

CHAPTER 3.20

STORM WATER HYDROLOGY

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3.20.005 PURPOSE. This Chapter represents the construction standards for private and public construction as it relates to storm drainage within the City. The following information is organized in such a way to follow the natural flow of storm water, from the initial rainfall hydrology (section 3.20.015), to conveying the rain water (section 3.20.020) to a basin (section 3.20.025), then discharging to a natural outlet location (section 3.20.030). Definitions (section 3.20.010) and Permits and Practices (section 3.20.035) are also discussed.

3.20.010 DEFINITIONS.

Detention Basin. A depression designed to detain or slow down storm water runoff until downstream storm sewer resources are less heavily taxed. A detention basin contains an inlet and an outlet, allows debris to settle out, and regulates water flow.

Development. Any man-made change to improved or unimproved real estate, including but not limited to site preparation, filling, grading, paving, excavation, and construction of buildings or other structures.

Disturb. To alter the physical condition, natural terrain or vegetation of land by clearing, grubbing, grading, excavating, filling, building or other construction activity.

Drain Inlet. A point of entry into a sump, detention basin, or storm drain system.

Drinking Water Source Protection Zone. Zones determined by Geo-Hydrology designed to protect groundwater aquifers of a well in a Culinary Water System.

Irrigation Ditch. A ditch to supply dry land with water artificially.

Percolation. The ability of a soil to absorb water. Typically measured by a Standard Percolation Test in units of minute per inch.

Retention Basin. A depression or cavity designed to retain or hold back all storm water runoff from flowing downstream. A retention basin contains an inlet with no outlet other than percolation or evaporation. A retention basin allows debris to settle out.

Storm Drain System. The system of conveyances (including sidewalks, roads with drainage systems, streets, catch basins, detention basins, curbs, gutters, ditches, man-made channels, sumps, storm drains, and ground water) owned and operated publically or privately, which is designed and used for collecting or conveying storm water.

Tail Water Ditch. A ditch or channel made along the lower end of a field to carry surface runoff from irrigation furrows off the field. This water may be reused again for irrigation purposes, left to evaporate, percolate into the ground, treated, and/or discharged to surface bodies of water.

3.20.015 RAINFALL HYDROLOGY All storm drain systems shall be designed to carry the one hundred (100) year storm.

A. STORM SPECIFICATION. Local storm drain piping shall be designed for the ten (10) year storm where the road or other above ground conveyance will carry the difference to the one hundred (100) year storm. Local Storm Detention Basins shall be designed for the one hundred (100) year storm. Regional Storm Detention Basins shall also be designed for the one hundred (100) year storm. The intensity used for the sizing of basins shall be based upon the worst case scenario and not the time of concentration.

B. INTENSITY-DURATION-FREQUENCY (IDF). For the use of the Rational Method, an IDF curve shall be obtained from the City Engineer for the project location.

1. For single site plans and small subdivisions (forty (40) acres max.) the rational equation may be used. For larger sites a City Engineer-approved computer model shall be used.

C. RAINFALL PATTERN. For the use of computer models one of the following rainfall patterns shall be used.

1. Farmer-Fletcher Storm - This pattern is based upon the Farmer-Fletcher Distribution. This pattern is for a one (1) inch storm and must be modified for storms of other magnitudes. The rainfall is expressed in inches of rainfall for the given time unit. The Farmer Fletcher distribution can be adjusted for storms from thirty (30) minutes to two (2) hours based on the time unit chosen. The storm duration must be chosen on a worst case scenario.

<u>time</u>	<u>inches</u>										
1	0.000	11	0.004	21	0.033	31	0.052	41	0.012	51	0.005
2	0.000	12	0.005	22	0.034	32	0.045	42	0.011	52	0.005
3	0.002	13	0.008	23	0.035	33	0.040	43	0.010	53	0.004
4	0.002	14	0.009	24	0.038	34	0.035	44	0.009	54	0.004
5	0.002	15	0.009	25	0.039	35	0.030	45	0.009	55	0.004
6	0.002	16	0.013	26	0.045	36	0.022	46	0.008	56	0.003
7	0.002	17	0.017	27	0.052	37	0.020	47	0.006	57	0.003
8	0.002	18	0.020	28	0.054	38	0.018	48	0.006	58	0.002
9	0.003	19	0.024	29	0.054	39	0.016	49	0.005	59	0.002
10	0.003	20	0.029	30	0.054	40	0.014	50	0.005	60	0.001

2. SCS - Type II storm

D. RAINFALL TOTAL. For the use of the above rainfall pattern, a rainfall total from the NOAA Atlas for the site must be obtained. This total shall be based upon the storm duration that produces the highest flow or basin size. Currently the ten (10) year – sixty (60) minute storm is 0.81 inches of rainfall, and the one hundred (100) year – sixty (60) minute storm is 1.57 inches of rainfall.

E. TIME OF CONCENTRATION CALCULATION. The Time of Concentration must be calculated using one or a combination of the following:

1. TR-55 equations for overland flow;
2. FHWA equations for overland flow;
3. Manning’s equation for open channel flow; or
4. Hazen-Williams equation for open channel flow.

a. The sheet flow distance may not exceed one hundred (100) feet. After one hundred (100) feet, sheet flow is to be considered shallow concentrated flow or open channel flow depending on the topography.

F. DIRECTLY CONNECTED IMPERVIOUS AREA. The storm water modeling method used must account for areas directly connected to the storm drainage system independently from landscaped grounds.

3.20.020 CONVEYANCE. Storm waters shall not be carried in irrigation ditches, nor shall irrigation water be conveyed in storm drain systems. Storm water may be conveyed in tail water ditches. Local pipes shall be sized for the ten (10) year storm where above ground facilities can control the difference to the one hundred (100) year storm.

A. PIPING. Storm drain lines shall be concrete pipe (NRCP or RCP) or corrugated high density polyethylene pipe, of appropriate class. Subsurface drains shall be PVC or reinforced concrete pipe or PVC pipe. Minimum size for storm sewer mains shall be fifteen (15) inch diameter; Pipe specifications are included in the Public Works Standards. Where determined by the City Engineer, larger drain lines shall be installed to accommodate future development. The cost to provide adequate storm drainage to a development shall be paid for by the Developer

B. ACCESS. Drain lines shall have clean-out boxes, inlets or manholes installed at all changes in grade or alignment, with a maximum distance of four hundred (400) feet between accesses. Structures shall be installed in accordance with the standard drawings.

Requirement: As Groundwater is involved with the Waters of the State, they are not the City's responsibility. The City may or may not choose to address them.

C. GROUND WATER. Where adverse groundwater conditions exist, the City may choose to allow the installation of a subsurface land drain. Laterals may be installed to each lot for clear groundwater only (no surface water permitted). Subsurface lines shall be installed with a slope adequate for proper drainage. Some type of backflow control may be required at the confluence of the land drain pipe and storm drain system as determined by the City Engineer.

3.20.025 BASINS. Requirement: The City requires storm drainage basins for all developments (site plans or subdivisions). Exception may be allowed where there is sufficient downstream storm drain capacity or where additional local storm drainage control is not needed as determined by the City Engineer.

A. LOCATIONS. Sites less than one (1) acre are generally not required to have detention unless otherwise determined by the City Engineer for reasons stated herein. Storm water detention design is critical for developments that are in close proximity to a Stream or River or within Drinking Water Source Protection Zones one (1) or two (2) as defined by the State Division of Drinking Water Rules. All detention basin designs and calculations shall be reviewed and approved by the City Engineer.

B. OWNERSHIP.

1. Private Basins. Where the development will have a Home Owners Association or in commercial applications, local detention basins shall be owned and maintained by the owner, or owning association.

2. Local Public. In subdivisions, local detention basin shall be constructed by the developer. Following acceptance of the construction, the ownership, operation and maintenance may be conveyed and maintained by the City.

3. Regional Detention Basins. Regional basins shall be owned and maintained by the City and constructed according to the criteria given herein and approved of the City Engineer. Actual ownership and responsibility shall be specifically defined in the Owners Dedication Certificates or Development Agreements or by Deed.

C. PERCOLATION. No reduction due to percolation for detention basins volumes shall be permitted in design, due to the nature of basins silting in over time and also possible frost conditions during a storm.

D. BASIN CONSTRUCTION. Basins must be construction to enhance safety, health and aesthetics of the area.

1. Engineering. Basins, whether detention or retention, must be designed and stamped by a Licensed Civil Engineer.

2. Location. Detention basins shall be located with convenient access for maintenance and repair by maintenance personnel. This means that the basin property has frontage along a public roadway and easements where necessary. Volume in ditches or roadside swales shall not be considered in the volume calculation.

3. Depth. If unfenced and open to general public, the maximum depth of water should not exceed three (3) feet for detention basins and two and a half (2½) feet for retention basins. Basins greater than three (3) feet in depth may be allowed, but only by special permission from the Land Use Authority.

4. Side slopes. Side slopes should not exceed 3:1 (horizontal to vertical) (4.5:1 is desirable) for ease of mowing and access.

5. Bottom Slope. The basin floor shall be designed so as to prevent the permanent ponding of water. The slope of the floor of the basin shall not be less than one (1) percent to provide drainage of water to the outlet grate and prevent prolonged wet, soggy or unstable soil conditions.

6. Freeboard. There should be at least one (1) foot of freeboard (berm above the high water mark).

7. Spillways. Spillways must be considered and a path with a maintained swale and drainage easement to a safe location. Attention should be given to the design of the spillway to avoid erosion. Overflow spillways are intended to introduce flows back into the main pipe and are typically downstream of the outlet control. Emergency Spillways are intended to carry flows beyond the capacity of the overflow spillway to a safe downstream location. All spillways shall be designed to protect adjacent embankments, nearby structures and surrounding properties.

8. Outlet Control. Small, local, private detention basins may be allowed to have calculated fixed orifice plates mounted on the outlet of the basin. Large, regional, public detention basins shall have movable screw-type head gates (Waterman C-10 O.A.E.) set at a calculated opening height for the discharge and with a chain to fix the position.

9. Grates. All grates on inlets and outlets must be hot dipped galvanized (not painted) with bars at spacing to prohibit feet from falling in and yet avoid clogging with debris. Generally bar spacing should never exceed three (3) inches.

10. Low Flow Piping. The inlet and outlet structures may be located in different areas of the basin, requiring a buried pipe to convey any base flows that enter and exit the basin. (Rather than a cross gutter or surface flow) The minimum pipe size and material for the low flow shall be as approved by the City Engineer.

11. Ground Covers. The surface area of the basin may be seeded, sodded, or covered with cobbles, as specified by the City. If seeded, measures shall be taken to eliminate erosion until grasses are established. A minimum of four (4) inches of top soil must be installed prior to sod or seed placement. Cobble sizes shall be eight (8) inches or greater in size overlying a City-approved weed barrier. A sprinkler irrigation system may be required for all grassed basins.

12. Embankment (Fill) Construction. If a raised embankment is constructed for a basin (constructed with granular materials), it shall be provided with a minimum of six (6) inches of clay cover on the inside of the berm to prevent water passage through the soil.

13. Excavation (Cut) Construction. If the basin is constructed primarily by excavation, then it may be necessary to provide an impermeable liner and land drain system when constructed in the proximity of basements or other below grade structures as determined by a Geotechnical evaluation.

14. Multi-Use Basins. Basins may be designed as multi-use facilities when appropriate precautions are incorporated into the design. If Parks & Recreation amenities are to be constructed within the water detention area of a basin they shall be designed appropriately. Structures shall be designed for saturated soil conditions and bearing capacities are to be reduced accordingly. Restrooms shall not be located in areas of inundation. Inlet and outlet structures should be located as far as possible from all facilities. No wood chips or floatable objects may be used in the area that will be inundated.

15. Fencing: Fencing will be required for any basin over three (3) feet in depth. If a fence is required, six (6) foot chain link fencing is desired and in accordance with these Public Works Standards and conform to City

Zoning Requirements.

E. DETENTION VOLUME. Detention basins shall be sized based upon the criteria set forth in Section 3.20.025. Detention Basins are designed to allow a pre-determined amount of flow to discharge during and after a storm event as discussed above. Detention Basins are preferred over Retention Basins or Groundwater Injection.

F. RETENTION BASINS. The City does not permit Retention basins for developments unless certain criteria is met. Regional Retention basins shall not be permitted by the City.

1. Retention Basin Criteria. Retention Basins (basins which hold all water coming to them) shall not be permitted for developments unless the following conditions are all met:

- a. The Basin is greater than five hundred (500) feet or fifty (50) feet times the number of lots in the entire development (whichever is greater) from the City Storm Drain System or water way, and is topographically capable of draining to the City System;
- b. The Basin is not located within a Hazardous Area (such as a steep slope) or some other fragile area (such as a Drinking Water Source Protection Zone); and
- c. The Basin is temporary in nature, meaning that a master planned storm drain pipe is eminent and a funding vehicle, (Special Improvement District (SID), Impact Fees, or Pioneering Agreement) is in place.

2. Retention Basin Design Volume. If permitted, local storm retention basins shall be designed for 1.73 inches of total rainfall (the one hundred (100) year-three (3) hour storm as determined by the NOAA Atlas 14). The infiltration vs runoff quantity shall be determined using a weighted C-value as determined using the rational method.

3. Percolation Rate for Retention Basins. Due to the silting in potential, no percolation rate may be used in the calculation of volume.

4. Retention basins shall not be permitted within a zone three (3) of any Drinking Water Source Protection Zone of any drinking water source.

G. STANDING WATER. Standing Water is to be eliminated wherever possible as an effort to minimize a mosquito problem and associated viruses. Low flow bypass pipes may be required.

H. GROUND SURFACE IMPROVEMENTS. The finished surface of the basin shall be improved to eliminate erosion and dust and to enhance the aesthetics of the area. The Planning Commission will determine the finishing requirements on a case by case basis for new detention/retention ponds.

1. Cobble Rock. Cobble rock may be permitted and no other alternative purpose is proposed for the land. The cobble size shall be sufficient (eight (8) inch minimum) to eliminate erosion. Permeable weed barrier fabric shall be placed under the rock. Fencing may be required around cobble rock basins.

2. Grass, Sod, Top Soil and Hydro Seeding. All grass or hydro-seeding on all basins shall be installed in accordance with the Public Works Standards. The basin shall be provided with an automated sprinkler irrigation system previously approved by the City Engineer. Drought tolerant grass may be used in lieu of Public Works Standard upon approval.

3.20.030 DISCHARGE. Storm water is to be controlled at the source and minimize the potential for flooding downstream. Storm Drainage leaving a site or subdivision shall not exceed, as much as practicable, the pre-developed quantities and qualities at a maximum rate.

A. Allowable Discharge: The allowable discharge from any non-regional basin shall not exceed the pre-hard surfacing discharge for the entire site for the ten (10) year storm event. This discharge shall not exceed *0.1 cubic feet per second per total acreage for areas draining to the Malad River. The discharge shall not exceed 0.05 cubic feet per second for areas draining to the Salt Creek when north of I-84 or for any areas draining to the Mill Ditch*

within the development draining to the basin. Controlled discharge may be established through an orifice or adjustable gate as approved by the City Engineer.

B. Flow Concentration. By nature of development, flows are concentrated to one or more locations where historically, sheet flow in lower concentrations may have left the site. Attempts shall be made to minimize the runoff concentrated quantity to the flows stated above by use of detention basins, down stream piping to safe areas or other methods as deemed necessary by the City Engineer.

C. Discharge to Irrigation Ditches. No Discharge shall be permitted to irrigation ditches and canals unless express written permission is obtained from the responsible ditch company or ditch owners.

D. Sump Drains (Underground Injection Wells). Sump Drains are strongly discouraged. Any sump drain used must specifically be approved by the City Engineer. Sump Drains shall not be permitted within a zone three (3) of any Drinking Water Source Protection Zone. Sumps within a zone four (4) must be specially designed to eliminate contaminates and silt to the groundwater including oil separators.

E. Basin Overflows. Attention shall be given to overflow locations and pathways to safe locations downstream as discussed above. In all new construction, easements shall be obtained and pipes or swales sized to handle the one hundred (100) year flow.

3.20.035 PERMITS / PRACTICES. Designs shall comply with all State and Federal requirements, this is to include applications, permits, plans and implementation.

A. PERMITS. The State requires a Storm Water Activity Permit for all sites greater than one (1.0) Acres.

1. **Utah Pollution Discharge Elimination System (UPDES) Permit.** This permit is filed with the Utah Division of Water Quality, Department of Environmental Quality. The permit can be obtained from the internet at: <http://waterquality.utah.gov/updes/stormwater.htm> then click on "Online Application Process Notice of Intent". All sites with a total plan to effect greater than one (1.0) acre must apply (this area includes staging and stock piling). The appropriate fee must be paid to the State.

a. A Storm Water Pollution Prevention Plan (SWP3, or Erosion Control Plan or Pollution Prevention Plan) must be prepared and on site for this application. As a minimum, The BMPs discussed herein must be addressed.

2. **Stream Alteration Permit.** A Stream Alteration Permit is filed with the State Department of Natural Resources, Division of Water Rights. This permit overlaps the 404 wetlands permit, discussed below, because it is applicable to the area equal to the stream plus two (2) times the bank full width (up to thirty (30) feet). Any modifications to the stream or banks within this area must comply with the Stream Alteration Permit. Permit information may be obtained online at: <http://nrwrt1.nr.state.ut.us/strmalt/default.asp>

3. **EPA 404 Wetlands Permit** this permit is filed with the US Army Corp of Engineers through the Utah Division of Water Rights using the Joint Permit Application Form referenced in Section 6.1.3. It is applicable for all wetlands within a development. This will apply to all wetlands depending upon the presence of water, soils type and vegetation as determined in a Wetlands Delineation Report.

All "Waters of the US" are effected to the normal high water mark. No fee is typically required for this permit. A letter of non-regulated wetlands may also be applicable. Any mitigation that may be required must be done prior to recording a Final Plat. Permit information may be obtained at: <http://nrwrt1.nr.state.ut.us/strmalt/default.asp>.

3.20.040 COMMERCIAL SITE DETENTION / RETENTION. All commercial, institutional, or industrial development, construction, reconstruction, alteration, or expansion which generates any storm drainage or any multiple-family or apartment housing development containing four (4) or more units shall be required to retain or detain all storm water drainage on its own property.