CACHE VALLEY
STORM WATER
DESIGN STANDARDS

Smithfield City

November 2010

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These standards cover the criteria and methodology to be utilized by the designers in the design, planning, evaluation, and reports associated with the design of storm water and related irrigation facilities. Any deviations from these criteria must be approved by the City Engineer in writing prior to initiating and again before finalizing the design. Where any deviations may also affect a canal company, a written approval of the canal company will also be required.

All designs completed must utilize and comply with the most current edition of the City Standards and Specifications.

A. DEFINITIONS

Certified Percolation Test: A saturated soil percolation test completed in accordance with Utah Administrative Rule, R317-4-5 with the exception that the test shall extend 2.0 feet below the bottom of the proposed invert of the pond. These tests shall be done in accordance with the certification requirements by a "qualified individual" as defined in R317-11.

Detention: The detaining or holding of water on site and releasing the water from the site into a pipeline, channel, or other water bodies at a slower rate than would otherwise occur.

DEQ: Utah Department of Environmental Quality

Detention Basin: A pond or basin, either above ground or below, that catches the storm water runoff from a contributing area and uses the detention process.

DWQ: Utah Division of Water Quality, a division of the DEQ.

EM 1110-2-1601: Engineering and Design – Hydraulic Design of Flood Control Channels, CECW-EH-D, US Army Corp of Engineers, June 1994

EPA: United States Environmental Protection Agency

HEC-11: Design of Rip-Rap Revetment, Hydraulic Engineering Circular No. 11, US Dept. of Transportation, Federal Highway Administration. (FHWA-IP-89-016, March 1989)

HEC-22: Urban Drainage Design Manual, Hydraulic Engineering Circular No. 22, US Dept. of Transportation, Federal Highway Administration. (FHWA-SA-96-078, August 2001).

HISTORICAL RUNOFF FLOW: The runoff that has historically flowed off of a given piece of land in the specified storm frequency and duration prior to development, either in the land's pre-development agricultural or native condition.

NOI: A notice of intent to construct permit obtained from the DWQ which is required for all construction on areas greater than or equal to 1.0 acres.

NOT: A notice of termination to construction submitted to the DWQ upon the stabilization of 70 percent of the project site that required a NOI.

PWD: Public Works Department

Retention: The retaining or keeping of water on site and preventing its release from the site by any method other than infiltration or evaporation.

Retention Basin: A pond that is built to capture and retain the design storm on site and dispose of it through infiltration.

Return Frequency: The frequency or likelihood of a storm of occurring. A 100-year storm has a one (1) percent chance of occurring in any given year while a 10-year storm has a ten (10) percent chance of occurring in any given year. This should never be interpreted as happening only once every 100 or 10 years for the two given examples.

Spread Width: The width of water flow as measured from the flow line of the gutter into the asphalt.

Stream Alteration Permit: A permit that is obtained through the Utah Division of Water Rights and is necessary anytime construction impacts a stream, wetland, riparian zone, or other water body defined as the waters of the U.S.

Storm Event: The event and hyetograph that define the design volume of precipitation, duration of the storm, intensity of the storm, and the pattern in which the precipitation falls.

SWPPP: A storm water pollution prevention plan which is required on any construction site.

Underground Injection/Retention System: A system designed to be fully underground and to dispose of water, entirely or in part, through infiltration. These require a special permit from the DWQ known as a Class 5 injection well permit.

Underground Injection Well: A facility, such as a pressured injection well, free draining injection well, sump, or other buried underground facility that infiltrates or injects surface water into the subsurface or groundwater system to eliminate surface runoff.

Wetlands Mitigation, or 404, Permit: A permit obtained through the US Army Corp of Engineers which allows the wetlands to be impacted and provides for required mitigation before the project can be approved.

B. DESIGN REQUIREMENTS

All projects, irrespective of the size or type, shall meet these requirements. Where projects are governed by a state or federal agency, their standards shall take precedence. All designs shall be in compliance with the City's constructions standards and specifications.

Subsequent sections within this chapter identify the required methodology based upon the size and type of the project.

1. Storm Event

Design all storm water facilities associated with permanent new and re-development for the 100-year event. Design construction BMP's for the 2 year storm. The storm duration is subject to the size of the contributing area and the project as discussed in Section C, Hydrologic Calculation.

Existing development shall be required to construct storm water facilities to detain and treat runoff anytime at the time of remodeling or reconstruction of any facilities under the same policy as the International Building Code. However, the return frequency and design duration may be modified under extreme conditions at the direction of the City Engineer with approval of the agency managing the receiving waters.

2. Allowable Storm Water Discharge

The storm water runoff leaving the site during the design storm is limited to the **lesser** of:

1. 0.1 cfs per acre, or
2. Discharge prior to development, current or pre-existing (Historical Runoff Flow).

Where insufficient information or where costs of the analysis of the pre-existing conditions are not justified for sites less than 1.0 acre, the runoff may be limited to 0.1 cfs per acre and documented as such on the site plan in the appropriate table upon approval of the City Engineer or his designee.

3. Curb and Gutter Flow Design

1. The flow depth in the gutter shall not be allowed to exceed the **lesser** of the top back of curb elevation (TBC) or the peak drive way approach elevation during the required storm event. This includes a combination of piping, curb and gutter, and ditches.
2. Where the flow depth is exceeded, storm drain inlets and a piped system shall be required and appropriate actions taken to eliminate overtopping of the curbs and flooding private property.

4. Channel Design

1. Channel side slopes shall not be steeper than 3:1 (H:V) unless they are concrete. Where they are incorporated into landscaping, flatter slopes shall be required. This will be evaluated on a case by case basis.
2. Channel velocities shall be slow enough to prevent scour, and where possible, facilitate further settlement of sediments unless the channel is used to deliver irrigation water as well. If the channel will also carry irrigation water, maintain velocities above 2 ft/sec if possible, but at no time exceed 4 ft/sec.
3. Where rip-rap is used, design shall be in accordance with EM-1110 from the US Army Corp of Engineers or HEC-11 from the Federal Highway Administration.
4. Free board on the channels shall be in compliance with the Bureau of Reclamation, Design of Small Canal Structures.
5. Channel maintenance easements shall be maintained as required in the City and Canal Company agreements.

5. Pipe Design

1. For storm water pipes, roughness coefficients listed in the table included in Section D of these standards that coincide with the accepted pipe materials in the City's Standard Specifications, most current edition shall be used.
2. Maintain velocities in the pipes at design flows sufficient to prevent sediment deposition and low enough to prevent scour damage to the pipe.
3. Pipe outlets shall have a flared end discharge unless more stringent methods of energy dissipation are required.
4. Minimum diameter of storm drains shall be:
    a. 12 inches for laterals
    b. 15 inches for trunk lines
    c. 18 inches under the UDOT right of way.
5. Pipe sizes shall not decrease in the downstream direction.
6. Maximum flow depth in the pipe during the design storm shall not exceed 0.85 times the diameter of the pipe.

6. Detention Basins

1. Detention basins, or other equivalent methods to limit the storm water release rate and improve the water quality when approved by the City Engineer, are required prior to discharge into any canal.
2. All detention basins shall be sized to meet the requirements of Section C of this chapter.
3. Side slopes shall not be steeper than 3:1 (H:V).

4. The maximum depth at the emergency overflow location of the pond shall be three feet plus one (1) foot of freeboard above the emergency overflow and a maximum water depth of three (feet) below the emergency overflow. All other ponds require special design, approval, and permitting including safety precautions on a case by case situation.
5. All ponds shall be stabilized with rocks or planted vegetation to prevent internal erosion. Vegetation or other stabilization must be maintained.
6. All ponds must have a water treatment method to prevent heavy sediment, floatable debris, or petroleum products from leaving the pond.
7. Where orifice and snouts are used, the orifice size is limited to not less than three (3) inches in diameter to prevent clogging.
8. Emergency overflows and the flow path of the overflows shall be mapped to natural streams, canals, or city approved drainage system for purpose of flood mapping using existing topographic mapping.
9. The emergency overflow shall be designed to pass the full 100 year event.
10. Other utilities (for example water lines, sewer lines, gas lines, power lines, phone lines, etc.) shall not be allowed through the detention pond or within 5 feet of the pond berms.
11. The invert or lowest point in the pond shall be not less than 12-inches above the existing or historical groundwater levels (whichever is higher).
12. The bottom of the pond shall be finished to maintain historical infiltration.

7. At Grade Retention Basins

1. All retention basins shall be sized to meet the requirements of Section C of this chapter and to contain 100 percent of project site runoff from the design storm.
2. Side slopes shall not be steeper than 3:1 (H:V).
3. The maximum depth of the pond shall be three feet plus one (1) foot of freeboard above the emergency overflow and a maximum water depth of three (feet) below the emergency overflow. All other ponds require special design, approval, and permitting including safety precautions on a case by case situation.
4. All ponds shall be stabilized with rocks or planted vegetation to prevent internal erosion. Vegetation or other stabilization must be maintained.
5. All ponds shall drain within 3 days (72 hours) from the end of the storm event. This is to be documented with a certified percolation test and documented in the soils report.
6. Emergency overflows and the flow path of the overflows shall be mapped for purpose of flooding.
7. The emergency overflow shall be designed to pass the full 100 year event.

8. Other utilities (for example water lines, sewer lines, gas lines, power lines, phone lines, etc.) shall not be allowed through the retention pond or within 5 feet of the pond berms.
9. The invert or lowest point in the pond shall be not less than 12-inches above the existing or historical groundwater levels (whichever is higher).
10. The bottom of the pond shall be finished to maintain historical infiltration.

8. Underground Detention, Retention, and Injection Systems

1. Underground retention and injections systems, including sumps, are not allowed in drinking water source protection zones.
2. All detention and retention basins are to be sized to meet all the requirements of Section B, Design Requirements of this chapter.
3. Underground systems shall provide adequate access points for cleaning and maintenance.
4. All systems shall drain by discharge (detention basins) or infiltration (retention basins) within 3 days (72 hours) from the end of the storm event. This is to be documented with a certified percolation test and documented in the soils report.
5. Sumps shall provide adequate water quality treatment to prevent contamination of the ground water aquifer.
6. Emergency overflows and the flow path of the overflows shall be mapped for purpose of flooding and flood insurance requirements.
7. The emergency overflow shall be designed to pass the full 100 year event.
8. Other utilities (for example water lines, sewer lines, gas lines, power lines, phone lines, etc.) shall not be allowed through or under the underground retention system.
9. Registration with the DWQ and a Class 5 Injection Well Permit are required for all underground systems.

9. Water Quality/Treatment Requirements

1. Water discharging from the project site shall not exceed 70 mg/L of total suspended sediments or increase the turbidity of the receiving waters by 10 NTU.
2. The treatment system shall remove oils, greases, and any other floatable petroleum products.
3. The treatment system and best management practices shall reduce the total phosphorus in the discharge to below 0.07 mg/L.
4. Total dissolved solids of the receiving waters must not be increased above 350 mg/L and the discharge water must not exceed 1000 mg/L.

5. All contaminants shall be stored to prevent impact by storm water and to contain any spilled materials on site. The location and methods of this storage shall be shown on the design plans.
6. The implementation of standard construction and post construction BMP's have historically met or exceeded the water quality criteria listed above. In rare cases where these are insufficient, PWD reserves the right to monitor and require owners to implement a mitigation plan or pay appropriate fines.

10. Irrigation Canals and Systems

All irrigation canals, pipes, ditches, channels, structures, diversions, and other portions of the system shall be designed for the full range of base flows including historical maximum flows, historical minimum flows, and the full water right flow. Then the channel shall have the upstream storm drain inflows and irrigation return flows added to the model to ensure that all future systems have sufficient capacity. These design flows must to be approved by the associated canal company in writing and the City Engineer.

11. Storm Water Pollution Prevention Plan

Storm water pollution prevention plans (SWPPP) are required on all projects in City boundaries and every project must comply with City standards and specifications, whether approved by the PWD or not. Table VIII-1 summarizes the requirements of the SWPPP.

Table B-1, SWPPP Requirements

Contributing Area Size	Minimum Requirements
Less than 1.0 Acre and NOT part of a common plan of development	Erosion and sediment control plan, dust control plan, debris and garbage control plan, post construction BMPs, Inspection and maintenance plan, record keeping and training, and final stabilization. These can be on a standard design sheet as detailed notes with supporting details.
1.0 Acre and larger OR Less than 1.0 Acre and part of a common plan of development	A full SWPPP using the UDEQ template downloadable from the DWQ at the following web site: http://www.waterquality.utah.gov/UPDES/stormwatercon.htm (click on SWPPP Template (Word Doc) All elements in the SWPPP document must be included in the submittal.

C. HYDROLOGIC CALCULATION

1. Design Methodology

Numerous methodologies and hydrologic methods are available. While, in some cases, these other methods might provide a more favorable estimate, they are not acceptable to PWD unless approved by the City Engineer. Table C-1 summarizes the required methods based on the area contributing flows to the system, including offsite flows.

Table C-1, Hydrologic Methods Required

Contributing Area (Acres)	Methodology Required
Less than 1.0 Acre	Rational Method, Time of concentration = 10 minutes for flow rates. Volumes by SCS method.
1.0 Acre to 10.0 Acres	SCS Method with calculated time of concentration
Greater than 10.0 Acres	SCS Method. The time of concentration can be calculated or hydrodynamic solutions may be used. If hydrodynamic solutions are used, the model must be provided to the PWD for detailed review of all assumptions and data used.

2. Design Hyetographs

The design hyetographs to be used for each storm vary based on the size of the area being modeled and designed. Table C-2 summarizes the hyetograph which shall be used during the design.

Table C-2, Required Design Hyetograph

Contributing Area (Acres)	Methodology Required
Less than 1.0 Acre	Rational Method
1.0 Acre to 10.0 Acres	SCS Type II Storm
Greater than 10.0 Acres	SCS Type II Storm or other acceptable Hyetograph with special approval.

3. Design Frequency

All storm water calculations for permanent infrastructure shall be based on the 100-year event within the City for subdivisions and contributing areas less than 640 acres (1 square mile). For areas larger than 640 acres, design shall address the 100-year, 50-year, 25-year, **and** 10-year events. Temporary storm water BMP's for use during construction shall be designed based on the 2-year- 24 hour storm.

4. Design Duration

Design duration shall be based on the criteria summarized in Table C-3.

Table C-3, Required Design Durations for Permanent Storm Water Systems

Larger of Contributing Area or Project Area (Acres	Pipes, Channels, Inlet Spacing	Detention Ponds and Facilities	Retention Ponds and Facilities
Less than 1.0 Acre	10 Minutes	24-hours	48-hours
1.0 Acre to 10.0 Acres	Calculated Time of Concentration	24-hours	48-hours
Greater than 10.0 Acres	Calculated Time of Concentration	24-hours	48-hours

The amount of rainfall depth versus duration and the intensity-duration tables for different rainfall events are included in Table C-4 and Table C-5 for use within the City. Data compatibility with PWD models is mandatory. This data is taken from the National Weather Service, Logan Radio KVNU site.

Table C-4, Depth-Duration Summary Table, (KVNU) Logan Station (inches)

ARI (Years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr
2	0.14	0.21	0.26	0.34	0.43	0.55	0.64	0.87	1.15	1.46	1.68
10	0.23	0.35	0.44	0.59	0.73	0.88	0.98	1.28	1.64	2.04	2.33
25	0.31	0.47	0.58	0.78	0.96	1.13	1.23	1.56	1.98	2.41	2.75
50	0.37	0.57	0.70	0.94	1.17	1.36	1.45	1.79	2.24	2.71	3.08
100	0.45	0.68	0.85	1.14	1.41	1.61	1.71	2.05	2.52	3.02	3.42

Table C-5, Intensity-Duration-Frequency, (KVNU), Logan Station (inches/hour)

ARI (Years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr
2	1.62	1.24	1.02	0.69	0.43	0.27	0.21	0.14	0.10	0.06	0.04
10	2.80	2.13	1.76	1.18	0.73	0.44	0.33	0.21	0.14	0.09	0.05
25	3.68	2.80	2.31	1.56	0.96	0.56	0.41	0.26	0.16	0.10	0.06
50	4.46	3.40	2.81	1.89	1.17	0.68	0.48	0.30	0.19	0.11	0.06
100	5.40	4.10	3.39	2.29	1.41	0.81	0.57	0.34	0.21	0.13	0.07

5. Runoff Coefficients

PWD has established standard runoff coefficients that shall be used to ensure compatibility of results from the base model and each individual project. Calculations differing from these values shall be returned to the design professional for corrections.

a) Rational Method Required Runoff Coefficients

Table C-6, Required Runoff Coefficient

Condition	Rational Method
Asphalt	0.95
Concrete Pavement	0.95
Grassed Open Space (slopes less than 2 percent)	0.15
Grassed Open Space (slopes greater than 2 percent)	0.20
Graveled Areas	0.85
[1)]Residential Lots <8000 sq-ft	0.70
[1)]Residential Lots, 8000 sq-ft to ¼ acre	0.50
[1)]Residential Lots, ¼ acre to ½ acre	0.45
[1)]Commercial Business Areas	0.75
[1)]Industrial Areas	0.85

[1)] Where the weighted values are less than these coefficients, or insufficient data is available outside of the project area, use these values. In no case will values less than the provided coefficients be used.

b) SCS Method

The SCS method, as developed in TR-55 by the Soil Conservation Service in the 1950s, requires more engineering interpretation than the rational method since it is also necessary to address the soil conditions, vegetative cover, and the antecedent soil condition (AMC) being evaluated. There are four primary soil conditions available in the SCS method, grouped as A, B, C, and D.

Group A soils typically are gravels and sands with fast infiltration rates and low runoff potential. While there are Group A soils on some of the benches and along the Logan river in some places, as soon as any landscaping with topsoil occurs, the storm water benefit is lost. Unless specific LID design is incorporated to maintain the infiltration potential of these soils, final landscaping will require a different soil group. This soil group shall be used to calculate historical runoff uphill of the Logan, Hyde Park, and Smithfield Canal.

Group B soils have moderate infiltration rates when wetted and consist of moderately well drained soils with moderately fine to course textures, typically without clay.

Group C soils have slow infiltration rates if thoroughly wetted and consist of soils that have a layer that impedes vertical infiltration.

Group D soils have a slow infiltration rate if thoroughly wetted and consist of clays, usually with high swelling potential, soils with a permanent high water table, soils with a clay pan or hard pan later near the surface, and shallow soils over an impervious material.

Soil maps and references available from the Natural Resource Conservation Service will identify the group associated with each soil class. HOWEVER, the designer needs to consider the effects of the final landscaping, such as the use of top soil, as part of his design.

In addition to the soil group, the antecedent moisture condition (AMC) must also be considered. For the average case, the SCS has defined AMC II to apply as the definition of the conditions preceding most annual floods. For this purpose, AMC II will be used for all PWD approved projects.

Upon selecting the soil group, the appropriate curve number can be selected from various standard references and text books. A common free reference is the HEC-HMS technical reference manual which can be downloaded from the Army Corp of Engineers HEC website. Runoff coefficients are subject to approval by the City Engineer.

6. Time of Concentrations Calculations

There are numerous equations for calculating the time of concentrations. While many may be applicable to various locations, Table VIII-8 identifies the methods that shall be used in determining the time of concentrations within the PWD areas.

Table VIII-8, Time of Concentration Calculations

Larger of Contributing Area or Project Area (Acres	Sheet Flow	Open Channel Flow	Piped Flow
Less than 1.0 Acre	Less than 10 min[1]	Less than 10 min[1]	Less than 10 min[1]
1.0 Acre to 10.0 Acres	Calculated per HEC-22	Calculated per HEC-22	Calculated per HEC-22
Greater than 10.0 Acres	Subject to City Requirements	Subject to City Requirements	Subject to City Requirements

1). For areas less than 1.0 acres, the total time of concentration adds to 10 minutes.

7. Total Allowable Discharge Design Flows

The total discharge design flows to be used for design shall be the combination of the allowable design storm flows and base flows which may include the maximum irrigation diversion based upon water rights, whether the existing facilities have sufficient capacity or not, and maximum return flows from sources upstream of the canal or irrigation ditch.

8. Total Runoff Volumes

Runoff volumes shall not be calculated using the rational method. The rational method does not account for infiltration and is not representative of the amount of water generated by a site. The volume of water from the site shall be calculated using the SCS Method.

D. HYDRAULIC CALCULATIONS

Hydraulic calculations shall be used for sizing pipes and open channels associated with the total design flows.

1. Channel Design

Channels shall be designed with a trapezoidal cross section using roughness coefficients associated with the final restored condition. The Manning's equation methodology shall be used for sizing and considering the associated backwater impacts from downstream conditions. Computer software can be used to calculate the channel size, but sufficient data and results shall be provided to validate the procedure, assumptions, and conclusions.

2. Pipe Design

For design of pipes and culverts, the designer shall demonstrate that the pipes meet the standard design requirements using Manning's equation for open channel flow and standard culvert calculation procedures to determine inlet and outlet control conditions. Full pipe flow designs are not allowed for gravity systems. For storm water pressure mains from pump stations, either the Hazen-Williams or Darcy-Weisbach equations will be allowed. Roughness coefficients and assumptions shall be in accordance with Table VIII-9 selected from various references.

Table VIII-9, Mannings Coefficients for Pipe

Material	Roughness "n"
Smooth Interior HDPE or ADS Pipe	.010
Corrugated Metal Pipe (CMP)	.024
Concrete	.013
PVC	.010

The design and sizing may be done manually or with the use of computer software. However the results must be provided as part of the submittal review process.

3. Spread Width Calculations

Spread width calculations and depth of flow in the gutters shall be completed in accordance with HEC-22 methodology developed by the Federal Highway Administration (FHWA). These calculations can be completed using numerous available software or manually. However, the calculations must be documented and provided to the City for review for the design storms.

E. DETENTION AND RETENTION BASIN DESIGNS

Detention or retention basins shall be used to reduce the peak flow rates to meet the discharge requirements and to provide water quality improvements by detaining the water and settling sediments and other contaminants or by preventing the storm water from leaving the site. These basins shall be constructed as part of the individual development projects, both residential and commercial, and regional projects as outlined in the most current PWD storm water master plan.

1. Detention Basins

The detention requirements shall be calculated differently depending upon the size of the projects and the storm water contributing area as summarized by the Table VIII-9.

Table VIII-9, Detention Basin Sizing Methodologies

Contributing Area Size	Method
Less than 1.0 Acre	Volume of runoff generated = volume of detention. This can be done with a simple spreadsheet.
1.0 Acre to 10 Acres	Volume of runoff generated = volume of detention - discharge through the outlet. Spreadsheet routing of the hyetograph or the use of more sophisticated models are required. Infiltration is not used for calculation on this site.
Greater than 10 Acres	Subject to additional requirements by each City. For construction sites that are 10 acres or larger, sediment basins of 3,960 cubic feet per acre are required by MS4 permits during construction. Infiltration may additionally be used as part of the discharge in this design.

The ponds shall be designed to meet all of the requirements in VIII.B.6. The outlets shall be modeled as a function of the depth of the ponds. In most cases, this results in a depth-discharge curve and a depth-storage curve being created for the ponds and used in routing the hyetographs. These curves shall be provided to the PWD for review as part of the calculations.

While the magnitude of flows from a storm larger than the design storm is unknown, the emergency overflows shall be sized sufficient to pass the full design storm to prevent jeopardy to the detention basin and provides for the normal outlet to fully fail, or a second design storm to occur prior to the basin fully draining.

As part of the design, a percolation test shall be completed at the site of the pond with the hole excavated to at least two feet below the design invert. As the hole is dug, the soils shall be logged and photographed, with particular care given to 1) when saturated soils were encountered, 2) the elevation of the water table, and 3) the presence of "mottling" in the soil showing the historical presence of groundwater. This information shall be used in establishing the final invert elevation as required in Section B.

2. Retention Basins

The retention requirements shall be calculated differently depending upon the size of the projects and the storm water contributing area as summarized by the Table VIII-10. All calculations for sizing shall be completed base on a time step not exceeding 15 minutes.

Table VIII-10, Retention Basin Sizing Methodologies

Contributing Area Size	Method
Less than 1.0 Acre	Volume of runoff = volume of retention. This can be done with a simple spreadsheet.
1.0 Acre to 10.0 Acres	Volume of runoff generated = volume of retention. Spreadsheet routing of the hyetograph or the use of more sophisticated models are allowed. Infiltration calculations only apply to post storm event.
Greater than 10.0 Acres	Subject to additional requirements by PWD. Infiltration may be used as a discharge calculation.

As part of the design, a percolation test shall be completed at the site of the pond with the hole excavated to at least two feet below the design invert. As the hole is dug, the soils shall be logged, with particular care given to 1) when saturated soils were encountered, 2) the elevation of the water table, and 3) the presence of "mottling" in the soil showing the historical presence of groundwater. This information shall be used in establishing the final invert elevation as required in Section B.

Since these ponds are dependent upon infiltration to dispose of the storm water, the designer shall designate methods of completion of the pond to maintain the infiltration rates determined by the certified percolation test. Note that where question of the effectiveness of the restoration and completion of the pond is present, the City may require the contractor to complete a new certified percolation test or dual ring infiltrometer test with a test hole not exceeding 6 inches to demonstrate the soil are not sealed by compaction.

3. Underground Retention and Injection Systems (Sumps)

Sumps, underground retention systems, and other underground injection systems are not allowed in drinking water source protection zones. Maps of these zones are available for review from the City Engineer. Additionally, all other locations are governed by the permitting requirements of the DWQ. Prior to submitting any designs for approval, the designer is expected to verify that location of the injection system is acceptable and obtain the Class 5 Injection Well Permit before any approvals will be granted.

F. WATER QUALITY TREATMENT

All designs shall provide performance that will meet or exceed the more stringent requirements between the City, DWQ, and EPA. Best management practices (BMPs) for erosion and sediment control are acceptable as the primary treatment method with the appropriate documentation demonstrating effectiveness. These BMP's may include but are not limited to: vegetated filter buffers, detention basins with outlet treatment such as floatable and sediment separation, retention basins, landscaping swells, engineered wetlands, or other acceptable methods.

G. IRRIGATION BASE FLOWS

Every existing irrigation ditch or canal has played a part of the City storm water facilities from the settling of the community. When the canals were built, they delivered water from the river and intercepted storm water runoff from uphill naturally. However, when the canals flooded, there weren't houses at risk back then. Now, with ongoing development, these conditions have changed. Design of storm drainage systems using the canals have special requirements as a result and must be approved by not only the City, but also the canal company serving the area of question.

1. Water Right Flows

The design flow will be the maximum flow allowed by the canal water rights. Flows down laterals and distribution ditches shall be obtained in accordance with the agreements between the Cities and the canal companies Obtain the water righted flows and the lateral flows directly from the canal companies. These must be documented in a letter signed by an authorized canal company representative to be accepted by the City. Primary canal company contacts are available from the City.

2. Return Flows

Many of the canals receive return flows from the upstream canals. This can seriously complicate the storm water design since many people turn off their irrigation water and simply pass it down the ditch during storms. This can result in major flooding issues on some canals, even without any storm water entering the canals. When designing a section of the canal, it shall be necessary to take the return flows into consideration and to discuss them with the canal companies. Again, the agreed upon flows must be obtained in accordance with the canal agreements with the Cities.

H. STORM WATER POLLUTION PREVENT PLAN

All elements of the DWQ template available from the DWQ website must be met without respect for project size. However the details and format changes tremendously as discussed in item B.11 above. Many designers have an erosion control plan that can be easily modified to meet all of the requirements for sites less than 1.0 acre. However, for larger sites, the PWD requires the DWQ template available from our website be used.

I. STORM WATER SUBMITTALS

1. Submittals Required for Hydrologic Calculations

Every submittal shall include the calculations in I-1 based on contributing storm water runoff source area.

Contributing Areas	Requirements
Less than 1.0 Acre disturbed and not part of a common plan of development	Area contributing flow, area disturbed, runoff coefficients before disturbance, runoff coefficients after disturbance, times of concentration = 10 minutes, historical runoff (pre-development agricultural or native vegetation), post development runoff volume, discharge flow rates, detention or retention volumes.
Greater than 1.0 acres disturbed or part of a common plan of development.	Hydrologic report included on SWPPP and summary on Erosion Control Plans including all assumptions and details of analysis.

2. Submittals Required for Water Quality/Treatment Requirements

The water quality control and treatment methods shall be defined in the SWPPP and on the plan sheets. Documentation of effectiveness from EPA or other acceptable fact sheets must be provided. The associated additional specifications shall provide sufficient information for the contractor to build the system and ensure that it will meet the required performance specifications during and after construction.

3. Submittals Required for SWPPP

A completed SWPPP prepared in accordance with Section B.11 shall be submitted with the review package. For all construction sites 1.0 acre or larger or sites part of a common plan of development, copies of the Notice of Intent (NOI) from the Utah Division of Water Quality shall be submitted. Additionally, copies of all additional permits which may be required for the project including stream alteration permits, wetlands permits,

Class 5 injection well permits, groundwater discharge permits, etc., shall be included with the SWPPP.

Storm water retention shall meet the 90th percentile rule that was adopted by the state Division of Water Quality.
Thereby retaining the water that was calculated to be the 90th percentile of the last 30 years at a weather station. This value has been determined to be 0.65 inches.