Long-Term Storm Water Requirements
for New Development
and Areas of Redevelopment

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Revised 08/2020

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1. Introduction

1.1 Purpose

The purpose of this handout is to assist in understanding and complying with the Bountiful City storm water requirements for areas of development and redevelopment. These requirements have been implemented in accordance with environmental regulations per Bountiful City's municipal storm water permit issued by the State of Utah.

1.2 Background

Storm water runoff is often transported to municipal storm drains and ultimately discharged into local rivers and streams without treatment. EPA's Storm Water Phase II Rule establishes a program that is intended to improve the Nation's public surface waters by reducing the quantity of pollutants that are introduced into storm sewer systems. Common pollutants include oil/grease, roadway salts/deicing materials, pesticides, fertilizers, sediment, and waste such as cigarette butts, paper wrappers, and plastic bottles. These pollutants can impair the waterways, thereby discouraging use of the resource, contaminating water supplies, and interfering with the habitat of aquatic creatures and wildlife.

1.3 Low Impact Development (LID) Concept

LID seeks to minimize the impact that changes (like development) make to the natural environment. When considering storm water, LID intends to mimic pre-development water cycle processes. This includes an effort to mimic the pre-development volume of water that is infiltrated and the runoff conditions from any given rainstorm. The LID concept also includes consideration of the utilization of methods which prevent pollutants from being carried from the property by runoff.

Infiltration, evapotranspiration, and the harvesting of rainfall are methods used to mimic the pre-development water cycle processes. Natural filtration and man-made filtration are utilized to remove pollutants from the storm water. These practices are best if utilized as close to the source of precipitation as possible.

2. Project Permitting and Review

2.1 Applicability

See the following flow charts to determine applicability of detention and on-site retention requirements for development projects:

DETENTION APPLICABILITY FLOW CHART

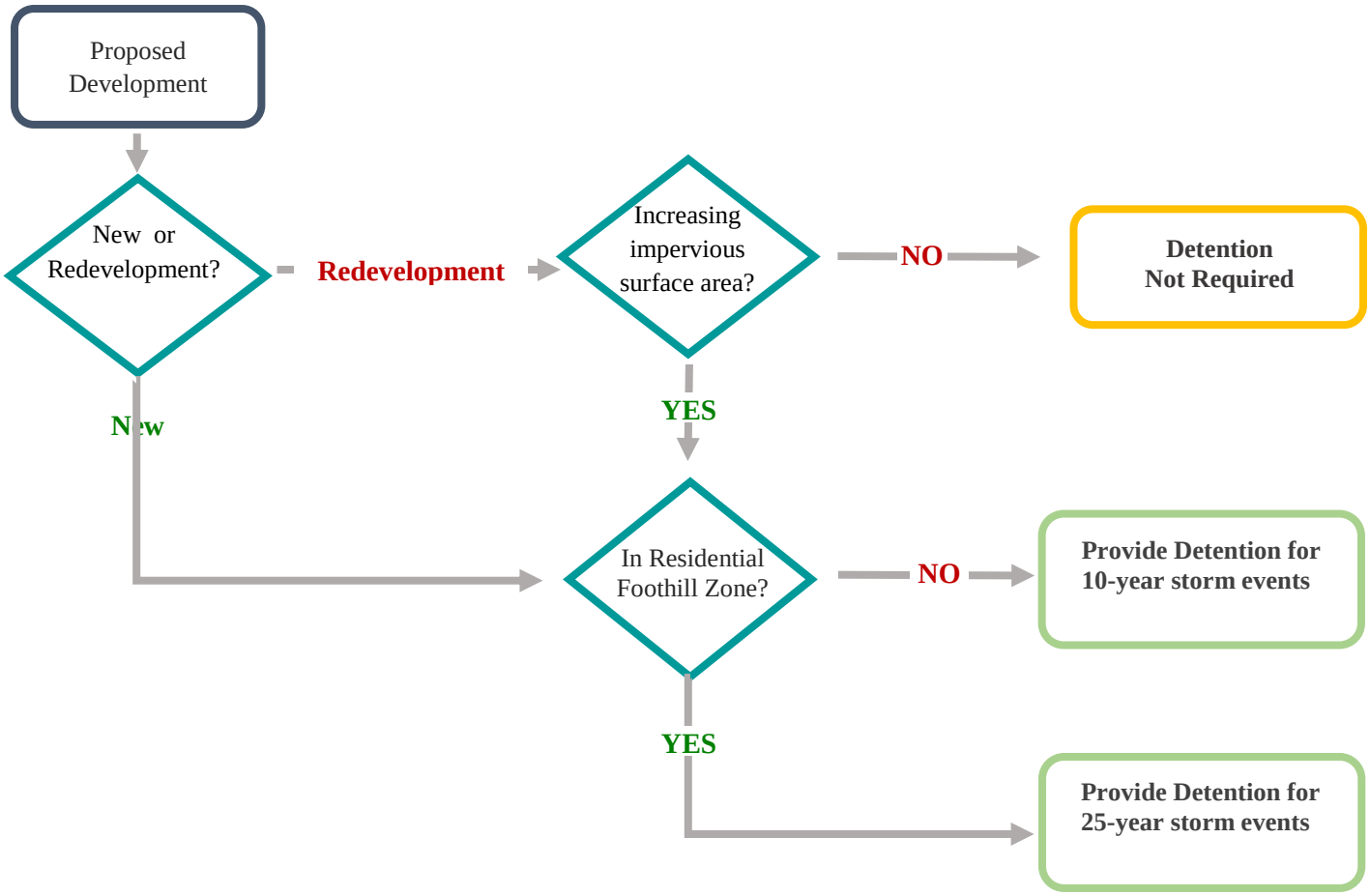

Figure 1: Detention Applicability Flow Chart

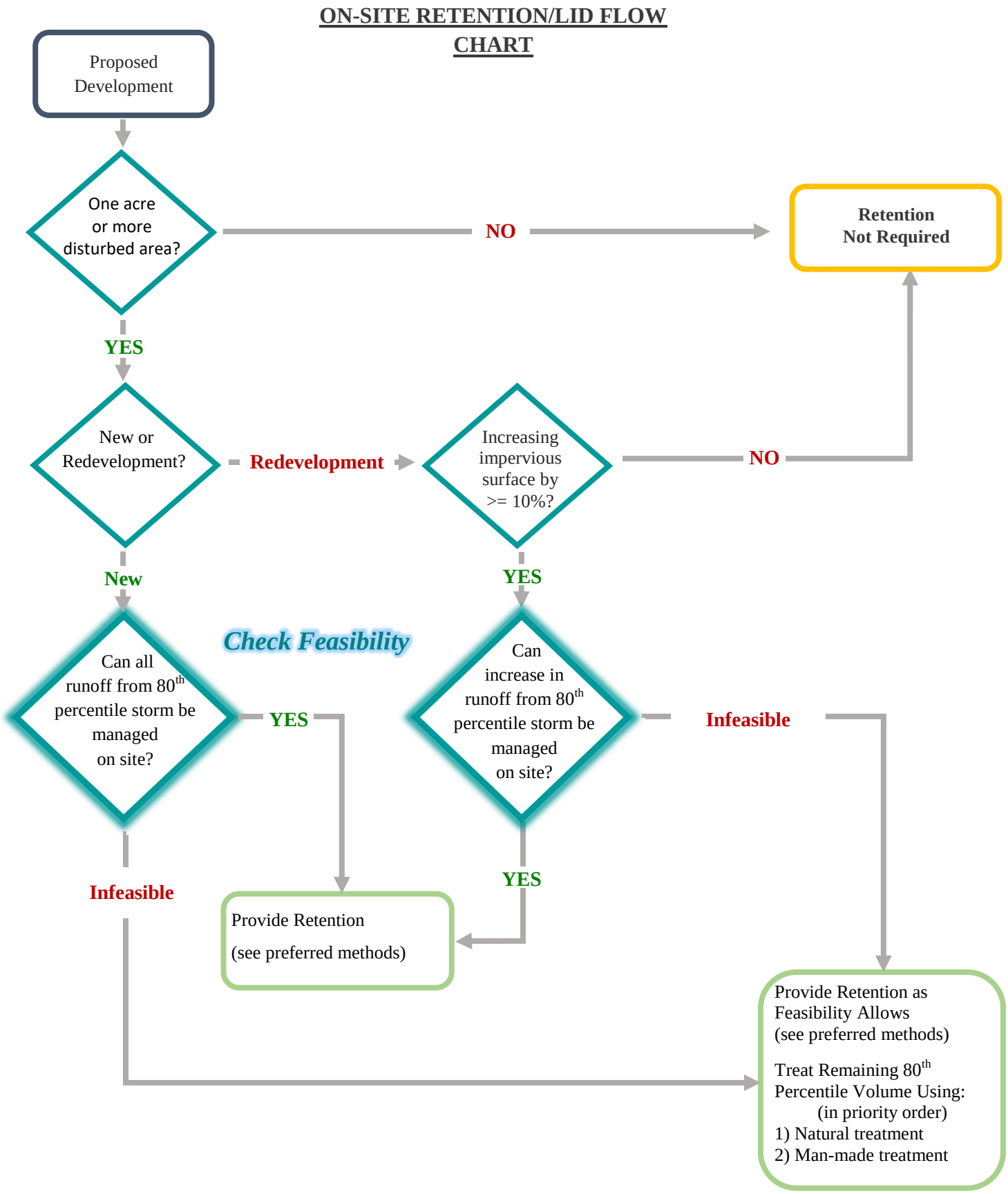

Figure 2: Retention Applicability Flow Chart

2.2 Design Calculations

2.2.1 Detention - Controlling Peak Runoff

Site designs shall establish storm water management practices to control the peak flow rates of storm water discharge associated with development to pre-development levels for specified design storms:

- Storms having a 25-year return frequency if located in the Residential Foothill subzone
- Storms having a 10-year return frequency for all other areas

The calculations should be based on one of the following methods:

(1) Rational Method
(2) National Resources Conservation Service (NRCS) Method
(3) Unit Hydrograph derived from locally-observed data
(4) Any methodology as approved by the City Engineer

Pre-development runoff may be assumed to be equal to 0.2 cfs/acre.

2.2.2 On-Site Retention – Controlling Runoff Volume

(a) Controlling Runoff Volume from Newly-Developed Sites:
New development projects must manage storm water on-site and prevent the off-site discharge of the precipitation from all rainfall events less than or equal to the 80th percentile rainfall event by the use of practices that infiltrate, evapotranspire, and/or harvest rainwater.

(b) Controlling Runoff Volume from Redeveloped sites:
Redevelopment projects that limit the increase of impervious surface to no more than 10% of existing impervious surface are not required to implement retention practices.
Otherwise, the net increase in volume associated with precipitation from all rainfall events less than or equal to the 80th percentile rainfall event is managed on site by the use of practices that infiltrate, evapotranspire, and/or harvest rainwater.

(c) 80^{th} Percentile Storm Depth:
The 80^{th} percentile rainfall event for Bountiful City has been calculated to be ***0.60 inches***.
This is based on historic precipitation data from the ValVerda weather station. If supplemental data is available for a specific location, an alternate 80^{th} percentile event depth may be proposed for a specific project. Use of supplemental data to develop an alternate 80^{th} percentile event depth must be approved by the City Engineer.

(d) Volume Calculations:
The current edition of the Utah Division of Water Quality publication: ***A Guide to Low Impact Development within Utah*** is to be used to calculate the following parameters:

- Project Volume Retention Goal

- Water Quality Volume (for specific practices)
- Volumetric Runoff Coefficient
- 80th Percentile event depth (if requesting an alternate 80th percentile depth)

2.2.3 On-Site Retention – Infiltration

Planned retention basins must have the native soil below the proposed basin identified according to Unified Soil Classification System (ASTM D4318). Saturated infiltration rate, as identified in the table below for specific soil classification is to be used for infiltration calculations:

Table 1: Design Parameters per Soil Type

NRCS Hydrologic Soil Group	USCS Soil Classification Group	Saturated Infiltration Rate (in/hr), K_{sat}	Porosity *n*	Field Capacity
A	Sand	5.0 (max for calc's)	0.437	0.062
A	Loamy Sand	2.0	0.437	0.105
B	Sandy Loam	1.0	0.453	0.190
B	Loam	0.5	0.463	0.232
C	Silt Loam	0.25*	0.501	0.284
C	Sandy Clay Loam	0.15*	0.398	0.244
D	Clay Loam & Silty Clay Loam	<0.09*	0.465	0.325
D	Clay	<0.05*	0.475	0.378

*Generally, infiltration practices in type C and D soils is not feasible

Applicant must provide hydraulic conductivity testing of in-situ soils according to ASTM D5856 or ASTM D2434, as appropriate, for site specific use of alternate saturated infiltration rate and porosity. The results must be accepted by the City Engineer.

Bountiful City requires that standing water AND saturated soil conditions for infiltration practices be limited to a maximum of 48 hours (surface) and 96 hours (total) from the end of the storm with the following additional conditions for calculating the drawdown time of standing water:

- Calculations must include a minimum Factor of Safety of 2.5
- Use the 100-year 24-hour design storm at the site to check drawdown time after the design storm ends
- Calculate standing water drawdown using formula in Utah LID Guidance (pg 23-24)
  $T = (D_T * n + d) / K_{sat}$

Where:

t = Drawdown time (hrs)
D_T = Total depth of soil matrix (in)
n = average porosity of soil matrix (weighted based on soil layer depth, if applicable)
d= ponding depth, in
K_{sat} = saturated infiltration rate of soil, in/hr

2.3 Maintenance Agreements

Maintenance is crucial for proper and continuous operation, effectiveness, and efficiency of a structural or treatment storm water facility. A maintenance agreement is required for all storm water storage and treatment facilities to ensure that they function as designed. The agreement must include provisions allowing for access, inspections, and a corrective action process.

The agreement must be signed by the legal owner of the property, who will assume responsibility as the property owner for the storm water facilities on the property. This document will be recorded at the County Recorder's office to permanently bind the agreement property it affects. Bountiful City has a maintenance agreement form that can be used (see appendix C).

The agreement will refer to a long-term storm water management plan as described in the following section.

2.4 Long Term Storm Water Management Plan

A Long-Term Storm Water Management Plan shall be submitted which describes each detention, retention, and filtration practice implemented at the site. The plan should also describe operation and maintenance procedures for each of these long-term storm water facilities. Employee training, inspection procedures, and other relevant information should also be included. A maintenance log shall be maintained at the facility to document all of the activities mentioned above. These documents may be inspected by the City at any time and shall be made available to upon request. The Long Term Storm Water Management Plan will not be recorded at the County Recorder's Office but a copy will be kept on file with Bountiful City Engineering Department.

The Long-Term Storm Water Management Plan must adapt to change in good judgement when site conditions and/or operations change and/or when existing programs are ineffective. Revision requests must be submitted to the Bountiful City Engineering Department. Any approved revisions to said plan must be filed with the Bountiful City Engineering Department.

Bountiful City has a Long-Term Storm Water Management Plan template that can be used (see appendix D).

2.5 Site Inspections

The following inspections of each long-term storm water feature are required (as applicable) to check that they are constructed and/or installed in accordance with the approved design plans:

- Grading inspection as soon as excavation of native soil is complete, before placing any fabric, drain, structure, or soil;
- Inspection for any new or modification to an embankment, riser, or spillway
- Construction of forebays and/or pretreatment feature
- Placement of underdrain system
- One inspection after construction is complete.

- Additional inspections as requested by inspector or City Engineer
- Third party inspections may be required for specialties including soils, concrete, and plantings

It is the owner's responsibility to monitor the progress of construction and schedule inspections as required by the previous list. Multiple inspections may be combined into one visit, when coordinated with inspector. Occasionally, a required inspection (as listed above) may require multiple inspections to verify that all components or portions are complete.

3. Selection of Controls

3.1 LID/Retention Planning

When implementing LID and meeting retention standards, each type of practice shall be implemented to the maximum extent feasible in the order listed below:

1) Reduce runoff generated from the site. Less runoff means less retention and less detention.
    a. Preservation. Preserve open space / Minimize Disturbance
    b. Eliminate directly-connected impervious areas
    c. Use soil amendments to promote retention (infiltration/evapotranspiration)
2) Infiltrate and evapotranspire
3) Harvest/Re-use

If, and only if, after implementing the above items, the project volume retention goal is not completely met for the project (infeasible), the following alternate (filtration) practices must be implemented and designed to manage the portion of the project volume retention goal that is not met with retention. In this case the applicant is required to document an explanation of the reasons that the project volume retention goal is not completely met (see feasibility criteria).

4) Natural filtration (biofilters, filter strips, etc.)
5) Man-made filtration or treatment (separators, skimmers, etc.)

Acceptable practices to accomplish the retention standard and feasibility restraints are described later in this document.

3.2 Maintenance Considerations

3.2.1 Pre-Treatment

Pretreatment is absolutely essential for all types of structural storm water controls to keep sediment out of the main treatment cell. The type, form, and volume of pretreatment may differ between controls.

All practices implemented for retention and underground detention must include a pretreatment component, where feasible. Preferred pretreatment methods are:

- Filter Strips

- Swales
- Fore-bays
- Separators (multi-chamber or hydrodynamic)

Pretreatment facilities should be designed to allow for removal of sediment and other pollutants anticipated at the site. Pretreatment design should also allow for regular maintenance. Pretreatment structures should include a permanent marking/label to indicate the height at which sediment build-up requires maintenance cleaning, where applicable.

3.2.2 Long-term Observations

Retention practices must be equipped with a way to observe the depth of the underground water surface. The observation well must extend down to the bottom of the storage level that is used in meeting volume storage requirements. A way to provide measurement of accumulated sediment must also be provided.

3.2.3 Access

Access paths (and any necessary easements) must be provided for long-term storm water controls. Features along access paths must be designed with load-bearing capacity suitable for maintenance equipment .

Access paths should be at least 12 feet wide, have a maximum slope of 15%, and be appropriately stabilized to withstand anticipated maintenance equipment and vehicle loads.

3.3 Retention Feasibility

Infiltration practices are not allowed in the following areas, and are therefore not feasible:

- Groundwater Source Protection Zones 1 and 2 (Engineering Department can assist in making this determination).
- Sites where promoting infiltration would worsen effects of known soil contamination.
- Sites with the following incompatible land uses: Solid Waste Handling, Automotive Repair, Gasoline Service Stations, Farm and Garden Supplies, and Dry Cleaning Services.
- Sites in areas having native soils in NRCS hydrologic soil groups C and D.
- Areas where a known geologic hazard would be adversely impacted including the following areas of:
    - Collapsible soils, including areas near 1500 S between Lakeview Drive and Millbrook Way
    - Landslide areas, including known landslide areas in Cave Hollow and Temple Ridge
    - Spring water, including Sunset Hollow, area near Hanna Holbrook Elementary, and near Concord Way above 800 East.
    - Any other area where a licensed geotechnical engineer determines that infiltration would adversely impact the risk associated with the geologic hazards on the project site or neighboring parcels

When considering the feasibility of on-site management of runoff, the following criteria shall be met:

- The lowest elevation of all retention facilities shall be a minimum of 5 feet above the seasonal high water table. This distance may be reduced to 3 feet with the City Engineer's approval.
- Retention volumes must dissipate all standing water and saturated soil conditions within 48 hours (surface) and 96 hours (total) after a **100-year 24-hour design** storm has subsided (calculated with a minimum factor of safety of 2.5 applied to saturated infiltration rate).
- Retention facilities can be no closer than 15 feet from the nearest building or wall foundation. This distance may be reduced with a certified recommendation from a professional engineer.
- Retention facilities can be no closer than 10 feet to the edge of asphalt (for public roads) unless the road section has been specifically designed to accommodate retention storage and is approved by the City Engineer. There is no minimum distance to edge of pavement for private roads and parking lots.
- Retention facilities are not allowed on or near the toe of slopes greater than 3:1 without a slope stability analysis (with a generally-accepted factor of safety) certified by a professional engineer.
- State of Utah allows rainwater harvesting as follows:
    - Without Registering with the State of Utah: May use up to two containers; each container must have a capacity of no more than 100 gallons.
    - With Registration (no fee): Up to 2500 gallons.

3.4 Acceptable Storm Water Controls

Bountiful City allows the following practices (within aforementioned constraints) to be implemented.

3.4.1 Preservation

- Cluster Development (per PUD ordinance)
- Open Space Preservation/Minimization of Disturbance (per Zoning ordinance)
- Eliminate Directly-Connected Impervious Areas
- Natural Buffers

3.4.2 Infiltration

- Amending Soil to promote Infiltration

The following practices are also allowed, as described in the Utah Division of Water Quality publication: ***A Guide to Low Impact Development within Utah.*** Some of these practices may offer limited infiltration along with filtration, depending upon the details of design and soil conditions.

- Rain Garden
- Bioretention Cell
- Infiltration Basin
- Infiltration Trench
- Dry Well
- Underground Infiltration Galleries
- Bioswale
- Vegetated Strip
- Tree Box Filter
- Green Roof

3.4.3 Harvesting

Storm water harvesting practices are allowed. However, feasibility constraints also apply to harvesting. Practices are required to disperse enough water from the holding container(s) within **72 hours of receiving runoff** to ensure that adequate capacity is available to capture water from another storm event at that time and to help protect the container from fouling. Additional filtration or disinfection may also be necessary to prevent fouling and the breeding of vectors. These scenarios will be reviewed on a case-by-case basis.

3.4.4 Natural Filtration

The following practices are also allowed as methods to provide filtration to runoff, and are described in the Utah Division of Water Quality publication: ***A Guide to Low Impact Development within Utah.***

- Bioswale
- Vegetated Strip
- Tree Box Filter

3.4.5 Man-Made Filtration/Treatment

- Hydrodynamic Separators
- Multi-Chamber Separators

Other man-made treatment devices such as media filters, skimmers, and baffles may be used with specific approval by City Engineer.

3.4.6 Standard Plans and Specifications

Refer to the following resources for additional applicability information, design standards, and maintenance activities for long-term controls:

- Utah Division of Water Quality publication: ***A Guide to Low Impact Development within Utah*** https://documents.deq.utah.gov/water-quality/stormwater/updes/DWQ-2019-000161.pdf

- Utah City Engineers Association Storm Water Standards: https://www.ucea.net/

3.5 Targeting Pollutants

Table 2: Pollutant Removal and Other Factors for Long-Term Controls

	Preservation			Retention							Retention/Filtration				Filtration	
PERFORMANCE ● = Strong o = Limited	Open Space Preservation	Disconnected Impervious Areas	Natural Buffers	Amended Soil	Rain Garden	Bioretention Cell	Infiltration Basin	Infiltration Trench	Dry Well	Underground Infiltration Galleries	Bioswale	Vegetated Strip	Tree Box Filter	Green Roof	Hydrodynamic Separator (vortex)	Multi-Chamber Separators
Sediment	●	●	●	●	●	●	●	●	●	●	o	●	●	●	●	●
Nutrients	●	o	o	o	●	●	●	●	●	●	o	o	o	o		
Oil & Grease	●	o	o	o	●	●	●	●	●	●	●	o	o		●	●
Metals	●	●	●	●	●	●	●	●	●	●	o	●	●	●	●	●
SITE SUITABILITY H = High, M = Medium, L = Low, Blank = N/A																
Dependency on Soil		M	L	M	H	H	H	H	H	H	M	M	H			
Suitability on Slopes >5%	H	M	H	M	L	L	L	L	M	L	M	M	M			
OTHER FACTORS + = Favorable, / = Neutral, - = Unfavorable, Blank = N/A																
Clogging Prevention		/	/	/	/	/	/	/	/	+	+	/	/		/	/
Freeze/Thaw Limitation		/		+	/	/	/	-	/	+	-	-	/	/	+	/
Maintenance Needs	+	+	+	+	-	/	-	/	/	-	/	+	/	-	-	-
O&M Cost	+	+	+	+	+	/	+	+	/	-	+	+	/	-	-	-
Construction Cost		+	+	/	-	/	-	/	+	-	-	+	/	-	/	/
Community Acceptance	+	+	+	+	-	+	+	+	/	/	/	+	+	/	/	/