flows are directed into curb and gutter conveyance and into the Homewood Suites stormwater collection network to the south.

C. Notable Features

- Floodplain - FEMA Zone A
- Wetlands present

D. Site Outfall and Ultimate Outfall Locations

EB1 outfalls into Walton Creek and ultimately the Yampa River.

E. USDA NRCS Soil Type

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

- Slocum Loam → Hydrologic Soil Group Rating: B/D
- Venable → Hydrologic Soil Group Rating: B/D

F. Existing Easements

See existing conditions drainage exhibit for existing easements. There are no dedicated drainage easements within EB1.

G. FEMA Map Review and Walton Creek Split Flow Analysis.

FEMA flood map No. 08107C0883D effective 2/4/2005 was reviewed. Lot 1 is partially located within a FEMA designated floodplain AKA a special flood hazard area (SFHS) with designation Zone AE. Base flood elevations were revised and indicated on the drainage exhibits based on the Hampton Inn and Holiday Inn Express Walton Creek HEC-RAS Split Flow Model Analysis report by Wohnrade Civil Engineers, Inc. April 22, 2022. The report concludes that proposed development in the floodplain SFHA will not increase base flood elevations.

Drainage Study: Insert information.

4.0 Proposed Conditions

Lot 1 development is proposed to be done in three phases. The first phase shall consist of installing a new shared cross access road through the east side of the lot and subsequent removal of the existing access to Fairfield Inn and a vacation of the existing access and public utility easement. Phase 1 shall also consist of a permanent water quality swale along the east property line (WQ Swale #1) that the cross access road drains to.

A. Ground Cover, Imperviousness, Topography and Size

- Total area of development is approximately 3.0 acres.
- Finished ground cover will consist of paving, multi-story hotels, landscaping, gravel, stone, and both maintained and unmaintained grasses.
- The proposed grading scheme will direct surface runoff to the proposed stormwater treatment BMPs which consist of rain gardens and water quality swales.
    - Water quality swale #1 (for SB1) will outfall into City land at the historical outfall point.
    - Water quality swales for phases 2 and 3 will receive treatment via rain gardens and enter a stormwater collection network and outfall at the same point as water quality swale #1.
- Impervious area: 50%-90% (varies by basin).
- Area to be treated: 3.06 acres
- Impervious area to be treated: 2.23 acres

B. Proposed Stormwater Systems

Stormwater swales, rain garden basins, valley pans, curb & gutter, stormwater inlets and piping will convey all runoff to the historical outfall point identified as design point No. 1. Sheet flow from the access road and parking lot will be conveyed to one of the permanent water quality treatment BMPs that then drain into the private stormwater collection network. The stormwater collection network will consist of Nyloplast inlets connected via smooth wall PVC or HDPE stormwater pipe. No public stormwater infrastructure is proposed.

Drainage Study: HDPE

Energy grades lines (EGL) and hydraulic grade lines (HGL) were developed for each run of storm sewer to analyze surcharging conditions under the minor and major event flows. The stormwater collection network was designed to handle the minor event without surcharging the system, and will effectively convey the major event without overflowing the water quality swales.

Pipe velocities were analyzed for standards conformance. Storm sewer velocities were analyzed for the major event. Pipe velocity was found to be within the required standards. See Appendix K for a summary table of pipe flow velocities.

A temporary 24-inch diameter CMP culvert is proposed to convey flows from Phases 2 and 3 as this area will be undeveloped and require drainage across the new cross access road. This road will essentially act as a levee, holding back runoff from the Phase 2 and 3 areas until the drainage improvements for those phases is complete.

During and following the Phase 2 construction, the site will be raised and create ponding at the low point of the Phase 3 development. It is proposed that this collection point of water be outfitted with a temporary sedimentation basin, submersible pump and sump to pump water into the Phase 2 swale along the west side of the cross access road. This temporary measure will need to be inspected and maintained regularly and shall be treated as a construction control measure.

Drainage Study: This needs to be included on the grading and drainage plans as an interim mitigation measure.

C. Outlets: Historic and Proposed Flow

SB1 will outfall into water quality swale #1 along the easterly property line. Flows from the sub-basins in Phase 2 will go through stormwater treatment, enter the storm sewer network and then outfall at design point No. 1. The proposed ultimate outfall point for all developed sub-basins occurs as design point No. 1.

D. Hydraulic Calculations

- Inlet capacity was analyzed using manufacturer capacity curves,
- Conveyance piping was analyzed with AutoCAD Storm Sewers software,
- and drainage swales and the temporary culvert crossing 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) and sub-basins (e.g. SB1). Major and minor flows for each basin are summarized in the following table, Table 1.

Table 1: Major and Minor Flow Summary Table

Basin Condition	Area (acres)	Impervious Area (%)	Runoff	
			Q_5 (cfs)	Q_{100} (cfs)
EB1	2.96	5%	0.86	5.34
EB2	0.86	8%	0.19	3.37
EB3	0.39	80%	0.57	2.31
SB1	0.31	49%	0.26	1.51
SB2	0.35	90%	0.97	2.38
SB3	0.50	76%	0.66	1.76
SB4	0.15	93%	0.44	1.07
SB5	0.17	94%	0.44	1.07
SB6	0.18	78%	0.31	0.81
SB7	0.08	88%	0.16	0.40

F. Proposed Easements

Drainage easements are proposed for the permanent water quality treatment BMPs (water quality swales and rain gardens). The drainage easements will be accessible from the proposed 30-foot-wide shared access easement and shared cross access road.

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. Please reference *Summary of Preliminary Findings for Hampton Inn and Holiday Inn Express Walton Creek HEC-RAS Split Flow Analysis* provided as part of the development plan package.

I. Potential Site Contaminants

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

J. On-Site Stormwater Flows

On site flows will originate primarily from the cross access road, parking lot, paved walkways, and the hotel rooftops. Flows shall be managed as designed and depicted in the proposed conditions drainage exhibit. *Note: The phase 1 and phase 2 parking lot designs are preliminary and may vary accordingly with this draft report.*

K. Water Quality Design Standard

Two water quality design standards were utilized for the water quality BMP designs. The TSS design standards were used for the water quality swale designs and the WQCV design standards were used for the rain gardens. TSS removal was determined using the City's prescribed method. WQCV was determined using the UDFCD UD_BMPv3.07 design spreadsheet for rain gardens (AKA bioretention). Table 2 and Table 3 below outline the design variable for water quality swales and rain gardens, respectively.

Table 2: Water Quality Swale Design Variables

Water Quality Feature Design Variables	Grass Lined Swales – By Sub-Basin		
	SB1	SB3	SB6
Design Standard	TSS	TSS	TSS
Design Event	1.25 year	1.25 year	1.25 year
Total Area Treated (acres)	0.31	0.50	0.18
Imperviousness of Area Treated	50%	76%	78%
C Values of Area Treated	0.33	0.56	0.58
Hydrologic Soil Types of Treatment Area	B	B	B
Design Treatment Area (ft^2)	200	100 x 2	100
Total Flat Treatment Area (ft^2)	200	100 x 2	100
Design Flow Rate (cfs)	0.18	0.29	0.14
Design Velocity (ft/sec)	(See appendix)	(See appendix)	(See appendix)

Table 3: Rain Garden Design Variables

Water Quality Feature Design Variables	Rain Gardens – By Sub-Basin		
	SB4	SB5	SB7
Design Standard	WQCV	WQCV	WQCV
Design Event	0.34 inch event	0.34 inch event	0.34 inch event
Total Area Treated (acres)	0.15	0.17	0.08
Imperviousness of Area Treated	93%	94%	88%
C Values of Area Treated	0.78	0.79	0.69
Hydrologic Soil Types of Treatment Area	B	B	B
Design Treatment Area (ft^2)	280	280	145
Total Flat Treatment Area (ft^2)	280	280	145
Design Flow Rate (cfs)	0.20	0.20	0.07
Design Velocity (ft/sec)	(See appendix)	(See appendix)	(See appendix)

L. Channels

Drainage swales and the water quality swales shall be utilized to convey and treat surface runoff from the access road and parking lot. All drainage swales shall be capable of conveying the major event peak flow rate. See appendices for drainage swale flow calculations.

M. Inlets and Stormwater Pipe

Nyloplast inlets with dome are proposed to collect stormwater flows from gutters, swales, and valley pans throughout the site. Each inlet has the capacity to capture the minor storm event with 100% efficiency. Major events may cause ponding within the swales and rain gardens, however there is minimal threat of over inundation and the occurrence of such is minimal. Dome inlets are proposed to limit clogging that is commonly associate with flat area inlets.

N. Culverts

A temporary 24" circular CMP culvert crossing shall be installed with the new cross access road construction parallel to the permanent storm sewer crossing. This culvert will remain until Phase 3 of the development occurs, in which it will then be abandoned in place once all permanent drainage improvements are installed.

5.0 Construction Stormwater Management

The contractor and owner shall be required to obtain a state general permit for the discharge of construction site stormwater associated with the approximate 3.0 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 for Phases 1, 2, and 3 of construction. The stormwater management plan should take into account the changing topography and conditions of the site throughout the construction process. For example, the cross access road for Phase 1 will require a temporary culvert crossing and during the construction of Phases 2 and 3, drainage patterns will change and ponding will need to be managed accordingly.

Lastly, in should be emphasized that Lot 1 discharges into delineated wetlands on City property that leads directly into Walton Creek a few hundred feet downstream of design point No. 1. This is a sensitive area and temporary stormwater control measures shall be properly implemented, inspected, and maintained throughout the entire construction phase and until at least 80% of final revegetation is achieved for the site.

6.0 Post Construction Stormwater Management

See Operation and Maintenance Plans provided in the appendices.

7.0 Concluding General Summary

Approximately 3.0 acres of land are proposed for development of two commercial hotel establishments. Existing drainage patterns will be changed due to the extent of development but the historic outfall point will be maintained under the proposed conditions. Permanent drainage features for the Project includes a combination of sheet flow, channel flow, stormwater BMPs and a stormwater collection and conveyance network to manage stormwater runoff. Treated stormwater runoff will be discharged onto City Land in the northeast corner of Lot 1 that leads to

Walton Creek via wetland drainage ways. All parking lot and access roads of the development will receive water quality treatment via the water quality swales and rain gardens.

A. Compliance

The proposed stormwater drainage system complies with City Drainage Criteria.

B. Historic and Proposed Site Flows

Peak proposed flows will be higher than historic peak flows. However, flows from the site immediately discharge into the Walton Creek floodplain and the increase in peak flow does not affect surrounding base flood elevations. Therefore, 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

Urban Drainage and Flood Control District Criteria Manual, 2018.

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

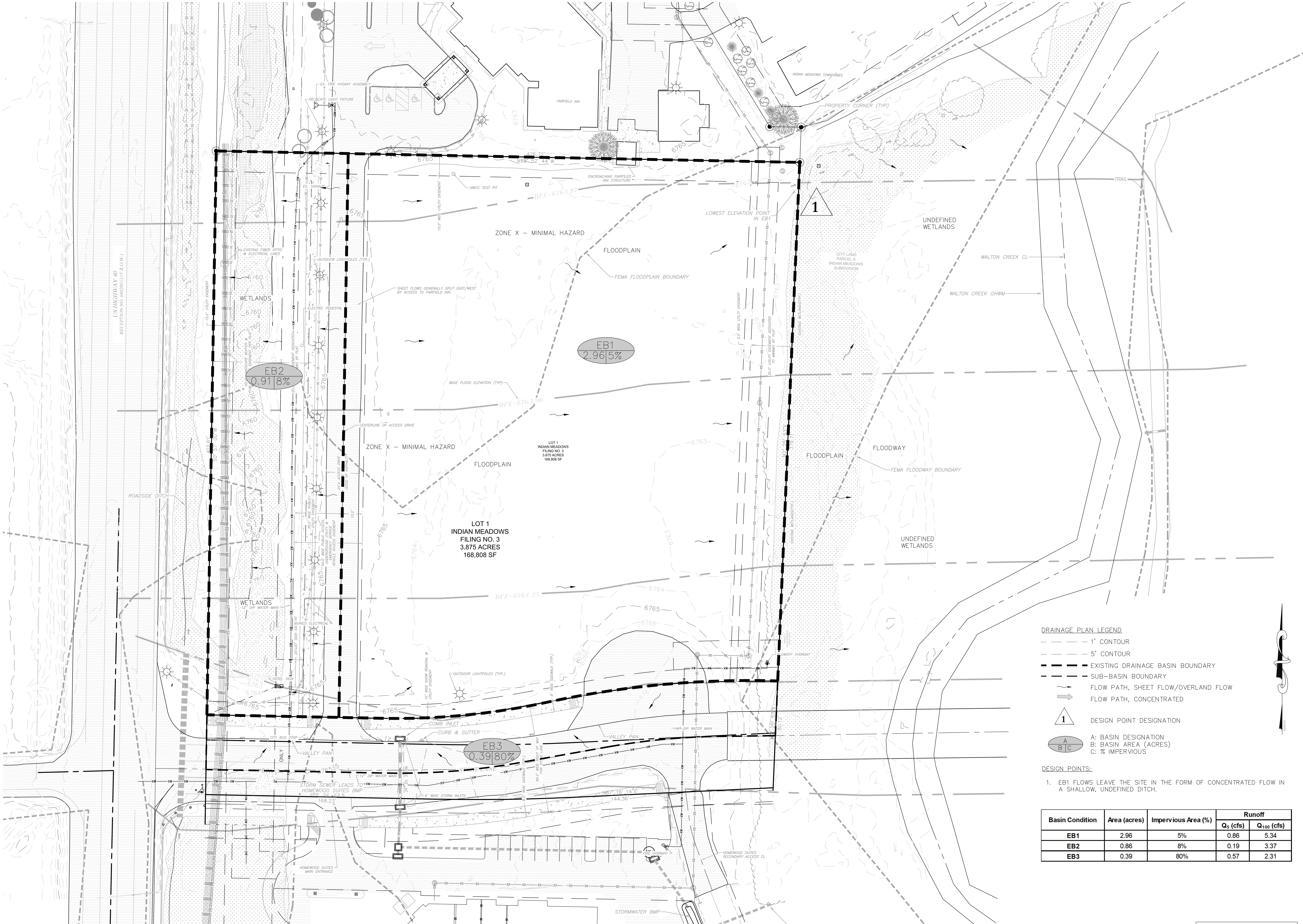
City of Steamboat Springs Engineering Drainage Criteria, Latest Version.

Summary of Preliminary Findings for the Hampton Inn and Holiday Inn Express – Walton Creek HEC-RAS Split Flow Analysis. Wohnrade Civil Engineers Inc., Mary B. Wohnrade, P.E.

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 Spreadsheet Calculations for TSS Concentration and WQCV
F. Channel Flow Calculations
G. Inlet Capacity Curves
H. Storm Sewer Capacity Calculations and EGL/HGL profiles
I. Standard forms No. 3, 4, & 5
J. Project Design Sheets
K. Operation and Maintenance Plan for Stormwater BMPs and Conveyance Network

Appendix A: Existing Conditions Drainage Exhibit, DR1



DRAINAGE PLAN LEGEND

- 1' CONTOUR
- 5' CONTOUR
- EXISTING DRAINAGE BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- FLOW PATH, SHEET FLOW/OVERLAND FLOW
- FLOW PATH, CONCENTRATED
- DESIGN POINT DESIGNATION
- A: BASIN DESIGNATION; B: BASIN AREA (ACRES); C: % IMPERVIOUS

DESIGN POINTS:

1. EB1 FLOWS LEAVE THE SITE IN THE FORM OF CONCENTRATED FLOW IN A SHALLOW, UNDEFINED DITCH.

Basin Condition	Area (acres)	Impervious Area (%)	Runoff	
			Q_5 (cfs)	Q_{100} (cfs)
EB1	2.96	5%	0.86	5.34
EB2	0.86	8%	0.19	3.37
EB3	0.39	80%	0.57	2.31

NOT FOR CONSTRUCTION

FOUR POINTS SURVEYING ENGINEERING

440 S. Lincoln Ave, Suite 4A
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(970)-871-6772
www.fourpointsse.com

No.	DATE	REVISIONS	INT

LOT 1 INDIAN MEADOWS DEVELOPMENT PLAN

LOT 1, INDIAN MEADOWS FILING NO. 3
STEAMBOAT SPRINGS, CO 80487

HORIZONTAL SCALE

0 30' 60'

SCALE: 1" = 30'

CONTOUR INTERVAL = 1FT

DATE: 11/30/2021
JOB #: 1448-005
DRAWN BY: SDW
DESIGN BY: JLW
REVIEW BY: RL

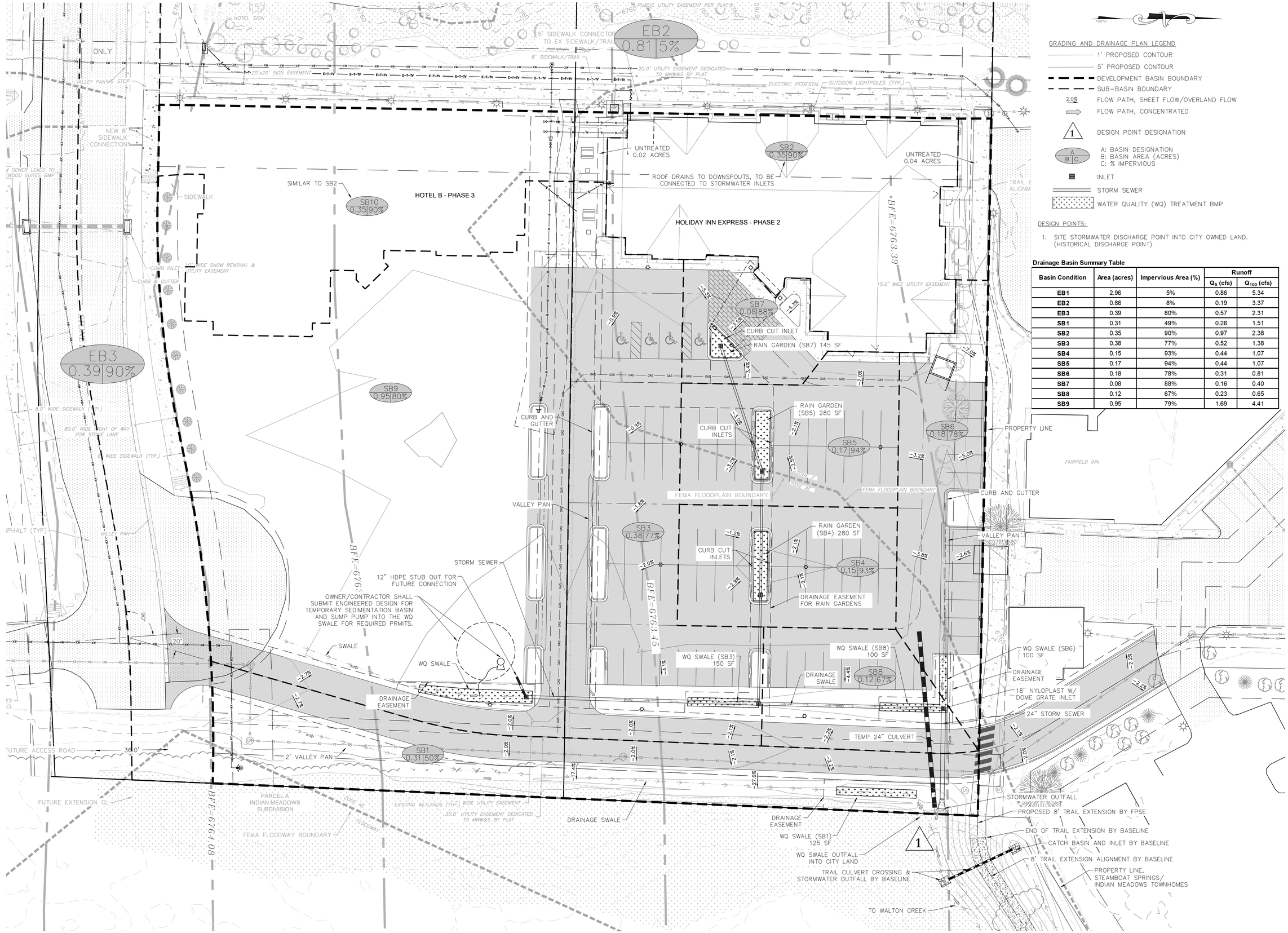
IF THIS DRAWING IS PRESENTED IN A FORMAT OTHER THAN 24" X 36", THE GRAPHIC SCALE SHOULD BE UTILIZED.

DRAWING: EXISTING CONDITIONS DRAINAGE

SHEET NO. C2

CTB: FPSE–BW.CTB
BY: JOE WIEDEMEIER
PLOT DATE: 2/4/2022 4:01 PM
DRAWING FILE: P:\1448–005 LOT 1 INDIAN MEADOWS F3 HOTELS\FPSE\DRAINAGE\1448–005 EXISTING CONDITIONS DRAINAGE.DWG

Appendix B: Proposed Conditions Drainage Exhibit, DR2



GRADING AND DRAINAGE PLAN LEGEND

- 1' PROPOSED CONTOUR
- 5' PROPOSED CONTOUR
- DEVELOPMENT BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- 2.0% FLOW PATH, SHEET FLOW/OVERLAND FLOW
- FLOW PATH, CONCENTRATED
- 1 DESIGN POINT DESIGNATION
- A / B | C — A: BASIN DESIGNATION, B: BASIN AREA (ACRES), C: % IMPERVIOUS
- INLET
- STORM SEWER
- WATER QUALITY (WQ) TREATMENT BMP

DESIGN POINTS:

1. SITE STORMWATER DISCHARGE POINT INTO CITY OWNED LAND. (HISTORICAL DISCHARGE POINT)

Drainage Basin Summary Table

Basin Condition	Area (acres)	Impervious Area (%)	Runoff	
			Q_5 (cfs)	Q_{100} (cfs)
EB1	2.96	5%	0.86	5.34
EB2	0.86	8%	0.19	3.37
EB3	0.39	80%	0.57	2.31
SB1	0.31	49%	0.26	1.51
SB2	0.35	90%	0.97	2.38
SB3	0.38	77%	0.52	1.38
SB4	0.15	93%	0.44	1.07
SB5	0.17	94%	0.44	1.07
SB6	0.18	78%	0.31	0.81
SB7	0.08	88%	0.16	0.40
SB8	0.12	67%	0.23	0.65
SB9	0.95	79%	1.69	4.41

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Steamboat Springs, CO 80487
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No.	DATE	REVISIONS	INT
1	6/10/22	PER 1ST DRT COMMENTS 6/3/22	JLW

LOT 1 INDIAN MEADOWS
PHASE II DEVELOPMENT PLAN
LOT 1, INDIAN MEADOWS FILING NO. 3
STEAMBOAT SPRINGS, CO 80487

HORIZONTAL SCALE
0 20' 40'
SCALE: 1" = 20'
CONTOUR INTERVAL = 1 FT

DATE: 4/14/2022
JOB #: 1448-005
DRAWN BY: SDW
DESIGN BY: JLW
REVIEW BY: RL

IF THIS DRAWING IS PRESENTED IN A FORMAT OTHER THAN 24" X 36", THE GRAPHIC SCALE SHOULD BE UTILIZED.

DRAWING: GRADING & DRAINAGE PLAN

SHEET NO.
DR2

PLOT DATE: 9/2/2022 10:22 AM BY: JOE WIEDEMEIER CTB: FPSE-BW.CTB

DRAWING FILE: P:\1448-005 LOT 1 INDIAN MEADOWS F3 HOTELS\FPSE\DRAWAGE\1448-005 PROPOSED CONDITIONS DRAINAGE - PH2.DWG

Appendix C: USDA NRCS Web Soil Survey

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Routt Area, Colorado, Parts of Rio Blanco and Routt Counties

February 4, 2022

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,080 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Routt Area, Colorado, Parts of Rio Blanco and Routt Counties
Survey Area Data: Version 11, Sep 2, 2021

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

Date(s) aerial images were photographed: May 8, 2012—Oct 5, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
25A	Toponas loam, 0 to 3 percent slopes	0.1	1.4%
49A	Slocum loam, gravelly substratum, 0 to 3 percent slopes	2.6	56.4%
AW	Venable, mucky peat, 0 to 3 percent slopes, frequently flooded	1.9	42.2%
Totals for Area of Interest		**4.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate

Map Scale: 1:1,080 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
25A	Toponas loam, 0 to 3 percent slopes	B/D	0.1	1.4%
49A	Slocum loam, gravelly substratum, 0 to 3 percent slopes	B/D	2.6	56.4%
AW	Venable, mucky peat, 0 to 3 percent slopes, frequently flooded	B/D	1.9	42.2%
Totals for Area of Interest			**4.5**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix D: Basin Runoff Calculations

RATIONAL METHOD RUNOFF ANALYSIS

Job #	1448-005	Date:	March 23, 2022
Job Name	Lot 1 Indian Meadows	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	2.86	2%	C	Surface Imperviousness	0.05	Surface Imperviousness	0.02	Land Surface	Paved Areas and Shallow Swales	Minimum	1.25 YR	0.08	0.7	2.96	0.17
Asphalt Parking & Walkways	0.10	100%		Length, ft	300	Length, ft	0	Length, ft	0	Tc, min	2-YR	0.08	1.1	2.96	0.25
Roof	0.00	90%	P2	Slope, percent	1.0000	Slope, percent	30.0000	Slope, ft/ft	2.0000	5.0	5-YR	0.18	1.6	2.96	0.86
Gravel	0.00	40%	1.4	Runoff Coefficient	0.18	Runoff Coefficient	0.162	Conveyance Coefficient	20	Final	10-YR	0.28	2.0	2.96	1.67
Other	0.00	0%						Velocity, ft/s	28.3	Tc, min	25-YR	0.39	2.6	2.96	3.04
	2.96	5%		Ti, min=	28.7	Ti, min=	0.0	Tt, min=	0.0	**28.7**	**100-YR**	**0.52**	**3.5**	**2.96**	**5.34**

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	0.81	2%	C	Surface Imperviousness	0.1	Surface Imperviousness	0	Land Surface	Paved Areas and Shallow Swales	Minimum	1.25 YR	0.10	1.6	0.86	0.13
Asphalt Parking & Walkways	0.05	100%		Length, ft	100	Length, ft	0	Length, ft	0	Tc, min	2-YR	0.10	2.3	0.86	0.19
Roof	0.00	90%	P2	Slope, percent	15.0000	Slope, percent	2.0000	Slope, ft/ft	0.0200	5.0	5-YR	0.20	3.4	0.86	0.58
Gravel	0.00	0%	1.4	Runoff Coefficient	0.21	Runoff Coefficient	0.15	Conveyance Coefficient	20	Final	10-YR	0.29	4.3	0.86	1.08
Other	0.00	0%						Velocity, ft/s	2.8	Tc, min	25-YR	0.40	5.6	0.86	1.94
	0.86	8%		Ti, min=	6.5	Ti, min=	0.0	Tt, min=	0.0	**6.5**	**100-YR**	**0.53**	**7.5**	**0.86**	**3.37**

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	0.08	2%	C	Surface Imperviousness	0.8	Surface Imperviousness	0	Land Surface	Paved Areas and Shallow Swales	Minimum	1.25 YR	0.59	1.7	0.39	0.39
Asphalt Parking & Walkways	0.31	100%		Length, ft	50	Length, ft	0	Length, ft	100	Tc, min	2-YR	0.59	2.4	0.39	0.57
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	2.0000	Slope, ft/ft	0.0200	5.0	5-YR	0.62	3.6	0.39	0.89
Gravel	0.00	0%	1.4	Runoff Coefficient	0.63	Runoff Coefficient	0.15	Conveyance Coefficient	20	Final	10-YR	0.66	4.6	0.39	1.19
Other	0.00	0%						Velocity, ft/s	2.8	Tc, min	25-YR	0.70	6.0	0.39	1.63
	0.39	80%		Ti, min=	4.7	Ti, min=	0.0	Tt, min=	0.6	**5.3**	**100-YR**	**0.74**	**8.0**	**0.39**	**2.31**

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	0.16	2%	C	Surface Imperviousness	0.5	Surface Imperviousness	0	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.33	1.7	0.31	0.18
Asphalt Parking & Walkways	0.15	100%		Length, ft	25	Length, ft	0	Length, ft	200	Tc, min	2-YR	0.33	2.5	0.31	0.26
Roof	0.00	90%	P2	Slope, percent	10.0000	Slope, percent	2.0000	Slope, ft/ft	0.0100	5.0	5-YR	0.39	3.7	0.31	0.45
Gravel	0.00	0%	1.4	Runoff Coefficient	0.4	Runoff Coefficient	0.15	Conveyance Coefficient	15	Final	10-YR	0.46	4.7	0.31	0.66
Other	0.00	0%						Velocity, ft/s	1.5	Tc, min	25-YR	0.53	6.0	0.31	0.99
	0.31	49%		Ti, min=	2.9	Ti, min=	0.0	Tt, min=	2.2	**5.1**	**100-YR**	**0.60**	**8.1**	**0.31**	**1.51**

Sub Basin 2 (SB2) - HOTEL A ROOFTOP

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	0.8	Surface Imperviousness	0	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.73	1.7	0.35	0.44
Asphalt Parking & Walkways	0.00	100%		Length, ft	100	Length, ft	0	Length, ft	0	Tc, min	2-YR	0.73	2.5	0.35	0.63

RATIONAL METHOD RUNOFF ANALYSIS

Job #	1448-005	Date:	March 23, 2022
Job Name	Lot 1 Indian Meadows	Revised:	
Designed by:	JLW		

Roof	0.35	90%	P2	Slope, percent	10.0000	Slope, percent	1.0000	Slope, ft/ft	0.0100	5.0	5-YR	0.75	3.7	0.35	0.97
Gravel	0.00	0%	1.4	Runoff Coefficient	0.63	Runoff Coefficient	0.15	Conveyance Coefficient	15	Final	10-YR	0.77	4.7	0.35	1.28
Other	0.00	0%						Velocity, ft/s	1.5	Tc, min	25-YR	0.80	6.1	0.35	1.72
	0.35	90%		Ti, min=	3.9	Ti, min=	0.0	Tt, min=	0.0	**5.0**	**100-YR**	**0.83**	**8.2**	**0.35**	**2.38**

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	0.09	2%	C	Surface Imperviousness	0.75	Surface Imperviousness	0	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.56	1.1	0.38	0.23
Asphalt Parking & Walkways	0.29	100%		Length, ft	250	Length, ft	0	Length, ft	100	Tc, min	2-YR	0.56	1.5	0.38	0.33
Roof	0.00	90%	P2	Slope, percent	1.0000	Slope, percent	1.0000	Slope, ft/ft	0.0100	5.0	5-YR	0.59	2.3	0.38	0.52
Gravel	0.00	0%	1.4	Runoff Coefficient	0.58	Runoff Coefficient	0.15	Conveyance Coefficient	15	Final	10-YR	0.63	2.9	0.38	0.70
Other	0.00	0%						Velocity, ft/s	1.5	Tc, min	25-YR	0.67	3.8	0.38	0.97
	0.38	77%		Ti, min=	14.8	Ti, min=	0.0	Tt, min=	1.1	**15.9**	**100-YR**	**0.72**	**5.1**	**0.38**	**1.38**

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	0.01	2%	C	Surface Imperviousness	0.95	Surface Imperviousness	0.4	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.78	1.7	0.15	0.20
Asphalt Parking & Walkways	0.14	100%		Length, ft	75	Length, ft	0	Length, ft	0	Tc, min	2-YR	0.78	2.5	0.15	0.29
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	10.0000	Slope, ft/ft	0.0100	5.0	5-YR	0.79	3.7	0.15	0.44
Gravel	0.00	0%	1.4	Runoff Coefficient	0.82	Runoff Coefficient	0.35	Conveyance Coefficient	15	Final	10-YR	0.82	4.7	0.15	0.58
Other	0.00	0%						Velocity, ft/s	1.5	Tc, min	25-YR	0.85	6.1	0.15	0.77
	0.15	93%		Ti, min=	3.5	Ti, min=	0.0	Tt, min=	0.0	**5.0**	**100-YR**	**0.87**	**8.2**	**0.15**	**1.07**

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	0.01	2%	C	Surface Imperviousness	0.85	Surface Imperviousness	0.4	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.79	1.5	0.17	0.20
Asphalt Parking & Walkways	0.16	100%		Length, ft	150	Length, ft	0	Length, ft	0	Tc, min	2-YR	0.79	2.2	0.17	0.29
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	10.0000	Slope, ft/ft	0.0100	5.0	5-YR	0.81	3.2	0.17	0.44
Gravel	0.00	0%	1.4	Runoff Coefficient	0.68	Runoff Coefficient	0.35	Conveyance Coefficient	15	Final	10-YR	0.83	4.1	0.17	0.58
Other	0.00	0%						Velocity, ft/s	1.5	Tc, min	25-YR	0.86	5.3	0.17	0.78
	0.17	94%		Ti, min=	7.3	Ti, min=	0.0	Tt, min=	0.0	**7.3**	**100-YR**	**0.88**	**7.1**	**0.17**	**1.07**

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	0.04	2%	C	Surface Imperviousness	0.8	Surface Imperviousness	0.4	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.58	1.3	0.18	0.14
Asphalt Parking & Walkways	0.14	100%		Length, ft	250	Length, ft	0	Length, ft	0	Tc, min	2-YR	0.58	1.9	0.18	0.19
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	10.0000	Slope, ft/ft	0.0100	5.0	5-YR	0.61	2.8	0.18	0.31
Gravel	0.00	0%	1.4	Runoff Coefficient	0.63	Runoff Coefficient	0.35	Conveyance Coefficient	15	Final	10-YR	0.64	3.6	0.18	0.41
Other	0.00	0%						Velocity, ft/s	1.5	Tc, min	25-YR	0.69	4.6	0.18	0.57
	0.18	78%		Ti, min=	10.6	Ti, min=	0.0	Tt, min=	0.0	**10.6**	**100-YR**	**0.73**	**6.1**	**0.18**	**0.81**

RATIONAL METHOD RUNOFF ANALYSIS

Job #	1448-005	Date:	March 23, 2022
Job Name	Lot 1 Indian Meadows	Revised:	
Designed by:	JLW		

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	0.01	2%	C	Surface Imperviousness	0.8	Surface Imperviousness	0.4	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.69	1.3	0.08	0.07
Asphalt Parking & Walkways	0.07	100%		Length, ft	250	Length, ft	0	Length, ft	0	Tc, min	2-YR	0.69	1.9	0.08	0.10
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	10.0000	Slope, ft/ft	0.0100	5.0	5-YR	0.72	2.8	0.08	0.16
Gravel	0.00	0%	1.4	Runoff Coefficient	0.63	Runoff Coefficient	0.35	Conveyance Coefficient	15	Final	10-YR	0.75	3.6	0.08	0.21
Other	0.00	0%						Velocity, ft/s	1.5	Tc, min	25-YR	0.78	4.6	0.08	0.29
	0.08	88%		Ti, min=	10.6	Ti, min=	0.0	Tt, min=	0.0	**10.6**	**100-YR**	**0.81**	**6.1**	**0.08**	**0.40**

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	0.04	2%	C	Surface Imperviousness	0.8	Surface Imperviousness	0.4	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.47	1.7	0.12	0.10
Asphalt Parking & Walkways	0.08	100%		Length, ft	50	Length, ft	0	Length, ft	50	Tc, min	2-YR	0.47	2.5	0.12	0.14
Roof	0.00	90%	P2	Slope, percent	4.0000	Slope, percent	10.0000	Slope, ft/ft	0.0100	5.0	5-YR	0.51	3.7	0.12	0.23
Gravel	0.00	0%	1.4	Runoff Coefficient	0.63	Runoff Coefficient	0.35	Conveyance Coefficient	15	Final	10-YR	0.56	4.7	0.12	0.32
Other	0.00	0%						Velocity, ft/s	1.5	Tc, min	25-YR	0.61	6.1	0.12	0.45
	0.12	67%		Ti, min=	3.8	Ti, min=	0.0	Tt, min=	0.6	**5.0**	**100-YR**	**0.66**	**8.2**	**0.12**	**0.65**

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	0.20	2%	C	Surface Imperviousness	0.8	Surface Imperviousness	0.4	Land Surface	Grassed Waterways	Minimum	1.25 YR	0.59	1.3	0.95	0.75
Asphalt Parking & Walkways	0.75	100%		Length, ft	200	Length, ft	0	Length, ft	50	Tc, min	2-YR	0.59	1.9	0.95	1.08
Roof	0.00	90%	P2	Slope, percent	2.0000	Slope, percent	10.0000	Slope, ft/ft	0.0100	5.0	5-YR	0.62	2.9	0.95	1.69
Gravel	0.00	0%	1.4	Runoff Coefficient	0.63	Runoff Coefficient	0.35	Conveyance Coefficient	15	Final	10-YR	0.66	3.7	0.95	2.27
Other	0.00	0%						Velocity, ft/s	1.5	Tc, min	25-YR	0.70	4.7	0.95	3.11
	0.95	79%		Ti, min=	9.5	Ti, min=	0.0	Tt, min=	0.6	**10.1**	**100-YR**	**0.74**	**6.3**	**0.95**	**4.41**

Appendix E: BMP Design Spreadsheet Calculations for TSS Concentration and WQCV

TSS Removal

BMP Designation SB1 Water Quality Swale

Event Mean TSS Per Table 5.12.3

140 mg/L

Drainage Study: Turbulence factor shall be 1.

Variable	Value	Unit	
n	1	-	(Turbulance Factor: 1=bad, 5=good)
V_s	0.0059	ft/sec	(Settling Velocity of Particles)
Q	0.18	ft^3/sec	(Applied Flow Rate, 1.25 Yr Peak Flow)
A	125	ft^2	(Area of Treatment)
R	**0.80**	-	(Fraction of solids removed)

TSS Concentration After Treatment

27.47 mg/L Min 80% Removal of Event Mean TSS

TSS Removal

BMP Designation SB3 Water Quality Swale

Event Mean TSS Per Table 5.12.3

140 mg/L

Drainage Study: Turbulence factor shall be 1.

Variable	Value	Unit	
n	1	-	(Turbulance Factor: 1=bad, 5=good)
V_s	0.0059	ft/sec	(Settling Velocity of Particles)
Q	0.23	ft^3/sec	(Applied Flow Rate, 1.25 Yr Peak Flow)
A	150	ft^2	(Area of Treatment)
R	**0.79**	-	(Fraction of solids removed)

TSS Concentration After Treatment

28.88 mg/L Min 80% Removal of Event Mean TSS

TSS Removal

BMP Designation SB6 Water Quality Swale

Event Mean TSS Per Table 5.12.3

140 mg/L

Drainage Study: Turbulence factor shall be 1.

Variable	Value	Unit	
n	1	-	(Turbulance Factor: 1=bad, 5=good)
V_s	0.0059	ft/sec	(Settling Velocity of Particles)
Q	0.14	ft^3/sec	(Applied Flow Rate, 1.25 Yr Peak Flow)
A	100	ft^2	(Area of Treatment)
R	**0.81**	-	(Fraction of solids removed)

TSS Concentration After Treatment

26.85 mg/L Min 80% Removal of Event Mean TSS

TSS Removal

BMP Designation SB8 Water Quality Swale

Event Mean TSS Per Table 5.12.3

140 mg/L

Variable	Value	Unit	
n	1	-	(Turbulance Factor: 1=bad, 5=good)
V_s	0.0059	ft/sec	(Settling Velocity of Particles)
Q	0.1	ft^3/sec	(Applied Flow Rate, 1.25 Yr Peak Flow)
A	100	ft^2	(Area of Treatment)
R	**0.86**	-	(Fraction of solids removed)

TSS Concentration After Treatment

20.29 mg/L Min 80% Removal of Event Mean TSS

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Designer: Joe Wiedemeier, PE
Company: Four Points
Date: March 25, 2022
Project: Lot 1 Indian Meadows Hotel A
Location: Rain Garden for SB4

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of rain garden)	I_a = 93.0 %
B) Tributary Area's Imperviousness Ratio (i = I_a/100)	i = 0.930
C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time (WQCV= 0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)	WQCV = 0.34 watershed inches
D) Contributing Watershed Area (including rain garden area)	Area = 6,500 sq ft
E) Water Quality Capture Volume (WQCV) Design Volume Vol = (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	$V_{WQCV\ OTHER}$ = 147 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 (12-inch maximum)	D_{WQCV} = 7 in
B) Rain Garden Side Slopes (Z = 4 min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls)	Z = 4.00 ft / ft
C) Mimimum Flat Surface Area	A_{Min} = 121 sq ft
D) Actual Flat Surface Area	A_{Actual} = 280 sq ft
E) Area at Design Depth (Top Surface Area)	A_{Top} = 280 sq ft
F) Rain Garden Total Volume (V_T= ((A_{Top} + A_{Actual}) / 2) * Depth)	V_T= 163 cu ft
3. Growing Media	Choose One: (•) 18" Rain Garden Growing Media ( ) 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 = N/A ft
ii) Volume to Drain in 12 Hours	Vol_{12} = N/A cu ft
iii) Orifice Diameter, 3/8" Minimum	D_O = N/A in

Design Procedure Form: Rain Garden (RG)

Designer: Joe Wiedemeier, PE
Company: Four Points
Date: March 25, 2022
Project: Lot 1 Indian Meadows Hotel A
Location: Rain Garden for SB4

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 Control A) Inlet Control	Choose One ◉ Sheet Flow- No Energy Dissipation Required ◯ Concentrated Flow- Energy Dissipation Provided
7. Vegetation	Choose One ◯ Seed (Plan for frequent weed control) ◉ Plantings ◯ Sand Grown or Other High Infiltration Sod
8. Irrigation A) Will the rain garden be irrigated?	Choose One ◉ YES ◯ NO NO SPRINKLER HEADS ON FLAT SURFACE

Notes:

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Designer: Joe Wiedemeier, PE
Company: Four Points
Date: March 25, 2022
Project: Lot 1 Indian Meadows Hotal A
Location: Rain Garden for SB5

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of rain garden): I_a = 94.0 %

B) Tributary Area's Imperviousness Ratio ($i = I_a/100$): i = 0.940

C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time ($WQCV = 0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)$): WQCV = 0.35 watershed inches

D) Contributing Watershed Area (including rain garden area): Area = 7,400 sq ft

E) Water Quality Capture Volume (WQCV) Design Volume, Vol = (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: $V_{WQCV\ OTHER}$ = 171 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 (12-inch maximum): D_{WQCV} = 8 in

B) Rain Garden Side Slopes (Z = 4 min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls): Z = 0.00 ft / ft

C) Mimimum Flat Surface Area: A_{Min} = 139 sq ft

D) Actual Flat Surface Area: A_{Actual} = 280 sq ft

E) Area at Design Depth (Top Surface Area): A_{Top} = 280 sq ft

F) Rain Garden Total Volume ($V_T = ((A_{Top} + A_{Actual}) / 2) * Depth$): V_T = 187 cu ft

3. Growing Media

Choose One
- (•) 18" Rain Garden Growing Media
- ( ) 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 = N/A ft

ii) Volume to Drain in 12 Hours: Vol_{12} = N/A cu ft

iii) Orifice Diameter, 3/8" Minimum: D_O = N/A in

Design Procedure Form: Rain Garden (RG)

Designer: Joe Wiedemeier, PE
Company: Four Points
Date: March 25, 2022
Project: Lot 1 Indian Meadows Hotal A
Location: Rain Garden for SB5

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 Control A) Inlet Control	Choose One ◉ Sheet Flow- No Energy Dissipation Required ○ Concentrated Flow- Energy Dissipation Provided
7. Vegetation	Choose One ○ Seed (Plan for frequent weed control) ◉ Plantings ○ Sand Grown or Other High Infiltration Sod
8. Irrigation A) Will the rain garden be irrigated?	Choose One ◉ YES ○ NO **NO SPRINKLER HEADS ON FLAT SURFACE**

Notes:

Design Procedure Form: Rain Garden (RG)

UD-BMP (Version 3.07, March 2018)

Designer: Joe Wiedemeier, PE
Company: Four Points
Date: March 25, 2022
Project: Lot 1 Indian Meadows Hotal A
Location: Rain Garden for SB7

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a (100% if all paved and roofed areas upstream of rain garden): I_a = 88.0 %

B) Tributary Area's Imperviousness Ratio ($i = I_a/100$): i = 0.880

C) Water Quality Capture Volume (WQCV) for a 12-hour Drain Time ($WQCV = 0.8 * (0.91* i^3 - 1.19 * i^2 + 0.78 * i)$): WQCV = 0.31 watershed inches

D) Contributing Watershed Area (including rain garden area): Area = 3,485 sq ft

E) Water Quality Capture Volume (WQCV) Design Volume, Vol = (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: $V_{WQCV\ OTHER}$ = 71 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 (12-inch maximum): D_{WQCV} = 6 in

B) Rain Garden Side Slopes (Z = 4 min., horiz. dist per unit vertical) (Use "0" if rain garden has vertical walls): Z = 0.00 ft / ft

C) Mimimum Flat Surface Area: A_{Min} = 61 sq ft

D) Actual Flat Surface Area: A_{Actual} = 145 sq ft

E) Area at Design Depth (Top Surface Area): A_{Top} = 145 sq ft

F) Rain Garden Total Volume ($V_T = ((A_{Top} + A_{Actual}) / 2) * Depth$): V_T = 73 cu ft

3. Growing Media

Choose One
- (•) 18" Rain Garden Growing Media
- ( ) 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 = N/A ft

ii) Volume to Drain in 12 Hours: Vol_{12} = N/A cu ft

iii) Orifice Diameter, 3/8" Minimum: D_O = N/A in

Design Procedure Form: Rain Garden (RG)

Designer: Joe Wiedemeier, PE
Company: Four Points
Date: March 25, 2022
Project: Lot 1 Indian Meadows Hotal A
Location: Rain Garden for SB7

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 Control A) Inlet Control	Choose One ◉ Sheet Flow- No Energy Dissipation Required ○ Concentrated Flow- Energy Dissipation Provided
7. Vegetation	Choose One ○ Seed (Plan for frequent weed control) ◉ Plantings ○ Sand Grown or Other High Infiltration Sod
8. Irrigation A) Will the rain garden be irrigated?	Choose One ◉ YES ○ NO NO SPRINKLER HEADS ON FLAT SURFACE

Notes:

Appendix F: Channel Flow Calculations

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Monday, Mar 28 2022

WQ Swale #3 (SB3) - Major Event Peak Flow

Trapezoidal

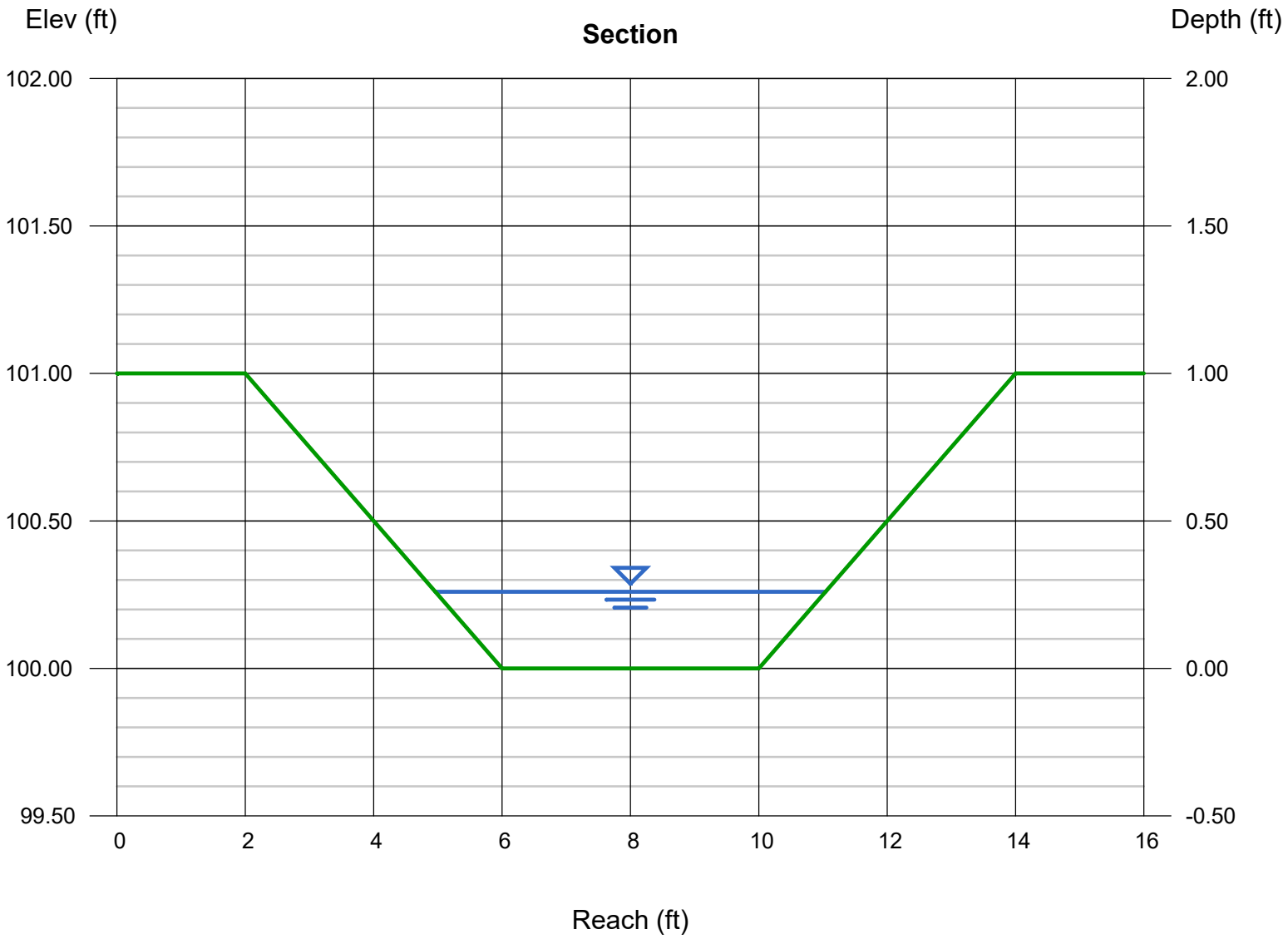
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.050

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.38

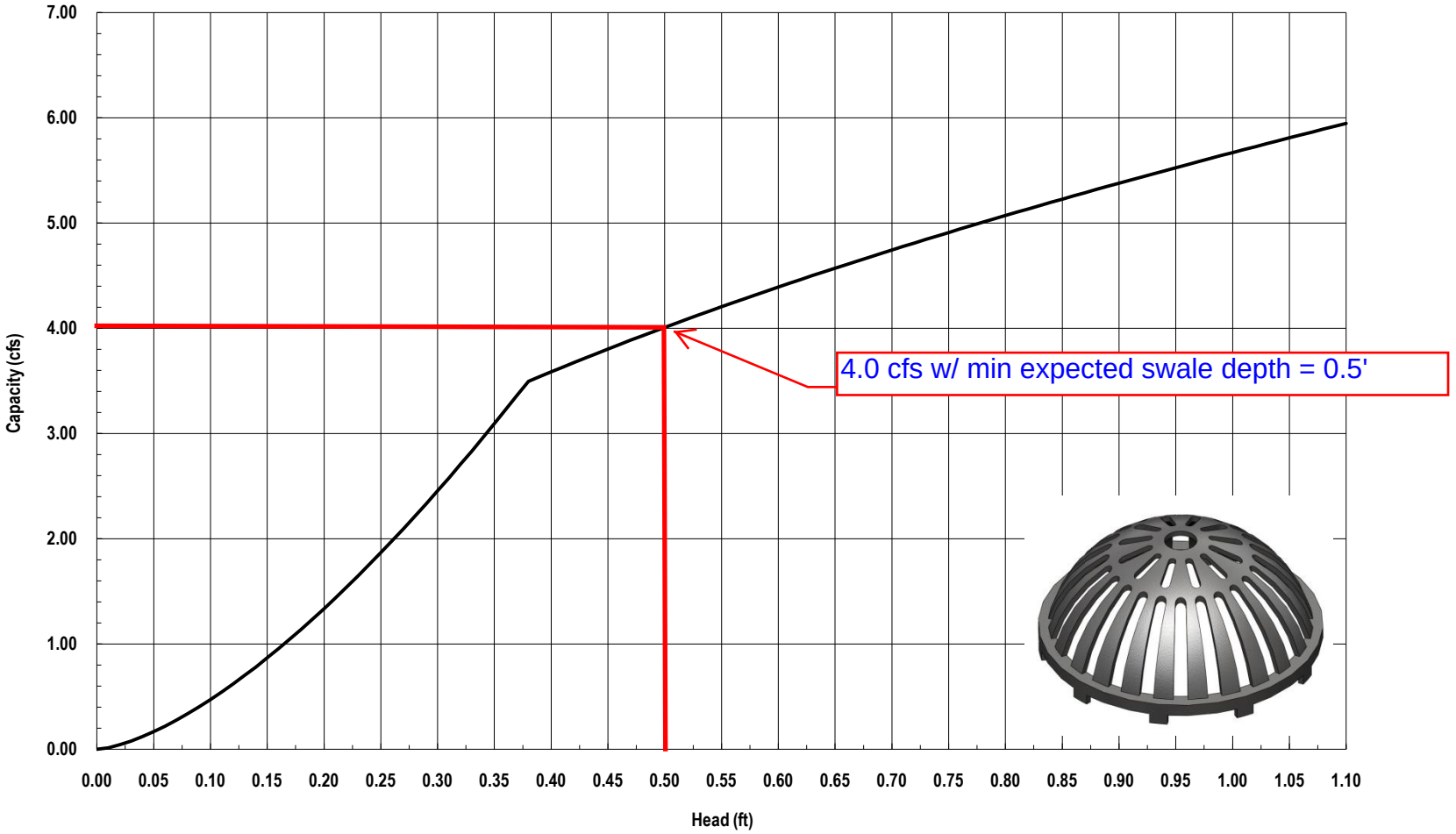
Highlighted

Depth (ft)	= 0.26
Q (cfs)	= 1.380
Area (sqft)	= 1.31
Velocity (ft/s)	= 1.05
Wetted Perim (ft)	= 6.14
Crit Depth, Yc (ft)	= 0.15
Top Width (ft)	= 6.08
EGL (ft)	= 0.28



Appendix G: Inlet Capacity Curves

Nyloplast 18" Dome Grate Inlet Capacity Chart



Nyloplast®
3130 Verona Avenue • Buford, GA 30518
(866) 888-8479 / (770) 932-2443 • Fax: (770) 932-2490

Appendix H: Storm Sewer Capacity Calculations

Hydraulic Grade Line Computations

MINOR EVENT FLOWS

Line	Size	Q	Downstream								Len	Upstream								Check		JL coeff	Minor loss
			Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf		Invert elev	HGL elev	Depth	Area	Vel	Vel head	EGL elev	Sf	Ave Sf	Enrgy loss		
	(in)	(cfs)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(ft)	(ft)	(ft)	(ft)	(sqft)	(ft/s)	(ft)	(ft)	(%)	(%)	(ft)	(K)	(ft)
1	24	5.73	6760.01	6760.93	0.92	1.26	4.06	0.32	6761.25	0.000	49.535	6760.26	6761.10 j	0.84**	1.26	4.54	0.32	6761.43	0.000	0.000	n/a	1.50	n/a
2	18	5.19	6760.26	6761.14	0.88*	1.07	4.84	0.36	6761.50	0.000	91.758	6760.72	6761.60	0.88**	1.07	4.84	0.36	6761.96	0.000	0.000	n/a	1.50	n/a
3	12	2.01	6760.72	6761.60	0.88	0.73	2.75	0.12	6761.72	0.245	53.842	6760.99	6761.71	0.72	0.60	3.34	0.17	6761.88	0.366	0.306	0.165	0.50	0.09
4	12	1.57	6761.00	6761.79	0.79	0.67	2.35	0.09	6761.88	0.177	61.270	6761.31	6761.89	0.58	0.47	3.35	0.17	6762.06	0.416	0.297	0.182	0.57	0.10
5	12	1.13	6761.31	6761.99	0.68	0.34	2.00	0.06	6762.05	0.134	65.557	6761.63	6762.08 j	0.45**	0.35	3.25	0.16	6762.25	0.477	0.306	0.200	1.00	0.16
6	12	2.66	6760.72	6761.60	0.88	0.73	3.65	0.21	6761.80	0.430	115.214	6761.30	6762.10	0.80	0.67	3.97	0.24	6762.34	0.503	0.466	0.537	1.43	0.35
7	12	0.97	6761.30	6762.45	1.00	0.79	1.24	0.02	6762.47	0.063	184.481	6762.24	6762.71	0.47	0.36	2.69	0.11	6762.82	0.318	0.191	0.352	1.00	0.11

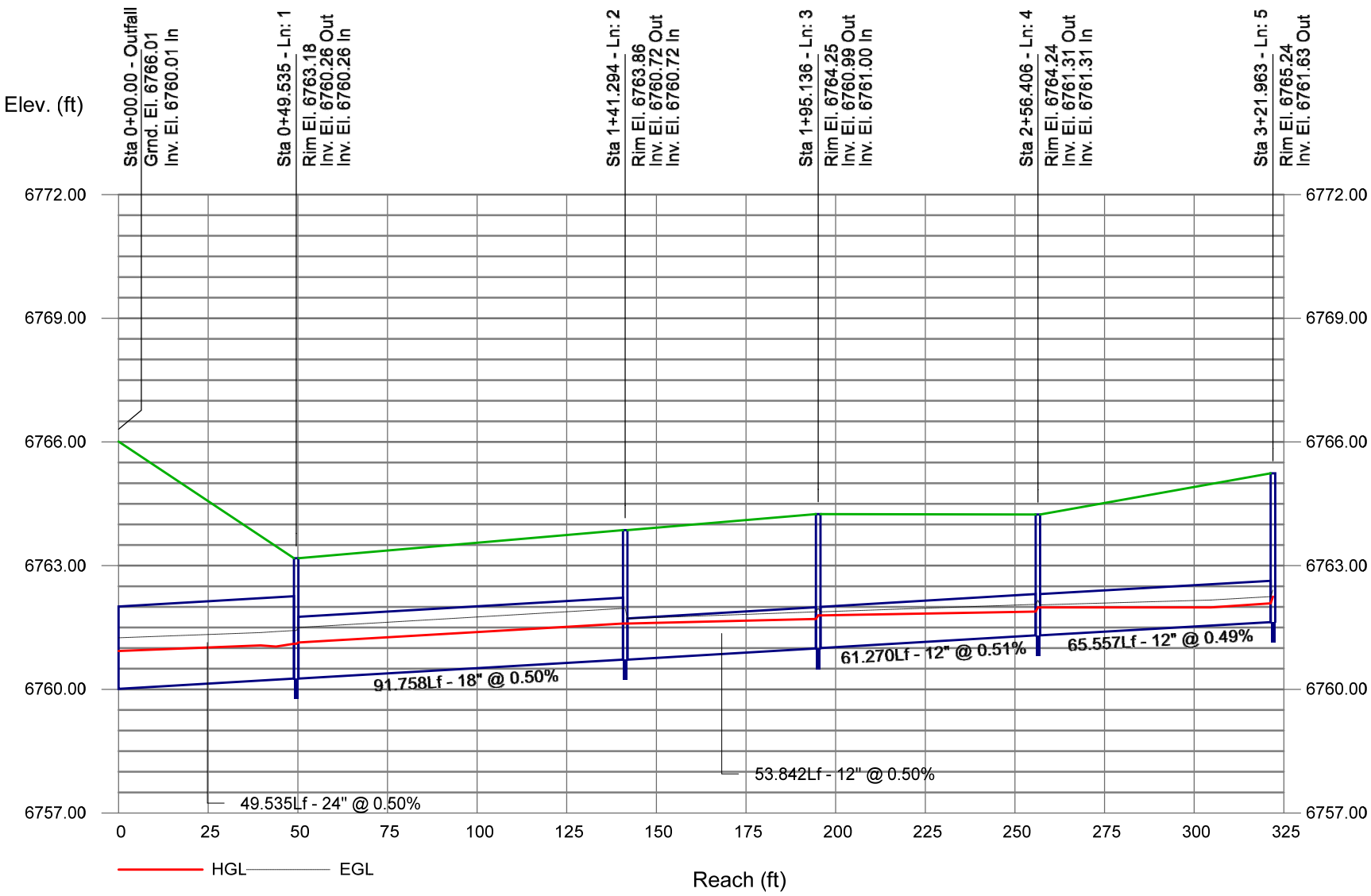
Project File: NETWORK_3-28-22_MINOR.stm | Number of lines: 7 | Run Date: 3/28/2022

Notes: * depth assumed; ** Critical depth.; j-Line contains hyd. jump ; c = cir e = ellip b = box

Storm Sewer Profile

HOTEL A STORM SEWER - MINOR

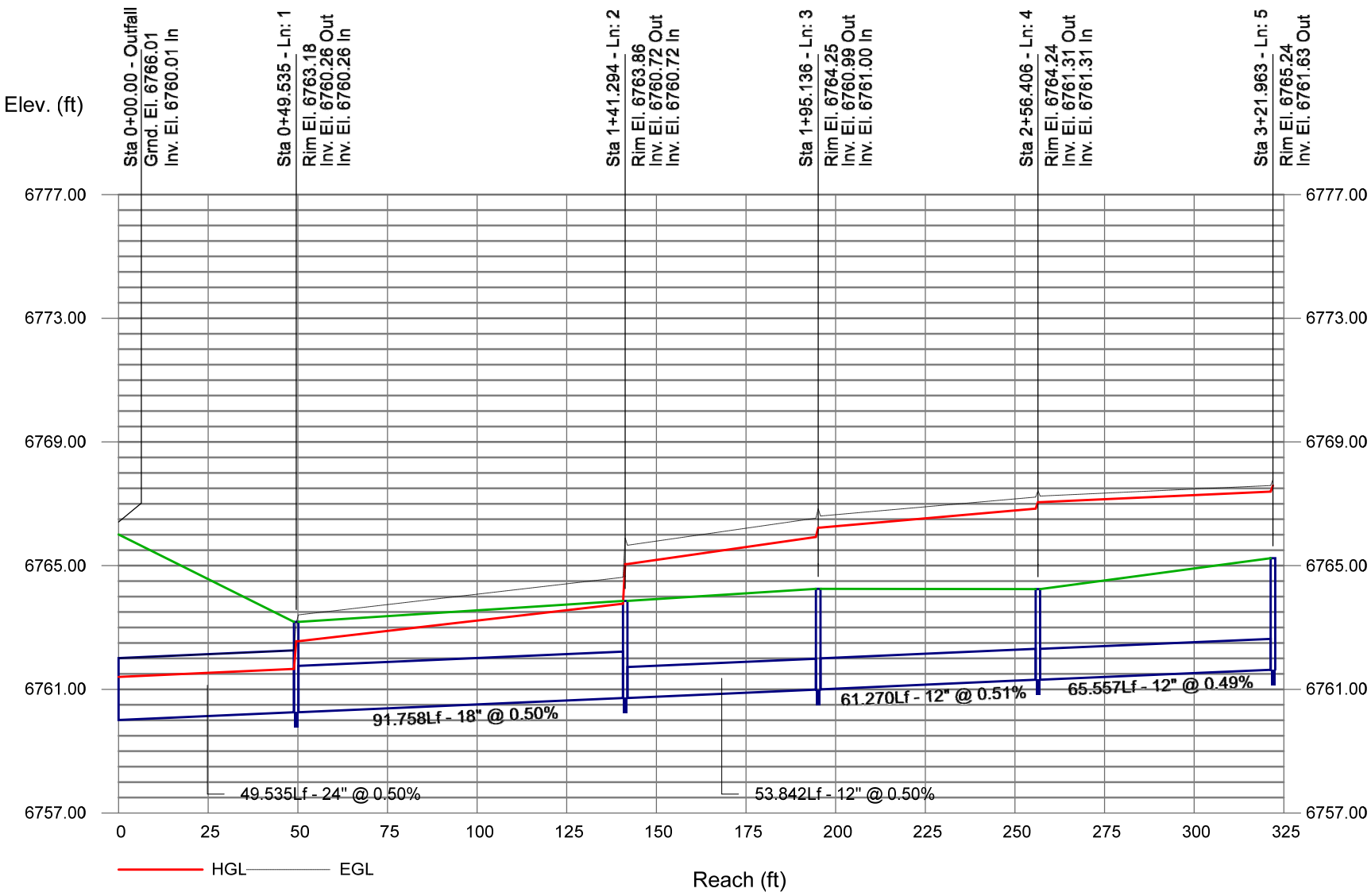
Proj. file: NETWORK_3-28-22_MINOR.stm



Storm Sewer Profile

HOTEL A STORM SEWER - MAJOR

Proj. file: NETWORK_3-28-22_MAJOR.stm



Storm Sewer Profile

HOTEL B STORM SEWER - MINOR

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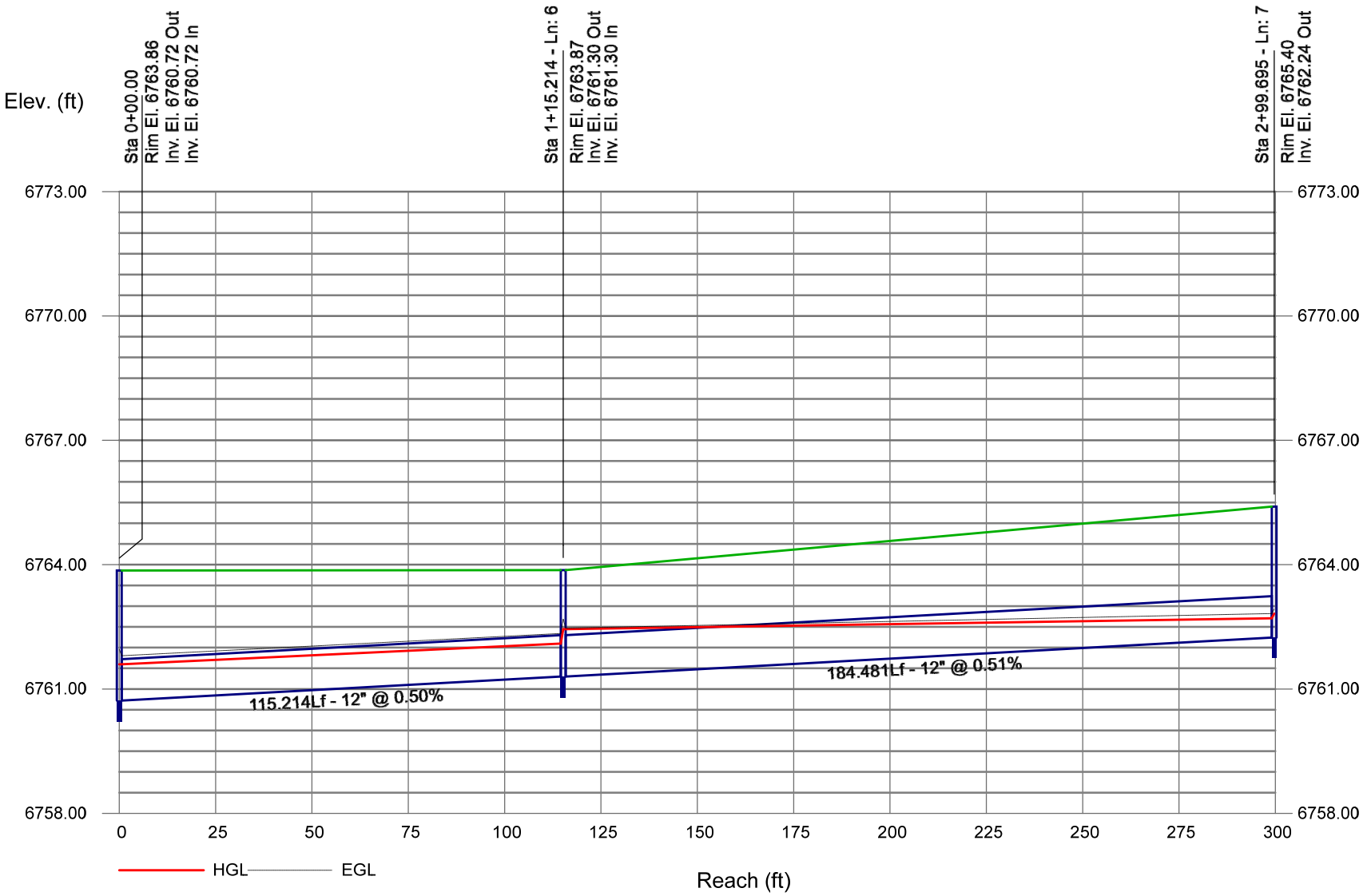
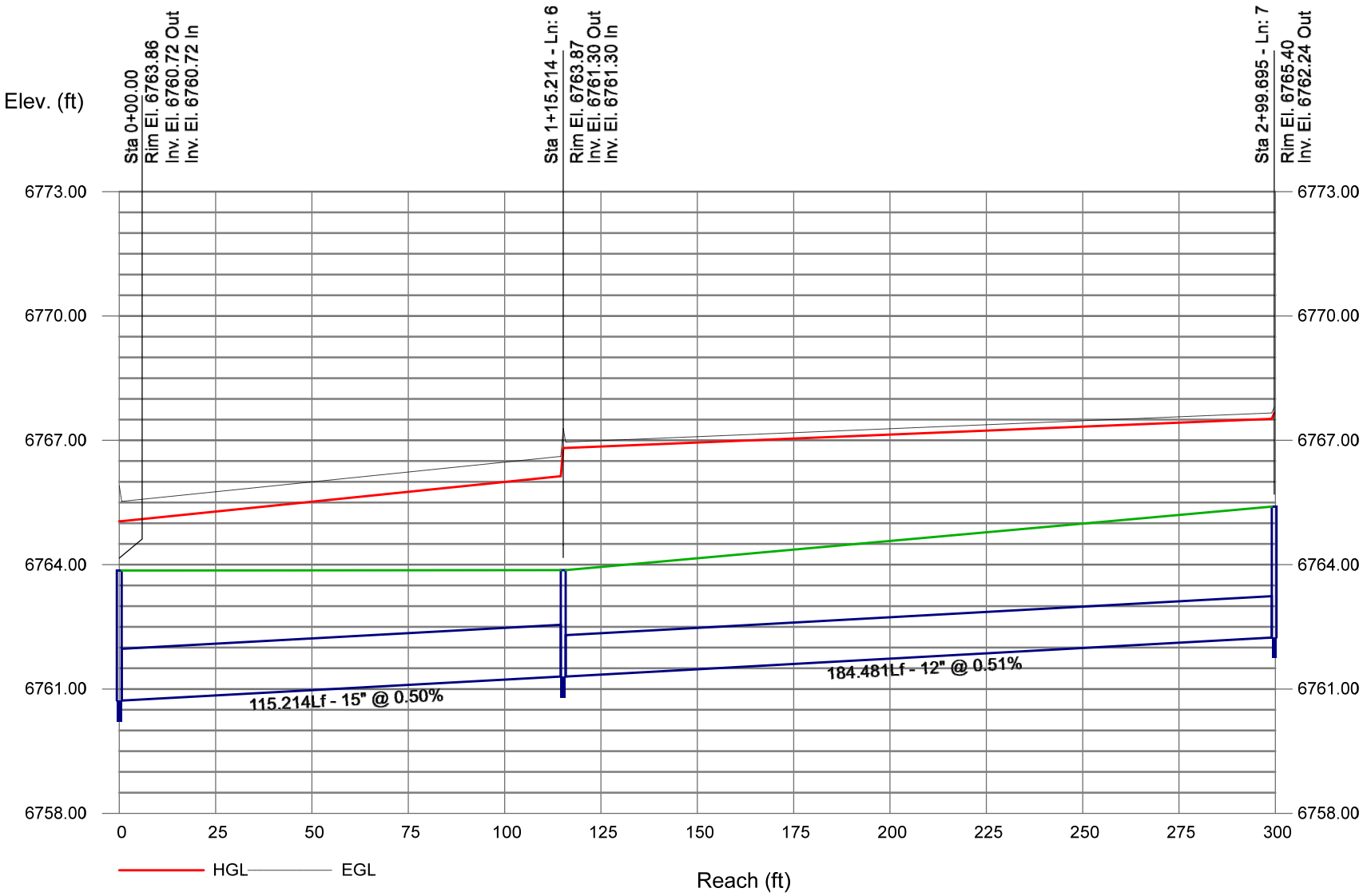


Storm Sewer Profile

HOTEL B STORM SEWER - MAJOR

Proj. file: NETWORK_3-28-22_MAJOR.stm



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

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

x A. Report typed and legible in 8½" x 11" format.
x B. Report bound (comb, spiral, or staple – no notebook).
x 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

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

III. Title Sheet

x A. Table of Contents.
____ B. Certification, PE Stamp, signature, and date from licensed Colorado PE.
x 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

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

V. Drainage Criteria and Methodology Used

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

VI. Existing Conditions (Pre-Development/Historic)

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

VII. Proposed Conditions

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

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

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

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

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

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

N. Site Discharge
n/a 1. Discuss use and design of detention to ensure discharge is less than or equal to historic flow.
x 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

x 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 Water Quality Plan shall be attached that will give details (see separate checklist)

IX. Conclusions

x A. Provide general summary.
x B. Note if site complies with criteria and any variances to criteria.
x 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.
x D. List proposed new stormwater system requirements.

X. References

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

XI. Tables

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

XII. Figures

x A. Vicinity Map.
x 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 2-ft.
x 4. Show existing runoff flow arrows.
x 5. Show existing stormwater features (structures, sizes, materials, etc.).
x 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
X 1. Delineate proposed basin boundaries.
X 2. Show proposed runoff flow arrows.
X 3. Show existing and proposed topography at an interval of at least 2-ft.
X 4. For each basin show bubble with basin number, acreage and percent impervious or provide a summary table or figure.
X 5. For each outlet show bubble with acreage, historic flow, and proposed flow or provide a summary table or figure.
x 6. Show floodplain limits and information.
X 7. Show proposed building footprints and FFE for commercial and multi-family
X 8. Show property lines and easements (existing and proposed).
x 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

x A. Runoff Calculations.
x B. Culvert Calculations.
n/a C. Pond Calculations.
x D. Other Calculations.

Acknowledgements

Standard Form No. 3 was prepared by: Joe Wiedemeier, PE 2-10-2022
Date

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

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

x A. Report typed and legible in 8½" x 11" format.
x B. Report bound (comb, spiral, or staple – no notebook) and in digital PDF format.
x 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 be at an appropriate size and scale to be legible and include project area.

II. Cover

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

III. Title Sheet

x A. Table of Contents.
_____ B. Certification, PE Stamp, signature and date from licensed Colorado PE (for Final).
x 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

x 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.
x B. State purpose and goal of Stormwater Quality Plan and report along with any special requirements of the desired outcome.
x C. List any project stakeholders and/or requestors.
x 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.

n/a 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.

X 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.

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

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

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

X E. Identify design specifications for construction.

Acknowledgements

Standard Form No. 4 prepared by: Joe Wiedemeier, PE 2-10-2022
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

Appendix K: Operation and Maintenance Plan for Stormwater BMPs and Conveyance Network

OPERATION AND MAINTENANCE PLAN
-
PERMANENT STORM WATER QUALITY BMPs for the HOTELS AT LOT 1 INDIAN MEADOWS

1. GENERAL PROJECT INFORMATION

A. (ADDRESS TBD), STEAMBOAT SPRINGS, ROUTT COUNTY, COLORADO.

2. GENERAL FACILITY DESCRIPTION

THE FACILITIES ASSOCIATED WITH THIS DEVELOPMENT ARE GRASS-LINED WATER QUALITY (WQ) SWALES AND BIO-RETENTION (RAIN GARDEN) THAT ARE CAPABLE OF TREATING RUNOFF FOR TOTAL SUSPENDED SOLIDS (TSS) AND OTHER POLLUTANTS COMMONLY DERIVED FROM VEHICLES AND OTHER MOTORIZED EQUIPMENT. THESE STORM WATER BEST MANAGEMENTS PRACTICES (BMPs) WERE DESIGNED AND ENGINEERED ACCORDING TO STEAMBOAT SPRINGS STANDARDS AND SPECIFICATIONS.

3. INSPECTION & MAINTENANCE FREQUENCY & PROCEDURE

A. THE FOLLOWING TABLES PROVIDES AN INSPECTION AND MAINTENANCE SCHEDULE FOR THE PROPOSED BMPs:

Grass Lined Water Quality Swale Inspection and Maintenance Schedule	
Activity	**Required Frequency**
Inspection for uniform cover, sediment accumulation, rill and gully development, and impacts from foot or vehicle traffic; maintain as necessary. Debris and litter removal.	Twice annually
Aeration practices	None required. Swales will be outfitted with a turf reinforcement matting that will provide a growing medium for grasses. Aeration would damage the turf reinforcement matting and should not be performed.
Mowing	As needed to maintain ~6" height
Irrigation and application of fertilizer, herbicide, and pesticide	As needed to maintain vegetative health.

Rain Garden Inspection and Maintenance Schedule	
Activity	**Required Frequency**
Inspection for uniform mulch cover, plant health, sediment accumulation, rill and gully development, and impacts from foot or vehicle traffic; maintain as necessary. Debris, sediment, and litter removal.	Twice annually. Typcailly performed in the spring and fall periods.
Inspect curb cut inlets and storm inlets. Ensure inlets are functioning properly and free of sediment buildup, debris, trash, etc.	Twice annually. Typcailly performed in the spring and fall periods.
Weeding and Mulching. Pull intrusive weeds. Apply a shredded hardwood much 2"-3" deep AFTER the afformentioned activties are completed.	Once annually. Typically performed in the spring.
Irrigation and watering.	Rain gardens are outfitted with irrigation. Ensure irrigation heads are working properly. Adjust irrigation schedule accordingly based on moisture conditions. Watering frequency is vital for first few years of vegetation establishment. At a minimu, rain gardens should be irrigated for 2 mins for grasses and shrubs and 5 minutes for trees at least two times per week durign the growing season. (Spring/Summer/Early Fall)
Pruning may be performed on well established shrubs and trees by qualified personell.	As needed.

B. INLET INSPECTION AND MAINTENANCE: ALL PRIVATE STORMWATER INLETS ARE OUTFITTED W/ 12" SUMPS. INLETS AND SUMPS SHOULD BE INSPECTED AND MAINTAINED ONCE ANNUALLY FOR BLOCKAGE AND SEDIMENT BUILDUP IN THE SUMP. SEDIMENT SHOULD BE REMOVED FROM SUMPS IF THE DEPTH EXCEEDS 6". DAMAGED INLETS SHOULD BE REPAIRED OR REPLACED IMMEDIATELY.

4. EQUIPMENT, STAFFING AND VEGETATION MANAGEMENT

A. EQUIPMENT:
A.A. VEGETATION MAINTENANCE TOOLS SUCH AS A LAWNMOWER, WEED WHACKER, AND BLOWER.
A.B. SEDIMENT AND DEBRIS REMOVAL TOOLS SUCH AS RAKES, SHOVELS, BUCKETS, BLOWERS, AND/OR LANDSCAPING VACUUM.

B. STAFFING: TBD BY OWNER

C. SEEDING: WQ SWALES WILL BE INSTALLED W/ PROPER SEEDING AND FERTILIZER TO ESTABLISH GROWTH. ANY BARE AREAS THAT APPEAR DURING THE WQ SWALE LIFE CYCLE SHOULD BE RE-SEEDED AS NECESSARY W/ NATIVE SEED MIX.

D. MOWING: VEGETATION HEALTH SHOULD BE MAINTAINED IN AND AROUND THE WQ SWALES WITH REGULAR MOWING AND WEEDEATING. THE REQUIRED MOW AREA POST-CONSTRUCTION FOR THE ENTIRE SITE WAS ESTIMATED TO BE 0.25 ACRES.

E. UNDESIRABLE VEGETATION AND WEEDS: UNDESIRABLE VEGETATION AND NOXIOUS WEEDS SHOULD BE REMOVED REGULARLY BY THE LANDSCAPING STAFF. WEEDS SHOULD BE MOWED OR REMOVED BY HAND.

5. SNOW AND ICE CONTROL

THE GRASS LINED WQ SWALES WILL SERVE AS A SNOW STORAGE AREAS DURING THE WINTER MONTHS. SNOW CAN BE PLOWED INTO THE SWALES. PLOW OPERATORS SHALL TAKE CARE NOT TO DAMAGE OR DISTURB THE FINISHED GRADE OF THE SWALES OR THE INSTALLED TRM AND UNDERDRAIN FEATURES. PLOW OPERATORS SHALL TAKE CARE NOT TO DAMAGE STORMWATER INLET GRATES.

6. RIGHT-OF-WAY, ADJACENT OWNERSHIP & ACCESS

A. ACCESS INFORMATION AND DETAILS: ACCESS FROM THE SHARED PRIVATE ACCESS RUNNING NORTH-SOUTH OFF STONE LANE. .

B. MAINTENANCE OPERATIONS WILL REQUIRE TEMPORARY OBSTRUCTION OF THE PRIVATE SHARED CROSS ACCESS ROAD TO FAIRFIELD INN FOR MAINTENANCE OPERATIONS. A RIGHT-OF-WAY PERMIT SHOULD NOT BE REQUIRED FOR TEMPORARY OBSTRUCTIONS BUT IT SHOULD BE NOTED THAT TRAFFIC WILL LIKELY NEED TO MANAGED FOR A ONE-WAY SCENARIO IF A SERVICE VEHICLE AND EQUIPMENT IS TO PARK ON THE CROSS ACCESS ROAD SHOULDER. MAINTENANCE CREWS SHOULD PLACE MUTCD APPROVED TRAFFIC CONTROL DEVICES (ORANGE CONES AND/OR BARRICADES) AROUND ALL VEHICLES AND EQUIPMENT THAT ARE TEMPORARILY WITHIN THE 30-FOOT ACCESS EASEMENT.

7. HYDRAULIC DESIGN OF WATER QUALITY SWALES

A. WQ SWALE #1 FLOW RATES (CFS)
A.A. DESIGN EVENT (1.25 YEAR) 1.23 CFS
A.B. MINOR EVENT (5-YEAR) 2.80 CFS
A.C. MAJOR EVENT (100-YEAR) 7.56 CFS

B. WQ SWALE #2 FLOW RATES (CFS)
B.A. DESIGN EVENT (1.25 YEAR) 0.54 CFS
B.B. MINOR EVENT (5-YEAR) 1.22 CFS
B.C. MAJOR EVENT (100-YEAR) 3.18 CFS

C. WQ SWALE #3 FLOW RATES (CFS)
C.A. DESIGN EVENT (1.25 YEAR) 0.54 CFS
C.B. MINOR EVENT (5-YEAR) 1.22 CFS
C.C. MAJOR EVENT (100-YEAR) 3.18 CFS

D. WQ SWALE #4 FLOW RATES (CFS)
D.A. DESIGN EVENT (1.25 YEAR) 0.54 CFS
D.B. MINOR EVENT (5-YEAR) 1.22 CFS
D.C. MAJOR EVENT (100-YEAR) 3.18 CFS

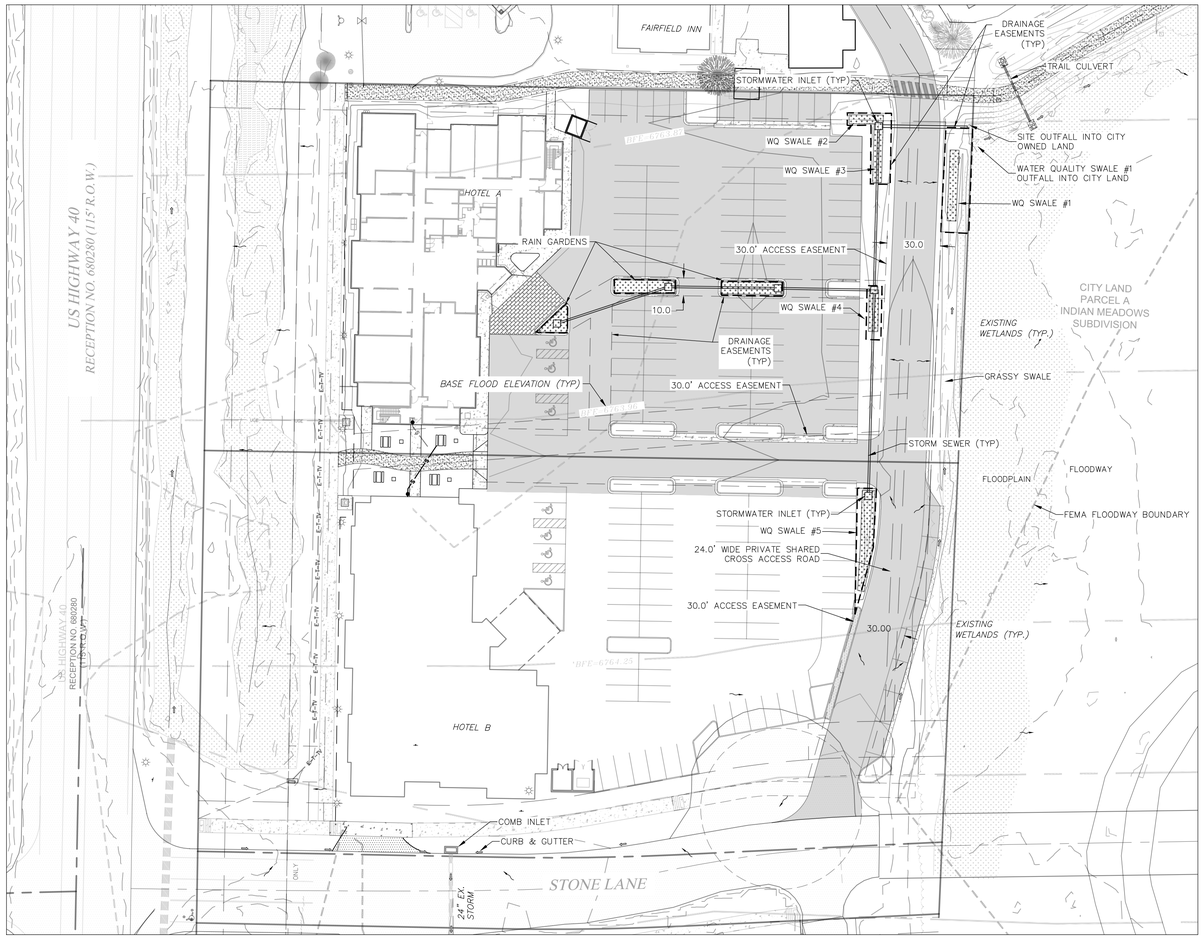
8. SENSITIVE AREA, WETLANDS & PERMITS

C. WETLANDS ARE PRESENT ON CITY OWNED LAND JUST ALONG THE EASTERLY PROPERTY LINE AND WHERE DRAINAGE FROM THE HOTEL PARKING LOTS ULTIMATELY OUTFALLS. WETLANDS SHOULD NOT BE DISTURBED AND SEDIMENT AND DEBRIS FROM MAINTENANCE OPERATIONS SHALL NOT BE DISCARDED INTO WETLANDS.

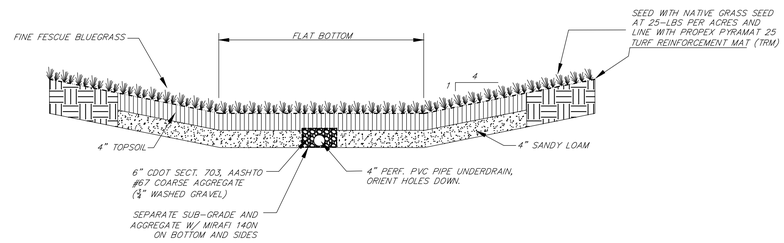
9. MISCELLANEOUS INFORMATION

A. PROJECT SURVEY: EXISTING CONDITIONS AND TOPOGRAPHIC SURVEY WAS PREPARED BY FOUR POINTS SURVEYING & ENGINEERING. ANY QUESTIONS COMMENTS OR CONCERNS REGARDING THIS OPERATION AND MAINTENANCE PLAN SHOULD BE CONVEYED TO FOUR POINTS SURVEYING AND ENGINEERING AND THE ENGINEER OF RECORD.

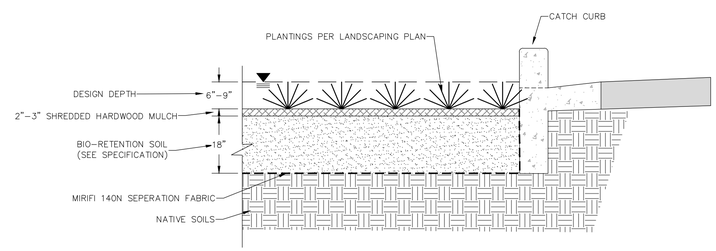
10. BMP DETAILS (SEE BELOW)



PROPOSED CONDITIONS SITE PLAN



GRASS-LINED WQ SWALE W/ UNDERDRAIN
N.T.S.



BIO-RETENTION/RAIN GARDEN DETAIL
N.T.S.

DRAFT - NOT FOR PRODUCTION

FOUR POINTS SURVEYING ENGINEERING

REVISIONS | INT | No. | DATE

LOT 1 INDIAN MEADOWS
PHASE I DEVELOPMENT PLAN
LOT 1, INDIAN MEADOWS FILING NO. 3
STEAMBOAT SPRINGS, CO 80487

HORIZONTAL SCALE
0 40' 80'
SCALE: 1" = 40'

DATE: 11/30/2021
JOB #: 1448-005
DRAWN BY: SDW
DESIGN BY: JLW
REVIEW BY: RL

IF THIS DRAWING IS PRESENTED IN A FORMAT OTHER THAN 24" X 36", THE GRAPHIC SCALE SHOULD BE UTILIZED.

DRAWING: OPERATION AND MAINTENANCE PLAN

SHEET NO.
OM1

4.0 Grass Buffers and Swales

Grass buffers and swales require maintenance of the turf cover and repair of rill or gully development. Healthy vegetation can often be maintained without using fertilizers because runoff from lawns and other areas contains the needed nutrients. Periodically inspecting the vegetation over the first few years will help to identify emerging problems and help to plan for long-term restorative maintenance needs. This section presents a summary of specific maintenance requirements and a suggested frequency of action.

Photograph 6-2. A lack of sediment removal in this grass swale has resulted in a grade change due to growth over the deposition and ponding upstream.

4.1 Inspection

Inspect vegetation at least twice annually for uniform cover and traffic impacts. Check for sediment accumulation and rill and gully development.

4.2 Debris and Litter Removal

Remove litter and debris to prevent rill and gully development from preferential flow paths around accumulated debris, enhance aesthetics, and prevent floatables from being washed offsite. This should be done as needed based on inspection, but no less than two times per year.

4.3 Aeration

Aerating manicured grass will supply the soil and roots with air. It reduces soil compaction and helps control thatch while helping water move into the root zone. Aeration is done by punching holes in the ground using an aerator with hollow punches that pull the soil cores or "plugs" from the ground. Holes should be at least 2 inches deep and no more than 4 inches apart.

Aeration should be performed at least once per year when the ground is not frozen. Water the turf thoroughly prior to aeration. Mark sprinkler heads and shallow utilities such as irrigation lines and cable TV lines to ensure those lines will not be damaged. Avoid aerating in extremely hot and dry conditions. Heavy traffic areas may require aeration more frequently.

4.4 Mowing

When starting from seed, mow native/drought-tolerant grasses only when required to deter weeds during the first three years. Following this period, mowing of native/drought tolerant grass may stop or be reduced to maintain a length of no less than six inches. Mowing of manicured grasses may vary from as frequently as weekly during the summer, to no mowing during the winter. See the inset for additional recommendations from the CSU Extension.

4.5 Irrigation Scheduling and Maintenance

Adjust irrigation schedules throughout the growing season to provide the proper irrigation application rate to maintain healthy vegetation. Less irrigation is typically needed in early summer and fall, with more irrigation needed during July and August. Native grass should not require irrigation after establishment, except during prolonged dry periods when supplemental, temporary irrigation may aid in maintaining healthy vegetation cover. Check for broken sprinkler heads and repair them, as needed. Do not overwater. Signs of overwatering and/or broken sprinkler heads may include soggy areas and unevenly distributed areas of lush growth.

Completely drain and blowout the irrigation system before the first winter freeze each year. Upon reactivation of the irrigation system in the spring, inspect all components and replace damaged parts, as needed.

CSU Extension Recommendations for Mowing Manicured Turf (Source: T. Koski and V. Skinner, 2003)

The two most important facets of mowing are mowing height and frequency. The minimum height for any lawn is 2 inches. The preferred mowing height for all Colorado species is 2.5 to 3 inches. Mowing to less than 2 inches can result in decreased drought and heat tolerance and higher incidence of insects, diseases and weeds. Mow the lawn at the same height all year. There is no reason to mow the turf shorter in late fall.

Mow the turf often enough so no more than 1/3 of the grass height is removed at any single mowing. If your mowing height is 2 inches, mow the grass when it is 3 inches tall. You may have to mow a bluegrass or fescue lawn every three to four days during the spring when it is actively growing but only once every seven to 10 days when growth is slowed by heat, drought or cold. Buffalograss lawns may require mowing once every 10 to 20 days, depending on how much they are watered.

If weather or another factor prevents mowing at the proper time, raise the height of the mower temporarily to avoid cutting too much at one time. Cut the grass again a few days later at the normal mowing height.

4.6 Fertilizer, Herbicide, and Pesticide Application

Use the minimum amount of biodegradable nontoxic fertilizers and herbicides needed to establish and maintain dense vegetation cover that is reasonably free of weeds. Fertilizer application may be significantly reduced or eliminated by the use of mulch-mowers, as opposed to bagging and removing clippings. To keep clippings out of receiving waters, maintain a 25-foot buffer adjacent to open water areas where clippings are bagged. Hand-pull the weeds in areas with limited weed problems.

Frequency of fertilizer, herbicide, and pesticide application should be on an as-needed basis only and should decrease following establishment of vegetation. See BMP Fact Sheet S-8 in Chapter 5 for additional information. For additional information on managing vegetation in a manner that conserves water and protects water quality, see the 2008 *GreenCO Best Management Practices Manual* (www.greenco.org) for a series of Colorado-based BMP fact sheets on topics such as irrigation, plant care, and soil amendments.

4.7 Sediment Removal

Remove sediment as needed based on inspection. Frequency depends on site-specific conditions. For planning purposes, it can be estimated that 3 to 10% of the swale length or buffer interface length will require sediment removal on an annual basis.

- **For Grass Buffers**: Using a shovel, remove sediment at the interface between the impervious area and buffer.
- **For Grass Swales**: Remove accumulated sediment near culverts and in channels to maintain flow capacity. Spot replace the grass areas as necessary.

Reseed and/or patch damaged areas in buffer, sideslopes, and/or channel to maintain healthy vegetative cover. This should be conducted as needed based on inspection. Over time, and depending on pollutant loads, a portion of the buffer or swale may need to be rehabilitated due to sediment deposition. Periodic sediment removal will reduce the frequency of revegetation required. Expect turf replacement for the buffer interface area every 10 to 20 years.

5.0 Bioretention (Rain Garden or Porous Landscape Detention)

The primary maintenance objective for bioretention, also known as porous landscape detention, is to keep vegetation healthy, remove sediment and trash, and ensure that the facility is draining properly. The growing medium may need to be replaced eventually to maintain performance. This section summarizes key maintenance considerations for bioretention.

5.1 Inspection

Inspect the infiltrating surface at least twice annually following precipitation events to determine if the bioretention area is providing acceptable infiltration. Bioretention facilities are designed with a maximum depth for the WQCV of one foot and soils that will typically drain the WQCV over approximately 12 hours. If standing water persists for more than 24 hours after runoff has ceased, clogging should be further investigated and remedied. Additionally, check for erosion and repair as necessary.

5.2 Debris and Litter Removal

Remove debris and litter from the infiltrating surface to minimize clogging of the media. Remove debris and litter from the overflow structure.

5.3 Mowing and Plant Care

- **All vegetation**: Maintain healthy, weed-free vegetation. Weeds should be removed before they flower. The frequency of weeding will depend on the planting scheme and cover. When the growing media is covered with mulch or densely vegetated, less frequent weeding will be required.
- **Grasses**: When started from seed, allow time for germination and establishment of grass prior to mowing. If mowing is required during this period for weed control, it should be accomplished with hand-held string trimmers to minimize disturbance to the seedbed. After established, mow as desired or as needed for weed control. Following this period, mowing of native/drought tolerant grasses may stop or be reduced to maintain a length of no less than 6 inches. Mowing of manicured grasses may vary from as frequently as weekly during the summer, to no mowing during the winter. See Section 4.4 for additional guidance on mowing.

5.4 Irrigation Scheduling and Maintenance

Adjust irrigation throughout the growing season to provide the proper irrigation application rate to maintain healthy vegetation. Less irrigation is typically needed in early summer and fall, while more irrigation is needed during the peak summer months. Native grasses and other drought tolerant plantings should not typically require routine irrigation after establishment, except during prolonged dry periods.

Check for broken sprinkler heads and repair them, as needed. Completely drain the irrigation system before the first winter freeze each year. Upon reactivation of the irrigation system in the spring, inspect all components and replace damaged parts, as needed.

5.5 Replacement of Wood Mulch

Replace wood mulch only when needed to maintain a mulch depth of up to approximately 3 inches. Excess mulch will reduce the volume available for storage.

5.6 Sediment Removal and Growing Media Replacement

If ponded water is observed in a bioretention cell more than 24 hours after the end of a runoff event, check underdrain outfall locations and clean-outs for blockages. Maintenance activities to restore infiltration capacity of bioretention facilities will vary with the degree and nature of the clogging. If clogging is primarily related to sediment accumulation on the filter surface, infiltration may be improved by removing excess accumulated sediment and scarifying the surface of the filter with a rake. If the clogging is due to migration of sediments deeper into the pore spaces of the media, removal and replacement of all or a portion of the media may be required. The frequency of media replacement will depend on site-specific pollutant loading characteristics. Based on experience to date in the metro Denver area, the required frequency of media replacement is not known. To date UDFCD is not aware of any rain gardens constructed to the recommendations of these criteria that have required full replacement of the growing media. Although surface clogging of the media is expected over time, established root systems promote infiltration. This means that mature vegetation that covers the filter surface should increase the life span of the growing media, serving to promote infiltration even as the media surface clogs.

FOUR POINTS SURVEYING ENGINEERING

No.	DATE	REVISIONS	INT

LOT 1 INDIAN MEADOWS
PHASE I DEVELOPMENT PLAN

LOT 1, INDIAN MEADOWS FILING NO. 3
STEAMBOAT SPRINGS, CO 80487

HORIZONTAL SCALE
0 40' 80'
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DRAWING:
UDFCD ADDITIONAL OPERATION AND MAINTENANCE REFERENCES

SHEET N0.
OM2