STORMWATER DESIGN MANUAL

THE CITY OF SOUTH SALT LAKE

July 2020

Table of Contents

CHAPTER 1 REGULATIONS

The federal, state, and local regulations shall be followed for all stormwater discharge and design. This chapter provides general information on related federal and state laws and regulations, and South Salt Lake City Ordinances. This chapter is informational only. Users of this manual shall verify and comply with all applicable laws and regulations.

1.1 Federal Laws and Regulations

EPA created the National Pollutant Discharge Elimination System (NPDES) in 1972 under the Clean Water Act. The NPDES permit program allows state governments to perform permitting, administrative, and enforcement aspects of this program. Refer to https://www.epa.gov/npdes for the latest information.

1.2 The State of Utah MS4 Permit

The MS4 permit is one of the sources that is regulated by the Utah Pollutant Discharge Elimination System (UPDES) which is the Utah version of the federal NPDES regulations. Refer to https://deq.utah.gov/water-quality/storm-water-permits-updes-permits for the latest information.

1.3 South Salt Lake City Ordinances and Storm Water Management Plans

The City of South Salt Lake implemented ordinances for storm water management as described in Chapter 13, while the city Stormwater Division has implemented the Storm Water Management Plan (SWMP) as a management guidance for developers.

CHAPTER 2 SUBMITTAL REQUIREMENTS

The storm water related submittals shall be in compliance with Federal, State, and City regulations/ordinances. Additional plans, reports, and memos may also be required by the Community Development Department, Engineering Department, or Public Works Stormwater Division.

2.1 General Submission Requirements

1. Site Plan
2. Grading Plan
3. Drainage Plan with Hydrology Calculations
4. Storm Water Pollution Prevention Plan (SWPPP) including Best Management Practices (BMPs)
5. Geotechnical Report
6. Post Construction (Design, performance, selection of BMP's, and maintenance requirements)
7. Other items listed on South Salt Lake Building/Right-of-way permit application checklist.

2.2 Special Requirements

1. For developments that disturb land greater than or equal to one acre, including projects that are part of a larger common plan of development or sale which collectively disturbs land greater than or equal to one acre, a full SWPPP including Notice of Intent (NOI) shall be submitted. Otherwise, general BMPs shall be submitted for review.
2. Infiltration rate shall be highlighted in geotechnical report for onsite retention systems.
3. Pre-construction meetings are required, to discuss the SWPPP and any Post Construction BMP's.

CHAPTER 3 NEW DEVELOPMENT HYDROLOGY CALCULATIONS

For new developments, the new MS4 permit requires 80th percentile storm precipitation for the total disturbed area. Refer to Figure 3-1 Design Process Flowchart for New Development.

3.1 80th Percentile Volume

1. Calculated 80th Percentile Precipitation Depth, d_{80} in South Salt Lake

   80th Percentile: **0.6** inches

2. Calculation Steps:

   a. Long-term daily rainfall data was obtained from National Oceanic and Atmospheric Administration (NOAA): https://www.ncdc.noaa.gov/cdo-web/datatools/selectlocation.

   b. South Salt Lake City data was selected and downloaded in .csv

   c. Data was sorted “low to high”

   d. Small precipitation events (< 0.1 inch) were deleted

   e. 80th Percentile Precipitation Depth was calculated

3.2 Calculations

1. Imperviousness

$$\%\ Project\ Impervious\ Area = \frac{Post\ Development\ Impervious\ Area}{Project's\ Disturbance\ Limits}$$

$$\%\ BMP\ Impervious\ Area = \frac{Post\ Development\ Impervious\ Area\ within\ BMP\ Drainage\ Area}{BMP\ Drainage\ Area}$$

2. Volumetric Runoff Coefficient

$$R_V = \frac{V_R}{V_P}$$

Where,

R_V – Volumetric Runoff Coefficient

V_R – Measured Runoff Volume, cf

V_P – Total Precipitation Volume, cf

$$V_P = \frac{d_{80} \cdot A}{12}$$

d_{80} – 80th Percentile Precipitation Depth, in

A – Parcel Area, sf

In this section, i represents the percent of impervious parcel area, in decimal format.

Reese Method

$$R_V = 0.91 \cdot i - 0.0204$$

NRCS Hydrological Soil Group Method

Table 3-1 NRCS Volumetric Runoff Coefficient

NRCS Soil Group	**A**	**B**	**C/D**
Equation	$R_V = 0.84 \cdot i^{1.302}$	$R_V = 0.84 \cdot i^{1.169}$	$R_V = 0.84 \cdot i^{1.122}$

3. 80th Percentile Volume

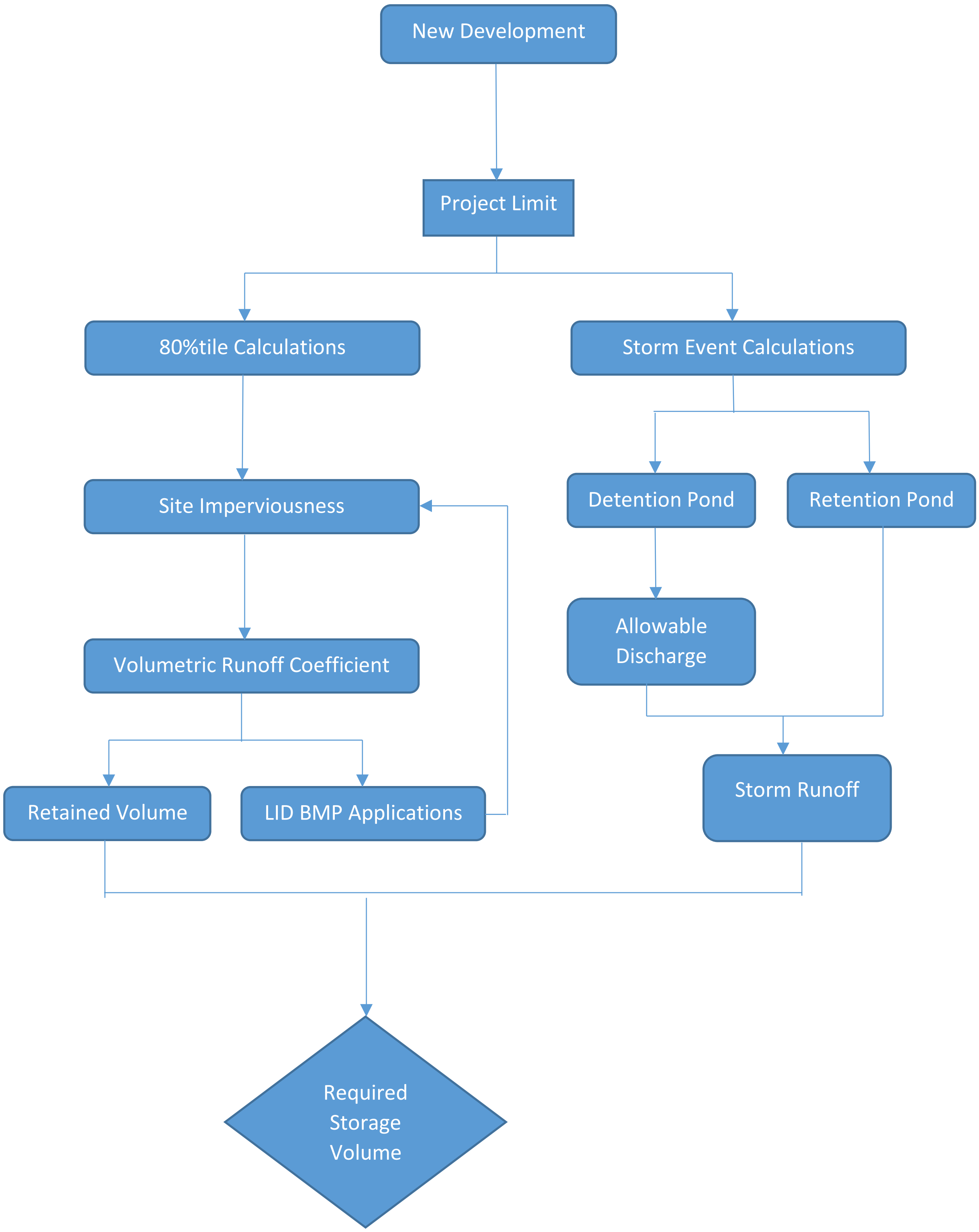
$$V_{80} = R_V \cdot d_{80} \cdot A$$

Where,

V_{80} – 80th Percentile Volume, cf

d_{80} – 80th Percentile Precipitation Depth, ft

Figure 3-1 Design Process Flowchart for New Development



CHAPTER 4 RE-DEVELOPMENT HYDROLOGY CALCULATIONS

If a redevelopment project increases the impervious surface by greater than 10%, the project shall manage rainfall on-site, and prevent the off-site discharge of the net increase in the volume associated with the precipitation from all rainfall events less than or equal to the 80th percentile rainfall event. Refer to Figure 4-1 Design Flowchart for Re-Development.

4.1 80th Percentile Volume

1. Percentile Precipitation Depth

   80th Percentile: **0.6** inches

2. Calculation Steps:

   a. Long-term daily rainfall data was obtained from National Oceanic and Atmospheric Administration (NOAA): https://www.ncdc.noaa.gov/cdo-web/datatools/selectlocation.

   b. South Salt Lake City data was selected and downloaded in .csv

   c. Data was sorted “low to high”

   d. Small precipitation events (< 0.1 inch) were deleted

   e. 80th Percentile Precipitation Depth was calculated

4.2 Calculations

1. Imperviousness

$$\%\,Existing\ Impervious\ Area = \frac{Existing\ Impervious\ Area}{Parcel\ Area}$$

$$\%\,Redevelopment\ Impervious\ Area = \frac{New\ Impervious\ Area + Existing\ Impervious\ Area}{Parcel\ Area}$$

$$\%\,Increase = \frac{\%\,Redevelopment\ Impervious\ Area - \%\,Existing\ Impervious\ Area}{\%\,Existing\ Impervious\ Area}$$

2. Volumetric Runoff Coefficient

$$R_V = \frac{V_R}{V_P}$$

Where,

R_V – Volumetric Runoff Coefficient

V_R – Measured Runoff Volume, cf

V_P – Total Precipitation Volume, cf

$$V_P = \frac{d_{80} \cdot A}{12}$$

d_{80} – 80th Percentile Precipitation Depth, in

A – Parcel Area, sf

In this section, i represents the percent of impervious parcel area, in decimal format.

Reese Method

$$R_V = 0.91 \cdot i - 0.0204$$

NRCS Hydrological Soil Group Method

Table 4-1 NRCS Volumetric Runoff Coefficient

NRCS Soil Group	**A**	**B**	**C/D**
Equation	$R_V = 0.84 \cdot i^{1.302}$	$R_V = 0.84 \cdot i^{1.169}$	$R_V = 0.84 \cdot i^{1.122}$

3. 80th Percentile Volume

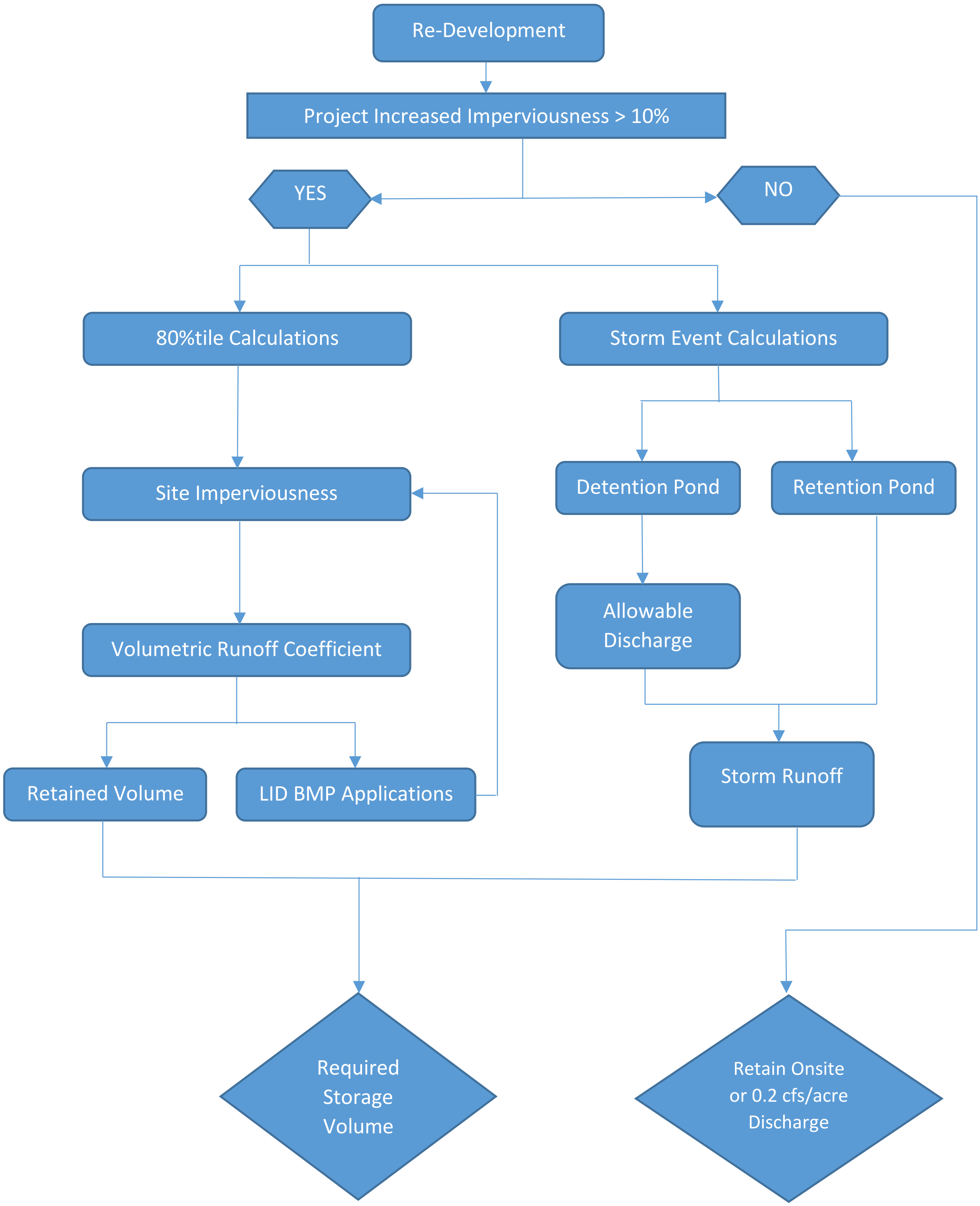
$$V_{80} = R_V \cdot d_{80} \cdot A$$

Where,

V_{80} – 80th Percentile Volume, cf

d_{80} – 80th Percentile Precipitation Depth, ft

Figure 4-1 Design Flowchart for Re-Development



CHAPTER 5   HYDROLOGY DESIGN

5.1 Methods

The City of South Salt Lake allows Rational Method and SCS Curve Number Method (NRCS TR-55 Hydrology Design Method) for the design of hydrology system.

5.2 Storm Event

The City of South Salt Lake requires 100 years 24 hours storm event for the new development/re-development hydrology calculations. For roadway hydrology design, refer to CHAPTER 6.

Table 5-1 South Salt Lake City 24-hr Storm Event Intensity Rate

Interval (min)	Intensity Rate (in/hr)			
	10-year*	25-year*	50-year*	100-year
5	3.2	4.26	5.26	6.34
15	2.01	2.68	3.30	4.05
30	1.35	1.80	2.22	2.72
60	0.838	1.11	1.38	1.68
120	0.492	0.638	0.772	0.92
180	0.356	0.447	0.529	0.62
720	0.133	0.158	0.179	0.2
1440	0.077	0.089	0.099	0.1

*: For roadway hydrology design use only.

5.3 Allowable Discharge

The City of South Salt Lake allows 0.2 cfs/acre discharge to City stormdrain system.

5.4 Rational Method Calculation

1. Rational Equation

$$Q = C \cdot I \cdot A$$

Where,

Q – Peak flow (ft^3/s);

C – Run-off coefficient (Table 5-2);

$$C_{weighted} = \sum C_i \cdot A_i / A_{total}$$

I – Storm intensity (in/hr), from *Table 5-1*;

A – Drainage Area (acres).

Run-off coefficient:

Table 5-2 Runoff Coefficient

	Run-off Coefficient, C
Hardscape, parking	0.9
Buildings	0.85
Landscape	0.15

5.5 NRCS Curve Number Method

$$Q = \frac{(P - 0.2 \cdot S)^2}{(P + 0.8 \cdot S)}$$

$$S = \frac{1000}{CN} - 10$$

Q, P, S typically units of inches.

Where,

Q – Run off (inches);

P – Precipitation (inches);

S – Potential maximum retention after runoff begins;

CN – Curve Number (Table 5-3)

Table 5-3 Runoff Curve Numbers for Urban Areas

Cover description		**Curve numbers for hydrologic soil group**			
Cover type and hydrologic condition	*average %impervious area*	*A*	*B*	*C*	*D*
Fully developed urban areas					
Open space (lawns, parks, golf courses, cemeteries, etc.)					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas					
Paved parking lots, roofs, driveways, etc.		98	98	98	98
Streets and roads					

Paved; curbs and storm sewers (excluding ROW)		98	98	98	98
Paved; open ditches (including ROW)		83	89	92	93
Gravel (including ROW)		76	85	89	91
Dirt (including ROW)		72	82	87	89
Western desert urban area:					
Natural desert landscaping (pervious areas only)		63	77	85	88
artificial desert landscaping		96	96	96	96
Urban districts					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)		77	86	91	94

CHAPTER 6 RIGHT-OF-WAY DRAINAGE SYSTEM

6.1 Catch Basins, Inlet Boxes, and Manholes

The City of South Salt Lake does not allow open-hooded inlet boxes in City's Right-of-way. Refer to the City of South Salt Lake Engineering Supplementary Plans for catch basins and inlet boxes standard drawings.

The City of South Salt Lake follows the latest version of Standard Plans published by the Utah Chapter of American Public Works Association for storm drain manholes.

Refer to Table 6-1 for maximum spacing of catch basins and manholes.

Table 6-1 Maximum Spacing of Catch Basins and Manholes

Size of Pipe (inches)	Maximum Spacing (ft)
15	200
18-24	300
27-36	400
42	500

6.2 Storm Drain Pipe Design

Manning's equation shall be used for the calculation of storm drain pipe diameter, reference to Chapter 7. However, a minimal diameter of 18 inches shall be used for main lines, and a minimal diameter of 15 inches shall be for laterals. The pipe materials shall be Class III RCP. Type C900/C905 may only be acceptable with the written approval from the City Engineer.

Installation shall comply with the latest version of Standard Specifications published by the Utah Chapter of American Public Works Association.

The minimum longitudinal pipe slope shall be 0.3%, while a minimum flow velocity of 2 ft/s or 3 ft/s when flowing full shall be provided.

The design capacity shall be sufficient so that stormwater does not flow under pressure. And the HGL shall be at least 1 ft below the top of grate for the Design Check Event, except the system downstream from a major sag can sustain flow under pressure for the 50-year storm event.

6.3 Roadway Hydrology Design Criteria

1. Design frequency.

Storm event data refer to CHAPTER 5. The Design Check Event shall be used to evaluate flood risks to the roadway and adjacent properties. The roadway hydrology design frequency requirements as shown in Table 6-2.

Table 6-2 Roadway Hydrology Design Frequency Requirement

Roadway Functional Class	**Design Frequency**	**Design Check Event**	**Storm Drainage System Characteristics**
Arterial, Collector	10-year	50-year	
	25-year	50-year	Major sag locations, including all downstream drainage features
Local	10-year	50-year	

2. Maximum Stormwater Spread Width

Inlet boxes shall be provided along the roadway to meet the spread requirements as shown in Table 6-3.

Table 6-3 Maximum Stormwater Spread Width

Roadway Characteristic	**Maximum Stormwater Spread Width**
Posted Speed < 45 mph	Shoulder + 3 ft
Posted Speed ≥ 45 mph	Shoulder only
Major Sag	Shoulder + 3 ft
Bridge Deck*	Shoulder Only
No Shoulder	3 ft

*: Refer to UDOT Drainage Manual of Instruction.

CHAPTER 7 OPEN CHANNELS

7.1 Types

Open channel flows may not occur in South Salt Lake City Right-of-way. However, flow patterns in detention/retention ponds or low impact developments can be treated as open channel flows. Some common types are: triangular or trapezoidal bioswales and rain gardens, trapezoidal detention/retention ponds.

7.2 Calculations

Manning's Equation

$$v = \frac{1.49}{n} \cdot R^{2/3} \cdot S^{1/2}$$

$$Q = v \cdot A$$

Where,

Q – Flow (ft^3/s);

v – Velocity (ft/s);

n – Manning's Coefficient (Appendix B);

R – Hydraulic Radius (ft)

S – Channel slope for uniform flow (ft/ft)

A – Flow area (ft^2)

Hydraulic Radius

$$R = \frac{Flow\ area}{Wetted\ perimeter} = \frac{A}{P}$$

Appendix A

Post Construction BMPs

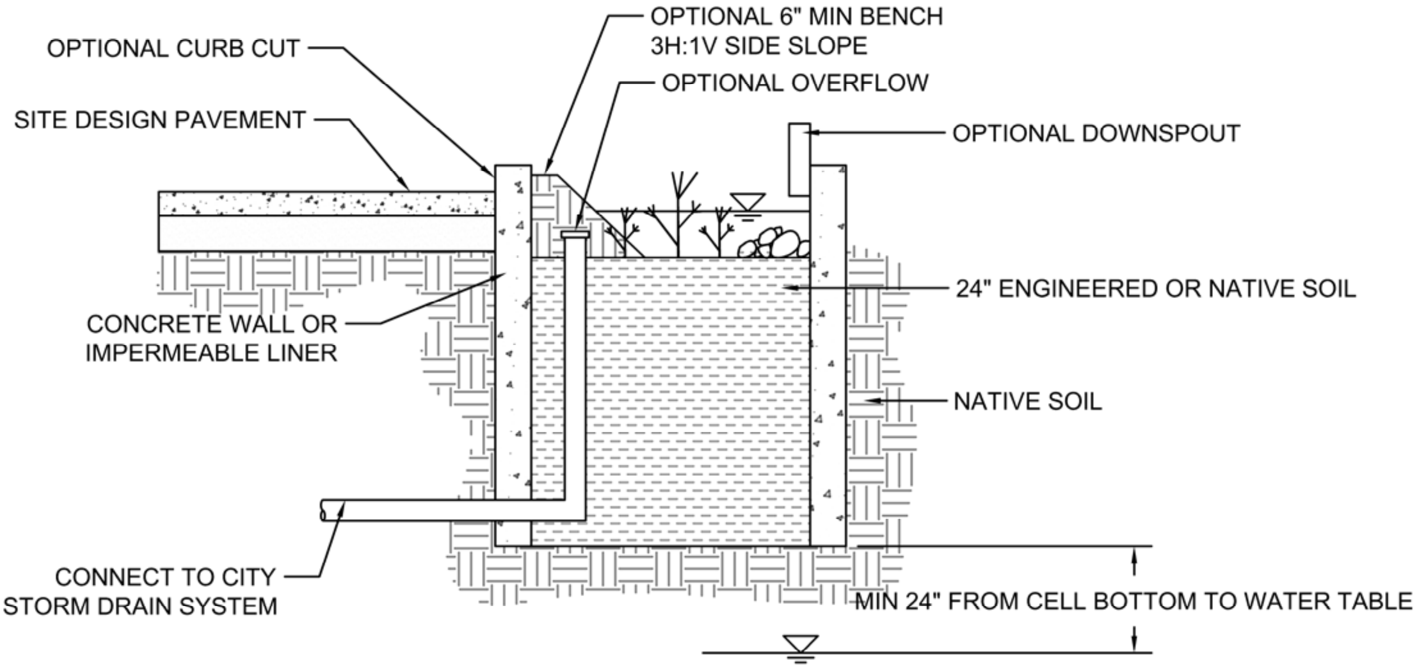
Sheet BR – Bioretention Cell

Sheet BS – Bioswale

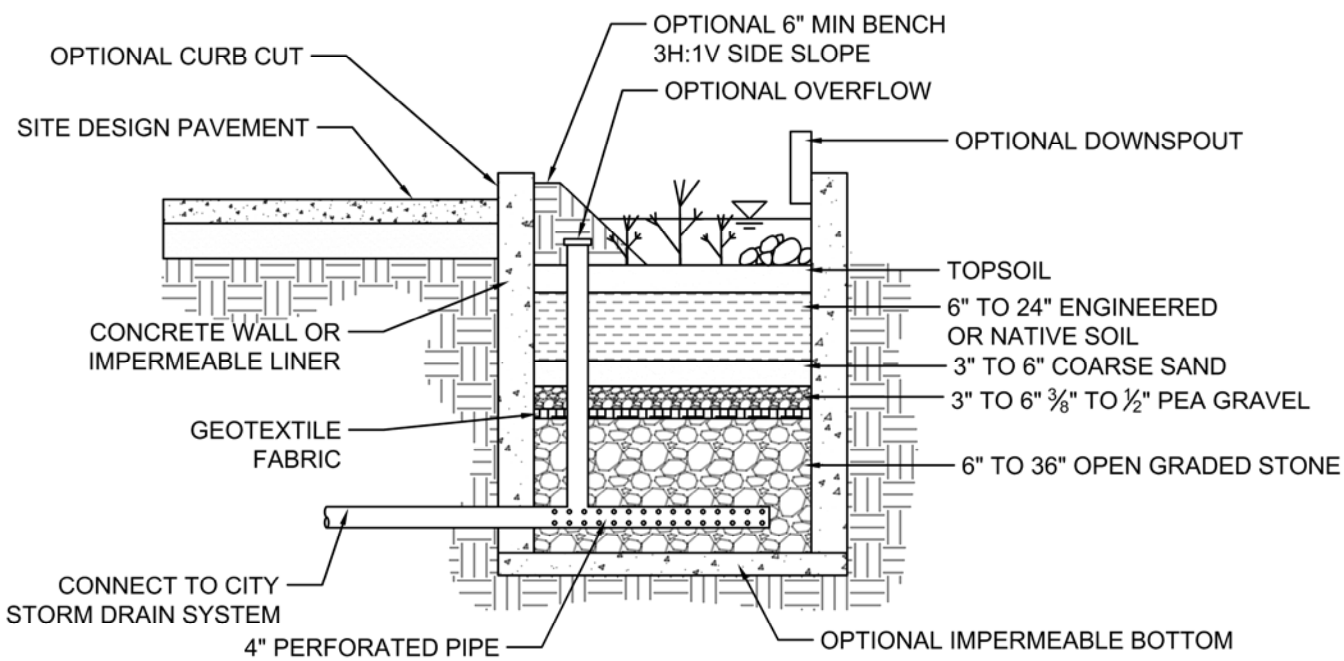
Sheet RG – Rain Garden

Sheet TB – Tree Box Filters

Sheet VS – Vegetated Strips

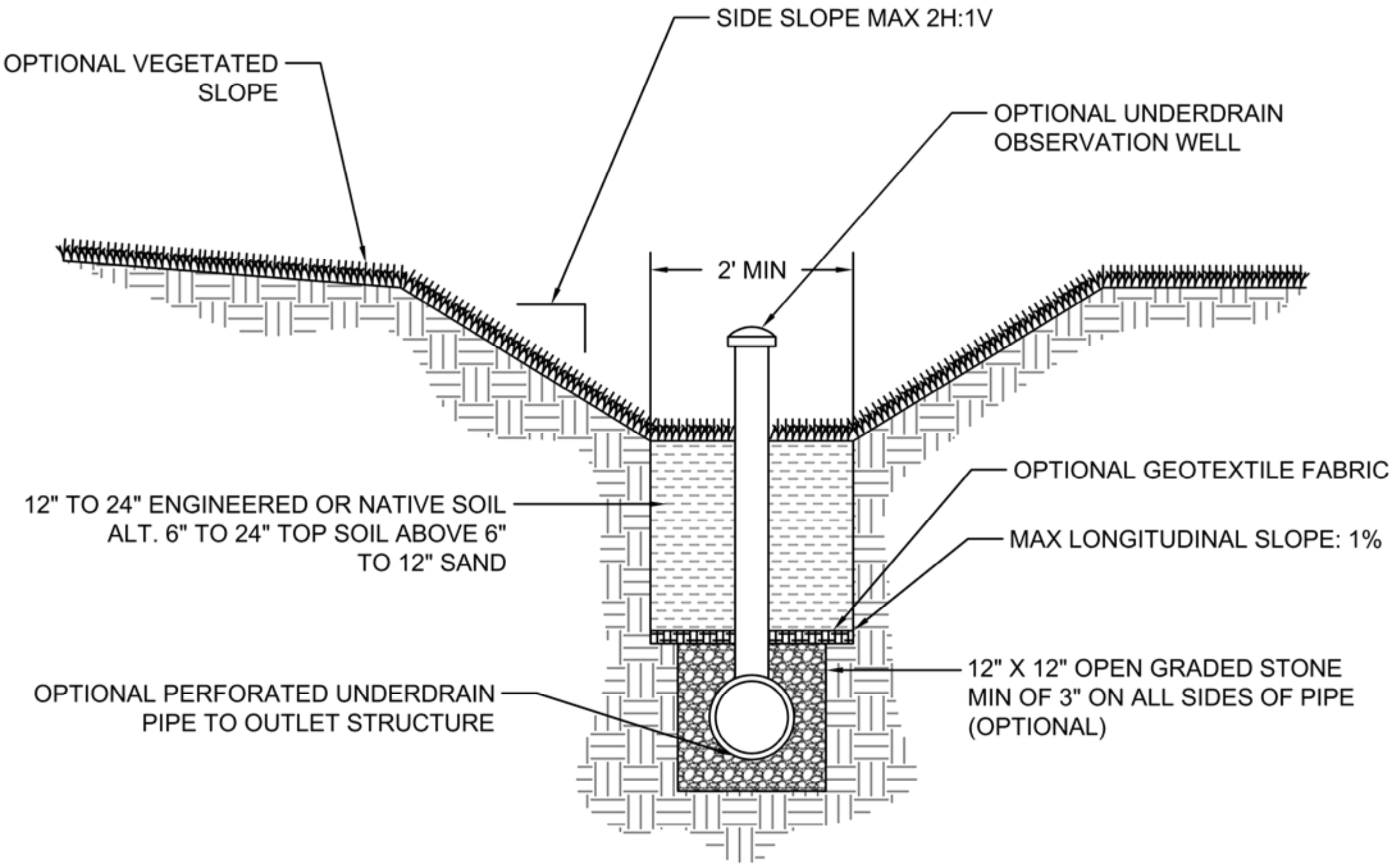


BIORETENTION CELL IN NATIVE OR ENGINEERED SOILS



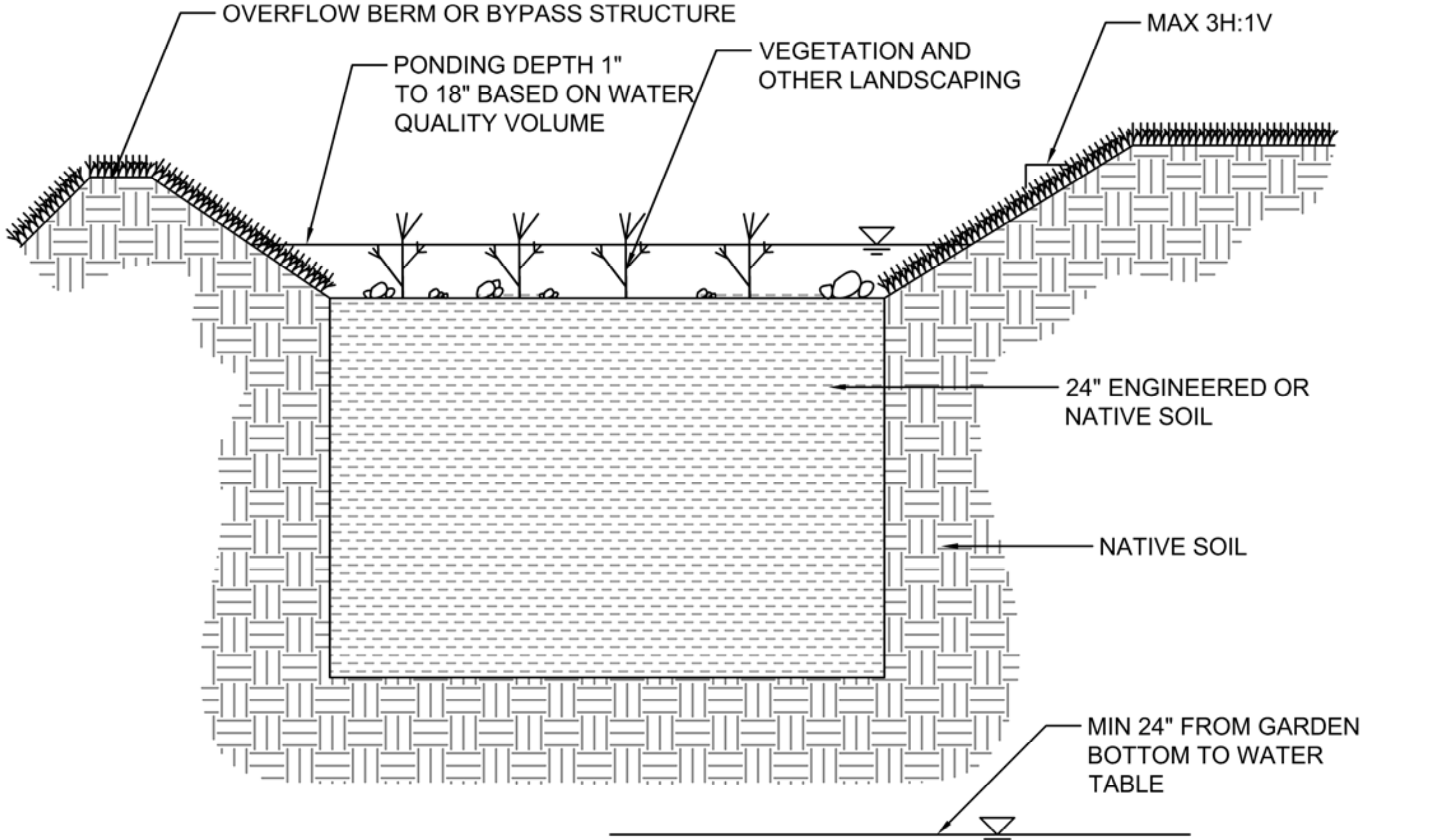
BIORETENTION CELL WITH UNDERDRAIN SYSTEM

SOUTH SALT LAKE ENGINEERING DEPARTMENT 220 E MORRIS AVENUE SOUTH SALT LAKE, UTAH 84115	CITY OF SOUTH SALT LAKE POST CONSTRUCTION BMPS	BIORETENTION CELL	SHEET BR DATE JULY, 2020

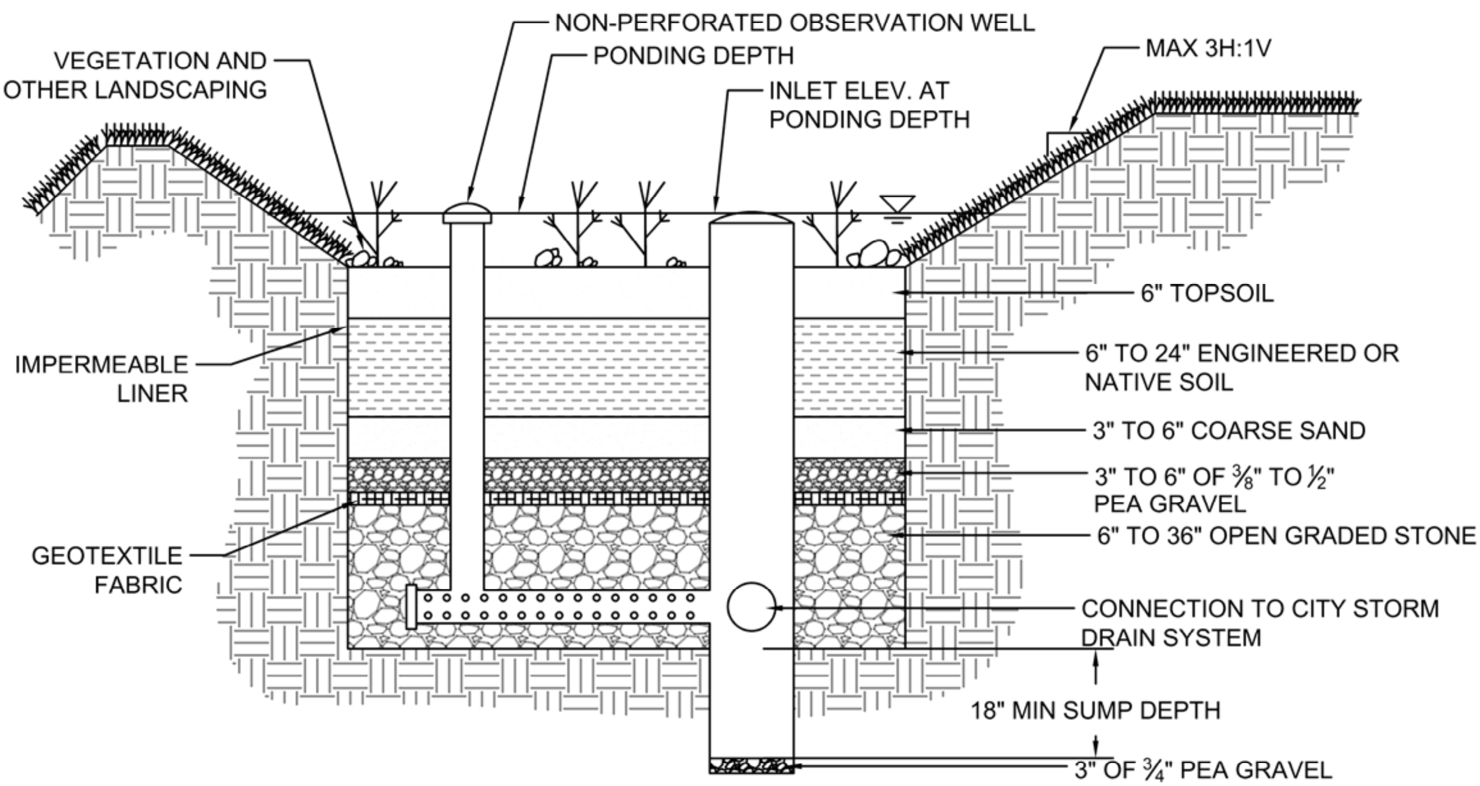


BIOSWALE

SOUTH SALT LAKE ENGINEERING DEPARTMENT 220 E MORRIS AVENUE SOUTH SALT LAKE, UTAH 84115	**CITY OF SOUTH SALT LAKE POST CONSTRUCTION BMPS**	**BIOSWALE**	SHEET BS DATE JULY, 2020

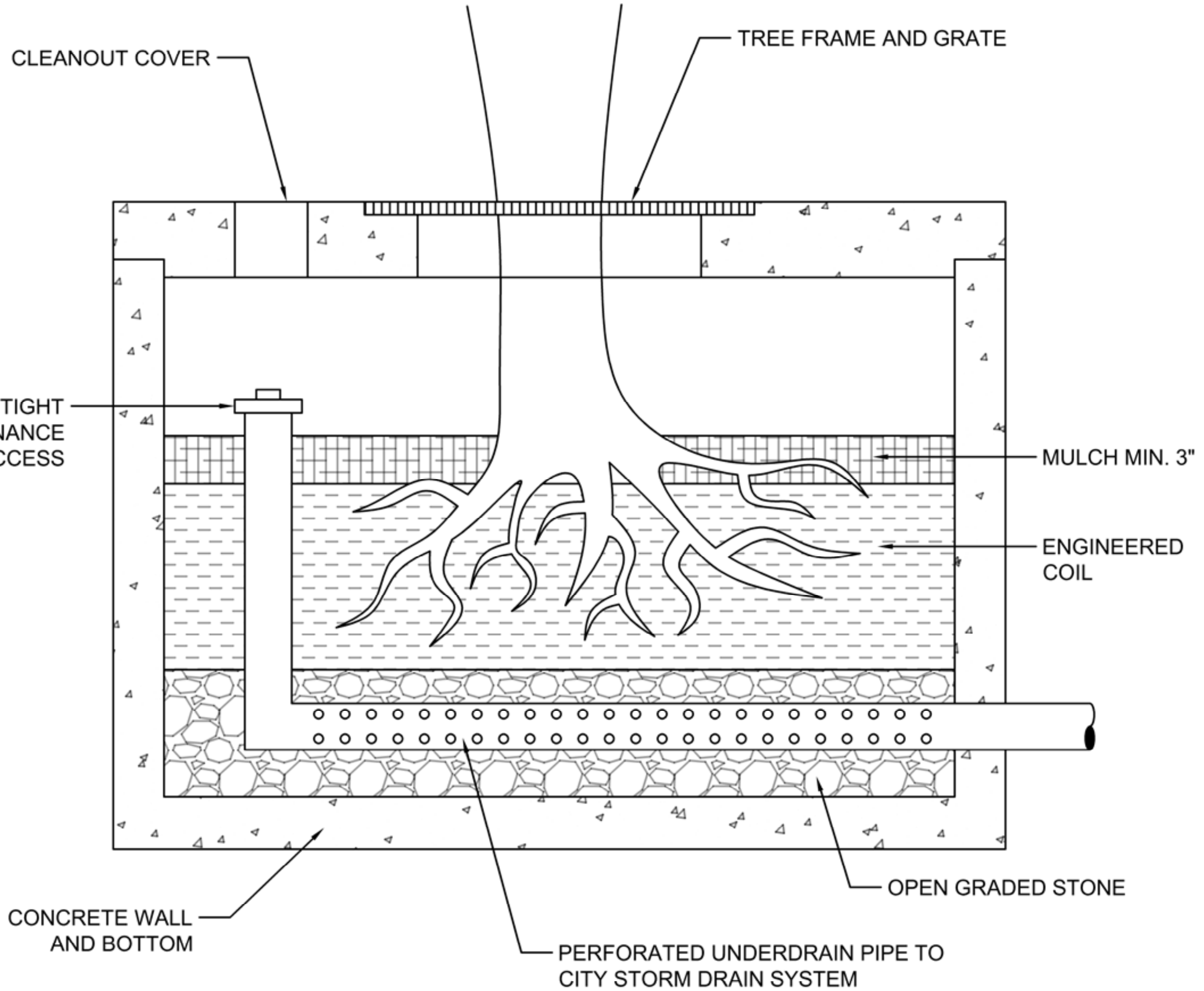


RAIN GARDEN IN NATIVE OR ENGINEERED SOILS



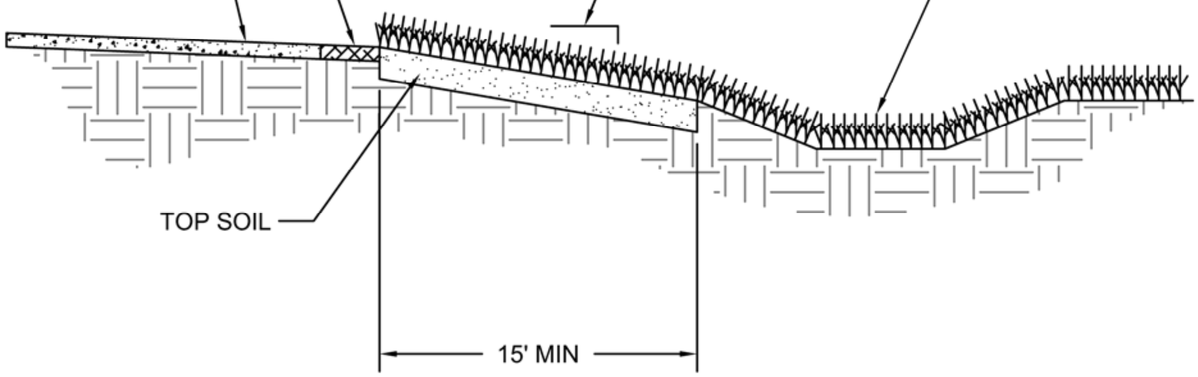
RAIN GARDEN WITH UNDERDRAIN SYSTEM

SOUTH SALT LAKE ENGINEERING DEPARTMENT 220 E MORRIS AVENUE SOUTH SALT LAKE, UTAH 84115	CITY OF SOUTH SALT LAKE POST CONSTRUCTION BMPS	RAIN GARDEN	SHEET RG DATE JULY, 2020



TREE BOX FILTERS

SOUTH SALT LAKE ENGINEERING DEPARTMENT 220 E MORRIS AVENUE SOUTH SALT LAKE, UTAH 84115	CITY OF SOUTH SALT LAKE POST CONSTRUCTION BMPS	TREE BOX FILTERS	SHEET TB DATE JULY, 2020



VEGETATED STRIPS

SOUTH SALT LAKE ENGINEERING DEPARTMENT
220 E MORRIS AVENUE
SOUTH SALT LAKE, UTAH 84115

CITY OF SOUTH SALT LAKE
POST CONSTRUCTION BMPS

VEGETATED STRIPS

SHEET VS

DATE JULY, 2020

Appendix B

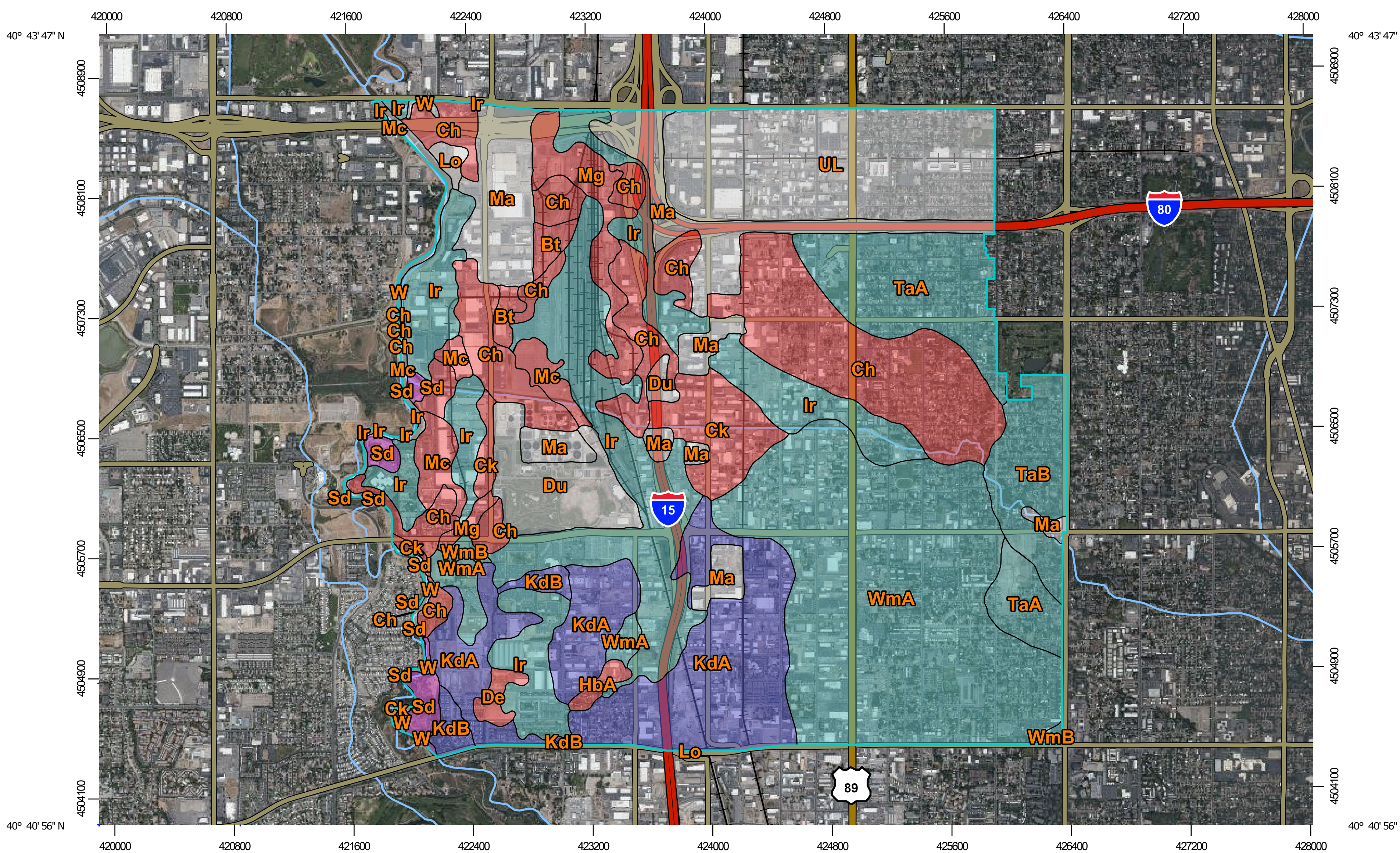
Manning's Coefficient

Channel material	n
Plastic (PVC and ABS)	0.009
Clean, uncoated cast iron	0.014
Clean, coated cast iron	0.013
Dirty, tuberculate cast iron	0.025
Riveted steel	0.016
Lock-ar and welded steel pipe	0.012
Galvanized iron	0.016
Brass and glass	0.011
Wood stave	
small diameter	0.011
large diameter	0.012
Concrete	
average value used	0.013
typical commercial, ball and spigot, rubber gasketed end connections	
full (pressurized and wet)	0.01
partially full	0.0085
with rough joints	0.0165
dry mix, ough forms	0.0155
wet mix, steel forms	0.013
very smooth, finished	0.0115
Vitrified sewer	0.014
Common-clay drainage tile	0.013
Asbestos	0.011
Planed timber (flume)	0.012
Canvas	0.012
Unplaned timber (flume)	0.013
Brick	0.016
Rubble masonry	0.017
Smooth earth	0.018
Firm gravel	0.023
Corrugated metal pipe (CMP)	0.0275
Natural channels, good condition	0.025
Rip rap	0.035
Natural channels with stones and weeds	0.035
Very poor natural channels	0.06

Appendix C

NRCS South Salt Lake City Hydrologic Soil Group

Hydrologic Soil Group—Salt Lake Area, Utah
(South Salt Lake City Hydrologic Soil Group)



Map Scale: 1:37,100 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 500, 1000, 2000, 3000

Feet: 0, 1500, 3000, 6000, 9000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 12N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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 1:20,000.

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: Salt Lake Area, Utah
Survey Area Data: Version 13, Jun 8, 2020

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

Date(s) aerial images were photographed: Aug 5, 2018—Sep 14, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Bt	Bramwell silty clay loam, hardpan variant	D	30.2	0.7%
Ch	Chipman silty clay loam, 0 to 1 percent slopes	D	622.0	14.0%
Ck	Chipman silty clay loam, saline, sodic, 0 to 1 percent slopes	D	124.6	2.8%
De	Deckerman fine sandy loam, 0 to 1 percent slopes	D	17.2	0.4%
Du	Dumps		133.7	3.0%
HbA	Harrisville silt loam, 0 to 1 percent slopes	D	13.0	0.3%
Ir	Lewiston loam, 0 to 1 percent slopes	C	720.0	16.2%
KdA	Kidman very fine sandy loam, 0 to 1 percent slopes	B	475.2	10.7%
KdB	Kidman very fine sandy loam, 1 to 3 percent slopes	B	34.6	0.8%
Lo	Loamy borrow pits		10.7	0.2%
Ma	Made land		346.6	7.8%
Mc	Magna silty clay, 0 to 1 percent slopes	D	71.0	1.6%
Mg	Magna silty clay, peaty surface	D	98.9	2.2%
Sd	Sandy alluvial lands	A	42.2	0.9%
TaA	Taylorsville silty clay loam, 0 to 1 percent slopes	C	267.8	6.0%
TaB	Taylorsville silty clay loam, 1 to 3 percent slopes	C	134.3	3.0%
UL	Urban land		405.6	9.1%
W	Water		41.8	0.9%
WmA	Welby silt loam, 0 to 1 percent slopes	C	837.7	18.9%
WmB	Welby silt loam, 1 to 3 percent slopes	C	13.1	0.3%
Totals for Area of Interest			**4,440.4**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher