

Portneuf Valley

STORMWATER DESIGN MANUAL

MAY 2015

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CHAPTER 1

INTRODUCTION

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1.1 PURPOSE AND SCOPE

This Manual provides Best Management Practices (BMPs) for managing stormwater runoff from new development and redevelopment projects to protect downstream water quality, minimize local flooding, and lessen impacts to down-gradient properties as more urban development occurs. This Manual has been developed to reduce costs of stakeholder and community compliance with the Pocatello Urbanized Area's federal MS4 discharge permit requirements.

This Manual presents technical guidelines, procedures and local information for the planning, design and maintenance of stormwater facilities located in the Portneuf Valley of southeast Idaho, including the cities of Pocatello and Chubbuck. The guidance outlined in this manual is fashioned to have direct applicability to this urban area. Stormwater facilities that retain water onsite, when feasible, are preferred given the area's semi-arid climate, water quality goals, existing stormwater infrastructure, and local soil conditions, as described below.

All engineering work must be performed by, or under the direction of, a professional engineer currently licensed in the State of Idaho.

1.2 AUTHORITY

Laws that provide local jurisdictions in the Portneuf Valley with the responsibility and authority to regulate drainage within their jurisdiction include, but are not limited to the following:

- Idaho Code 50-331, 50-332, and 50-333 authorizes municipalities to control and secure watercourses and drains within their jurisdiction, and to take action to prevent flooding.
- Idaho Code 50-334, 50-315, 50-317, and 50-323 authorizes local jurisdictions to abate nuisances and provide for rehabilitation improvements.
- Idaho Code 67-6518 authorizes local jurisdictions to adopt standards for storm sewer systems.
- Idaho Administrative Procedures Act (IDAPA) 58.01.11, 2009, provides standards that prohibit discharge of contaminants into the environment in a manner that causes a groundwater standard to be exceeded, or is not in accordance with a permit or generally accepted management practice.
- IDAPA 58.01.11, Stormwater discharges to ground water must comply with Idaho Groundwater Quality rules that state: "The implementation of water quality programs shall ensure that the quality of ground water that discharges to surface water does not impair the identified beneficial uses of the surface water and that surface water infiltration does not impair beneficial uses of ground water."
- The Clean Water Act (CWA) of 1972, as amended by the Water Quality Act of 1987, prohibits the discharge of pollutants into waters of the United States unless the discharge complies with the National Pollutant Dis-

charge Elimination System (NPDES) permit. Communities in the Portneuf Valley, including the City of Pocatello, City of Chubbuck, Bannock County and Idaho Transportation Department (District 5), are subject to Phase II Stormwater NPDES permitting requirements issued by the Federal Environmental Protection Agency (EPA). These regulations, which apply within the city limits of Pocatello and Chubbuck, as well as the urbanized area of north Bannock County, require control of pollutants in urban stormwater discharges to surface waters and mandate an extensive permitting process for municipal stormwater systems. The area's current Phase II permit states that stormwater discharges "...that will cause, or have the reasonable potential to cause or contribute to, violations of water quality standards" are not permitted.

- Section 303 of the CWA requires the development of Total Maximum Daily Loads (TMDLs) for impaired water bodies listed on the 303(d) list. The Portneuf River Total Maximum Daily Load (TMDL), revision and addendum February 2010, recommends reductions in sediment, nitrogen, phosphorous, bacteria and oil & grease within the Portneuf River watershed. The "Portneuf River TMDL Implementation Plan," July 2003, was developed by the Idaho Department of Environmental Quality. This plan outlines strategies to limit these pollutants in the Portneuf River.

1.3 LOCAL CONDITIONS

The Portneuf Valley lies at a relatively low elevation (~4500ft) within the Basin and Range topography of southeastern Idaho. The following is a brief overview of regional conditions and how they affect stormwater designs:

Temperature

Temperature affects the performance of, and therefore will influence the type and size of a stormwater facility appropriate for a site. For example, since there is little rain and hot temperatures during summer months, wetponds are not a preferred method for water quality treatment, since they will be difficult to keep wet. Also, since the majority of precipitation falls in the winter and spring months, frozen ground (which allows for minimal infiltration) should be taken into consideration in assessing treatment performance.

July and August tend to be the hottest months with an average low of 51 degrees and an average high of 87 degrees. Peak summer temperature highs will sometimes reach over 100 degrees. The months of December and January tend to be the coldest months with an average low of 17 degrees and an average high of 34 degrees.

Precipitation

The climate of the Portneuf Valley is semi-arid. Vegetated treatments may require irrigation during the summer months, depending on the vegetation.

The average annual precipitation for the Portneuf Valley is 12 inches (1981-2010). Most of this precipitation occurs during the winter and spring. During the summer months the area occasionally experiences intense short-duration thunderstorms. Annual snowfall amounts average 44 inches per year in town.

Soil Conditions

Surface soil types vary in their ability to absorb water and in their erodability, which influences runoff calculations, while subsurface soil profiles are important in BMP design when considering subsurface treatment, infiltration and disposal. In some cases oversizing the facility can be used to make up for limited infiltration rates.

The soils in the Portneuf Valley originated from basalt lava flows, Bonneville flood deposits, and wind-blown fine particles (loess). The Bonneville flood deposits are more than 12,000 years old and are located in the Valley floor. Large vehicle-size boulders are found in the central to southern part of the valley; near the Pocatello Regional Airport the deposits are cobble sized. Wind-blown loess lies deeply over the benches on either side of the valley, and covers much of the valley floor. While there is little shallow groundwater in the Portneuf Valley, groundwater depth does vary seasonally due to precipitation and irrigation.

For more specific local soil data (based on the 1987 Soil Survey of Bannock County), refer to the Natural Resource Conservation Service (NRCS) soil survey webpage at: websoilsurvey.nrcs.usda.gov/. Detailed information, including for depths up to 5 feet below the stormwater facility, is required in final design, as described in Sections 6.5 and 6.6.

Since groundwater elevations and soil conditions can vary greatly within a small area, it is required that the conditions on each project site be field-verified by conducting on-site soil investigations. Refer to Section 3.1.1 for geotechnical site characteristic report (GSR) requirements.

Lower Portneuf Valley Aquifer

A high-quality, underground water body called the Lower Portneuf Valley Aquifer (LPVA) provides the sole source of drinking water for Portneuf Valley residents. This aquifer extends across the Valley from the gap to the Snake River Plain and provides drinking water for more than 80,000 people. Most of the developed areas in Pocatello and Chubbuck lie directly over the LPVA. The LPVA feeds the Eastern Snake River Plain Aquifer, which provides the sole source of drinking water for an additional 200,000 people.

Unlike many other aquifers, much of the LPVA does not have protective layers of clay or rock to deter infiltration of surface contaminants. The soil layer above the aquifer is relatively thin in most areas, and fluids readily infiltrate into the porous gravel that make up the aquifer materials. Additionally, where there are protective layers, contaminants such as nitrates and cleaning solvents (i.e. perchloroethylene (PCE)) have migrated into the aquifer. Local jurisdictions have addressed these contaminants by closing wells and/or applying treatment prior to distribution.

Potential contamination poses the most serious threat to the LPVA as a regional drinking water resource. Contamination in the aquifer may be cleaned up, or remediated, but this process is costly and does not eliminate 100% of the contamination.

Pollutants enter the aquifer by stormwater, septic tank leachate, fertilizer leachate, leakage from underground storage tanks and other sources that percolate downward from the surface. Stormwater can collect a variety of contaminants as it flows across roads, parking lots, roofs and other impervious surfaces.

The LPVA Map (Appendix 1A) depicts the various parts of the aquifer. The geology of this aquifer (and the 100% reliance on it by residents of the Valley) drive treatment requirements for stormwater, particularly on the Valley Floor.

Impaired Surface Waters

Throughout the valley, the Portneuf River fails to fully support aquatic life and / or human health due to the following pollutants: sediment, nitrogen, phosphorous, oil & grease, and E. coli. Specifically, the Portneuf River is on the Federal Clean Water Act Section 303(d) list as water quality limited. In response, the Idaho Department of Environmental Quality has developed a water quality improvement plan to reduce the pollution in the Portneuf River. This plan may require projects draining to the Portneuf River and other impaired waters to have additional design and permit requirements not noted in this Manual. Project proponents should coordinate with the local jurisdictions to determine if additional requirements exist for their project due to water quality improvement plans for impaired waters.

Special Drainage Areas

Special Drainage Areas (SDAs) have shallow soils, bedrock near the surface of the land, or soils or geological features that may make long-term infiltration of stormwater difficult or a potential problem for onsite and/or adjacent properties. These areas may also contain steep slopes where infiltration of water and dispersion of water into the soils may be difficult or delayed, creating drainage or potential drainage problems such as erosion. Known areas of flooding or areas that historically have had drainage and/or high groundwater problems (mapped or unmapped) are also SDAs.

Appendix 1B designates SDAs within the Portneuf Valley, including the benches on either side of the valley and known areas within the City of Pocatello's valley floor with historic stormwater drainage issues. All areas with slopes over 15% are mapped as SDAs. The limited pipe size and extent of the stormwater infrastructure within the City of Pocatello drives most of the SDA boundaries.

Table 2-1 outlines additional flow control design requirements for special drainage areas.

1.4 MANUAL'S ROLE: TECHNICAL GUIDANCE

This Manual provides guidance for planners, engineers, developers, reviewers and the general public for designing stormwater management facilities.

The contents of this Manual are specifically applied to the geography, climate and land use of the Portneuf Valley region. If these guidelines are implemented correctly, they should provide compliance with the Federal Clean Water Act, the Federal Safe Drinking Water Act, and the Idaho Administrative Policy Act. The use of this Manual and its guidelines does not excuse any project proponents from the obligation to apply additional stormwater management practices as necessary in order to comply with Federal and State water quality standards, and local ordinances established to comply with these standards.

1.5 INTRODUCTION TO LOW IMPACT DEVELOPMENT (LID)

The Portneuf Valley's semi-arid climate, water quality goals, existing stormwater infrastructure, and local soil conditions have led to a preference for retaining water onsite, when feasible.

Low impact development (LID) is a stormwater management process that replicates natural hydrologic patterns. LID uses a variety of design principles, including reducing impervious surfaces and using smaller-scale stormwater controls. The LID approach can be applied in a variety of settings including: large lots in rural areas; low, medium, and high-density development within urban growth boundaries; redevelopment of highly urbanized areas; and commercial and industrial development. LID applications can be designed for use on various soil types.

LID practices are particularly useful on sites where conditions limit the use of traditional stormwater BMPs. Using many smaller BMPs closer to the sources of runoff can eliminate the need for an extensive pipe network and large treatment facility.

Chapter 10 of this Manual references the Eastern Washington LID Guidance Manual (2013), which provides additional information on LID practices and strategies. Chapter 6 includes design guidelines for several LID facilities, including permeable pavement and bio-infiltration swales. The intent of LID in this Manual is for introduction rather than application. However, it is strongly encouraged for projects to implement LID practices and strategies.

1.6 STEP BY STEP DESIGN PROCESS

The following is a step-by-step summary of the design process presented in this Manual. The following steps are generic and users should refer to the Manual's chapters for detail; some steps noted below may not be applicable to your project. In particular, users should also familiarize themselves with Chapters 2 and 3 of this Manual to clarify requirements. Use the flow chart in Appendix 2A to determine the applicable Core Elements for your project.

STEP 1 Refer to Core Element #1 – Preparation of Stormwater Site Plan Section 3.1.1.

- a. Determine the Core Elements that apply to your project.
- b. Gather specific site data.
- c. Assess upland drainage and site topography for diversion, conveyance, and/or treatment (Core Element #4).
- d. Determine project limitations influencing BMP selection. Field investigations required to confirm conditions.
- e. Determine whether a Geotechnical Site Characteristic Report (GSR) is required. GSR may impact BMP selection. GSR is typically required to confirm depth to groundwater, existing soil treatment capacity and infiltration design rate.

STEP 2

- a. Determine how project will dispose of runoff, including meeting onsite retention requirements (Core Element #5). See Table 2-1 and Figure 6-1. The type of BMP selected may influence configuration and size of the project.
- b. If project has downstream bypass, prepare a Post Construction Downstream Analysis as identified in Section 3.1.2. Also refer to Appendix 3A for Stormwater Site Plan Checklist.
- c. Based upon Treatment Facility Menu, select a Treatment BMP. Refer to Figure 6-1.
- d. Check to see if the selected Treatment BMP can be used given any specific site limitations determined in Step #1d. The most common determination will be the depth and characteristics of the soil beneath the facility. If BMP cannot be used due to site limitations, select an alternate BMP that can be used.
- e. Size water quality treatment facility (Core Element #6). Refer to Section 2.3.6 and Chapter 6 for Runoff Treatment. Refer to Chapter 4 for hydrological analysis procedures for sizing facilities.
- f. Size flow control facility for design storm (Core Element #7). Refer to Section 2.3.7 and Chapter 6 for specific information on Flow Control. Refer to Chapter 4 for hydrological analysis procedures for sizing computation procedures.

- g. Identify any lower thresholds or exemptions that apply to BMP selection and design.
- h. Implement source controls into project design (Core Element #3). Refer to Chapter 5.
- i. Size conveyance systems for design storm (Core Element #4). Refer to Table 2-1 for sizing requirements. Refer to Chapter 7 for specific information on Conveyance Systems and Chapter 4 for Hydrologic Analysis and Design criteria.
- j. Prepare Permanent Stormwater Control Plan as noted in Section 3.1.2. Refer to Appendix 3A for Stormwater Site Plan checklist.
- k. Prepare Drainage Report Analysis as noted in Section 3.1.2. Include GSR and any other applicable design reports.

STEP 3

- a. Apply for (if applicable) a Construction General Permit. Refer to Section 2.3.2.
- b. Prepare Erosion and Sediment Control Plan (Core Element #2). Refer to Section 3.1.3 and Chapter 8 for specific information on ESC Plan.

STEP 4

- a. Prepare a maintenance plan and agreement (Core Element #8). See Section 3.1.4.

SUBMITTAL

- a. Submit Stormwater Site Plan documents to local jurisdiction for plan review and approvals. See Section 3.1.3 and Appendix 3A Stormwater Site Plan Checklist.
- b. Register Underground Injection Control (UIC) facilities with the Idaho Department of Water Resources if applicable.

1.7 GLOSSARY

Adsorption - The adhesion of a substance to the surface of a solid or liquid; often used to extract pollutants by causing them to be attached to such adsorbents as activated carbon or silica gel. Hydrophobic, or water repulsing adsorbents, are used to extract oil from waterways when oil spills occur. Heavy metals such as zinc and lead often adsorb onto sediment particles.

Antecedent moisture conditions (AMC)- The degree of wetness of a watershed or within the soil at the beginning of a storm.

Aquifer - A geologic stratum containing ground water that can be withdrawn and used for human purposes.

Arid - Excessively dry; having insufficient rainfall to support agriculture without irrigation; a climate where evaporation exceeds precipitation. The arid index is annual evaporation divided by annual precipitation.

Average daily traffic (ADT) - The expected number of vehicles using a roadway is represented by the projected average daily traffic volume considered in designing the roadway. ADT counts must be estimated using "Trip Generation" published by the Institute of Transportation Engineers or from a traffic study prepared by a professional engineer or transportation specialist with expertise in traffic volume estimation. ADT counts are made for the design life of the project. For project sites with seasonal or varied use, evaluate the highest period of expected traffic impacts.

Bedrock - The more or less solid rock in place, either on or beneath the surface of the earth. It may be soft, medium, or hard and have a smooth or irregular surface.

Berm - A constructed barrier of compacted earth, rock, or gravel. In a storm-water facility, a berm may serve as a vertical divider typically built up from the bottom.

Best Management Practices (BMPs) - The schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices that, when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to receiving waters.

Buffer zone - The area adjacent to a critical or sensitive area for which location and limits are described by federal, state, or local governments and intent is ensuring protection of the critical area by separating incompatible use from the critical or sensitive area.

Catch basin - A chamber or well, usually built at the curb line of a street, for the admission of surface water to a sewer or subdrain, having at its base a sediment sump designed to retain grit and detritus below the point of overflow.

Cation Exchange Capacity (CEC) - The amount of exchangeable cations that a soil can absorb at pH 7.0.

Channel, constructed - Reconstructed natural channels or other channels or ditches constructed to convey surface water.

Channel, natural - Streams, creeks, or swales that convey surface water and groundwater and have existed long enough to establish a stable route and/or biological community.

Channel stabilization - Erosion prevention and stabilization of velocity distribution in a channel using vegetation, jetties, drops, revetments, and/or other measures.

Check dam - Small dam constructed in a gully or other small watercourse to decrease the streamflow velocity, minimize channel scour, and promote deposition of sediment.

Compaction - The densification, consolidation, settlement, or packing of soil in such a way that permeability of the soil is reduced. Compaction effectively shifts the performance of a hydrologic group to a lower permeability hydrologic group. For example, a group B hydrologic soil can be compacted and be effectively converted to a group C hydrologic soil in the way it performs in regard to runoff. Compaction may also refer to the densification of a fill by mechanical means.

Concentrated Flow - Flowing water that has been accumulated into a single fairly narrow stream.

Contaminant - See Pollution.

Conveyance system - The drainage facilities, both natural and man-made, which collect, contain, and provide for the flow of surface and stormwater from the highest points on the land down to a receiving water. The natural elements of the conveyance system include swales and small drainage courses, streams, rivers, lakes, and wetlands. The human-made elements of the conveyance system include gutters, ditches, pipes, channels, and most retention/detention facilities.

Critical area - Any of the following areas and ecosystems: wetlands, areas with a critical recharging effect on aquifers used for potable water, fish and wildlife habitat conservation areas, frequently flooded areas, and geologically hazardous areas.

Design storm frequency - The anticipated period in years that will elapse, based on average probability of storms in the design region, before a storm of a given intensity and/or total volume will recur. Thus a 10-year storm can be expected to occur on the average once every 10 years; the same storm has a 10 percent chance of occurring each year. Facilities designed to handle flows that occur under such storm conditions would be expected to be surcharged by any storms of greater amount or intensity.

Detention - The release of stormwater runoff from the site at a slower rate than it is collected by the stormwater facility system, the difference being held in temporary storage.

Detention facility - A type of stormwater facility design to hold surface and stormwater runoff for a short period of time and then release it to the surface and stormwater management system. There is little or no infiltration of stored stormwater.

Development - Means new development, redevelopment, or both. See definitions for each.

Discharge - Runoff leaving a new development or redevelopment via overland flow, built conveyance systems, or infiltration facilities. A hydraulic rate of flow, specifically fluid flow; a volume of fluid passing a point per unit of time, commonly expressed as cubic feet per second, cubic meters per second, gallons per minute, gallons per day, or millions of gallons per day.

Dispersion - Release of surface and stormwater runoff from a drainage facility system such that the flow spreads over a wide area, and is located so as not to allow flow to concentrate anywhere upstream of a drainage channel with erodible underlying granular soils.

Ditch - A long narrow excavation dug in the earth for drainage with its top width less than 10 feet at design flow.

Diversion – Extracts a part of flow, etc.

Drainage basin - That portion of the earth's surface upon which all falling precipitation flows to a given location.

Drywell - A well completed above the water table so that its bottom and sides are typically dry except when receiving fluids. Drywells are designed to disperse water below the land surface and are commonly used for stormwater management in parts of southeastern Idaho.

Effective impervious surface - Those impervious surfaces that are connected via sheet flow or a conveyance system to a drainage system. Most impervious areas are effective.

Emerging technology - Treatment technologies that have not been evaluated with approved protocols, but for which preliminary data indicate that they may provide a necessary function(s) in a stormwater treatment system. Emerging technologies need additional evaluation to define design criteria to achieve, or to contribute to achieving, state performance goals, and to define the limits of their use.

Erodible or leachable materials - Substances which, when exposed to rainfall, measurably alter the physical or chemical characteristics of the rainfall runoff. Examples include: erodible soils that are stockpiled, uncovered process wastes, manure, fertilizers, oily substances, ashes, kiln dust, and garbage dumpster leakage.

Erosion - The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. Also, detachment and movement of soil or rock fragments by water, wind, ice, or gravity.

Erosion and sedimentation control (ESC) - Any temporary or permanent measures taken to reduce erosion, control siltation and sedimentation, and ensure that sediment laden water does not leave the site.

Evapotranspiration - The collective term for the processes of evaporation and plant transpiration by which water is returned to the atmosphere.

Excavation - The mechanical removal of earth material.

Exception - Relief from the application of a Core Element to a project. A deviation from the standards outlined in this manual.

Existing condition - The impervious surfaces, drainage systems, land cover, native vegetation and soils that exist at the site with approved permits and engineering plans when required. If sites have impervious areas and drainage systems that were built without approved permits, then the existing condition is defined as those that existed prior to the adoption of this Manual. These conditions can be verified by record aerial photography, or other methods.

Flow - A term used to define the movement of water, silt, sand, etc; discharge; total quantity carried by a stream.

Flow Path - The route that stormwater runoff follows between two points of interest.

Freeboard - The distance between the water surface elevation and the top of the sides of a facility (channel, pond, ditch, etc).

Groundwater - Water in a saturated zone or stratum beneath the land surface or beneath a surface water body.

Groundwater Recharge - Inflow to a groundwater reservoir or aquifer.

Groundwater Table - The free surface of the ground water, that surface subject to atmospheric pressure under the ground, generally rising and falling with the season, the rate of withdrawal, the rate of restoration, and other conditions. It is seldom static.

Gully - A channel caused by the concentrated flow of surface and stormwater runoff over unprotected erodible land.

Gutter - A constructed flow path which gathers sheet flow by a barrier or a trench, concentrates the water into a flow stream, and conveys it by open channel surface flow to a desired point.

Hazardous Substance or Waste - According to RCW 70.105.010 includes all dangerous and extremely hazardous waste, including substances composed of both radioactive and hazardous components. See also dangerous waste. They may be liquid, solid, gas, or sludge, including any material, substance, product, commodity, or waste, regardless of quantity.

Hydrograph - A graph of runoff rate, inflow rate, discharge rate, or another characteristic of a body of water during a specific period of time.

Hydrologic Soil Groups - A soil characteristic classification system defined by the U.S. Soil Conservation Service in which a soil may be categorized into one of four soil groups (A, B, C, or D) based upon infiltration rate and other properties:

Hydrology - The science of the behavior of water in the atmosphere, on the surface of the earth, and underground.

Hydraulically Isolated - Impervious areas where surface runoff is contained through grading, berms, or drains to prevent inflow from or outflow to other areas.

Hyetograph - A graph or table of incremental precipitation for a series of time steps representing the total time in which precipitation occurs.

Impaired waters - Water bodies not fully supporting their beneficial uses.

Impervious surface - A hard surface area which either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development. A hard surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, roof tops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam or other surfaces which similarly impede the natural infiltration of stormwater. For purposes of determining whether thresholds for application of Core Elements are exceeded, open, uncovered retention or detention facilities are not considered as impervious surfaces. Open, uncovered retention or detention facilities are considered impervious surfaces for purposes of runoff modeling.

Industrial Activities - Material handling, transportation, or storage; manufacturing; maintenance; treatment; or disposal. Areas with industrial activities include plant yards, access roads and rail lines used by carriers of raw materials, manufactured products, waste material, or by-products; material handling sites; refuse sites; sites used for the application or disposal of process waste waters; sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to stormwater.

Infiltration - The downward movement of water from the land surface to the subsoil.

Infiltration Facility - A drainage facility designed to use the hydrologic process of surface and stormwater runoff soaking into the ground, commonly referred to as a percolation, to dispose of surface and stormwater runoff.

Infiltration Rate - The rate, usually expressed in inches per hour, at which water percolates, or moves downward through the soil profile. Short-term infiltration rates may be inferred from soil analysis or texture, or derived from field measurements. Longterm infiltration rates are affected by variability in soils and subsurface conditions at the site, the effectiveness of pretreatment or influent control, and the degree of longterm maintenance of the infiltration facility.

Land Disturbing Activity - Any activity that results in movement of earth, or a change in the existing soil cover (both vegetative and non-vegetative) and/or the existing soil topography. Land disturbing activities include, but are not limited to clearing, grading, filling, and excavation. Compaction associated with stabilization of structures and road construction are also considered a land disturbing activity. Vegetation maintenance practices are not considered land-disturbing activity.

Local Jurisdiction - Any county, city, town, or special purpose district having its own incorporated government for local affairs.

Low Flow Channel - An incised or paved channel from inlet to outlet in a dry basin which is designed to carry low runoff flows and(or) baseflow, directly to the outlet without detention.

Low Impact Development (LID) - LID is an evolving approach to land development and stormwater management using the natural features of a site and specially designed BMPs to manage stormwater. LID involves assessing and understanding the site, protecting native vegetation and soils, and minimizing and managing stormwater at the source. LID practices appropriate for a variety of development types.

Maintenance - Repair and maintenance includes activities conducted on currently serviceable structures, facilities, and equipment that involves no expansion or use beyond previously existing use, and resulting in no significant adverse hydrologic impact. It includes those usual activities taken to prevent a decline, lapse, or cessation in the use of structures and systems, and includes replacement of disfunctioning facilities, including cases where environmental permits require replacing an existing structure with a different type structure, as long as the functioning characteristics of the original structure are not changed. For example, replacing a collapsed, fish blocking, round culvert with a new box culvert under the same span, or width, of roadway.

Monitoring - The systematic collection of data by various methods for the purposes of understanding natural systems and features, evaluating the impacts of development proposals on such systems, and assessing the performance of mitigation measures imposed as conditions of development.

Native vegetation - Vegetation comprised of plant species that are indigenous to southeastern Idaho and which reasonably could have been expected to naturally occur on the site. Plant species classified as noxious weeds are excluded from this definition.

Natural location - The location of those channels, swales, and other non-man-made conveyance systems, as defined by the first documented topographic contours existing for the subject property, either from maps or photographs, or such other means as appropriate. In the case of outwash soils with relatively flat terrain, no natural location of surface discharge may exist.

New development - Land disturbing activities, including construction or installation of a building or other structure; creation of impervious surfaces; and subdivision, short subdivision and binding site plans. Projects meeting the definition of redevelopment are not considered new development.

Non-pollutant generating surfaces (NPGS) - NPGS are considered to be insignificant or low sources of pollutants in stormwater runoff. Roofs that are subject only to atmospheric deposition or normal heating, ventilation and air conditioning vents are considered NPGS. The following may also be considered NPGS: paved bicycle pathways and pedestrian sidewalks that are separated from and not subject to drainage from roads for motor vehicles, fenced fire lanes, infre-

quently used maintenance access roads, and “in-slope” areas of roads. Sidewalks that are regularly treated with salt or other deicing chemicals are not considered NPGS.

NPDES - National Pollutant Discharge Elimination System. A provision of the Clean Water Act which prohibits point-source discharges of pollutants into waters of the United States unless a special permit is issued and administered by the U.S. Environmental Protection Agency in Idaho. Municipal separate stormwater sewer systems are classified as point-source discharges.

Off-line facilities - Water quality treatment facilities to which stormwater runoff is restricted to some maximum flow rate or volume by a flow-splitter.

Oil/water separator - A vault, usually underground, designed to provide a quiescent environment to separate oil from water.

Orifice - An opening with closed perimeter, usually sharp-edged, and of regular form in a plate, wall, or partition through which water may flow, generally used for the purpose of measurement or control of water.

Outlet - Point of water disposal from a stream, lake, stormwater facility, or artificial drain.

Overflow - A pipeline or conduit device, together with an outlet pipe, that provides for the discharge of portions of combined sewer flows into receiving waters or other points of disposal, after a regular device has allowed the portion of the flow which can be handled by interceptor sewer lines and pumping and treatment facilities to be carried by and to such water pollution control structures.

Overtopping - Flow over the limits of a containment or conveyance element.

Particle size - The effective diameter of a particle as measured by sedimentation, sieving, or micrometric methods.

Peak discharge - The maximum instantaneous rate of flow during a storm, usually in reference to a specific design storm event.

Perennial stream - A stream reach that does not go dry during a year of normal precipitation: the elevation of the water table is always above the bottom of the stream channel during a year of normal precipitation.

Permanent Stormwater Control Plan - A plan which includes permanent Best Management Practices (BMPs) for preventing and controlling pollution of stormwater runoff. These BMPs will remain in place after construction and/or land disturbing activity has been completed.

Permeable soils - Soil materials with a sufficiently rapid infiltration rate so as to greatly reduce or eliminate surface and stormwater runoff. These soils are generally classified as SCS hydrologic soil types A and B.

Pesticide - A general term used to describe any substance - usually chemical - used to destroy or control organisms; includes herbicides, insecticides, algicides, fungicides, and others. Many of these substances are manufactured and are not naturally found in the environment. Others, such as pyrethrum, are natural toxins that are extracted from plants and animals.

Plat - A map or representation of a subdivision showing the division of a tract or parcel of land into lots, blocks, streets, or other divisions and dedications.

Pollution - Contamination or other alteration of the physical, chemical, or biological properties of waters of the state, including change in temperature, taste, color, turbidity, or odor of the waters; or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the state as will, or is likely to, create a nuisance or render such waters harmful, detrimental, or injurious to the public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to live-stock, wild animals, birds, fish or other aquatic life.

Pollutant-generating impervious surface (PGIS) - PGIS are considered to be significant sources of pollutants in stormwater runoff. Such surfaces include those that are subject to vehicular use, industrial activities, or storage of erodible or leachable materials that receive direct rainfall, or run-on or blow-in of rainfall. Metal roofs are considered to be PGIS, unless coated with an inert, non-leachable material. Roofs that are subject to venting of manufacturing, commercial, or other indoor pollutants are also considered PGIS. A surface, whether paved or not, is considered PGIS if it is regularly used by motor vehicles. The following are considered regularly-used surfaces: roads, unvegetated road shoulders, bike lanes within the traveled lane of a roadway, driveways, parking lots, unfenced fire lanes, vehicular equipment storage yards, and airport runways.

Pre-developed condition - The native vegetation and soils that existed at a site prior to the proposed development activity. All pre-development calculations shall consider open space, woods and fields to be in good condition, regardless of actual conditions at the time of application.

Prediction - For the purposes of this document an expected outcome based on the results of hydrologic modeling and/or the judgment of a trained professional civil engineer or geologist.

Preservation/maintenance - A preservation or maintenance project is defined as preserving/ protecting infrastructure by rehabilitating or replacing existing structures to maintain operational and structural integrity, and for the safe and efficient operation of the facility. Traffic area maintenance projects do not increase the traffic carrying capacity of a roadway or parking area.

Pretreatment - The removal of material such as solids, grit, grease, and scum from flows prior to physical, biological, or physical treatment processes to improve treatability. Pretreatment may include screening, grit removal, settling, oil/water separation, or application of a basic treatment BMP prior to infiltration.

Process wastewater - The used water and solids from an industrial source. This water should be directed to a treatment facility and kept separate from the stormwater generated from the site.

Project - Any proposed action to alter or develop a site; or the proposed action of a permit application or an approval which requires drainage review.

Project site - That portion of a property, properties, or right of way subject to land disturbing activities, and new or replaced impervious surfaces.

Proposed development condition - The impervious surfaces, drainage systems, land cover, native vegetation and soils that are proposed to exist at the site at the completion of the project (complete build-out).

Rational Method - A method of computing storm drainage flow rates (Q) by use of the formula $Q = CIA$, where C is a coefficient describing the physical drainage area, I is the rainfall intensity, and A is the area. In this Manual, use of the Rational Method is limited to sizing only certain types of runoff treatment facilities, drywells, and conveyance; see Chapter 4.

Reach - A length of a water body with uniform characteristics.

Receiving waters - Bodies of water or surface water systems to which surface runoff is discharged via a point source of stormwater or via sheet flow.

Redevelopment - On a site that is already substantially developed, the replacement or improvement of impervious surfaces, including buildings and other structures, and replacement or improvement of impervious parking and road surfaces that is not part of a routine maintenance activity. Any new impervious surfaces created by a redevelopment project are subject to the requirements for new development.

Release rate - The computed peak rate of surface and stormwater runoff from a site.

Retention - The process of collecting and holding surface and stormwater runoff with no surface outflow.

Retention facility - A type of drainage facility designed to hold water for a considerable length of time and then release it by evaporation, plant transpiration, and/or infiltration into the ground.

Retrofitting - The renovation of an existing structure or facility to meet changed conditions or to improve performance.

Runoff - Water originating from rainfall and other precipitation that is found in drainage facilities, rivers, streams, springs, seeps, ponds, lakes, and wetlands, as well as shallow ground water. As applied in this manual, it also means the portion of rainfall or other precipitation that becomes surface flow and interflow.

Saturation point - In soils, the point at which a soil or an aquifer will no longer absorb any amount of water without losing an equal amount.

SCS - Soil Conservation Service (now the Natural Resources Conservation Service), U.S. Department of Agriculture.

SCS Method – see NRCS Method.

Sediment - Fragmented material that originates from weathering and erosion of rocks or unconsolidated deposits, and is transported by, suspended in, or deposited by water.

Semi-arid - Characterized by light rainfall; having from about 10 to 20 inches of annual precipitation.

Sheet flow - Runoff that flows over the ground surface as a thin, even layer, not concentrated in a channel.

Siltation - The process by which a river, lake, or other waterbody becomes clogged with sediment.

Site - The area defined by legal boundaries of a parcel or parcels of land that is (are) subject to new development or redevelopment. For road projects, the length of the project site and the right-of-way boundaries define the site.

Soil stabilization - The use of measures, such as rock lining, vegetation or other engineering structures, to prevent the movement of soil when loads are applied to the soil.

Source control BMP - A structure or operation intended to prevent pollutants from coming into contact with stormwater through physical separation of areas or careful management of activities that are sources of pollutants.

Spillway - A passage such as a paved apron or channel for surplus water over or around a dam or similar obstruction. An open or closed channel, or both, used to convey excess water from a reservoir. It may contain gates, either manually or automatically controlled, to regulate the discharge of excess water.

Storm drain system - The system of gutters, pipes, streams, or ditches used to carry surface and stormwater from surrounding lands to streams or lakes.

Storm sewer - A sewer that carries stormwater and surface water, street wash and other wash waters or drainage, but excludes sewage and industrial wastes. Also called a "storm drain."

Stormwater - That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows, via overland flow, interflow, pipes and other features of a stormwater drainage system, into a defined surface water body or a constructed infiltration facility.

Stormwater facility - A constructed component of a stormwater drainage system designed or constructed to perform a particular function or multiple functions. Stormwater facilities include, but are not limited to: pipes, swales, ditches, culverts, street gutters, detention ponds, retention ponds, constructed wetlands, infiltration devices, catch basins, oil/water separators, and biofiltration swales.

Subbasin - A drainage area that drains to a water-course or water body named and noted on common maps and which is contained within a basin.

Suspended solids - Organic or inorganic particles suspended in and carried by the water. The term includes sand, mud, and clay particles (and associated pollutants), as well as solids in stormwater.

Swale - A shallow drainage conveyance with relatively gentle side slopes, generally with flow depths less than one foot.

Stormwater Pollution Prevention Plan (SWPPP) - A document that describes the potential for pollution problems on a construction project. The SWPPP includes a narrative report, drawings and details that explains and illustrates the measures to be taken on the construction site to control those problems. Guidance in preparing a SWPPP is provided in Chapter 9.

Time of concentration - The time period necessary for surface runoff to reach the outlet of a subbasin from the hydraulically most remote point in the tributary drainage area.

Topography - General term to include characteristics of the ground surface, such as plains, hills, mountains, degree of relief, steepness of slopes, and other physiographic features.

Travel time - The estimated time for concentrated surface water to flow between two points of interest.

Treatment BMP - A BMP that is intended to remove pollutants from stormwater. A few examples of treatment BMPs are detention ponds, oil/water separators, biofiltration swales, and constructed wetlands.

Treatment train - A combination of two or more treatment facilities connected in series.

Turbidity - Dispersion or scattering of light in a liquid, caused by suspended solids and other factors; commonly used as a measure of suspended solids in a liquid.

Underground Injection Control (UIC) - A manmade subsurface fluid distribution system designed to discharge fluids into the ground. UICs consist of an assemblage of perforated pipes, drain tiles, or other similar mechanisms, or a dug hole that is deeper than the largest surface dimension. These devices include (but are not limited to) drywells and infiltration trenches. The Idaho Department of Water Resources (IDWR) administers the UIC Program for the State of Idaho.

Urban runoff - Stormwater from streets and adjacent domestic or commercial properties that may carry pollutants of various kinds into storm sewers or drywells and/or receiving waters.

Watershed - The land area that drains into a stream, lake, or other body of water. An area of land that contributes runoff to one specific delivery point. Large watersheds may be composed of several smaller subwatersheds, each of which contributes runoff to different runoff locations that ultimately combine at a common delivery point or receiving water. The words "watershed" and "basin" are often used interchangeably.

Water quality - A term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

Water quality criteria - Levels or measures of water quality considered necessary to protect a beneficial use.

Water quality standards - Minimum requirements of purity of water for various uses; levels or measures of water quality considered necessary to protect a beneficial use. In Idaho, the Idaho Department of Environmental Quality sets water quality standards.

Waters of the US - Federal waters include lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, wetlands, and all other surface waters and watercourses within the state of Idaho.

Water table - The upper surface or top of the saturated portion of the soil or bedrock layer, indicating the uppermost extent of groundwater where water pressure equals atmospheric pressure.

Wetlands - Areas characterized by saturated or nearly saturated soils most of the year that form an interface between terrestrial (land-based) and aquatic environments. Wetlands include marshes around lakes or ponds and along river or stream channels.

1.7.1 ABBREVIATIONS AND ACRONYMS

AASHTO — American Association of State Highway and Transportation Officials

ADT — Average Daily Traffic

AMC — Antecedent Moisture Condition

ARC — Antecedent Runoff Condition

ASTM — American Society for Testing and Materials

BMP — Best Management Practice

BST — Bituminous Surface Treatment

CARA — Critical Aquifer Recharge Area

CC&R — Conditions, Covenants and Restrictions

CEC — Cation Exchange Capacity

cfs — Cubic Feet per Second

CMP — Corrugated Metal Pipe

CN — Curve Number

IDWR — Idaho Department of Water Resources

IDEQ — Idaho Department of Environmental Quality

EPA — Environmental Protection Agency

ESC — Erosion & Sediment Control

ESCP — Erosion and Sediment Control Plan

FEMA — Federal Emergency Management Agency

FHWA — Federal Highway Administration

GSR — Geotechnical Site Characterization Report

HDPE — High-Density Polyethylene

HOA — Homeowner's Association

LID — Low Impact Development

NLDS — Natural Location of Drainage Systems

NPDES — National Pollutant Discharge Elimination System

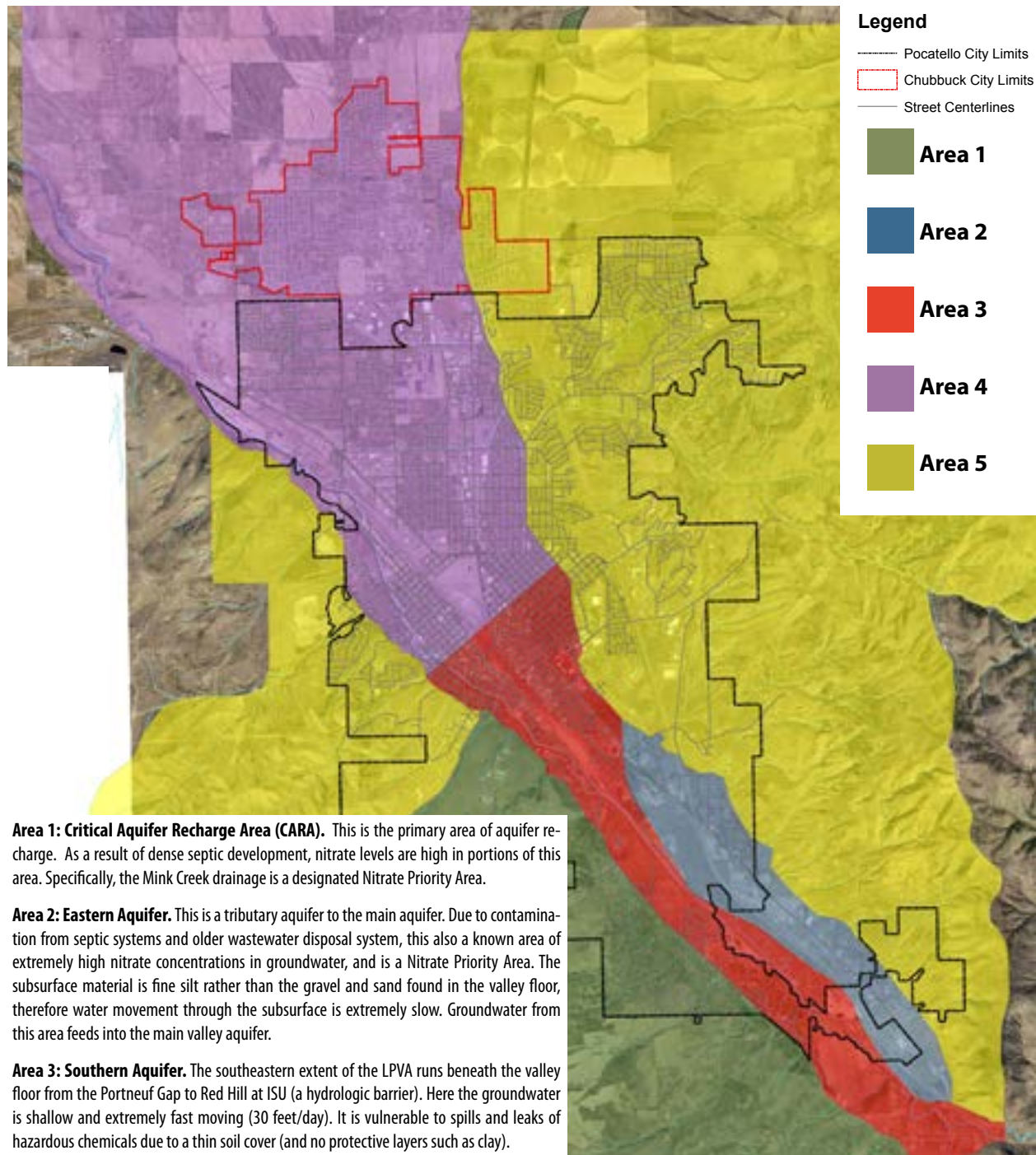
NPGS — Non-Pollutant Generating Surface

NRCS —Natural Resources Conservation Service (a.k.a. SCS)
O&M—Operation and Maintenance
PGS—Pollutant Generating Surface
POA—Property Owners Association
SCS – Soil Conservation Service. (a.k.a NRCS)
SDA—Special Drainage Areas
sf—Square Feet
SSP – Stormwater Site Plan
SWPPP—Stormwater Pollution Prevention Plan
TAPE —Technology Assistance Protocol - Ecology
TMDL—Total Maximum Daily Load
TPH—Total Petroleum Hydrocarbons
TSS—Total Suspended Solids
UIC—Underground Injection Control
USGS—United States Geological Survey
IDAPA—Idaho Administrative Policy Act
IDT—Idaho Department of Transportation

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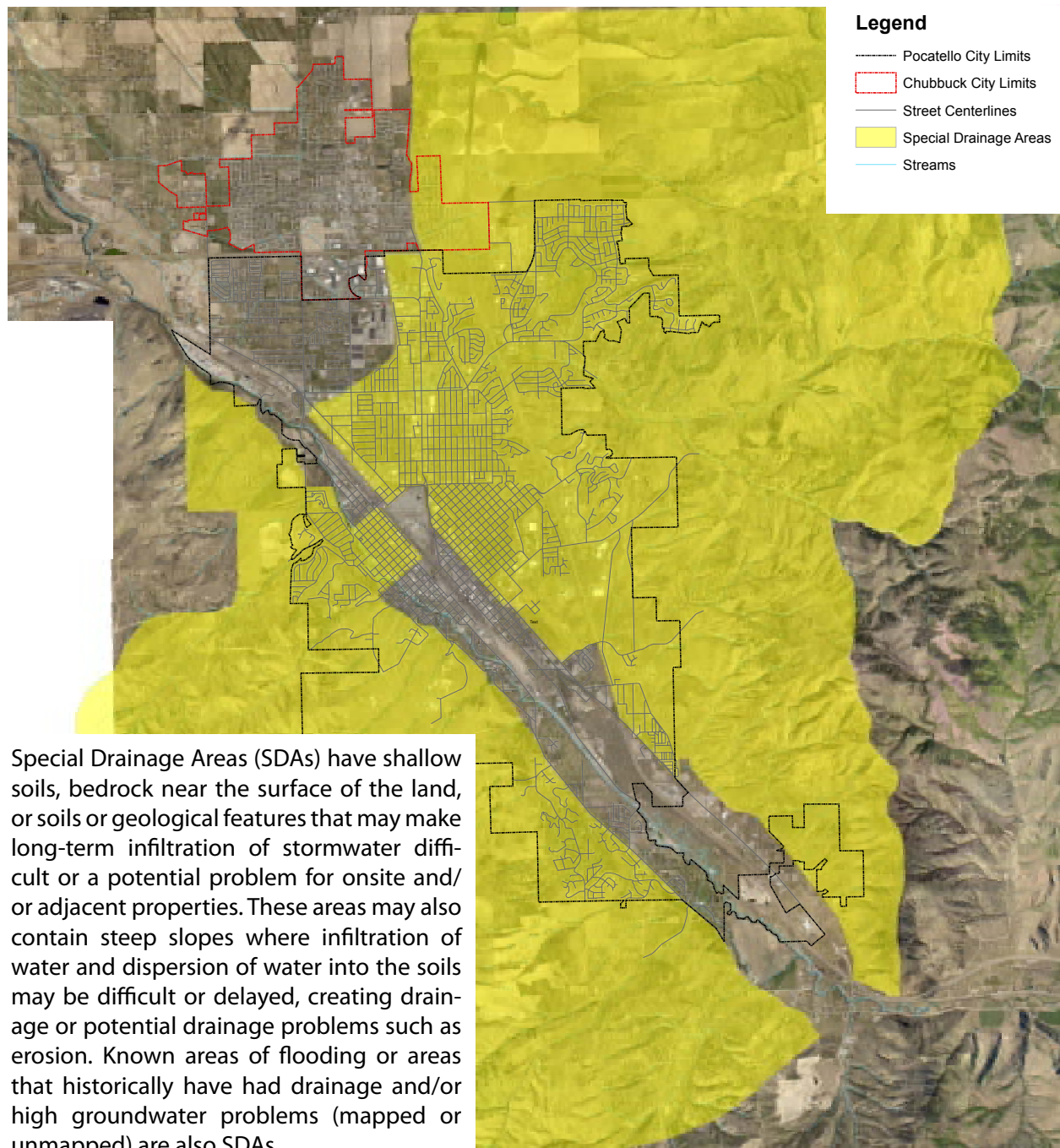
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APPENDIX 1A: LOWER PORTNEUF VALLEY AQUIFER (LPVA) PROTECTION AREA



Source: Bannock County Groundwater Technical Advisory Committee, 2010.

APPENDIX 1B: SPECIAL DRAINAGE AREAS (SDAs)



This map designates SDAs within the Portneuf Valley, including the benches on either side of the valley and known areas within the City of Pocatello's valley floor with historic stormwater drainage issues. All areas with slopes over 15% are mapped as SDAs. The limited pipe size and extent of the stormwater infrastructure within the City of Pocatello drives most of the SDA boundaries.

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CHAPTER 2

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2.1 INTRODUCTION

This chapter identifies eight (8) Core Elements of stormwater management at new development and redevelopment sites:

- Core Element #1 – Stormwater Site Plan (Ch 3)
- Core Element #2 – Erosion and Sediment Control (Ch 8)
- Core Element #3 – Source Control (Ch 5)
- Core Element #4 – Natural and Constructed Conveyance (Ch 7)
- Core Element #5 – Onsite Retention (Ch 6)
- Core Element #6 – Water Quality Treatment (Ch 6)
- Core Element #7 – Flow Control (Ch 6)
- Core Element #8 – Operations and Maintenance (Ch 9)

The applicability of Core Elements depends on many factors, including type, size and location of the project. Project proponents will need to familiarize themselves with the Core Elements in order to determine when they are applicable.

2.2 APPLICABILITY OF CORE ELEMENTS

2.2.1 REGULATORY THRESHOLD

The regulatory threshold is the trigger for requiring compliance with all the Core Elements of this Manual. It is the **addition or replacement of 5,000 square feet or more of impervious surfaces, or the disturbance of one (1) acre or more**. If either of these conditions is met, the regulatory threshold is triggered. Projects that don't trigger the regulatory threshold are considered partially exempt, and only need to comply with certain Core Elements, as described in Section 2.2.5.

All projects proposing underground injection control (UIC) facilities must comply with all the Core Elements, regardless of whether or not they trigger the regulatory threshold.

2.2.2 NEW DEVELOPMENT

New development is the conversion of previously undeveloped or permeable surfaces to impervious surfaces and managed landscape areas. New development occurs on undeveloped land or through expansion of partially developed sites. The new development thresholds apply to the total amount of impervious surfaces added at full build-out when all project phases are complete.

2.2.3 REDEVELOPMENT

Redevelopment is the replacement of impervious surfaces on a developed site by demolishing existing facilities (and rebuilding) and/or substantially changing existing facilities through reconstruction.

When a redevelopment project adds or replaces 5,000 square feet or more of impervious surface or proposes a new UIC facility, the rebuilt or reconstructed facility shall be regarded in the same manner as New Development (see Section 2.2.2). The Core Elements stated in Section 2.1 shall be applied to all of the new and replaced impervious surfaces at the site. The redevelopment thresholds apply to the total amount of impervious surfaces replaced and added at full build-out when all project phases (if applicable) are complete.

Retrofit of existing stormwater management facilities on redevelopment sites is not required if the existing facilities remain hydraulically isolated from the redevelopment area.

2.2.4 EXEMPTIONS

Projects in the following categories are generally exempt from all the Core Elements, provided the project does not include a UIC facility:

1. Drain tiling, tilling, or planting incidental to agricultural crops, and harvesting of agricultural, horticultural or silvicultural (forestry) crops.
2. Actions by a public utility or other government agency to remove or alleviate an emergency condition, restore utility service, or reopen a public thoroughfare to traffic.
3. Change of use permits to less intense or similar uses;
4. Records of survey, minor lot line adjustments, and property aggregations, unless the action affects drainage tracts or easements;
5. Minor land-disturbing activities that do not require a permit;
6. Permits or applications for projects not physically disturbing the land;
7. Municipal road/parking lot preservation/maintenance projects such as:
 - Pothole and patching;
 - Crack sealing;
 - Resurfacing with in-kind material without expanding the area of coverage;
 - Overlaying existing asphalt or concrete pavement with bituminous surface treatment (BST), chip seal, asphalt or concrete without expanding the area of coverage;
 - Shoulder grading;
 - Reshaping or regrading drainage systems; and
 - Vegetation maintenance.
8. Operation and maintenance or repair of existing facilities.
9. Landscaping and maintenance on residential lots (excluding modifications to stormwater drainage/treatment swales) by homeowners, including gardening.

2.2.5 PARTIAL EXEMPTIONS

Partially exempted practices are generally exempt from Core Elements, except:

- Core Element #1 – Stormwater Site Plan (see 2.2.6 for exemptions to Core Element #1)
- Core Element #2 – Erosion and Sediment Control
- Core Element #3 – Source Control
- Core Element #4 – Natural and Constructed Conveyance Systems

The following practices are partially exempt:

1. New and re-development projects adding or replacing less than 5,000 square feet of impervious areas and disturbing less than one acre (at full build-out or when all project phases are complete);
2. Single-family residential/duplex building permits without special conditions;
3. Temporary use permits;
4. Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics;
5. Projects that improve roadway user safety without increasing traffic capacity. Certain safety improvement projects such as sidewalks, bike lanes, bus pullouts and other transit improvements shall be evaluated on a case-by-case basis to determine whether additional Core Elements apply;
6. Maintenance projects that do not increase the traffic capacity of a roadway or parking area such as:
 - Removing and replacing a concrete or asphalt roadway to base course or subgrade or lower without expanding the impervious surfaces;
 - Repairing the roadway base or subgrade;
 - Overlaying existing gravel with BST, chip seal or asphalt or concrete without expanding the area of coverage, or overlaying BST with asphalt, without expanding the area of coverage. This partial exemption only applies if the overlaid surface continues to drain to the existing facilities or structures and if:
 - The road traffic surface will be subject to an Average Daily Traffic (ADT) volume of less than 7,500 on an urban road or an ADT volume of less than 15,000 vehicles on a rural road, freeway, or limited access control highway; or,
 - The parking area traffic surface will be subject to less than 40 trip ends per 1,000 square feet of building area or 100 total trip ends.

2.2.6 SITE PLAN SUBMITTAL EXEMPTIONS

The following activities are exempt from Core Element #1: Stormwater Site Plan Submittal.

1. Single-family residential/duplex building permits without special conditions;
2. Remodeling permits or tenant improvements that do not add or replace 5,000 or more square feet of impervious surface;
3. Maintenance and repair to any stormwater BMP deemed necessary by the City;
4. Any emergency project that is immediately necessary for the protection of life, property or natural resources;
5. Sidewalk and ADA compliance work; and
6. Landscaping and maintenance on residential lots, including gardening, noncommercial agricultural activity, and limited clearing and grading.

2.2.7 DESIGN EXCEPTIONS

An exception may be granted by the local jurisdiction to approve design elements that do not conform to or are not explicitly addressed by this Manual. Design exceptions are at the sole discretion of the local jurisdiction. Contact the local jurisdiction for specific procedures for applying for design exceptions.

The requirements of this Manual represent the minimum criteria for the design of stormwater management systems within jurisdictions that have adopted the Manual or sections of it. Designs that offer a superior alternative to standard measures, or creative means not yet specified in the standards, are welcomed towards the goal of providing better stormwater management.

2.3 CORE ELEMENTS

This section describes the basic requirements for each Core Element. See Table 2-1 for a summary of the volume and flow requirements for the Core Elements.

Table 2-1: Volume and Flow Design Requirements

Core Element	Design Requirement	City of Pocatello	City of Chubbuck
#4	Stormwater constructed channel, pipe, culvert and inlet sizing ¹	Conveyance of 50-year/24-hour design storm with 6" freeboard.	Conveyance of 50-year/24-hour design storm with 6" freeboard.
#5	Onsite retention of the 95% storm ²	0.67" of predicted runoff	0.67" of predicted runoff
#6	Treatment design volume	0.5" of predicted runoff	0.5" of predicted runoff
#6	Treatment design flow	Type II NRCS 6-month storm	Type II NRCS 6-month storm
#6	Treatment bypass	Required unless treatment facility can handle the flow control design storm.	Required unless treatment facility can handle the flow control design storm.
#7	Flow control design storm flow rates and volumes ³	Design storm release rate for the post-development flow must be below the pre-development release rate for the 2, 10, 25, and 50 year/24-hour storms.	0.5" of predicted runoff
#7	Flow control design storm flow rates and volumes for Special Drainage Areas ⁴ , as well as sites over 15% slope.	Design storm release rate must be below the pre-development release rate for the 2, 10, 25, 50 and 100 year storms. Additionally, design storm release rate may not exceed 0.1 cfs/acre.	Design storm release rate must be below the pre-developed release rate for the 2, 10, 25, 50 and 100 year storms. Additionally, design storm release rate may not exceed 0.1 cfs/acre.
#7	Site Passage of upland flow and site runoff ⁵	100-year/24-hour	100-year/24-hour

¹ Constructed channels have varying freeboard requirements (see Section 2.3.4); safe overflow for 100-year storm always required.

² Only required for sites that discharge to surface water or a stormwater system connected to surface water. Sites that retain the treatment design volume and detain the 50 year event with a detention pond designed per the requirements in Section 6.7 will meet this requirement.

³ Post-developed flow is equal to the release from detention facility plus the bypass flow

⁴ Special Drainage Areas are depicted in the Special Drainage Area Map, Appendix 1B, and include all of the east and west benches in Pocatello and Chubbuck, as well as much of the valley floor within Pocatello.

⁵ The overflow route shall direct the 100-year post-developed flow safely towards the downstream conveyance system. This may require obtaining easements and/or restrictions. Facilities that do not have an adequate overflow location or bypass path for the 100-year storm event must be sized to fully infiltrate/detain the 100-year storm. Contact the local jurisdiction regarding use of the right-of-way for overflow.

2.3.1 CORE ELEMENT #1 STORMWATER SITE PLAN SUBMITTAL

A Stormwater Site Plan (SSP) submittal is necessary in order to evaluate the potential adverse impacts of drainage patterns resulting from site alterations due to land development. The specific requirements for the Stormwater Site Plan are discussed in Chapter 3 and include:

- Geotechnical Site Characteristic Report (GSR);
- Construction plans;
- Drainage report;
- Erosion and Sediment Control (ESC) Plan;
- Operations & Maintenance Plan; and
- Any applicable special reports or studies.

Applicability

All projects are required to prepare a SSP, unless exempted under sections 2.2.4 or 2.2.6.

2.3.2 CORE ELEMENT #2 EROSION AND SEDIMENT CONTROL (ESC) PLAN

During the construction phase, sediment-laden runoff can enter newly constructed or existing drainage facilities, facilities. This can reduce their infiltration and/or treatment capacity, shorten operational lifetime or increase maintenance costs.

In order to control erosion and to prevent sediment and other pollutants from leaving the project site during construction, select and implement BMPs that are appropriate both to the site and to the season during which construction activities take place. The objectives of the Erosion and Sediment Control (ESC) Plan are to:

- Protect and prevent damage to existing or proposed stormwater management infrastructure;
- Minimize damage to private property, water bodies, public roads and right-of-ways due to erosion, sedimentation, and increased runoff resulting from land-disturbing activities.
- Protect the health, safety and welfare of the general public; and,
- Protect water quality.

Applicability

Land-disturbing activities are activities that result in a change in existing soil cover (vegetative or non-vegetative) or site topography. Land-disturbing activities include, but are not limited to, demolition, construction, clearing and grubbing, grading and logging. All projects, regardless of the quantity of created

impervious area or amount of land disturbed, are responsible for preventing erosion and preventing the discharge of sediment and other pollutants into surface waters, drainage facilities and/or adjacent properties.

Local jurisdictions require ESC Plans for all projects with an ESC permit. These ESC Plans can be 1) general or 2) site specific. General plan templates are provided by the local jurisdiction (generally for single-family residential construction).

Site specific ESC Plans are required for the following land disturbing activities (unless exempted by Section 2.1.5):

1. Major land-disturbing activities involving one (1) acre or more of disturbed area (a federal Construction General Permit may also be required);
2. Minor land-disturbing activities, such as grading or excavation, involving less than one (1) acre of disturbed area, but requiring an ESC permit by the local jurisdiction and having one or more of the following characteristics:
 - Subdivision development;
 - Over 15% slope;
 - Within 50 feet of a body of water or wetland area;
 - Commercial or multi-family building;
 - Sites located entirely or partly within an environmentally sensitive area as identified by the local jurisdiction, or by state or federal authorities; and
 - Any other site determined by the local jurisdiction to have conditions necessitating additional control measures.

Site specific ESC Plans (except for single family residential development under one acre) must be prepared by a professional engineer licensed in the state of Idaho with good knowledge of hydrology and ESC practices. All ESC Plans must adhere to the minimum requirements specified in Chapter 8 of this manual.

2.3.3 CORE ELEMENT #3 SOURCE CONTROL

Source control BMPs are a cost-effective means of reducing pollutant loading in stormwater and shall be the first consideration in all projects. The objective of source control BMPs is to prevent pollutants from coming into contact with stormwater.

Applicability

All projects (unless they are exempt as per Sections 2.3.5 and 2.3.6) shall comply with this Core Element. All new UIC wells shall implement this Core Element unless the stormwater is from a non-pollutant generating surface (NPGS).

Following construction, projects shall apply all known, available and reasonable source control BMPs. A project proponent is not relieved from the responsibility of preventing pollutant release resulting from contact with stormwater, whether or not the project exceeds the regulatory threshold.

The source control measures applicable to various site uses are outlined in Chapter 5.

2.3.4 CORE ELEMENT #4

NATURAL AND CONSTRUCTED CONVEYANCE SYSTEMS

Conveyance systems are natural or constructed components that collect stormwater runoff in a manner that adequately drains structures, sites and roadways, minimizing the potential for flooding and erosion. Engineered conveyance systems are designed and constructed to provide protection against damage to property and improvements from uncontrolled or diverted flows, flooding and erosion.

Natural drainage features, including floodplains, drainage ways, and natural depressions, store water or allow it to infiltrate into the ground. These features are referred to as the “natural location of drainage systems” (NLDS). Projects shall be designed to protect the NLDS to ensure that stormwater runoff can continue to be conveyed and disposed of at its natural location.

Stormwater runoff shall be discharged in the same manner and at the same location as in the pre-developed condition, unless otherwise specifically accepted by the local jurisdiction. Stormwater runoff may not be concentrated onto down-gradient properties where sheet flow previously existed nor diverted to points not receiving stormwater runoff prior to development.

Applicability

All projects, regardless of whether they meet the regulatory threshold, shall comply with the Core Element for conveyance systems (unless they are exempt as per Sections 2.3.5).

NLDS

Project proponents are required preserve natural drainage systems as specified in Section 7.4.2 of this Manual.

Conveyance Sizing

Constructed channels shall be designed with sufficient capacity to convey and contain, at a minimum, the 50-year peak flow, plus the following freeboard requirements, assuming developed conditions for onsite tributary areas and existing conditions for any offsite tributary areas. Refer to Chapter 7 for additional criteria.

Table 2-2: Freeboard for Constructed Channels

Water depth	Freeboard
<12"	4"
12-24"	8"
>24"	12"

The design shall bypass storm events that exceed the above criteria and shall provide an overflow path, with the capacity to convey the 100-year storm event. The overflow path should drain toward the natural discharge point of the contributing basin, away from adjacent buildings, residences, etc.

New culverts shall be designed with sufficient capacity to convey the 50-year design storm assuming developed conditions for the onsite basin and existing conditions for the offsite basin. Increase culvert size to pass the 100-year event if a safe overflow for flows above the 50-year event cannot be provided.

Additionally, new culverts shall be designed with sufficient capacity to meet the headwater and tailwater requirements in Chapter 7.

New enclosed systems and inlets shall be designed with sufficient capacity to convey peak flow rate for the 50-year design storm event with at least six-inches of freeboard between the water surface and the proposed ground surface. Enclosed systems may surcharge or overtop drainage structures for storm events that exceed the 50-year event, so long as an overflow path is provided. The overflow path must be capable of conveying the 100-year storm event and should drain toward the natural discharge point of the contributing basin, away from adjacent buildings, residences, etc.

Drainage inlets shall be designed with sufficient capacity to convey the 50-year design storm assuming developed conditions for the contributing area.

2.3.5 CORE ELEMENT #5 ONSITE STORMWATER MANAGEMENT

Projects shall employ On-site Stormwater Management BMPs to infiltrate, disperse, and retain stormwater runoff on-site to the extent feasible without causing flooding or erosion impacts. The objective of onsite stormwater management BMPs is to use practices distributed across a development that reduce the amount of disruption of the natural hydrologic characteristics of the site.

Applicability

All projects that meet the regulatory threshold (see Section 2.2.1) and discharge to surface water (or a stormwater system that connects to surface water) must meet the requirements listed in Table 2-1 for onsite retention of stormwater.

Design Criteria

Project proponents are encouraged to utilize Low Impact Development site design (see Chapter 10) to achieve this objective. Flow Control and Treatment BMPs (Chapter 6) may also be used.

2.3.6 CORE ELEMENT #6

WATER QUALITY TREATMENT

Water quality treatment is required to reduce pollutant loads and concentrations in stormwater and can be achieved using physical, biological, and chemical treatment.

The total quantity of pollutants removed from the stormwater will vary greatly from site to site based on precipitation patterns, land use, site geology, effectiveness of source controls, and operation and maintenance of the treatment facilities. Pollutant removal can be improved when water quality treatment BMPs are installed in series (aka a “treatment train”). When treatment facilities are required, they shall be designed and sized according to the criteria specified in Chapter 6.

Treatment goals are governed by state and federal regulations, specifically the Federal Clean Water Act, the Federal Safe Drinking Water Act, and the Idaho Administrative Policy Act (58.01.08 and 58.01.11). Based on these requirements, the Water Quality Design Storm volume and flow rates are sized and designed to 1) capture and effectively treat at least 90% of the annual stormwater runoff volume prior to surface water discharge; and 2) prevent treated discharge to groundwater from causing a groundwater standard to be exceeded. The key pollutants of concern are:

- Total Suspended Solids (TSS) – Primary Treatment Facilities
- Total Petroleum Hydrocarbons (TPH) – Oil Control Facilities

The primary treatment facility BMPs presented in Chapter 6 are intended to achieve 80% removal of suspended solids for typical influent concentrations ranging from 30 mg/l to 100 mg/l. Refer to Table 6-1 for applicable primary treatment BMPs.

Oil Control facilities are intended to have a 24-hour average Total Petroleum Hydrocarbon (TPH) concentration no greater than 10 mg/l, and a maximum of 15 mg/l for a discrete sample (grab sample) with no ongoing or recurring visible sheen. Refer to Table 6-1 for applicable oil control BMPs.

Runoff Treatment Sizing (see Table 2-1)

Volume Based: For volume based treatment facilities, the water quality storm is equal to 0.5 inches of predicted runoff from all impervious surfaces that contribute to the treatment facility.

Flow Based Upstream of Stormwater Facility: Flow based treatment facilities located upstream of stormwater facilities are designed to treat the peak runoff flow rate predicted for the proposed development condition from the 6-month/24-hour storm.

Flow Based Downstream of Stormwater Facility: Flow based treatment facilities located downstream of stormwater facilities (i.e. detention facility) are designed to treat the full 2-year release rate of the upstream stormwater facility. Refer to Section 6.4 for additional information about sizing.

Bypass Sizing: A bypass shall be provided for all treatment BMPs unless the facility is able to convey the treatment and flow control design storm without damaging the BMP or dislodging pollutants from within it. The designer must check the maximum allowable velocity (typically less than 2 ft/s) or shear stress specified for the BMP and implement a flow bypass as necessary to prevent exceeding these velocities. Bypass shall be discharged to flow control facilities.

Primary Treatment Applicability

Treatment of the Water Quality Design Storm is required for all projects adding or replacing 5,000 square feet of impervious surface, unless the discharge satisfies the requirements for full dispersion (see Chapter 6) and is not a high-use site. Projects that discharge into the ground (using surface or subsurface facilities) may be able to achieve primary treatment using existing soil conditions. Primary treatment is required of all projects that discharge to waters of the U.S., including perennial and seasonal streams, lakes and wetlands where the impervious surface threshold is met. Project designers should also consider the possible impact of additional TSS loading from pervious areas at the project site on the long-term function of the treatment facility.

Refer to Chapter 6 for applicable Basic Treatment BMPs.

Primary Treatment Exemptions:

Primary treatment is not required for Non Pollutant Generating Surface (NPGS) areas unless the runoff is hydraulically connected to a PGS area. That is, treatment is not required unless the runoff from the NPGS area mixes with runoff from a PGS area upstream of the water quality treatment facility. Runoff from NPGS areas does not require treatment if it mixes with the PGS runoff downstream of the water quality treatment facility.

Oil Control Applicability

Oil control is required for sites that add or replace 5,000 square feet or more impervious surfaces and are defined as high-use (where the proposed land use suggests that sufficient quantities of free oil are likely to be present such that the oil can be effectively removed with special treatment). The specific land use types requiring Oil control are listed in Section 6.3. For qualifying land uses located within a larger project area, only the impervious area associated with the land use subject to oil control must apply the more stringent water quality treatment, but the flow from that area must be separated; otherwise the treatment controls must be sized for the entire project area.

All High Pollutant Loading sites (see Section 6.3) require oil/water separator technology, such as a coalescing plate or baffle-type oil control mechanism, which removes oil from the stormwater in a separate step from any other pollutant removal BMP. Oil/water separator technology typically involves a “treatment train” of two (or more) BMPs in series to meet the treatment goals of pollutants other than oil. See Table 6-1.

Exceptions: The following high pollutant loading sites require only sorptive technology, such as amended soils in an infiltration swale, which physically or chemically binds pollutants to organic particles. These site conditions typically do not require a multi-facility treatment train to address both oil control and other treatment requirements:

- Commercial on-street parking areas located on streets with an expected total ADT count equal or greater than 7,500;
- Outdoor storage yards and other sites subject to frequent use or storage of forklifts and/or other hydraulic equipment;

Oil control is not required for moderate or low pollutant loading sites (see Section 6.2).

2.3.7 CORE ELEMENT #7 FLOW CONTROL

Objective

Flow control facilities are necessary to mitigate potential adverse impacts on downstream properties and floodplains due to the increase in stormwater runoff caused by land development and for protecting in-stream morphology and habitat.

When site conditions allow, infiltration is the preferred method of flow control for urban runoff. All projects are encouraged to infiltrate stormwater runoff on site to the greatest extent possible if such infiltration will not have probable adverse impacts to down-gradient properties or improvements. Flow control facilities shall be designed and constructed according to the criteria in Chapter 6.

Unless specifically approved by the local jurisdiction, stormwater runoff from any proposed land development to any natural or constructed point of discharge downstream shall not exceed the pre-development peak rate of runoff. Additional requirements apply for Special Drainage Areas, see Table 2-1.

Stormwater generated on private property and/or commercial/industrial sites shall be disposed of either onsite or in an offsite easement, but not in the public ROW unless the public facilities have been specifically designed to accommodate private property runoff and approval is provided by the local jurisdiction.

Flow Control Sizing

The NRCS Type II 24-hour storm event is the design storm utilized for all flow control facilities regardless of whether they use surface or subsurface discharge. Refer to Table 2-1 to determine the appropriate sizing requirement.

Infiltration Facilities: All collected stormwater must drain from the facility within 72 hours. The design shall provide a safe overflow path with the capacity to convey the 100-year storm event. The overflow path shall drain toward an appropriate detention facility and not adversely impact downstream properties or structures.

Facilities that do not have an adequate overflow location or bypass path for the 100-year storm event must be sized to fully infiltrate the 100-year storm. Contact the local jurisdiction regarding use of the right of way for overflow.

Detention Facilities: For projects proposing to detain and release stormwater runoff, the facilities shall be designed such that the release rate does not exceed the predeveloped conditions for multiple storm events. The analysis of multiple design storms is needed to control and attenuate both low and high flow storm events.

The total post-developed discharge rate (including bypass flow) shall be limited to the rates outlined in Table 2-1. Bypass flow is the runoff that leaves the site without being conveyed through the detention facility. All collected stormwater must drain from the facility within 72 hours.

Evaporation Facilities: For projects proposing to evaporate runoff as a means of stormwater disposal, the facilities shall be designed to control the mean annual precipitation.

Applicability

All projects (unless exempted by Section 2.2.4 or 2.2.5) that add or replace 5,000 square feet or more of impervious surfaces or disturb one acre or more shall comply with the Core Element for flow control.

2.3.8 CORE ELEMENT #8 OPERATION AND MAINTENANCE

Objective

To ensure that stormwater control facilities are adequately maintained and properly operated, the Engineer is required to prepare documentation for the entity responsible for maintaining the stormwater system, which describes the appropriate preventive maintenance and details the recommended maintenance schedule.

For drainage ponds and other drainage facilities located outside of the public road rights-of-way, the project proponent shall provide the financial means and arrangements for the perpetual maintenance of the drainage facilities.

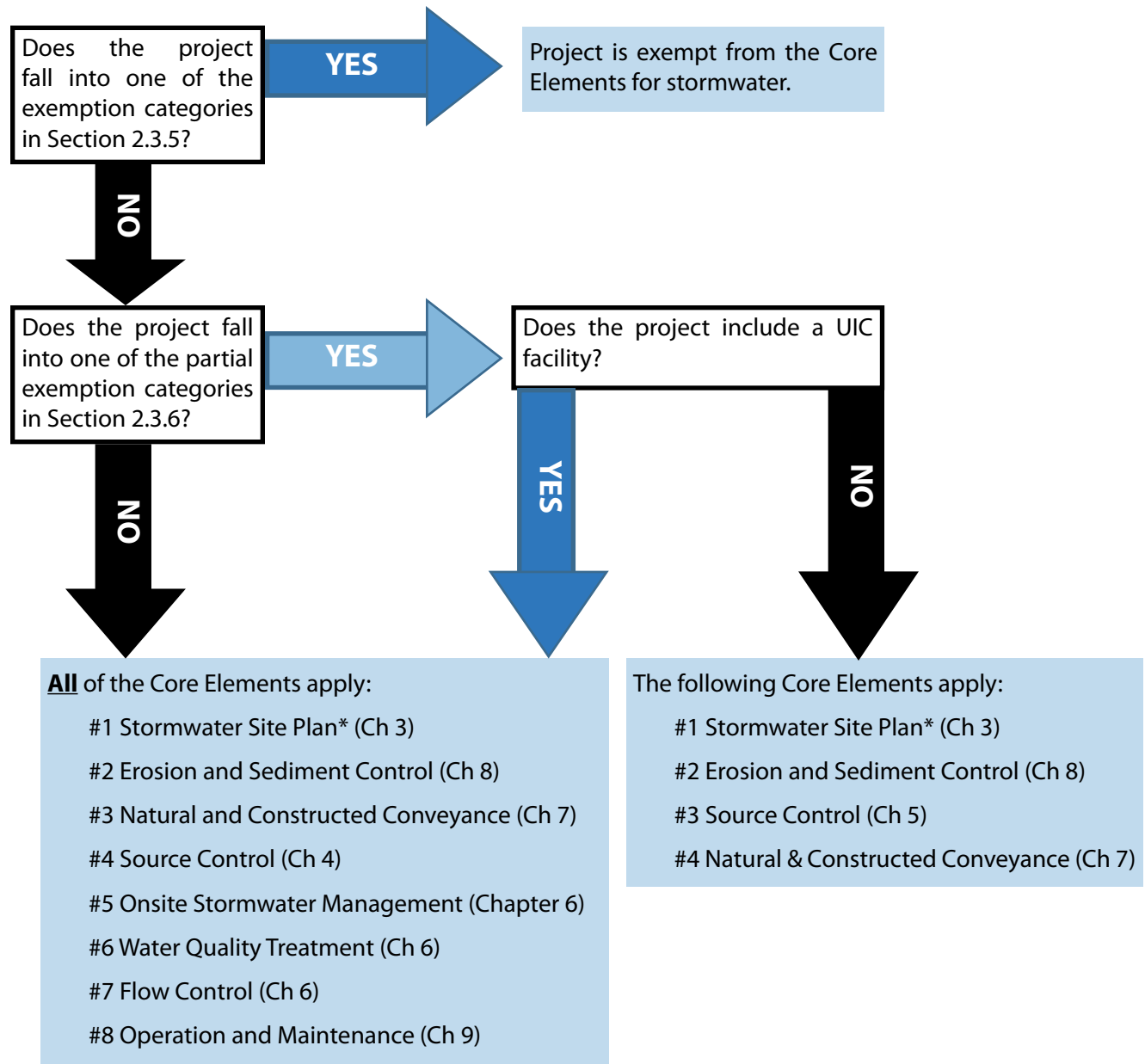
Proponents shall operate and maintain the facilities in accordance with an Operation and Maintenance plan that meets the criteria specified in Chapter 9. The Operation and Maintenance Plan shall also include applicable source control BMPs as specified in Chapter 5.

Applicability

This Core Element applies to all projects that propose drainage facilities or structures. All projects that propose UIC facilities also must implement the operation and maintenance requirements, regardless of whether or not they exceed the regulatory threshold.

APPENDIX 2A – CORE ELEMENTS FLOW CHART

The following flow charts are included to assist project proponents in determining which of the Core Elements apply to a given site. The definitions of terms used in the flow charts are included the text of Chapter 2.



* Not all projects are required to submit a Stormwater Site Plan. See Section 2.2.6 for exemptions.

APPENDIX 2B – APPROPRIATE BMPS FOR CHALLENGING SITES

Physical site conditions (deep loess soil, basalt outcrops, steep slopes) can constrain options for stormwater management facilities in many areas of the Portneuf Valley. Certain types of facilities may be either physically infeasible or may not provide sufficient removal of pollutants to meet regulatory standards. The tables below provide guidance as to the appropriateness of various treatment, flow control, and low impact development BMPs.

These tables are intended to be used as general guidance. It is the responsibility of the design engineer to evaluate specific site conditions and select the appropriate BMPs or combination of BMPs to meet the requirements of a particular project site.

Deep Loess Soil

Wind-blown silt deposits known as loess soil cover much of the Portneuf Valley's benches. This soil is generally composed of >85% fine silts that are highly erodible and easily clog infiltration facilities.

Generally Appropriate	Potentially Appropriate	Inappropriate
Downspout Disconnects Green Roofs/ Roof Rainwater Collection Systems Oil/Water Separator (in a treatment train) Natural Dispersion Vegetated Filter Strips Grassy Channel Detention Pond Evaporation Pond	Infiltration Swales Bio-retention Pervious Pavement Infiltration Trench/Infiltration gallery Infiltration Pond	Drywell

Steep Slopes

On steep slopes there is often not enough level area to install facilities to store, infiltrate or appropriately disperse stormwater. Treating the stormwater near the source and using low impact development techniques to reduce stormwater runoff is preferable.

Generally Appropriate	Potentially Appropriate	Inappropriate
Green Roofs/ Roof Rainwater Collection Systems Oil Water Separator (in a treatment train)	Infiltration Swales Grassy Channel Bio-retention Pervious Pavement Infiltration Trench/Infiltration gallery Infiltration Pond	Downspout Disconnects Detention Pond Evaporation Pond Infiltration Trench/Infiltration gallery Infiltration Pond Drywell

Areas of Natural Impermeability

Impermeable basalt underlies some portions of the Portneuf Valley. In these areas, BMPs that rely on infiltration or dispersal of stormwater may not be feasible. BMPs that treat and/or store stormwater above the ground surface are preferable.

Generally Appropriate	Potentially Appropriate	Inappropriate
Green Roofs/ Roof Rainwater Collection Systems Oil/Water Separator (in a treatment train) Vegetated Filter Strips Grassy Channel Detention Pond Evaporation Pond	Infiltration Swales Bio-retention Pervious Pavement Downspout Disconnects Natural Dispersion	Drywell Infiltration Trench/ Infiltration gallery Infiltration Pond

Areas of Fractured Rock/Minimal Soil Cover

In some areas of the Portneuf Valley, fractured basalt is very close to the surface and soil depths are minimal. Fractured rock can also be created through blasting of bedrock. For these sites, stormwater managers must take great care not to let untreated stormwater discharge to groundwater.

Generally Appropriate	Potentially Appropriate	Inappropriate
Downspout Disconnects Green Roofs/ Roof Rainwater Collection Systems Oil/Water Separator (in a treatment train) Vegetated Filter Strips Pervious Pavement Grassy Channel Detention Pond Evaporation Pond Natural Dispersion	Infiltration Swales Bio-retention Pervious Pavement Grassy Channel Detention Pond Drywell Infiltration Trench/Infiltration gallery Infiltration Pond	

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CHAPTER 3

SITE PLAN SUBMITTAL

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3.1 STORMWATER SITE PLAN

The Stormwater Site Plan (SSP) is the comprehensive report containing all of the technical information and analysis necessary for regulatory agencies to evaluate a proposed new development or redevelopment project for compliance with stormwater requirements. Contents of the SSP will vary with the type and size of the project, and individual site characteristics.

The scope of the SSP also varies depending on the applicability of the Core Elements (see Section 2.2 and Appendix 2A) and local regulations. This chapter describes the contents of a SSP and provides a general procedure for how to prepare the plan.

The goal of this chapter is to provide a framework for consistency in plan preparation. Such consistency will ensure that designs are appropriate for specific sites and projects, critical plan components are not omitted, and help secure prompt governmental review and approval. Properly drafted engineering plans and supporting documents will also facilitate the operation and maintenance of the proposed system long after its review and approval.

While local jurisdictions may review and accept stormwater-related submittals as compliant with this Manual's requirements, this does not confer responsibility upon those local governments. The project proponent and his/her design team are responsible for ensuring that all stormwater elements are safe and effective for their intended purpose, and that all calculations, plans, specifications, construction, and as-built drawings comply with accepted engineering standards, applicable federal, state, or local laws and codes, and this manual, and demonstrate good engineering practice.

All engineering work must be performed by, or under the direction of, a professional engineer currently licensed in the State of Idaho.

STORMWATER SITE PLAN COMPONENTS

The components to develop a SSP are listed below:

Step 1: Collect and Analyze Information on Existing Conditions

- Project Description
- Geotechnical Information

Step 2: Prepare a Permanent Stormwater Control Plan

- Drainage Report (Map and Narrative)
- Construction Plans
- Downstream/Down-Gradient Analysis

Step 3: Prepare an ESC Plan

Step 4: Prepare a Maintenance Plan and Agreement

The level of detail needed for each step depends upon the project size, as explained in the individual steps. Provide the information as specified below.

3.1.1 - STEP 1: COLLECT AND ANALYZE INFORMATION ON EXISTING CONDITIONS

Project Description

Collect and review information on existing site conditions, including topography, drainage patterns, soils, ground cover, presence of any critical areas, adjacent areas, existing development, existing stormwater facilities, and adjacent on- and off-site utilities. Analyze data to determine site limitations including:

- Areas with high potential for erosion and sediment deposition (based on soil properties, slope, etc.);
- Locations of sensitive and critical areas (e.g., vegetative buffers, wetlands, steep slopes, floodplains, geologic hazard areas, streams, etc.);
- Observation of potential runoff contribution from off-site basins;
- Adjacent properties and (or) projects that have a history of stormwater problems, noting whether the cause of the problem(s) has been determined;
- Adjacent properties and (or) projects where geotechnical investigations have identified shallow bedrock, high groundwater, seasonally perched groundwater, or clay lenses in the substrata; and
- Upland drainage areas that are currently and (or) have the potential to convey and (or) discharge runoff to and across the proponents project.

Delineate these areas on the vicinity map and/or a site map that are required as part of Step 2 – Preparing a Permanent Stormwater Control Plan. Prepare an Existing Conditions Summary that will be submitted as part of the Site Plan. Part of the information collected in this step should be used to help prepare the ESC Plan.

Refer to local maps for more information:

- Floodplain, Water Resources, Zoning, Property Ownership, etc: <https://webmap.pocatello.us/public/>
- Soils (including depth to groundwater, depth to hardpan and hydrologic soil classification). <http://websoilsurvey.sc.egov.usda.gov/>
- Lower Portneuf Valley Aquifer (LPVA) Protection Area Map (see Appendix 1A)
- Special Drainage Areas (see Appendix 1B)

Geotechnical Site Characteristic Report (GSR)

A Geotechnical Site Characteristic Report (GSR) may be required to develop construction feasibility design requirements for storm drainage facilities and sub-surface/level structures. A professional engineer currently licensed in the State of Idaho is required to perform the GSR. A GSR will be required based upon the following criteria:

- Projects proposing infiltration (drywells, infiltration trenches, infiltration basins, other detention facilities receiving credit for pond bottom infiltration, etc.) or non-standard drainage systems;
- Projects located within or draining to a problem drainage area, flood-prone basin, or study area as determined by the local jurisdiction.;
- Projects located in geohazard areas as identified by the local jurisdiction;
- Projects located within or draining to a drainage problem or study area as recognized the local jurisdiction; or,
- Projects with administrative conditions requiring a GSR.

Refer to Section 6.4 and 6.6 for site suitability requirements.

The local jurisdiction may reduce or waive the GSR requirements where sufficient geotechnical data is already available for a project site. It is recommended to check with local jurisdiction if this information is available.

The following are the minimum components to be included in the GSR:

- A vicinity map;
- Site layout map which includes:
 - Project boundaries (include lot lines, if applicable);
 - Labeled topographic contours, which extend beyond the project or drainage basin far enough to define drainage boundaries. Projects within an urban area shall utilize a maximum contour interval of 2 feet. At the discretion of the local jurisdiction, projects outside an urban area, such as a large lot subdivision, may utilize the best available topographic information; this may involve contours on a scale larger than the 2 foot minimum required. In either case, the project proponent's Engineer shall field verify the basin limits;
 - Location of the soil units identified;
 - Significant structures (including irrigation canals), properties, or geologic conditions (such as springs or steep slopes) onsite and within the project vicinity;
 - Existing natural or constructed drainage related features onsite and within the project vicinity;
 - Exploratory borings or test pits, and in-place field tests (if performed); and,
 - Proposed site infrastructure including roadways and drainage features such as ponds, drywells, etc.

- Descriptions of soil units within the vicinity of the site;
- A description of the site, surface conditions, slopes, soil conditions, groundwater conditions, etc;
- Logs of borings and/or test pits (including groundwater elevation, if encountered);
- Results of field and or laboratory testing conducted including raw data, assumptions, and calculations;
- Results of the sub-level structure feasibility study and downstream/down-gradient analysis, as applicable;
- A finding that proposed stormwater facilities will neither adversely affect the structural integrity of any irrigation canal or be adversely affected by seepage from an irrigation canal; and,
- Conclusions and recommendations.

FIELD AND LABORATORY TESTING

The exploration, testing, and associated engineering evaluations are critical not only for identifying permeable soils, but to determine the thickness, extent, and variability of said soils. This information is necessary for proper function of stormwater facilities.

Infiltration rates shall be determined using one or more of the following methods:

- The grain size distribution method (see Appendix 3B) can be used to estimate soil permeability in uniform deep soils where 85% of the material is retained on the 200 sieve (for finer material this method is only appropriate to use with mostly CL-ML soils where the liquid limit is greater than 20 and the plasticity is over 10). The estimation method is well documented and supported by standard geotechnical engineering principals. This approach is only allowed to initially assess the suitability of onsite soils for subsurface stormwater disposal and to estimate infiltration rates for design purposes. Engineers shall apply a safety factor to the estimated infiltration rates to account for long term plugging of the system by sediments and debris. For newly constructed drywells, a full-scale drywell test is required prior to construction certification in order to verify the infiltration rates utilized in the design, unless waived by the local jurisdiction;
- The full-scale drywell or drill hole test (see Appendix 3C) utilizes field data to determine actual infiltration rates of a drywell or drill hole. This test method is required for all existing drywells and drill holes to verify the condition and capacity of the structure. For newly constructed drywells or drill holes, a fullscale test is required prior to construction certification in order to verify the infiltration rates utilized in the drainage design, unless waived by the local jurisdiction (Note that testing beyond the capacity used in the system design is not required.);
- The test pit method (see Appendix 3D) utilizes field data to estimate the

infiltration rates of drywells and determine infiltration rates of other subsurface disposal facilities. This test is not suitable for drill holes. A Professional Engineer may elect to use this test method to further verify the design infiltration rates utilized in the drainage design when soil gradations indicate marginal infiltration rates. Also, this test method may be used for analyzing non-standard subsurface disposal systems (infiltration galleries, under-drain systems, etc). For newly constructed drywells or drill holes, a full-scale drywell or drill hole test is required prior to construction certification to verify the infiltration rates utilized in the design, unless waived by the local jurisdiction;

- The single-ring infiltrometer test (see Appendix 3E) or the pond flood test (see Appendix 3G) can be used to verify the pond drawdown times as required in Chapter 6 and the infiltration rates of the subgrade and treatment zone of a water quality facility as discussed in Chapter 6; the single-ring infiltrometer test utilizes field data to determine the hydraulic conductivity of surficial soils. One of these tests is required prior to construction certification of infiltration ponds, unless waived by the local jurisdiction. This test is not suitable for drill holes;
- The swale flood test (see Appendix 3F) utilizes field data to verify swale drawdown times and functionality, as discussed in Chapter 6, and is required prior to release of bond or other surety, if required by the local jurisdiction; and,
- Additional or alternate test methods, upon approval from the local jurisdiction.

The following guidelines are recommended for determining the locations, depths, and frequencies of field explorations:

- Test borings and/or test pits should be located within the footprint of proposed stormwater disposal facilities;
- At least one subsurface exploration should be performed for each proposed drywell or drill hole and for every 1,200 square feet of disposal area (infiltration pond bottom, infiltration trench side walls and bottom). For a linear swale, one subsurface exploration should be performed every 300 feet. Subsurface explorations and sampling should be conducted according to applicable ASTM standards. In areas with known horizontal and vertical uniformity of soils, the local jurisdiction may reduce the recommended number of subsurface explorations;
- Unless otherwise recommended by the Professional Engineer, subsurface explorations should extend to a depth 5 feet below the bottom of the stormwater facility. Local jurisdictions may increase the subsurface exploration depth at their discretion.
- When Grain Size Distribution Methods are used to estimate hydraulic conductivity, a minimum of two laboratory gradation tests should be performed per subsurface exploration. Gradations should be performed

on samples taken at varying depths below the ground surface, within the target soil deposit, in order to adequately characterize the proposed disposal site soils. Laboratory testing should be conducted according to applicable ASTM standards; and,

- Field explorations and laboratory testing should be conducted under the direct supervision of a licensed professional engineer.

3.1.2 - STEP 2: PREPARE A PERMANENT STORMWATER CONTROL PLAN

Select stormwater control BMPs and facilities that will serve the project site in its developed condition. The Core Elements identified earlier in this chapter must be determined before the selection of stormwater control BMPs and facilities. Site limitations will also influence the type of stormwater facility. Refer to Chapters 5, 6 and 7 of this Manual for specific information on stormwater BMPs.

A preliminary design of the BMPs and facilities is necessary to determine how they will fit within and serve the entire preliminary development layout. After a preliminary design is developed, the designer may want to reconsider the site layout to reduce the need for construction of facilities, or the size of the facilities by reducing the amount of impervious surfaces created and increasing the areas to be left undisturbed. After the designer is satisfied with the BMP and facilities selections, the information must be presented within a Permanent Stormwater Control Plan. The Permanent Stormwater Control Plan should contain the following sections:

Drainage Report Analysis

A Drainage Report Analysis is required as part of Core Element #1 – Stormwater Site Plan. The Drainage Report Analysis is to be inclusive, clear, legible, and reproducible, with a complete set of stamped drainage computations. A professional engineer currently licensed in the State of Idaho is required to perform the Drainage Report Analysis.

The computations are to be presented in a clear and organized format with information included so as to allow a reviewer to be able to reproduce the same results. The computations should provide sufficient information for an unbiased third party to be able to review the report and determine that all applicable standards have been met. All assumptions and computer input and output data, and variables listed in the computer printouts, should be clearly identified. Computer printouts should clearly show which subbasin(s) they are applicable to, and the design storm event identified thereon if multiple-storm events are addressed in the design. Copies of design charts, nomographs, or other design aids used in the analysis should be included in the calculations.

All relevant geotechnical information (refer to GSR) related to the project and all site specific soil logs and subsurface testing information should be included in the Drainage Report Analysis or provided in a separate report prepared and stamped by the geotechnical engineer or licensed engineering hydrogeologist.

Basin Map: The Drainage Report Analysis should include a drainage basin map. Under most conditions both a pre-developed drainage basin map and post-developed drainage basin map should be provided, unless deemed unnecessary by the local jurisdiction (see Appendix 3A – Step 1 for a checklist of items to be included on the basin map).

Narrative: The Drainage Report Analysis should include a narrative with the following components:

- Hydraulic Analysis – Identify the hydrologic methods and storm events used to calculate runoff rates and size drainage facilities. Summarizes the pre- and post-development drainage basins and includes a basin map as described in Section 3.4.3.
 - Discuss the assumptions (existing vegetation, size of roofs and driveways, etc.) used to determine curve numbers and/or runoff coefficients utilized in the analysis;
 - Include a table that breaks down the impervious and permeable areas in each subbasin for both pre- and post- development conditions;
- Stormwater Facility Analysis and Design – Describe facilities selected to provide water quality treatment, flow control, and conveyance. Summarize the results of the calculations and the type of facilities that are proposed.
 - Include facility dimensions, and tables summarizing the maximum water elevation of the facilities for the storms analyzed, outflow structure information, size of facilities “required” by the calculations, and size of facilities “provided” by the design;
 - When applicable, include a table comparing the pre-developed and post-developed outflow conditions;
 - Verification of capacity must be provided for each element of the conveyance system including natural and constructed channels, culverts, storm drain systems, gutters, and drainage inlets;
 - Identify existing drainage facilities which are clearly inadequate or need repair, such as collapsed culverts or culverts with a substantial amount of debris. The condition and capacity of existing drainage facilities located onsite, which are proposed to be utilized by the development, should be evaluated and disclosed.
- Calculations - Calculations for infiltration basins, infiltration trenches and evaporation ponds may include the following: inflow and outflow hydrographs, a listing of the maximum water surface elevation, a pond volume rating table (e.g., stage vs. storage), and discharge rating table (e.g., stage vs. discharge). Each hydrograph calculation sheet is to have clearly marked: the design storm event, the applicable subbasin(s), and the pond identification name, which corresponds with the basin map and plans.

The drainage submittal should incorporate all calculations for the determina-

tion of the required size of the systems. Typical calculations include:

- Hydrology computations
- Inlet capacities
- Retention storage capacities
- Culvert and pipe system capacities and outlet velocities
- Ditch capacities and velocities
- Map with the project plotted thereon

A copy of applicable floodplain maps, or studies within the project area should be included in the Drainage Report Analysis.

Construction Plans

Construction plans should be prepared for all open and closed stormwater collection systems. The plans should call out sufficient hydraulic and physical data for construction of the system and future evaluation of the design. A checklist describing many of the items typically shown on construction plans is included in Appendix 3A.

Construction drawings shall be submitted for review by the local jurisdiction. The submittal and acceptance process shall be in accordance with the current local jurisdiction standards and specifications. Road and drainage plans shall include the local jurisdiction's standard notes for construction.

The road and drainage plans shall provide enough detail for a third party to be able to construct the proposed facilities per the engineer's design. At a minimum, the plans shall meet the local jurisdiction's design standards, and also provide the following information, per this Manual:

- Flow line and/or spot elevations, slopes, lengths, and cross sections of ditches;
- Rim elevations of inlet grates, drywells, and any other structure;
- A profile of the main line stormwater system (and connections, where applicable), showing size, material type, lengths of pipes (or culverts), and invert elevations. For lateral pipe connections to storm drain lines in existing rights-of-way, fixed invert elevations are preferred but not required; only a minimum depth from finish grade (i.e. grate elevation) to pipe invert and the minimum pipe slope must be provided. This allowance is made to account for potential conflicts with existing utilities in the right-of-way;
- Record drawing information, including invert elevations of the existing drainage system to which the drainage plan proposes to connect. Record drawing information should be field verified whenever possible;
- Construction details or a referenced standard drawing for all structures;
- Drainage easements with all survey information shown;
- Grading plan for drainage ponds/swales. The grading plan shall include

existing contours, proposed contours and catch points. A cross-section of each pond or swale shall be provided in the plans, showing pond/swale bottom elevation, maximum water surface elevation for the design storm(s), inlet and outlet elevations, berm elevation and slopes, and keyway location and dimensions;

- Each drainage pond/swale/dry well corner, pipe inlets and outlets, pipe system angle points, ditches, and drainage structures, shall be horizontally defined with respect to property corners, street stationing, or a coordinate system; and,
- Material gradation, thickness, and dimensions of riprap pads.

Post-Construction Downstream Analysis

The purpose of the downstream/down-gradient analysis is to inventory and map the downstream/down-gradient drainage features of concern and evaluate potential adverse impacts due to the proposed land action. Some of the common negative impacts of land development can be erosion, flooding, slope failures, changed runoff patterns and reduced groundwater recharge (to springs, streams, wetlands and wells, etc.). The proposed facilities shall be designed to mitigate the adverse impacts identified in the downstream/down-gradient analysis. Offsite drainage facilities, natural or constructed, need to be identified and evaluated as to their condition and capacity (i.e. collapsed culverts, substandard conveyance channels, etc.).

The downstream analysis should generally extend from the project site to the receiving water, but need not exceed one mile unless requested by the local jurisdiction. If the receiving water is within one-quarter mile of the project site, the analysis should extend within the receiving water one-quarter mile from the project site. For projects with subsurface discharge, the down-gradient analysis shall extend at least one-quarter mile from the project site.

A downstream/down-gradient analysis is required for all projects that require a drainage submittal. Projects that detain the 100-year storm event below pre-development levels do not need to conduct a downstream analysis. The level of detail required will vary depending upon the location of the project. In project areas where soils are well-draining, drainage problems have not been identified and land features that rely on groundwater recharge are not within the vicinity of the project site, the level of effort required to meet this requirement may be quite brief. Conversely, if the project is located in a Special Drainage Area (SDA) or known problem drainage area, as determined by the local jurisdiction, or non-standard disposal systems are proposed, or land features of concern have been identified downstream/down-gradient of the project site, the level of analysis should match the complexity of the site.

Note that a geotechnical engineer may be required to participate in the down-gradient portion of the study, if it requires expert knowledge with regard to subsurface hydrology.

For any existing or potential offsite drainage problems which are downstream or down-gradient of the project, it shall be demonstrated that the proposed

stormwater disposal system has been designed such that:

- The stormwater runoff leaves the site in the same manner and at the same location as in the pre-developed condition;
- It takes into account the necessity for groundwater recharge (reduced or increased), that may have the potential to adversely impact downstream/down-gradient land features;
- The proposed design does not aggravate an existing drainage problem nor create a new drainage problem; and,
- Underground injection facilities are not located in the following areas:
 - Within 200 feet of drinking water wells;
 - Within an abandoned septic tank or drain field; or
 - Where the injection may impact contaminated soil or a clean-up site.

At a minimum, this analysis shall include:

- A visual inspection of the site by the project proponent's Engineer that extends to where adverse impacts are anticipated to be negligible;
- A schematic which adequately identifies those areas that have been investigated (drawing/map/figure must include enough information for the reader/reviewer to recognize the areas analyzed, and the areas identified as being problematic);
- A written summary addressing the following items:
 - Existing or potential offsite drainage problems that may be aggravated by the project;
 - Undeveloped downstream/down-gradient property, that if developed, could be adversely impacted;
 - Information on the condition and capacity of the conveyance route, new or existing, that includes potential backwater conditions on open channels, constrictions or low capacity zones, surcharging of enclosed systems, or localized flooding;
 - Presence of existing natural or constructed land features that are dependent upon pre-developed surface and/or subsurface drainage patterns;
 - Potential adverse impacts to groundwater including, but not limited to, changes to the groundwater characteristics in the area whereby sub-level structures, foundations, or surface areas have increased amount or increased frequency or duration of groundwater intrusion;
 - Potential adverse impacts to natural or constructed drainage channels due to an increase in stormwater runoff;
 - Erosive conditions (existing or potential scour, landslide hazards, etc.) onsite or downstream/down-gradient of project;

- Slope stability or landslide areas, whether existing or where there is potential for failure; and,
- Flood hazard areas identified on Federal Emergency Management Agency (FEMA) maps.

The downstream/down-gradient analysis should be included as a section of the Drainage Report. However, if the study is extensive, it may be submitted as a separate document with the GSR as part of the overall Drainage Submittal.

Special Reports and Studies

Include any special reports and studies conducted to prepare the SSP (e.g. soil testing, wetlands delineation).

Replacement Costs

Depending upon the location and type of stormwater facility will have great impact on replacement costs. If you place a subsurface infiltration facility underneath parking lot; then a portion of the parking lot would have to be replaced in conjunction with the stormwater facility if it were to fail. Typically subsurface stormwater facilities generally cost more to replace than a surface facility especially if they have structural components.

3.1.3 - STEP 3 – PREPARE A STORMWATER EROSION & SEDIMENT CONTROL (ESC) PLAN

Erosion and Sediment Control, Core Element #7, must contain sufficient information to satisfy the local jurisdiction that the potential pollution problems have been adequately addressed for the proposed project. An adequate Construction ESC Plan includes a narrative and drawings. The narrative is a written statement that explains the pollution prevention decisions made for a particular project. The narrative contains concise information concerning existing site conditions, construction schedules, and other pertinent items that are not contained on the drawings. The drawings and notes describe where and when the various BMPs should be installed, the performance the BMPs are expected to achieve, and actions to be taken if the performance goals are not achieved.

The 12 Elements listed below must be considered in the development of the ESC plan unless site conditions render the element unnecessary and the exemption from that element is clearly justified in the narrative of the ESC plan. These elements are described in detail in Chapter 9. They cover the general water quality protection strategies of limiting site impacts, preventing erosion and sedimentation, and managing activities and sources. The 12 Elements are:

- Mark Clearing Limits
- Establish Construction Access
- Control Flow Rates
- Install Sediment Controls
- Stabilize Soils

- Protect Slopes
- Protect Drain Inlets
- Stabilize Channels And Outlets
- Control Pollutants
- Control De-Watering
- Maintain BMPs
- Manage the Project

A complete description of each Element and the BMPs applicable to particular Elements are given in Chapter 9.

On construction sites that discharge to surface water, the primary consideration in the preparation of the ESC Plan is compliance with the Water Quality Standards. The step-by-step procedure outlined in Chapter 9 is recommended for the development of these ESC Plans. A checklist is contained in Chapter 9 that may be helpful in preparing and reviewing the ESC Plan.

On construction sites that infiltrate all stormwater runoff, the primary consideration in the preparation of the ESC Plan is the protection of the infiltration facilities from fine sediments during the construction phase and protection of ground water from other pollutants. Several of the other elements are very important at these sites as well, such as marking the clearing limits, establishing the construction access, and managing the project.

3.1.4 - STEP 4 – PREPARE A MAINTENANCE PLAN AND AGREEMENT

An operations and maintenance plan and agreement must be prepared for all projects that use structural or nonstructural measures for stormwater control. The owner shall execute a stormwater maintenance agreement prior to the local jurisdiction granting final approval for the plan. The agreement shall be recorded with Bannock County and shall run with the land.

The stormwater maintenance agreement designates for the land development the owner, governmental agency, or other legally established entity (responsible party) the party that shall be permanently responsible for maintenance of the structural or non- structural measures required by the plan. The plan and agreement must pass the responsibility for such maintenance to successors in title.

In addition, the plan must authorize local jurisdiction representatives the right of entry for the purposes of inspecting all stormwater BMPs at reasonable times and in a reasonable manner.

The maintenance plan should ensure the continued performance of the maintenance obligations by including a list of inspection and maintenance tasks, a schedule for routine inspection and maintenance, actions to be taken when maintenance is required, and other items listed in this manual.

Maintenance access easements must be provided to ensure access from public right-of-way to stormwater management facilities and practices requiring regular maintenance at the site for the purpose of inspection and repair. Access must be sufficient in size for all equipment required for maintenance activities. Upon final inspection and approval, a plat or document indicating that such easements exist shall be recorded and shall remain in effect even with the transfer of title of the property.

3.2 PLANS REQUIRED AFTER STORMWATER SITE PLAN APPROVAL

This section includes the specifications and contents required of those plans submitted after the local government agency with jurisdiction has approved the original Stormwater Site Plan.

Stormwater Site Plan Changes

If the designer wishes to make changes or revisions to the originally approved stormwater site plan, the proposed revisions should be submitted to the local jurisdiction with review authority prior to construction. The submittals should include the following:

- Brief narrative description of the change and the purpose/ reason for the change.
- Substitute pages of the originally approved Stormwater Site Plan that include the proposed changes.
- Revised drawings showing structural changes.
- Other supporting information that explains and supports the reason for the change.

Final Corrected Plan Submittal

If the project included construction of conveyance systems, treatment facilities, flow control facilities, or structural source control BMPs, the applicant should submit a final corrected plan (Record Drawings) to the local government agency with jurisdiction when the project is completed. These should be engineering drawings that accurately represent the project as constructed. These corrected drawings must be legibly drafted revisions that are stamped, signed, and dated by a professional engineer licensed in the state of Idaho.

APPENDIX 3A – STORMWATER SITE PLAN CHECKLIST

Common address, parcel number(s), and legal description of site.			
STEP 1: Existing Conditions Evaluation (Chapter 3)	Y	N	N/A
Basin Map: A topographic map of existing site conditions			
• North arrow, scale and elevation datum			
• Drainage basin(s) boundaries and acreage			
• Soil types			
• Land cover of areas for each sub-basin affected by the project			
• All intermittent and perennial streams and other surface water features			
• All existing stormwater conveyances and structural control facilities			
• Direction of flow and exits from the site, maximum contour interval of 2 feet. <i>Contour intervals of less than 2 feet may be required in flat locations to demonstrate current and proposed drainage performance.</i>			
• Analysis of runoff provided by off-site areas upstream of the project site			
• Methodologies, assumptions, site parameters and supporting design calculations used in analyzing the existing conditions site hydrology			
Site limitations identified:			
• Areas with high potential for erosion and sediment deposition (based on soil properties, slope, etc.)			
• Locations of sensitive/ critical areas (e.g. vegetative buffers, wetlands, steep slopes, floodplains, geologic hazard areas, streams, etc.)			
• Observation of potential runoff contribution from off-site basins			
• Adjacent properties and (or) projects that have a history of stormwater problems, noting whether the cause of the problem(s) has been determined			
• Adjacent properties and (or) projects where geotechnical investigations have identified shallow bedrock, high groundwater, or clay lenses in the substrata.			
Geotechnical Site Characterization Report (GSR)			
Review of available geologic, topographic, and soils maps and ground water condition information (e.g. well logs, hydrogeologic maps, documented local project experience) for the site area and/or the construction of sub-level structures (i.e. basements or underground parking structures);			
Review of locations of nearby public and private wells, critical aquifer recharge areas, as well as any existing geotechnical engineering reports or studies for sites within the vicinity;			
An evaluation of the potential impacts from groundwater on the existing and proposed storm drainage facilities, roadways, and public infrastructure, including consideration of indications of a seasonally high groundwater table.			
Results of surface reconnaissance of the site and adjacent properties			
Potential impacts from the stormwater system assessed			
Conditions verified consistent with the mapped information			
Results of field exploration, test pits/bores, and, in some cases, laboratory testing, when subsurface disposal is proposed.			

STEP 2: Permanent Stormwater Control Plan	Y	N	N/A
Drainage Report			
A map and/or drawing or sketch of the stormwater management facilities			
• Lot grading elevations if modified from existing grade			
• Location of nonstructural site design features			
• Placement of existing and proposed structural stormwater controls			
• Design water surface elevations			
• Storage volumes available from zero to maximum head			
• Location of inlets, outlets, bypasses and discharge systems.			
• Orifice/restrictor sizes			
Narrative describing how the selected structural stormwater controls will be appropriate and effective			
Hydrologic and hydraulic analysis, including supporting calculations, demonstrating stormwater system performance for applicable design storms:			
• Conveyance facilities			
• Treatment facilities			
• Flow Control facilities			
Cross-section and profile drawings and design details for each of the structural stormwater controls in the system			
Documentation and supporting calculations to show that the Permanent Stormwater Control Plan adequately meets performance criteria			
Stormwater Construction Plans & Construction drawings showing:			
Elevations and hydraulic grade lines for all existing and proposed stormwater elements including, but not limited to:			
• Conveyance facilities (e.g. channels, pipes, culverts, catch basins)			
• Treatment BMPs			
• Flow Control BMPs (e.g. Detention Ponds)			
• Areas of overland flow			
• Other			
The location of existing underground and above-ground utilities			
Stationing of all inlets, culverts and pipe systems angle points			
Invert elevations of pipes at all structures such as catch basins or manholes			
Construction details for inlets, drywells, detention facilities, etc. (notes referring to standard plans may suffice where applicable)			
Drainage easements shown, depicting location, width, length, and facility access			
Post-Development Downstream Analysis			
Analysis extends downstream up to one (1) mile. If receiving water is within one-quarter mile, analysis extends within the receiving water to one-quarter mile from the project site.			
Analysis considers water quality, erosion, slope stability & drainage impacts.			
Analysis discusses appropriate mitigation of those impacts.			

STEP 3: Construction Phase ESC Plan (Chapter 9)	Y	N	N/A
EPA – Construction General Permit (CGP)			
Copy of NOI (copy of SWPPP does NOT need to be submitted to local jurisdiction)			
OR - Copy of Low Erosivity Waiver			
Local Jurisdiction ESC Plan			
ESC plan including:			
• ESC certified person identified			
• ESC Plan View			
• ESC Details			
• ESC Standard Notes			
• Plan contains information on the sequence/phasing of construction and temporary stabilization measures			
• Revegetation plan, including seed mix			
• Plan contains information on temporary structures that will be converted into permanent stormwater controls			

STEP 4: Operations & Maintenance Plan and Agreement (Chapter 10)			
Maintenance Agreement			
A Maintenance Agreement is required when:			
• The stormwater site plan requires structural or nonstructural measures.			
Agreement Components:			
• Responsible party identified			
• Plan passes such responsibility to any successor owner			
• Plan grants the local jurisdiction and its representatives the right of entry for the purposes of inspecting all stormwater BMPs at reasonable times and in a reasonable manner			
CC&Rs attached			
Financial plan included			
Agreement executed and recorded with Bannock County			
Operations and Maintenance (O&M) Manual			
• List of inspection responsibility & tasks			
• List of maintenance responsibility & tasks			
• Schedule for routine inspection and maintenance			
• Actions to be taken by responsible parties when maintenance is required			
• Maintenance access easements identified			

APPENDIX 3B – GRAIN SIZE DISTRIBUTION METHOD

PURPOSE AND APPLICABILITY

The Grain Size Distribution Method allows an engineer to estimate the permeability of a soil and normalized infiltration rates for designing drywells, infiltration ponds, and infiltration trenches using the results of laboratory soil gradation tests. Laboratory tests can also be performed to measure the saturated hydraulic conductivity of the soil sample. The method described below is generally acceptable for soils down to a particle size of very fine sands, including degraded pumice soils. *Soils finer than very fine sand, such as silts, tills, and ash, should have direct measurement of the saturated hydraulic conductivity done in the lab or field.*

Where soils are known to be uniform and deep, a professional engineer may elect to utilize this method as an alternative to any type of field infiltration test to initially assess the suitability of site soils for stormwater disposal. An appropriate Geotechnical Site Characterization, as discussed in Section 3.1.1, shall be conducted in conjunction with the laboratory testing. For newly constructed drywells and drill holes, a full-scale drywell or drill hole test is required prior to final construction acceptance in order to verify design infiltration rates, unless waived by the local jurisdiction.

PROCEDURE

1. Perform the field and laboratory testing as detailed in the minimum requirements found in Section 3.1.1.
2. Determine the subsurface conditions (i.e. thickness of target soil layer or approximate location of groundwater, impervious soil layer and/or limiting layer) to verify that the minimum requirements for the proposed facilities are met (see Section 6.4 and 6.6).
3. Determine the effective Grain Size Diameter, D_{10} , which is the grain diameter in mm corresponding to 10 percent passing by weight (10 percent of the sample by weight is smaller than D_{10}).
4. Estimate the hydraulic conductivity using the Hazen Formula:

$$k = C(D_{10})^2$$

Where: k = hydraulic conductivity (cm/sec)
 C = a constant and unit conversion factor equal to 0.7
 D_{10} = effective Grain Size Diameter (mm).

5. Calculate the approximate maximum drywell, infiltration trench, infiltration swale, or infiltration pond infiltration rate, q_A , using the following equation:

$$q_A = (k)(A) \text{ (make proper unit conversions to cfs)}$$

Where: q_A = infiltration rate
 A = the total infiltration area of the soil interface

The total infiltration area of the soil interface can be: (1) the walls and bottom area of the pit that the granular drywell bedding will be placed within; (2) the sidewall and bottom areas of infiltration trenches; (3) the infiltration area of a swale or pond. Note that this equation is generally acceptable for estimation purposes since studies have shown that, under ponding, the long term vertical infiltration rate of a soil usually approaches a steady value equal to the saturated hydraulic conductivity.

6. Determine the allowable design infiltration rates (q_p) by applying the appropriate factor of safety (FS) for the type of soil involved.

Table 3B-1: Required Safety Factors¹

GENERAL SOIL TYPE	SAFETY FACTOR
Clean medium to coarse gravel or equivalent (e.g. large granular volcanic pumice)	2.5 (with woven geotextiles) 5 (with non-woven geotextiles)
Fractured basalt	2.5
Sandy gravels or mixed granular pumice and coarse degraded pumice	3.3
Medium to coarse sands or coarse loose sandy pumice	3.3
Fine sands and finely degraded pumice	1.7
Silts, glacial till, volcanic ash, consolidated fine pumice	1.25

¹The safety factors noted in Table 3B-1 account for plugging of the infiltration system over time by sediments, debris, and slime. Sandy gravels, gravelly sands, medium sands, and coarse sands (and equivalent soils) have the highest safety factor because they are very susceptible to plugging by sediment in stormwater – a small amount of sediment will form a surface seal causing their permeability to drop greatly. Fine sands and equivalent soils have a fairly low permeability to begin with. Therefore, fine stormwater sediments do not reduce the permeability as much compared to their natural value, so the safety factor is not as great. Fine and consolidated soils such as silts, till, ash and consolidated (compacted) ash have a low natural permeability which is nearly the same as the permeability of fine stormwater sediments. Therefore, a lower safety factor can be used.

Two safety factors are provided for gravels to reflect the influence that geotextile selection can have on long term performance. It is common practice to use a geotextile liner between the native soil and the gravel bedding used for drywells and infiltration trenches. Drainage theory indicates that needle punched non-woven geotextiles (probably the most commonly used), should not be used in subsurface drainage applications where “dirty” water is involved (such as stormwater) due to their propensity to be quickly plugged with sediment, after which the plugged geotextile will control the infiltration rate. Generally it is advised that a woven geotextile with a high percent open area and relatively small opening size be used.

REPORT

1. Provide subsurface soil logs. Include photographs showing soil types encountered and the surrounding areas.
2. Report laboratory test data in a format that includes the sieve analysis graphically and in a tabular format.
3. Report the actual infiltration rates, design infiltration rates, and factors of safety. Include the equations, calculations, and assumptions used to compute the infiltration rates.
4. Provide name, title, and qualifications of person directing the test and providing the report.

APPENDIX 3C – FULL-SCALE DRYWELL/DRILL HOLE TEST

PURPOSE AND APPLICABILITY

The full-scale drywell drill hole test method determines the normalized infiltration rates for drywells and drill holes. This testing is required for all existing and newly constructed drywells or drill holes prior to construction certification, unless specifically waived by the local jurisdiction.

PROCEDURE

1. Install the drywell or drill hole as per the local jurisdiction's standard plans, specifications and applicable construction guidelines.
2. Inspect the drywell or drill hole and take photographs.
3. Before beginning the test, field check the accuracy of the flow meter by filling up a suitable container of known volume; for example, a calibrated 55-gallon barrel.
4. Introduce clean water into the drywell or drill hole. Monitor flow using an in-line flow meter.
5. If possible, raise the water level in the structure until it reaches the top of the active barrel section. In the case of structures interconnected by pipes, raise the water level to the invert elevation of the connecting pipe, or use an expandable pipe plug to seal the connecting pipe.
6. Monitor and record the flow rate required to maintain the constant head level in the drywell or drill hole at appropriate intervals. In no case shall the interval exceed 10 minutes in length.
7. Maintain the water level in the structure, by adjusting the flow rate, for a minimum of 2 hours or until a stabilized flow rate has been achieved, whichever is longer. Test time begins after the water level in the structure has reached the top of the active barrel section, or the invert elevation of any interconnecting pipes. The flow rate is considered stable when the water level in the structure is maintained and the incremental flow rate does not vary by more than 10 percent. (In any case, the total volume and rate injected into the drywell or drill hole does not need to exceed the design storm volume.)
8. Upon completion of the constant head period, discontinue flow, monitor and record the water level in the drywell or drill hole at intervals no more than 5 minutes in length, for a 30-minute time period. This time may need to be extended depending upon the soil performance.

CALCULATIONS

1. Calculate the actual potential maximum infiltration rate (q_A)

$$q_A = (Q/H)H_D \text{ (cfs)}$$

Where: Q = stabilized flow rate observed near the end of the constant-head portion of the test (cfs);
H = level of water within the drywell or drill hole (ft); and,
HD = maximum design drywell or drill hole head

2. Determine the design infiltration rates for a drywell or drill hole (q_D). Apply the appropriate factor of safety (FS), see Table 3B-1.

$$q_D = \frac{q_A}{FS} \text{ (cfs)}$$

Table 3C-1: Required Safety Factors¹

GENERAL SOIL TYPE	SAFETY FACTOR
Clean Medium to Coarse Gravel or Equivalent, such as Large Granular Volcanic Pumice;	2.5 (With Woven Geotextiles) 5 (With Non-Woven Geotextiles)
Fractured Basalt	2.5
Sandy Gravels or Mixed Granular Pumice and Coarse Degraded Pumice	3.3
Medium to Coarse Sands or Coarse Loose Sandy Pumice	3.3
Fine Sands and Finely Degraded Pumice	1.7
Silts, Glacial Till, Volcanic Ash, Consolidated Fine Pumice	1.25

¹See Table 3B-1 for notes on the development of safety factors.

REPORT

1. Report the condition of the drywell or drill hole. When applicable, include the following information:
 - General site, weather and drywell or drill hole conditions prior to the test;
 - Silt build-up;
 - Water level in the drywell or drill hole;
 - Connections to other structures;
 - Overall depth of the drywell or drill hole from finished grate to bottom;
 - Photographs taken of the drywell or drill hole during or after installation;
 - Distance from finished grate to the invert elevation of any inter-connecting pipes; and,
 - The length of the active barrel section. (the vertical length of the drywell or drill hole in contact with water during the test)
2. Report test data in a format that includes time of day, flow meter readings, incremental flow rates, observed head levels and water depths in the structure, and total flow volumes.
3. Report the actual infiltration rates, design infiltration rates, and factors of safety.
4. Provide any conclusions or recommendations.
5. Provide name, title, and qualifications of person directing the test and providing the report.

APPENDIX 3D – TEST PIT METHOD

PURPOSE AND APPLICABILITY

This test method is applicable for determining soil permeabilities for subsurface disposal systems incorporating such features as subsurface trenches, subsurface galleries, low-profile drywells, etc.

PROCEDURE

1. Perform the field and laboratory testing as detailed in the minimum requirements found in Section 3.1.1.
2. Determine the subsurface conditions (i.e. the thickness of target soil layer or approximate location of groundwater or impervious soil layer) to verify that the minimum requirements for the proposed facilities are met (See Section 6.6).
3. Excavate a rectangular test pit having approximate bottom dimensions of 2 feet wide by 4 feet long. Deepen the pit until its bottom elevation is approximately 2 - 5 feet below the bottom elevation of the proposed drainage structure. As practical, excavate the pit to clean dimensions, free of surface slough, organics, and other deleterious material.
4. Measure and record the dimensions (length, width, depth) of the test pit. Include photographs of the test pit both before and after the test.
5. Line the walls and bottom of the pit with a highly porous, non-woven, geotextile fabric. Install a vertical, PVC observation pipe in the pit. Then backfill the pit with clean, uniform, pervious, fine gravel; or clean, uniform, pervious, open-graded coarse gravel. The omission of the PVC observation pipe and pervious gravel backfill is an allowable practice if the test pit walls will not slough when water is introduced.
6. Introduce clean water into the test pit using an in-line, commercially available, flow meter. Prior to the test, field check the accuracy of the flow meter using a suitable container of known volume (i.e., 5 gallon bucket, 55 gallon barrel, etc).
7. Raise the water level in the pit until a level consistent with the operating head anticipated in the proposed drainage structure is achieved. Based upon the soil permeability, the subsurface soil profile, and the water supply system available, head levels lower than those anticipated in the drainage structure are permitted.
8. Adjust the flow rate as needed to maintain the constant head level in the pit. Minimum required test time is 2 hours or the time needed to discharge the expected design storm volume into the facility, whichever is shorter. (Note: In highly permeable soils it is possible that no ponding in the test pit will occur even for high flows. In such a case, assume a constant-head depth of 0.5 feet for calculation purposes.)
9. Monitor and record the flow rate required to maintain the constant-head level at appropriate intervals. In no case shall the interval exceed 15 minutes in length.

10. Continue maintaining the constant head until a stabilized flow rate has been achieved. Consider the flow rate stable when the incremental flow rate required to maintain the head does not vary by more than about 5 percent between increments. The intent of this section is to achieve a relatively steady-state flow condition between the minimum 2 hour test time and a maximum test time of 2½ hours. At the discretion of the onsite Engineer or engineering technician, the test may be extended beyond the 2½ hour maximum.
11. Upon completion of the constant-head period, discontinue flow, and monitor the head level drop in the drill hole at appropriate intervals over at least a 30-minute falling-head period.
12. Compute the permeability for the constant-head portion of the test using the simplified approach below or the methods outlined in the following: United States Bureau of Reclamation (USBR) Procedure 73000-89: Performing Field Permeability Testing by the Well Permeameter Method. And USBR Procedure 7305-89: Field Permeability Test (Shallow-Well Permeameter Method). Note: Utilize stabilized flow rates observed near the end of the constant-head period in the permeability calculations. See section 13.3 of USBR Procedure 7300-89 for test pit method.

CALCULATIONS

For ease of calculation purposes, a very simplified and conservative approach is allowed for estimating the maximum infiltration discharge (cfs) rate for dry wells, infiltration trenches, infiltration swales and infiltration ponds.

1. Calculate the normalized infiltration rate of the test pit (q_N):

$$q_N = \frac{Q / A}{H / 2} \text{ (cfs per ft}^2 \text{ per ft of head)}$$

Where:

Q	= stabilized flow rate observed near the end of the constant-head portion of the test (cfs);
A	= wetted bottom and sidewall area of the flooded test pit (ft ²); and,
H	= depth of water in the test pit.

2. Determine the approximate infiltration rate for the intended infiltration facility (q_f) using:

$$q_f = q_N A_f \frac{H_f}{2} \text{ (cfs)}$$

Where:

A_f	= wetted bottom and sidewall area of the intended facility (ft ²), some facilities may only have a bottom area; and,
H_f	= maximum depth of water for the intended facility.

3. Calculate the design infiltration rate (q_D):
Apply the appropriate factor of safety (FS), see Table 3C-1.

$$q_D = \frac{q_A}{FS} \text{ (cfs)}$$

4. Iterate through steps 2 and 3 until the facility infiltration area provides an allowable design infiltration rate that matches the design inflow rate calculated from the site hydrology.

Table 3C-1: Required Safety Factors¹

GENERAL SOIL TYPE	SAFETY FACTOR
Clean Medium to Coarse Gravel or Equivalent, such as Large Granular Volcanic Pumice	2.5 (With Woven Geotextiles) 5 (With Non-Woven Geotextiles)
Sandy Gravels or Mixed Granular Pumice and Coarse Degraded Pumice	3.3
Medium to Coarse Sands or Coarse Loose Sandy Pumice	3.3
Fine Sands and Finely Degraded Pumice	1.7
Silts, Glacial Till, Volcanic Ash, Consolidated Fine Pumice	1.25

¹See Table 3A-1 for notes on the development of safety factors.

REPORT

1. Provide a description of the equipment used to perform the test (including the type of flow meter and the results of the onsite flow meter accuracy check). When applicable, describe the type of fabric lining and gravel backfill used.
2. Describe any difficulties encountered during excavation and testing, including any surface sloughing
3. Provide subsurface soil logs of the test pits and surrounding areas and test pit dimensions. Include photographs showing the test pit and soil types encountered.
4. Report test data for both constant and falling head periods in a format that includes time of day, flow meter readings, incremental flow rates, observed head levels and water depths in the test pit, and total flow volumes.
5. Report the actual infiltration rates, design infiltration rates, and factors of safety. Include the equations, calculations, and assumptions used to compute the infiltration rates.

APPENDIX 3E – SINGLE-RING INFILTROMETER TEST

PURPOSE

The single-ring infiltrometer test method is applicable for estimating infiltration and permeability rates for surficial soils to verify drawdown times in bio-infiltration swales and detention ponds.

PROCEDURE

1. Drive, jack, or hand-advance a short section of steel or PVC pipe having a minimum inside diameter of 12 inches, and a beveled leading edge into the soil surface to a depth of about 8 inches, leaving approximately 12 inches of pipe exposed above the ground surface. If after installation the surface of the soil surrounding the wall of the ring shows signs of excessive disturbance such as extensive cracking or heaving, reset the ring at another location using methods that will minimize the disturbance. If the surface of the soil is only slightly disturbed, tamp the soil surrounding the inside and outside wall of the ring until it is as firm as it was prior to disturbance.
2. Before beginning the test, field check the accuracy of the flow meter by filling up a suitable container of known volume; for example, a 5-gallon bucket or a 55-gallon barrel.
3. Introduce clean water into the ring. Use a splash-guard or diffuser apparatus such as a highly porous, non-woven, geotextile fabric or a sheet of thin aluminum plate to prevent erosion of the surface of the soil during filling and testing. Monitor flow using an in-line flow meter.
4. Raise the water level in the ring until a head-level of at least 6 inches above the soil surface is achieved.
5. Monitor and record the flow rate required to maintain the constant head level at appropriate intervals. In no case shall the interval exceed 10 minutes in length.
6. Maintain the water level in the ring, by adjusting the flow rate, for a minimum of two (2) hours or until a stabilized flow rate has been achieved, whichever is longer. Test time begins after the water level in the ring has reached 6 inches above the soil surface. The flow rate is considered stable when the water level in the ring is maintained and the incremental flow rate does not vary by more than 5 percent.
7. Upon completion of the constant-head period, discontinue flow, monitor and record the water level in the ring at intervals, not more than 5 minutes in length, for a 30-minute period.
8. One single-ring infiltrometer shall be performed for every 1,200 square feet of bioinfiltration swale/pond bottom area or detention pond bottom area or every 300 feet of linear swale, with a minimum of one per swale/pond.

CALCULATIONS

1. Calculate the surface infiltration rate (I)

$$I = \frac{Q}{A} \text{ (ft/sec)}$$

Where: Q = stabilized flow rate observed near the end of the constant-head portion of the test (cfs); and,
A = area of soil inside the ring (ft²).

2. Compute the permeability rate (K)

$$K = \frac{(QL)}{(AH)} \text{ (ft / sec)}$$

Where: L = depth of soil contained within the ring (in);
A = area of soil inside the ring (ft²); and,
H = constant level of water within the ring, measured from the base of the ring to the free water surface (in).

REPORT

1. Provide a description of the equipment used to perform the test.
2. Describe any difficulties encountered during testing.
3. Provide subsurface soil logs of the test pits and surrounding areas, if available.
4. Report test data in a format that includes time of day, flow meter readings, incremental flow rates, observed head levels and water depths in the ring, and total flow volumes.
5. Provide name, title, and qualifications of person directing the test and providing the report.

REFERENCED DOCUMENTS

(United States Bureau of Reclamation (USBR) Drainage Manual: Section 3-8 Ring Permeameter Test)

APPENDIX 3F – SWALE FLOOD TEST

PURPOSE

The swale flood test verifies the path of flow into a swale and the drawdown time of the bioinfiltration swale. The flood test shall be conducted, when required, after the swale has been constructed and the vegetation has been established.

PROCEDURE

1. Introduce clean water into the swale by directing the water (via hose from a hydrant or other clean water source) along the curb and gutter upstream of the swale inlet.
2. Raise the water level in the swale until it reaches 6 inches in depth and note the time; this is the beginning of the flood test.
3. If the swale is draining rapidly, the progress is observed, and when the swale is empty, the time is documented, and the flood test has ended.
4. If the swale is not draining, measure the depth of water currently in the swale, documenting the time, and return to the swale site at a later time in order to verify that the swale has completely drained within 72 hours.

NOTE: Flood tests are performed by the project proponent in the presence of local jurisdiction staff. The project proponent will be notified should the swale fail to perform as designed (i.e. completely drain within 72 hours).

APPENDIX 3G – POND FLOOD TEST

PURPOSE

The pond flood test method verifies drawdown time of a stormwater disposal facility, such as an infiltration pond. The pond flood test shall be conducted, when required, after the pond has been constructed, and preferably after vegetation has been established.

PROCEDURE

1. Introduce clean water into the pond. Use some form of splash-guard or diffuser device to prevent surface erosion of the pond.
2. Raise the water level in the pond until it reaches operational depth; i.e. to the invert elevation of first outlet device (culvert, orifice, weir, etc.).
3. Document the time and measure the depth of water in the pond; this is the beginning of the pond flood test.
4. The progress of the pond's ability to drain is observed. If the pond appears to be emptying rapidly, as soon as the pond is empty, the time is documented, and the flood test has ended.
5. If the pond is not draining, or is draining very slowly, measure the depth of water currently in the pond, documenting the time, and return to the pond site at a later time in order to verify that the pond has completely drained within 72 hours.

Flood tests are performed by the project proponent in the presence of local jurisdiction staff. The project proponent will be notified should the pond fail to perform as designed (i.e. completely drain with 72 hours).

Some ponds will be large enough that a pond flood test may not be the most efficient method of determining drawdown time or infiltrative ability. Consideration may need to be given to other types of infiltrative test methods, such as the single-ring infiltrometer test as described in Appendix 3E. If the pond flood test is pursued for larger ponds, the local water purveyor must be contacted so that water service is not disrupted.

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CHAPTER 4

HYDROLOGIC

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4.1 INTRODUCTION

The purpose of this chapter is to provide the tools for estimating peak flow rates and volumes for sizing conveyance, treatment, and flow control facilities. Treatment facilities are designed to remove pollutants contained in stormwater runoff. Flow control facilities are necessary to mitigate potential adverse impacts on downstream/down-gradient properties due to the increase in stormwater runoff caused by land development.

Stormwater runoff from any proposed land development to any point of discharge downstream shall not exceed that of the pre-development condition, unless an exception is granted by the local jurisdiction.

Stormwater runoff from a developed site shall leave the site in the same manner and at the same location as in the pre-developed condition. Flow may not be concentrated onto downstream properties where sheet flow previously existed. Drainage shall not be diverted from a proposed development and released downstream at points not receiving stormwater runoff prior to the proposed development.

Non-standard systems shall be evaluated individually by the local jurisdiction and shall require a GSC report, a downstream analysis, and any additional information deemed necessary by the local jurisdiction. All engineering work shall be performed by, or under the direction of, a professional engineer.

4.2 HYDROLOGIC ANALYSIS METHODS

The following methods shall be used for the design of flow control and conveyance systems:

- The National Resource Conservation Service (NRCS) Curve Number Method¹ can be used to estimate peak flow rates and volumes;
- The Rational Method can be used to estimate peak runoff rates
- The Modified Rational Method (Bowstring Method) can be used to estimate peak flow rates and detention volumes;
- The Water Budget Method can be used to size evaporation facilities; and,
- Other hydrologic analysis methods appropriate to the site conditions and approved by the local jurisdiction.

Note that regardless of the methodology used, if utilizing a given method yields a runoff volume or rate that is incongruent with the physical site characteristics and stormwater runoff patterns, the Engineer will be required to provide support for why the results should be accepted by the local jurisdiction. The local jurisdiction shall reserve the ability to limit discharge rates and volumes into any publicly owned facilities.

4.2.1 PRECIPITATION DEPTHS

Table 4-1 lists regional average storm events with associated amounts in inches.

Projects in the City of Pocatello and City of Chubbuck (except at the Airport) shall use precipitation values from the Pocatello Creek rain gauge.

Table 4-1: 24-Hour Storm Depths for Selected Areas (inches)

AREA	6-MONTH ¹	2-YEAR	10-YEAR	24-YEAR	50-YEAR	100-YEAR
Pocatello Creek	0.5	0.92	1.41	1.67	1.87	2.07
Pocatello Airport	0.5	0.82	1.05	1.37	1.49	1.61

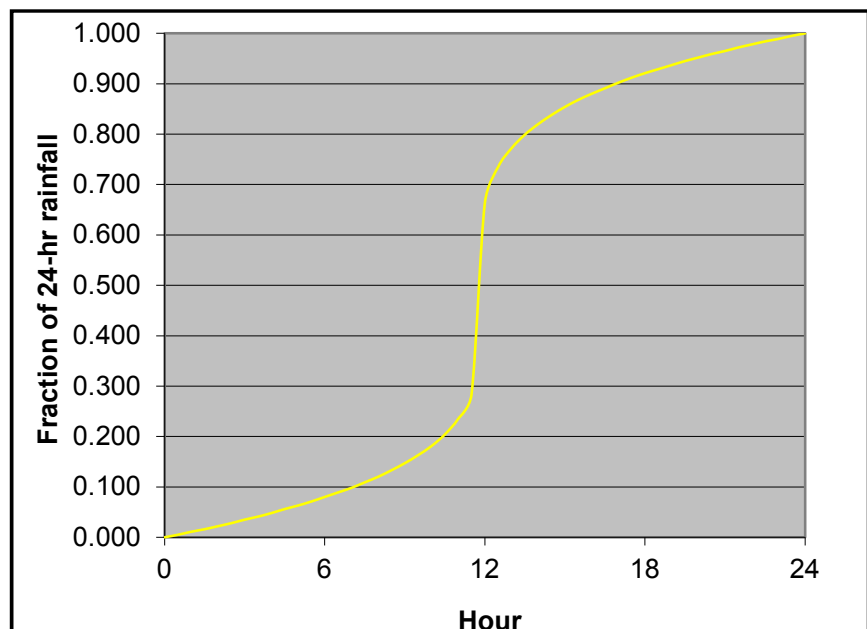
¹ Calculated as ~ 2/3 of the 2-year, 24-Hour storm depth

Source: Based on rainfall data from 1939-2014 (Airport) and 1956- 2013 (Pocatello Creek), Williams Engineering Inc. March, 2014.

4.2.2 DESIGN STORM DISTRIBUTIONS

- Short durations, high intensity, and smaller volumes relative to general storms characterize summer thunderstorms. The peak three hours of the NRCS Type II storm is the accepted storm distribution for flow based facilities.
- The full NRCS Type II 24 hour storm generates the greatest runoff volume. Use of this storm is appropriate for the design of stormwater retention and water quality treatment facilities where total runoff volume is the primary concern.

Figure 4-1: NRCS Type II 24-Hour Rainfall Distribution



4.3 CURVE NUMBER METHOD

Single event hydrograph methods such as the NRCS Curve Number Method can be used to develop hydrographs to estimate the peak flow rate and volumes for specific design storms. These methods can also be used with flow routing techniques to size detention facilities.

This section presents a general description of the NRCS Curve Number Method. For additional information refer to the NRCS National Engineering Handbook. Modeling with these methods is generally conducted using commercially available computer software packages.

4.3.1 NRCS CURVE NUMBER METHOD THEORY

In general, the rainfall-runoff equation of the NRCS Curve Number Method relates a land area's runoff depth (precipitation excess) to the precipitation it receives and to its natural storage capacity. The amount of runoff from a given watershed is solved with the following equations:

NRCS Curve Number Equation

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

NRCS Rainfall Excess Equation

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

$$Q = 0 \text{ for } P < 0.2S$$

Where: S = maximum storage volume of water on and within the soil (in);
 CN = curve number (dimensionless).
 Q = runoff depth (in); multiply by drainage area to determine runoff volume
 P = precipitation (in); and
 $0.2S$ = initial abstraction; the fractional amount estimated as intercepted, evaporated and/or absorbed by the soil (in).

The NRCS Curve Number Method has the following limitations:

- When the calculated depth of runoff is less than 0.5 inch, another method shall be used, as approved by the local jurisdiction;
- When $(P - 0.2S)$ is a negative number, another method shall be used, as approved by the local jurisdiction;
- When the weighted curve number is less than 40, another method shall be used, as approved by the local jurisdiction;

- For additional limitations, see NRCS publication 210-VI-TR-55, Second Edition, June 1986; and,
- Local jurisdictions reserve the ability to limit discharge to public facilities.

Note that regardless of the methodology used, if utilizing a given method yields a runoff volume or rate that is incongruent with the physical site characteristics, the engineer will be required to provide support for why the results should be accepted.

4.3.2 DESIGN STEPS

The following steps are based on the assumption that the Engineer uses a software package that utilizes the NRCS Curve Number. If hand calculations are proposed, the engineer can consult currently available technical publications on hydrograph routing for additional information. Additional calculation details are provided in sections 4.3.3 through 4.3.8.

1. Determine the pre-developed and post-developed drainage basin boundaries and identify permeable and impervious areas per Section 4.3.3;
2. Determine the hydrologic soil group classification(s) per Section 4.3.4 and correlate to the drainage basin boundaries;
3. Identify the appropriate land use(s) within the delineated basins and select CN values for each of the pre-developed and post-developed basins per Section 4.3.5;
4. Determine the time of concentration per Section 4.3.6 for both pre-developed and post-developed conditions;
5. Determine the precipitation (Section 4.3.7) for the required design storms specified in Chapter 2 and input into software program;
6. Select the appropriate storm type in the software program or enter the hyetograph as necessary (Section 4.3.8). For the Portneuf Valley use: 1) the NRCS Type II, 24-hour storm for volume-based facility calculations; and 2) the peak 3 hours of the NRCS Type II 24 hour storm for all flow based facility calculations.
7. Set the routing and hydrograph time increments in the computer software program to six-minutes or less;
8. Compute peak flow rates and volumes for the pre-developed basins and determine the allowable release rates per the design criteria specified in Chapter 2;
9. Compute peak flow rates and volumes for the post-developed basins, assuming no flow control (retention/detention/infiltration) facilities have been installed to mitigate flows;
10. Compute the surface area or volume at incremental stages (heights) of the drainage facility, beginning at the bottom of the anticipated drainage facility to an elevation at least 1 foot above the overflow;
11. Input the elevation and storage volume relationship into the software program;

12. For infiltration facilities, determine soil infiltration rate in accordance with Chapter 5;
13. Input the geometry of the anticipated outflow structures (i.e. weirs, orifices, etc.) into the software program;
14. Create basin links for combining and/or routing basin hydrographs to the proposed facility. Links may have routing elements, such as pipes or channels;
15. Using the hydrographs of the post-developed basins, combine and route the hydrographs to the drainage facility and route the inflow hydrograph through the facility; and,
16. Verify that the release from the site does not exceed the allowable release rate (or volume, when required), as determined in step 8. Modify the pond geometry and outflow structure input data if the results indicate that the allowable thresholds are exceeded.

4.3.3 BASIN AREAS

The basin modeling (drainage areas and assumptions) needs to reflect the actual runoff behavior as closely as feasible. The impervious and permeable areas must be estimated from best available plans, topography, or aerial photography, and verified by field reconnaissance.

4.3.4 HYDROLOGIC SOIL GROUP CLASSIFICATION

The NRCS has classified over 4,000 soil types into the following four soils groups listed below. For local soil data (based on the 1987 Soil Survey of Bannock County by the NRCS), refer to the Pocatello Maps webpage at the following link: <https://webmap.pocatello.us/public/> Additionally, the NRCS provides an interactive online soils mapping tool at <http://websoilsurvey.nrcs.usda.gov/>.

Group A soils have high infiltration rates, even when thoroughly wetted, and consist chiefly of deep, well-to-excessively drained sands or gravels. These soils have a high rate of water transmission and low runoff potential.

Group B soils have moderate infiltration rates when thoroughly wetted, and consist chiefly of moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission and moderately low runoff potential.

Group C soils have slow infiltration rates when thoroughly wetted, and consist chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine textures. These soils have a slow rate of transmission and moderately high runoff potential.

Group D soils have very slow infiltration rates when thoroughly wetted, and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a hardpan or clay layer at or near the surface, and shallow soils over nearly impervious materials. These soils have a very slow rate of transmission and high runoff potential.

4.3.5 CURVE NUMBERS

Curve Numbers (CNs) indicate the runoff potential of a watershed. The higher the CN value, the higher the potential for runoff. The CN takes into consideration the hydrologic soil group, land use, and cover.

Weighting CNs

Connected impervious areas can include driveways and adjacent sidewalks discharging directly into the drainage system without first traversing an area of permeable ground. Connected impervious areas shall not be weighted with permeable areas.

Unconnected impervious areas are defined as those that discharge over a permeable area as sheet flow, such as a tennis court in the middle of a lawn or runoff from roofs flowing over lawn. Unconnected impervious areas can be weighted with permeable areas.

Basin configurations shall be consistent with surface runoff patterns. For example, the roof and lawn areas of residential neighborhoods can be combined and considered one basin when the roof runoff travels through the lawn before getting to the streets.

The driveway and street areas should be combined, as they are typically hydraulically connected and should be considered a separate basin. The impervious and permeable hydrographs shall then be linked with or without a routing element, such as a pipe or a channel.

In most cases, if permeable areas within the same basin have CN values that differ by more than 20 points, separate hydrographs shall be generated for each and the hydrographs shall be combined.

Table 4-1 lists CNs values for agricultural, suburban, and urban land use classifications. See NRCS publication 210-VI-TR-55 for additional CN values. For an example of weighting CNs and addressing both connected and unconnected impervious areas refer to Appendix 5D.

Antecedent Runoff Condition – Curve Number Adjustment

The moisture condition in a soil prior to a storm event is referred to as the antecedent runoff condition (ARC). The NRCS developed three antecedent runoff conditions:

- ARC I (Dry Condition): soils are dry but surface cracks are not evident.
- ARC II (Average Condition): soils are not dry or saturated. The CN values listed in Table 4-1 are applicable under this condition and do not account for snowmelt or runoff on frozen ground conditions.
- ARC III (Wet Condition): soils are saturated or near saturation due to heavy rainfall or light rainfall and low temperatures within the last 5 days.

The design of detention or infiltration ponds shall be based on ARC II. When ARC III applies, such as when designing evaporation facilities or modeling the winter months (Section 4.7.4), Table 4-2 shall be used to adjust the CN values.

Table 4-2: Runoff Curve Numbers - Antecedent Runoff Condition (ARC) II

Cover Type And Hydrologic Condition	Hydrologic Soil Group			
	A	B	C	D
Open Space (lawns, parks, golf courses, cemeteries, landscaping, etc.): ¹				
Poor condition (grass cover <50% of the area)	68	79	86	89
Fair condition (grass cover on 50% to 75% of the area)	49	69	79	84
Good condition (grass cover on >75% of the area)	39	61	74	80
Impervious Areas:				
Open water bodies: lakes, wetlands, ponds, etc.	100	100	100	100
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	98	98	98	98
Streets and Roads:				
Paved: curbs and storm sewers (excluding right-of-way)	98	98	98	98
Paved: open ditches/swales (including right-of-way)	83	89	92	93
Gravel (including right-of-way)	76	85	89	91
Dirt (including right-of-way)	72	82	87	89
Porous Pavers and Permeable Interlocking Concrete (assume 85% impervious and 15% fair condition lawn):	91	94	95	96
Urban Districts:				
Commercial and Business (average 85% impervious)	89	92	94	95
Industrial (average 72% impervious)	81	88	91	93
Residential Districts By Average Lot Size:				
1/8 acre or less or townhouses (average 65% impervious)	77	85	90	92
1/4 acre (average 38% impervious)	61	75	83	87
1/3 acre (average 30 % impervious)	57	72	81	86
1/2 acre (average 25% impervious)	54	70	80	85
1 acre (average 20% impervious)	51	68	79	84
2 acres (average 12% impervious)	46	65	77	82
Newly graded areas (pervious areas only, no vegetation)	77	86	91	94
Farmsteads – buildings, lanes, driveways, and surrounding lots	59	74	82	86
Pasture, Grassland, or Range-Continuous Forage for Grazing:				
Poor condition (ground cover <50% or heavily grazed with no mulch)	68	79	86	89
Fair condition (ground cover 50% to 75% and not heavily grazed)	49	69	79	84
Good condition (ground cover >75% and lightly or only occasionally grazed)	39	61	74	80
Meadow (continuous grass, protected from grazing and generally mowed for hay)	30	58	71	78
Cultivated Agricultural Lands:				
Row Crops (good) e.g. corn, sugar beets, soy beans	64	75	82	85
Small Grain (good) e.g. wheat, barley, flax	60	72	80	84

Table 4-2: Runoff Curve Numbers - Antecedent Runoff Condition (ARC) II

Cover Type And Hydrologic Condition	Hydrologic Soil Group			
	A	B	C	D
Woods:				
Poor (Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning)	45	66	77	83
Fair (Woods are grazed but not burned, and some forest litter covers the soil)	36	60	73	79
Good (Woods are protected from grazing, and litter and brush adequately cover the soil)	30	55	70	77
Brush-Weed-Grass Mixture (with brush the major element):				
Poor (<50% ground cover)	48	67	77	83
Fair (50% to 75% ground cover)	35	56	70	77
Good (>75% ground cover) ²	30	48	65	73
Herbaceous (mixture of grass, weeds, and low-growing brush, with brush the minor element) ³ :				
Poor (<30% ground cover)		80	87	93
Fair (30% to 70% ground cover)		71	81	89
Good (>70% ground cover)		62	74	85
Pinyon-Juniper (pinyon, juniper, or both; grass understory) ³ :				
Poor (<30% ground cover)		75	85	89
Fair (30% to 70% ground cover)		58	73	80
Good (>70% ground cover)		41	61	71
Sagebrush With Grass Understory ³ :				
Poor (<30% ground cover)		67	80	85
Fair (30% to 70% ground cover)		51	63	70
Good (>70% ground cover)		35	47	55

¹ Composite CNs may be computed for other combinations of open space cover type.

² Actual curve number is less than 30; use CN = 30 for runoff computations.

³ Curve numbers have not been developed for group A soils.

Table 4-3: Antecedent Runoff Condition (ARC)

CN ARC II	CN ARC I	CN ARC III		CN ARC II	CN ARC I	CN ARC III
100	100	100		76	58	89
99	97	100		75	57	88
98	94	99		74	55	88
97	91	99		73	54	87
96	89	99		72	53	86
95	87	98		71	52	86
94	85	98		70	51	85
93	83	98		69	50	84
92	81	97		68	48	84
91	80	97		67	47	83
90	78	96		66	46	82
89	76	96		65	45	82
88	75	95		64	44	81
87	73	95		63	43	80
86	72	94		62	42	79
85	70	94		61	41	78
84	68	93		60	40	78
83	67	93		59	39	78
82	66	92		58	38	76
81	64	92		57	37	75
80	63	91		56	36	75
79	62	91		55	35	74
78	60	90		54	34	73
77	59	89		50	31	70

Curve Number Conversions for different ARC are for the case of $I = 0.2$ S. **Source:** NRSC-National Engineering Handbook

4.3.6 TIME OF CONCENTRATION

Time of concentration is affected by the way stormwater moves through a watershed. Stormwater can move in the form of sheet flow, shallow concentrated flow, open channel flow, or some combination of these. The type of flow should be verified by field inspection.

The time of concentration for rainfall shall be computed for all overland flow, ditches, channels, gutters, culverts, and pipe systems. When using the NRCS Curve Number the time of concentration for the various surfaces and conveyances shall be computed using the procedures presented in this section, these procedures are based on methods described in NRCS publication 210-VI-TR-54.

Travel time (T_t) is the time it takes stormwater runoff to travel from one location to another in a watershed. Time of concentration (T_c) is the time for stormwater runoff to travel from the hydraulically most distant point to the point of discharge of a watershed. T_c is computed by adding all the travel times for consecutive components of the drainage conveyance system as given by the following equation:

$$T_c = T_{t1} + T_{t2} + \dots T_{tn}$$

Where: T_c = time of concentration (min); (minimum 5 minutes)
 n = number of flow segments; and
 T_t = travel time (min) is the ratio of flow length to flow velocity given by:

$$T_t = \frac{L}{60V}$$

Where: L = flow length (ft);
 V = average velocity (ft/s); and,
 60 = conversion factor (seconds to minutes).

T_c influences the shape and peak of the runoff hydrograph. Urbanization usually decreases T_c , thereby increasing the peak discharge. But T_c can be increased as a result of ponding behind small or inadequate drainage systems, including storm drain inlets and road culverts, or reduction of land slope through grading. Note: the minimum T_c for any runoff calculations should be 5 minutes.

Sheet Flow

Sheet flow is flow over plane surfaces and shall not be used over distances exceeding 300 feet. Use Manning's kinematic solution to directly compute T_t :

$$T_t = \frac{0.42(n_s L)^{0.8}}{(P_2)^{0.5} (S_0)^{0.4}}$$

Where: T_t = travel time (min);
 n_s = Manning's effective roughness coefficient for sheet flow (use Table 4-4);
 L = flow length (ft);
 P_2 = 2-year, 24-hour rainfall (in); and,
 S_0 = slope of hydraulic grade line (land slope, ft/ft).

The friction value (n_s) is used to calculate sheet flow. The friction value is Manning's effective roughness coefficient modified to take into consideration the effect of raindrop impact; drag over the plane surface; obstacles such as litter, crop ridges, and rocks; and erosion and transportation of sediment. The n_s val-

ues are for very shallow flow depths of about 0.1 foot and are only used for travel lengths up to 300 feet. Table 4-4 gives Manning's n_s values for sheet flow for various surface conditions.

Shallow Concentrated Flow

After 300 feet, sheet flow is assumed to have developed into shallow concentrated flow. The average velocity is calculated using velocity equation below.

Velocity Equation

A commonly used method of computing average velocity of flow, once it has measurable depth, is the following equation:

$$V = k\sqrt{S_o}$$

Where: V = velocity (ft/s);
 k = k_s or k_c , time of concentration velocity factor (ft/s); and,
 S_o = slope of flow path (ft/ft).

Table 4-4 provides “ k ” for various land covers and channel characteristics with assumptions made for hydraulic radius. For flow situations not addressed in Table 4-4, calculate “ k ” using the following equation:

$$k = \frac{1.49R^{2/3}}{n}$$

Where: R = hydraulic radius; and,
 n = Manning's roughness coefficient for open channel flow (Table 4-4 or 4-5).

Open Channel Flow

Open channels are assumed to exist where channels are visible on aerial photographs, where streams appear on United States Geological Survey (USGS) quadrangle sheets, or where topographic information indicates the presence of a channel. The k_c values from Table 4-4 (used in the above velocity equation) or water surface profile information can be used to estimate average flow velocity. Average flow velocity is usually determined for bank-full conditions. After average velocity is computed the travel time (T_t) for the channel segment can be computed.

**Table 4-4: Friction Values (n and k)
for Computing Time of Concentration**

SHEET FLOW ¹	n_s
Bare sand	0.010
Smooth surfaces (concrete, asphalt, gravel, or bare hard soil)	0.011
Asphalt and gravel	0.012
Fallow fields of loose soil surface (no vegetal residue)	0.05
Cultivated soil with crop residue (slope < 0.20 ft/ft)	0.06
Cultivated soil with crop residue (slope > 0.20 ft/ft)	0.17
Short prairie grass and lawns	0.15
Dense grass	0.24
Bermuda grass	0.41
Range, natural	0.13
Woods or forest, poor cover	0.40
Woods or forest, good cover	0.80
SHALLOW, CONCENTRATED FLOW	k_s
Forest with heavy ground litter and meadows (n = 0.10)	3
Brushy ground with some trees (n = 0.06)	5
Fallow or minimum tillage cultivation (n = 0.04)	8
High grass (n = 0.035)	9
Short grass, pasture and lawns (n = 0.030)	11
Newly-bare ground (n = 0.025)	13
Paved and gravel areas (n = 0.012)	27
CHANNEL FLOW (INTERMITTENT, R = 0.2)	k_c
Forested swale with heavy ground litter (n=0.10)	5
Forested drainage course/ravine with defined channel bed (n=0.050)	10
Rock-lined waterway (n=0.035)	15
Grassed waterway (n=0.030)	17
Earth-lined waterway (n=0.025)	20
CMP pipe (n=0.024)	21
Concrete pipe (n=0.012)	42
Other waterways and pipes	0.508/n
CHANNEL FLOW (CONTINUOUS STREAM, R = 0.4)	k_c
Meandering stream with some pools (n=0.040)	20
Rock-lined stream (n=0.035)	23
Grassed stream (n=0.030)	27
Other streams, man-made channels and pipe	0.807/n

¹ These values were determined specifically for overland (sheet) flow conditions and are not appropriate for conventional open channel flow calculations.

Source: WSDOT Hydraulics Manual, March 2004; Engman (1983) and the Florida Department of Transportation Drainage Manual (1986).

**TABLE 4-5: SUGGESTED VALUES OF THE MANNING'S ROUGHNESS
COEFFICIENT "n" FOR CHANNEL FLOW**

TYPE OF CHANNEL AND DESCRIPTION		"n" ¹	TYPE OF CHANNEL AND DESCRIPTION		"n" ¹
A. CONSTRUCTED CHANNELS			7. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush		0.100
a. Earth, straight and uniform					
1. Clean, recently completed	0.018				
2. Gravel, uniform selection, clean	0.025	b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
3. With short grass, few weeds	0.027				
b. Earth, winding and sluggish					
1. No vegetation	0.025	1. Bottom: gravel, cobbles and few boulders		0.040	
2. Grass, some weeds	0.030	2. Bottom: cobbles with large boulders		0.050	
3. Dense weeds or aquatic plants in deep channels	0.035	B-2 Flood Plains			
4. Earth bottom and rubble sides	0.030	a. Pasture, no brush			
5. Stony bottom and weedy banks	0.035	1. Short grass		0.030	
6. Cobble bottom and clean sides	0.040	2. High grass		0.035	
c. Rock lined		b. Cultivated areas			
1. Smooth and uniform	0.035				
2. Jagged and irregular	0.040				
d. Channels not maintained, weeds and brush uncut		1. No crop		0.030	
1. Dense weeds, high as flow depth	0.080	2. Mature row crops		0.035	
2. Clean bottom, brush on sides	0.050	3. Mature field crops		0.040	
3. Same, highest stage of flow	0.070	c. Brush			
4. Dense brush, high stage	0.100	1. Scattered brush, heavy weeds		0.050	
B. NATURAL STREAMS		2. Light brush and trees		0.060	
B-1 Minor Streams (top width at flood stage < 100ft.)		3. Medium to dense brush		0.070	
a. Streams on plain		4. Heavy, dense brush		0.100	
		d. Trees			
1. Clean, straight, full stage, no rifts or deep pools	0.030	1. Dense willows, straight		0.150	
2. Same as above, but more stones and weeds	0.035	2. Cleared land with tree stumps, no sprouts		0.040	
3. Clean, winding, some pools and shoals	0.040	3. Same as above, but with heavy growth of sprouts		0.060	
4. Same as above, but some weeds	0.045	4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches		0.100	
5. Same as 4, but more stones	0.050	5. Same as above, but with flood stage reaching branches		0.120	
6. Sluggish reaches, weedy deep pools	0.070				

¹The "n" values presented in this table are the "Normal" values as presented in Chow (1959). For an extensive range and for additional values refer to Chow (1959).

4.4 RATIONAL METHOD

The rational method is used to predict peak flows for small undeveloped or developed drainage areas. The rational method can be used for the design of conveyance, flow control, and subsurface infiltration facilities. The greatest accuracy is obtained for areas smaller than 10 acres and for developed conditions with large impervious areas. In the Portneuf Valley, the Rational Method is recommended for small projects (less than 25 acres) in urbanized areas. For larger basins, the Curve Number Method in Section 4.3 should be used whenever possible. The rational method peak flow rate is calculated using the following equation:

$$Q_p = CIA$$

Where: Q_p = peak flow rate (cfs);
 C = runoff coefficient (dimensionless units);
 I = rainfall intensity (in/hr); and,
 A = drainage area (acres).

Calculation details are provided in the Section 4.4.1 through 4.4.3. An example runoff calculation using the Rational Method is included as steps 1-4 in the Bowstring Method example in Appendix 4C.

4.4.1 RUNOFF COEFFICIENTS

Table 4-6 provides runoff coefficients for the 10-year storm frequency. Less frequent, higher intensity storms require the use of higher coefficients because infiltration and other losses have a proportionally smaller effect on runoff. When designing for a 24-, 50-, or 100-year frequency, runoff coefficients should be increased by 10 percent, 20 percent, and 25 percent respectively. Runoff coefficients shall not be increased above 0.95. Higher values may be appropriate for steeply sloped areas and/or longer return periods, because in these cases infiltration and other losses have a proportionally smaller effect on runoff.

Table 4-6: Runoff Coefficients for the Rational Method - 10-Year Return Frequency¹

TYPE OF COVER	FLAT (<2%)	ROLLING (2% - 10%)	HILLY (>10%)
Pavement and Roofs	0.90	0.90	0.90
Earth Shoulders	0.50	0.50	0.50
Drives and Walks	0.75	0.80	0.85
Gravel Pavement	0.85	0.85	0.85
City Business Areas	0.80	0.85	0.85
Apartment Dwelling Areas	0.50	0.60	0.70
Light Residential: 1 to 3 units/acre	0.35	0.40	0.45
Normal Residential: 3 to 6 units/acre	0.50	0.55	0.60
Dense Residential: 6 to 15 units/acre	0.70	0.75	0.80
Lawns	0.17	0.22	0.35
Grass Shoulders	0.25	0.25	0.25
Side Slopes, Earth	0.60	0.60	0.60
Side Slopes, Turf	0.30	0.30	0.30
Median Areas, Turf	0.25	0.30	0.30
Cultivated Land, Clay and Loam	0.50	0.55	0.60
Cultivated Land, Sand and Gravel	0.25	0.30	0.35
Industrial Areas, Light	0.50	0.70	0.80
Industrial Areas, Heavy	0.60	0.80	0.90
Parks and Cemeteries	0.10	0.15	0.25
Playgrounds	0.20	0.25	0.30
Woodland and Forest	0.10	0.15	0.20
Meadow and Pasture Land	0.25	0.30	0.35
Unimproved Areas	0.10	0.20	0.30

Source: ODOT Hydraulics Manual, June 2006

¹When designing for the 25-, 50-, or 100-year storm events, increase the runoff coefficients by 10%, 20%, and 25% respectively. Coefficients should not exceed 0.95.

4.4.2 TIME OF CONCENTRATION

The travel time, the time required for flow to move through a flow segment, shall be computed for each flow segment. The flow path for each basin should be divided into segments representing different land cover and flow types (i.e. overland flow through grass vs. shallow gutter flow). The time of concentration is equal to the sum of the travel times for all flow segments. As with the Curve Number method, any overland flow segments should be limited to 300 feet in length.

The procedure described below was developed by the NRCS. It is sensitive to slope, type of ground cover, and the size of channel. The time of concentration can be calculated as follows:

$$T_t = \frac{L}{K\sqrt{S}}$$

$$T_c = T_{t1} + T_{t2} + \dots + T_{tn}$$

Where:

- T_t = travel time of flow segment (min);
- T_c = time of concentration (min);
- L = length of segment (ft);
- K = ground cover coefficient, Table 4-7 (ft/min);
- S = slope of segment (ft/ft); and,
- n = number of flow segments.

The time of concentration for any one basin shall not be less than 5 minutes. An example time of concentration calculation is provided in Step 2 of Appendix 4C. For a few drainage areas, the time of concentration that produces the largest amount of runoff is less than the time of concentration for the entire basin. This can occur when two or more basins have dramatically different types of cover. The most common case would be a large paved area together with a long narrow strip of natural area. In this case, the Engineer shall check the runoff produced by the paved area alone to determine if this scenario would cause a greater peak runoff rate than the peak runoff rate produced when both land segments are contributing flow. The scenario that produces the greatest runoff shall be used, even if the entire basin is not contributing flow to this runoff.

Table 4-7: Ground Cover Coefficients

TYPE OF COVER	K (ft/min)
Forest With Heavy Ground Cover	150
Minimum Tillage Cultivation	280
Short Pasture Grass Or Lawn	420
Nearly Bare Ground	600
Small Roadside Ditch W/Grass	900
Paved Area	1,200
Gutter Flow:	
4 inches deep	1,500
6 inches deep	2,400
8 inches deep	3,100
Storm Sewers:	
12 inch diameter	3,000
18 inch diameter	3,900
24 inch diameter	4,700
Open Channel Flow (n = .040):	
12 inches deep	1,100
Narrow Channel (w/d =1):	
2 feet deep	1,800
4 feet deep	2,800
Open Channel Flow (n = .040):	
1 foot deep	2,000
Wide Channel (w/d =9):	
2 feet deep	3,100
4 feet deep	5,000

Source: WSDOT Hydraulics Manual, March 2004;

4.4.3 INTENSITY

Rainfall intensity is related to rainfall duration and the recurrence interval (or frequency) of the design storm. Rainfall Intensity-Duration-Frequency Interval (IDF) curves for the Portneuf Valley are as provided in Appendix 4A.

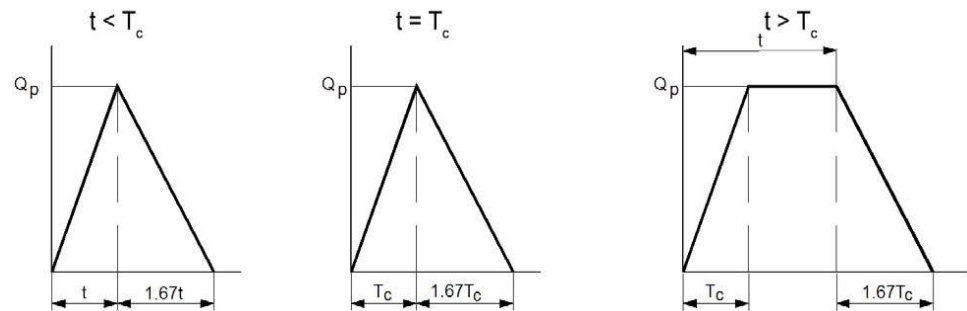
For each project, first determine the appropriate curve to use based on the project location and the IDF Curve Map. Then calculate the appropriate rainfall intensity for each basin based on the time of concentration (T_c) calculated in Section 4.4.2 and the desired storm recurrence interval. Curves are provided for the 2, 5, 10, 25, 50, and 100-year storm events.

4.4.4 BOWSTRING METHOD

This method is used to estimate storage requirements for a given design storm using a series of hydrographs for different storm durations (t). It is recommended for small projects (under 25 acres) in urbanized areas. Larger projects should use the NRCS Curve Number Method.

Depending on the relative magnitude of the time of concentration (T_c) and the storm duration, the shape of the hydrograph generated with this method varies from triangular to trapezoidal (see Figure 4.2).

FIGURE 4-2 BOWSTRING HYDROGRAPH



The recession period (T_R) of the hydrograph is given by the following equation:

$$T_R = 1.67T_p$$

Where:

$$T_p = \begin{cases} T_c, & \text{when } t \geq T_c; \text{ or} \\ t, & \text{when } t < T_c. \end{cases}$$

The volume (V) under the hydrograph at a given time (t) is given by:

$$V(t) = 1.34Q_p t \text{ for } t \leq T_c \text{ (triangular hydrograph)}$$

$$V(t) = Q_p t + 0.34Q_p T_c \text{ for } t > T_c \text{ (trapezoidal hydrograph)}$$

With these equations, the base of the triangular hydrograph is equal to $2.67t$. For the trapezoidal hydrograph, the time base is $t + 1.67T_c$. The top width of the trapezoid is equal to $t - T_c$. With this method, the hydrograph for each storm duration is overlaid with the outflow hydrograph. The outflow hydrograph is given by the following equation:

$$V_{OUT}(t) = Q_{OUT} t$$

The critical storm duration is the storm duration that results in the maximum required flow control storage.

DESIGN STEPS

The following steps outline how to use the spreadsheet referenced in Appendix 4C. The spreadsheet was created specifically for projects in the Portneuf Valley. Users of spreadsheet must understand input data, output results and must certify that results are accurate regardless of spreadsheet output. The highlighted fields in the spreadsheet require input or consideration of the designer. An example of the spreadsheet input and results for a sample project site is shown in Appendix 4C.

For detention and retention pond design using the Bowstring Method, the following procedure can be used:

1. Determine the weighted Runoff Coefficient (C) for the post-developed condition. Refer to Table 4-2.
2. Calculate Time of Concentration (T_c) using Rational Method. Refer to Section 4.3.6. T_c shall not be less than 5 minutes.
3. Calculate Intensity (I) for T_c . Refer Section 4.4.3 and Appendix 4A.
4. Compute flow rate Q_p for $t = T_c$ for the post-developed condition using Rational Method equation in Section 4.4.
5. Calculate allowable release rate (Q_{OUT}). For infiltration facilities, Q_{OUT} is the calculated rate being discharge into subsurface soils based upon the design infiltration rate as determined in the GSR. For detention facilities Q_{OUT} is limited to either the pre-developed peak flow rate or 0.1 cfs/acre (which ever is less). The Bowstring Method is not intended to size evaporation ponds. Refer to the Water Budget Method if using 0.00 cfs as a release rate.
6. Calculate the outflow volume $V_{OUT} = Q_{OUT} * t$.
7. Compute intensities (I), peak flow rates (Q_p), and inflow and outflow volumes (V, V_{OUT}) for various times (i.e. $t = 5, 10, 25 \dots$ minutes).
8. The required storage is obtained as the maximum difference between inflow and outflow volumes by the tabular methods as shown in the sample spreadsheet.

4.5 WATER BUDGET METHOD

A water budget analysis is required for the design of an evaporative pond. The analysis utilizes average monthly precipitation and pan evaporation values to estimate the net stormwater runoff volume increase during a two year cycle. The water budget analysis is conducted for a two-year cycle to account for seasonal variations in precipitation, pan evaporation and antecedent runoff conditions and to verify that equilibrium is reached. Equilibrium is reached when the analysis confirms that the required pond size does not increase in the second year of the cycle.

4.5.1 WATER BUDGET METHODOLOGY

The water budget analysis is performed utilizing the following relationships:

$$V_{STORAGE}(x) = V_{IN}(x) - V_{OUT}(x) + V_{STORAGE}(x-1)$$

$$V_{POND} = \max[V_{STORAGE}(x)]$$

Where: $x =$ any given month;

$V_{IN} =$ water volume entering the evaporative pond in a given month. Stormwater runoff volume is calculated using the NRCS runoff equations described in Section 4.3.1;

$V_{OUT} =$ stormwater volume leaving the evaporative pond in a given month (i.e. pan evaporation, surface release);

$V_{STORAGE} =$ storage volume necessary for a given month; and,

$V_{POND} =$ storage volume necessary to reach equilibrium in a 2-year cycle.

The analysis is repeated until the maximum storage volume in the second year is equal or less than the maximum storage volume in the first year.

The cycle shall start in October, the month that yields the greatest net storage volume for the year.

Water loss through evaporation from overland surface areas is not considered in the water budget due to the wide variation in evaporation rates that occur over these types of surfaces. Depressional storage is the only reduction that can be considered in this analysis. This reduction may be considered if closed depressions are present on site in the pre-developed condition and are proposed to remain as an existing topographical feature, set aside for drainage purposes. Vegetal and minor topographical abstraction and interception are already ac-

counted for in the NRCS curve numbers.

Depending on the site conditions and proposed pond design, evaporative systems shall be designed using the Outflow or Full Containment method design criteria.

Outflow Method

The Outflow Method is used to size evaporation facilities that store the excess stormwater runoff volume (after evaporation losses) created when new development occurs. Design guidelines for Evaporation Ponds can be found in the Yakima Stormwater Manual.

The water budget analysis needs to demonstrate that the volume of runoff leaving the site, over the 2-year cycle, is below or equal to the pre-developed volume for the cycle. In addition, if the facility has a surface release, the rate of release from the facility shall meet the detention design criteria (Section 6.7.1). If site conditions permit, the pre-developed volume should be infiltrated when a defined release point is not present onsite. The evaporative system shall have a containment volume separate from the detention system to provide attenuation of peak flows during the storm events. A minimum factor of safety of 1.2 shall be applied to the evaporative volume, normally by increasing the depth of the facility.

If the evaporative system is designed in combination with a surface discharge, then additionally use the following two equations:

$$V_{ALL} \leq V_{PRE}$$

$$Q_{ALL} \leq Q_{PRE}$$

Where:

- V_{ALL} = the total volume released from the site in two year cycle (not including pan evaporation or infiltration);
- V_{PRE} = the total pre-developed volume of runoff for two year cycle;
- Q_{PRE} = the pre-developed rate for the contributing basin;
- and,
- Q_{ALL} = the release rate from the facility.

This analysis is run on a 2 year cycle to determine the maximum required storage volume.

Full Containment Method

The Full Containment Method is used to size evaporation facilities that store the total post-developed runoff volume (less evaporative losses) or full containment evaporative systems. The Full Containment Method is used when the project site does not have a defined discharge point or when site conditions are not conducive to infiltration of the pre-developed volume. A minimum of one (1)

foot of freeboard shall be added to the calculated storage depth.

The facility shall be sized to store the volume per the following additional equations:

$$V_{STORAGE}(o) = V_{100} + V_{IN}(o) - V_{OUT}(o)$$

Where: o = first month of the two year cycle; and,

V_{100} = the volume of stormwater runoff resulting from a 100 year, 24-hour storm event.

The analysis is run on a 2 year cycle to determine the maximum required storage volume.

The facility shall be sized with a dead storage that is at least as large as equivalent to the 100-year storm, 24-hour storm event. A full containment evaporative pond is required when there is no discharge point or site conditions prohibit the use of infiltration. These conditions may include little infiltrative capacity in the soil, existing high groundwater, or potential for adverse impacts to adjacent or downstream/down-gradient properties from additional stormwater being injected into the subsurface.

4.5.2 CURVE NUMBER ADJUSTMENT

The antecedent runoff conditions (ARC) need to be considered during the months of the year when the ground may be saturated or frozen. The following should be noted when choosing CN values:

- For impervious surfaces such as roads, sidewalks and driveways, the ARC II CN is typically 98, and the correlating ARC III CN is 99. From December through February, the assumption is that if the CN of 98 goes up to 99 during the wet months, it will not revert to 98 during frozen ground conditions; and,
- During December through February, the CN for permeable surfaces is 95 regardless of the ARC II or III CNs; this is meant to approximate runoff from permeable surfaces during snowpack buildup and snowmelt.

The CNs shall be adjusted as indicated in Table 4-8 and Table 4-2 (ARC conversion table).

Table 4-8: Curve Number Adjustment for Antecedent Runoff Condition

MONTH	ANTECEDENT RUNOFF CONDITION (ARC)	CURVE NUMBER
April through October	Normal (ARC = II)	See Table 4-2
November and March	Wet (ARC = III)	See Table 4-2
December, January & February	n/a	99 impervious 95 permeable

4.5.4 AVERAGE PRECIPITATION AND EVAPORATION

The average Annual Precipitation for the Portneuf Valley is 11.59 inches at the airport (Pocatello Airport, 1939- 2013) and 12.94 inches in town (Pocatello 2, 1899 - 2013).

Table 4-9: Average Monthly Precipitation

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Pocatello Airport	0.92	1.05	1.07	1.08	0.90	1.17	1.12	1.34	1.05	0.53	0.59	0.78
Pocatello Creek	1.07	1.00	1.11	1.07	1.10	1.11	1.29	1.59	1.23	0.59	0.79	0.99

Source: Western Region Climate Center

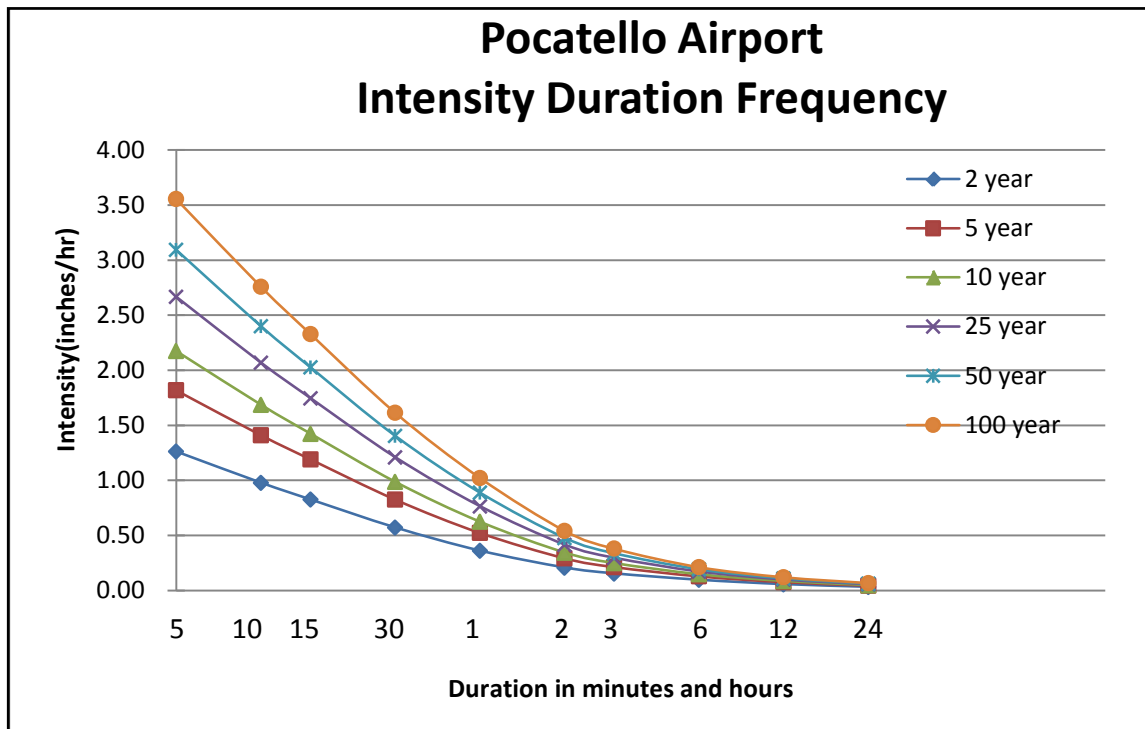
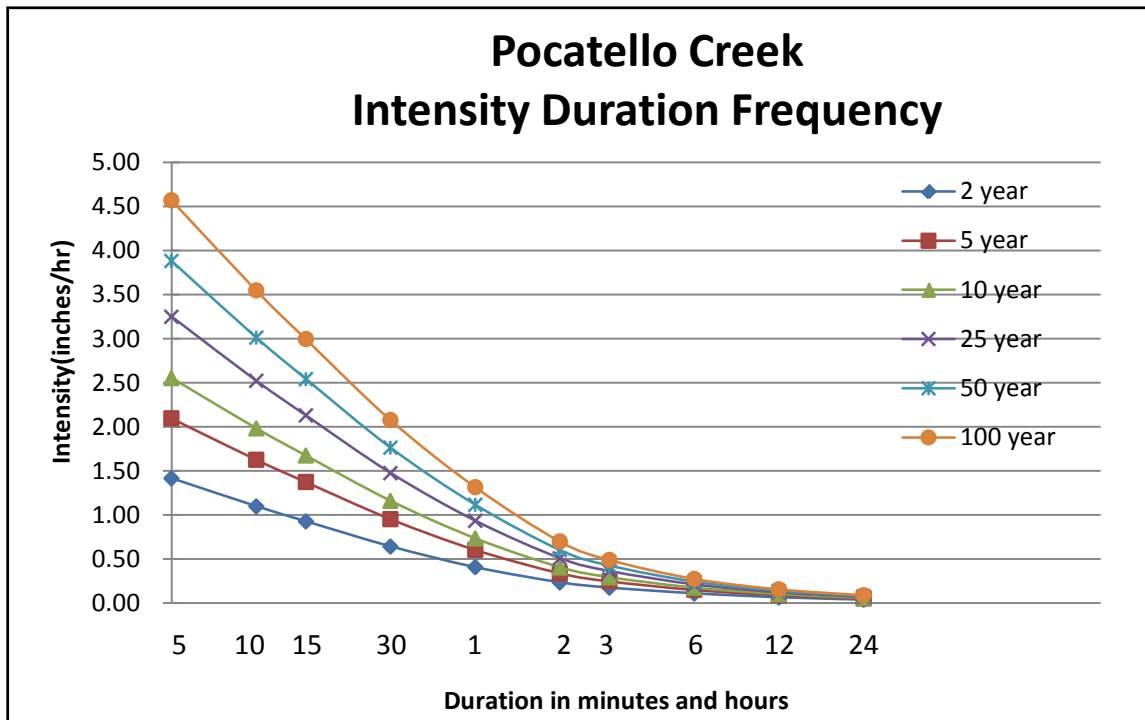
Table 4-10: Pan Evaporation Values

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Pocatello Airport	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.56	9.19	7.42	3.97

Source: Western Region Climate Center

¹ No evaporation measurements were available for the winter months.

APPENDIX 4A – IDF CURVES



Projects in Pocatello and Chubbuck shall use the Pocatello Creek IDF curves, except at the Airport (which shall use the Airport curves)

APPENDIX 4B – EXAMPLE CALCULATION – WEIGHTING CNs

GIVEN

- The existing site is approximately 10-acres, consisting of Type B soils. Existing surface vegetative conditions include short grass and weeds.
- Post developed site conditions consist of:
 - 38 – 10,000 square foot lots;
 - 1,500 sq ft homes with 500 sq ft driveways;
 - 1.3 acres of road and sidewalk impervious areas; and,
 - No sidewalks are proposed.

CALCULATIONS

1. Find the CNs for the lawn areas and the roofs, driveways, and streets.
From Table 4-1:

CN = 61 permeable areas – lawns (good condition) – Type B soils

CN = 98 impervious areas – streets, driveways, and roofs

2. Calculate the CN for the impervious basin. The connected impervious areas are the driveways and the streets. No weighting is required because the CNs for the impervious areas are the same.

CN FOR THE IMPERVIOUS BASIN = 98

3. Calculate the CN for the permeable basin. Although the roof area is impervious, it can be weighted with the lawn area because the two are considered homogeneous; (i.e. the roofs drain onto landscaped areas and are not hydraulically connected to the roads or driveways.)

Total roof area: (38 houses)*(1500 sf/roof) = 57,000 sf = 1.31 ac

Total lawn area: Total site– total impervious area = 10 ac–1.74 ac–1.31 ac = 6.95 ac

Total permeable basin: 1.31 ac + 6.95 ac = 8.26 ac

Weighted CN for permeable basin: $\frac{6.95(61) + 1.31(98)}{8.26} = 66.87 \approx 67$

CN FOR THE PERMEABLE BASIN = 67

APPENDIX 4C – BOWSTRING METHOD EXAMPLE

GIVEN:

The existing site is approximately 5-acres, consisting of silty soils. Existing surface vegetative conditions include short grass and weeds.

Post-developed site conditions are as follows:

- 20-10,000 square foot (s.f.) residential lots;
- 1,500 s.f. homes with 750 s.f. concrete driveways;
- 0.50 acres of street impervious surface; and,
- Topography 2%-5%.

Post-developed time of concentration

- 100-ft of overland flow @ 3.0%;
- 300 feet of gutter flow @ 3.0%; and,
- 300 feet of pipe flow @ 2.0%.

Project proponent proposes a bio-infiltration swale with overflow to a subsurface infiltration gallery.

CALCULATIONS:

1. Determine the weighted Runoff Coefficient (C) for the post-developed condition:

From Table 4-6:

Lawns (silty soils, rolling 2%-10%): $C = 0.22 * 1.2$ (50 year storm conversion) = 0.264.

Streets, driveways, roofs and sidewalks: $C = 0.90 * 1.2$ (50 year storm conversion) = 1.08. Reduce to $C = 0.95$ per Table 4-6.

Total Area Breakdown

Roof Area	= 20 homes * 1,500 s.f./home	= 30,000 s.f.
Square Feet to Acres	= 30,000 s.f./43,560 s.f. per acre	= 0.689 acres
Driveway Area	= 20 homes * 750 s.f./home = 15,000 s.f.	= 0.344 acres
Streets		= 0.500 acres
Lawn/Landscape	= 5.0 ac – 0.689ac – 0.344ac – 0.500ac	= 3.467 acres
Weighted C	= ((3.467*0.264) + (1.533*0.94))/1	= 0.47

2. Determine Time of Concentration (T_c)

Ground Cover Coefficient (K): Refer to Table 4-7

Flow Segment of Travel Time (T_t): $T_t = \frac{L}{K\sqrt{S}}$

Table 4C-1

Flow Segment	Length (feet)	Slope (feet/foot)	K (feet/minute)	T _t (minutes)
Overland Flow	100	0.03	420	1.375
Gutter Flow	300	0.03	1500	1.155
Pipe Flow	300	0.02	3000	0.707
Total Time of Concentration (T _c)				3.24

3. Determine storm intensity using Appendix 4A.

For a 50-year storm (design event for many areas in the Portneuf Valley) and a T_c of 3.24 minutes: I = 4.19 in/hr. Since T_c < 5 min, use T_c = 5 min = 3.88 in/hour

4. Determine the peak flow rate for t = T_c using equation Q_p = CIA

$$Q_p = 0.47 * 3.88 \text{ inches/hour} * 5.0 \text{ acres} = 9.13 \text{ cfs}$$

5. Compute the volume for t = T_c using equation V(t) = 1.34Q_p t

$$\begin{aligned} V(t) &= 1.34 * 9.13 \text{ cfs} * 5.0 \text{ min} * 60 \text{ sec/min} \\ &= 3,669 \text{ cubic feet} \end{aligned}$$

6. Determine the allowable release rate (Q_{OUT})

For this example, Q_{OUT} is determined to be 2.0 cfs.

7. Compute the outflow volume (V_{OUT}) for t = T_c

$$\begin{aligned} V_{OUT}(t) &= Q_{OUT} * t \\ &= 2 \text{ cfs} * 5.0 \text{ min} * 60 \text{ sec/min} = 600 \text{ c.f.} \end{aligned}$$

8. Compute intensities (I), peak flow rates (Q_p), and inflow and outflow volumes (V, V_{OUT}) for various times (i.e. t = 5, 10, 25... minutes). A spreadsheet can be created to perform this task. Refer to the following sample spreadsheet.

9. The required storage volume is obtained as the maximum difference between inflow and outflow volumes. Refer to the following sample spreadsheet. Minimum required storage volume is 4,618 cubic feet.

Example Spreadsheet

Areas colored blue must be entered by the project designer. Local jurisdictions may provide excel versions of this spreadsheet to aid calculations.

sample BOWSTRING (MODIFIED RATIONAL) WORKSHEET

Design Storm 50 year
 Area 5.00 acres
 Time of Concentration 3.24 min
 Weighted Cpost 0.47
 Allowable Release Rate 2 cfs

PROJECT : Flows Downhill Estates
 BASIN: #1 of 3
 DESIGNER: Drip Drop
 DATE: 6/1/2015

TIME t(min)	TIME t(sec)	Intensity (in/hr)	Qp(cfs)	Vin (cu.ft)	Vout (cu.ft)	Storage cu.ft
5.00	300	3.88	9.13	3669	600	3069
5	300	3.88	9.13	3669	600	3069
10	600	3.01	7.08	4970	1200	3770
15	900	2.54	5.98	5991	1800	4191
20	1200	2.28	5.37	6988	2400	4588
25	1500	2.02	4.76	7618	3000	4618
30	1800	1.76	4.14	7881	3600	4281
35	2100	1.66	3.89	8565	4200	4365
40	2400	1.55	3.64	9098	4800	4298
45	2700	1.44	3.38	9479	5400	4079
50	3000	1.33	3.13	9707	6000	3707
55	3300	1.22	2.88	9784	6600	3184
60	3600	1.12	2.62	9708	7200	2508
65	3900	1.07	2.52	10091	7800	2291
70	4200	1.03	2.42	10413	8400	2013
80	4800	0.94	2.22	10875	9600	1275
90	5400	0.86	2.02	11096	10800	296
100	6000	0.77	1.81	11074	12000	-926
110	6600	0.69	1.61	10810	13200	-2390
120	7200	0.60	1.41	10303	14400	-4097

INPUT NEEDED

OUTPUTS

Minimum Storage required 4618

Define Cpost

Area	Type	Cpost	sq.ft	acres
1	Driveways/Roofs/Roads	0.95	66780	1.533
2	Lawns	0.264	151000	3.466
				0.000
				0.000

total acres 5.00
 Weighted C 0.47

Define Time of Concentration

Flow Segment	Length(ft)	Slope(ft/ft)	K(ft/min)	Tt(min)
Overland flow	100	0.03	420	1.37
Gutter flow	300	0.03	1500	1.15
Pipe flow	300	0.02	3000	0.71
Total L = hydraulic length.			Tc(min)	3.24

Length (L): Measured from site plan
 Ground Cover Coefficient (K): Table 4-7
 Flow Segment Travel Time(Tt): $Tt/(K \cdot S^{0.5})$

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CHAPTER 5

SOURCE CONTROL

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5.1 INTRODUCTION

This chapter of the stormwater manual focuses on prevention of water quality impacts from potential pollutant sources. Source control BMPs are structures or operations intended to prevent pollutants from coming into contact with stormwater through physical separation of areas or careful management of activities that are sources of pollutants. Source control BMPs are the most cost effective means of reducing pollutant loading and concentrations in stormwater and should be a first consideration in all projects.

5.1.1 APPLICABILITY:

All projects, unless exempted in Section 2.2.4, shall comply with this Core Element. All local jurisdictions have ordinances in place prohibiting the discharge of polluted stormwater into the municipal storm drain system (which includes streets and alleys) or local streams. Local governments, businesses and project proponents are not relieved from the responsibility of preventing pollutant release from coming in contact with stormwater, whether or not the project triggers the regulatory threshold.

5.2 SOURCE CONTROL BMPs

Reduction or the elimination of stormwater pollutants can be achieved by implementing “operational source control BMPs,” including good housekeeping, employee training, spill prevention and cleanup, preventive maintenance, regular inspections, and record keeping. These BMPs can be combined with impervious containments and covers, i.e., structural source control BMPs. If operational and structural source control BMPs are not feasible or adequate, then stormwater treatment BMPs will be necessary. Selecting cost-effective BMPs should be based on an assessment of the pollutants and their sources.

This chapter provides design guidelines for Structural Source Control BMPs, which are physical, structural, or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. Examples of Structural Source Control BMPs typically include:

- Enclosing and/or covering the pollutant source (e.g., within a building or other enclosure, a roof over storage and working areas, temporary tarp, etc.);
- Physically segregating (hydraulically isolating) the pollutant source to prevent run-on of uncontaminated stormwater; and
- Devices that direct only contaminated stormwater to appropriate treatment BMPs (e.g., discharge to a sanitary sewer). Discharge to the sanitary sewer always requires written approval from the sanitary sewer authority and all applicable sanitary sewer pretreatment requirements must be met.

The applicable BMPs described in this section, or equivalent BMPs, will help businesses comply with EPA’S Multi Sector General Permit requirements which

apply to new and existing facilities. For new developments or redevelopments not covered under that permit, implementation of those BMPs that are specified as applicable BMPs in this Manual, or equivalent BMPs, will also be required if incorporated into local government ordinances or equivalent documents. Facilities that are not required to apply the applicable and recommended BMPs described in this chapter are encouraged to implement them.

The selection of source control BMPs described in this chapter should be based on land use and the pollutant generating sources.

Basic Structural Source Control BMPs:

- Prevent the discharge of unpermitted liquid or solid wastes, process wastewater, and sewage to ground or surface water, or to storm drains that discharge to surface water, or to the ground.
- Do not connect floor drains in potential pollutant source areas to storm drains, surface water, or to the ground.
- Conduct all oily parts cleaning, steam cleaning, or pressure washing of equipment or containers inside a building, or on an impervious contained area, such as a concrete pad. Direct contaminated stormwater from such an area to an approved treatment facility. Discharge to the sanitary sewer requires written approval from the local sanitary sewer authority and all applicable sanitary pretreatment requirements must be met.
- Do not pave over contaminated soil unless it has been determined that groundwater has not been and will not be contaminated by the soil. Call DEQ for assistance.
- Construct impervious areas that are compatible with the materials handled. Portland cement concrete, asphalt, or equivalent material may be considered.
- For the storage of liquids use containers, such as steel and plastic drums, that are rigid and durable, corrosion resistant to the weather and fluid content, non-absorbent, water tight, rodent-proof, and equipped with a close fitting cover.
- For the temporary storage of solid wastes contaminated with liquids or other potential pollutant materials use dumpsters, garbage cans, drums and comparable containers, that are durable, corrosion resistant, non-absorbent, non-leaking, and equipped with either a solid cover or screen cover to prevent littering. If covered with a screen, the container must be stored under a lean-to or equivalent structure.
- Where exposed to stormwater, use containers, piping, tubing, pumps, fittings, and valves that are appropriate for their intended use and for the contained liquid.
- Where feasible, store potential stormwater pollutant materials inside a building or under a cover, and (or) containment.
- Stencil warning signs at stormwater catch basins and drains, e.g., "Dump no waste."

5.3 POLLUTANT SOURCE-SPECIFIC BMPS

The following are the more common Pollutant Source –Specific BMPs that will typically be needed for local conditions.

5.3.1 Fueling at Dedicated Stations

Description of Pollutant Sources: A fueling station is a facility dedicated to the transfer of fuels from a stationary pumping station to mobile vehicles or equipment. It includes above or under-ground fuel storage facilities. In addition to general service gas stations, fueling may also occur at 24-hour convenience stores, construction sites, warehouses, car washes, manufacturing establishments, port facilities, and businesses with fleet vehicles. Typically, stormwater contamination at fueling stations is caused by leaks/spills of fuels, lube oils, radiator coolants, and vehicle wash water.

Pollutant Control Approach: New or substantially remodeled* fueling stations must be constructed on an impervious concrete pad under a roof to keep out rainfall and stormwater run-on. A treatment BMP must be used for contaminated stormwater and wastewaters in the fueling containment area.

* Substantial remodeling includes replacing the canopy, or relocating or adding one or more fuel dispensers in such a way that the Portland cement concrete (or equivalent) paving in the fueling area is modified.

For new or substantially remodeled fueling stations:

Applicable Structural Source Control BMPs:

- Design the fueling island to control spills (dead-end sump or spill control separator to treat collected stormwater and(or) wastewater to required levels. Slope the concrete containment pad around the fueling island toward drains; either trench drains, catch basins and(or) a dead-end sump. The slope of the drains shall not be less than 1 percent. Drains to treatment shall have a shutoff valve, which must be closed in the event of a spill.
- Design the fueling island as a spill containment pad with a sill or berm raised to a minimum of four inches to prevent the runoff of spilled liquids and to prevent run-on of stormwater from the surrounding area. Raised sills are not required at the open-grate trenches that connect to an approved drainage- control system.
- The fueling pad must be paved with Portland cement concrete, or equivalent. Asphalt is not considered an equivalent material.
- The fueling island must have a roof or canopy to prevent the direct entry of precipitation onto the spill containment pad. The roof or canopy should, at a minimum, cover the spill containment pad (within the grade break or fuel dispensing area) and preferably extend several additional feet to reduce the introduction of windblown rain. Convey all roof drains to storm drains outside the fueling containment area.

- Stormwater collected on the fuel island containment pad must be conveyed to an approved treatment system such as an oil/water separator and a water quality treatment BMP. Discharges to the sanitary sewer system require written approval from the sanitary authority. Discharges from treatment systems to storm drains, to surface water, or to the ground must not display ongoing or recurring visible sheen and must not contain greater than a significant amount of oil and grease.
- Alternatively, stormwater collected on the fuel island containment pad may be collected and held for proper offsite disposal.
- Conveyance of any fuel-contaminated stormwater to a sanitary sewer must be approved by the local sanitary sewer authority and must comply with pretreatment regulations. These regulations prohibit discharges that could “cause fire or explosion.” An explosive or flammable mixture is defined under state and federal pretreatment regulations based on a flash point determination of the mixture.
- Transfer the fuel from the delivery tank trucks to the fuel storage tank in impervious contained areas and ensure that appropriate overflow protection is used. Alternatively, cover nearby storm drains during the filling process and use drip pans under all hose connections.

Additional BMP for vehicles ten feet in height or greater:

A roof or canopy may not be practicable at fueling stations that regularly fuel vehicles ten feet in height or greater, particularly at industrial sites. At those types of fueling facilities, the following BMPs apply, as well as the applicable BMPs for fueling stations:

- If a roof or canopy is impractical the concrete fueling pad must be equipped with emergency spill control that includes a shutoff valve for the drainage from the fueling area. The valve must be closed in the event of a spill. An electronically actuated valve is preferred to minimize the time lapse between spill and containment. Spills must be cleaned up and disposed off-site in accordance with BMPs for Spills of Oil and Hazardous Substances.
- The valve may be opened to convey contaminated stormwater to oil removal treatment such as a Coalescing Plate or Baffle Type oil/water separator, catchbasin insert, or equivalent treatment, and then to a basic treatment BMP. Discharges to the sanitary sewer require written approval from the sewer authority. Discharges from treatment systems to storm drains, or surface water or to the ground must not display ongoing or recurring visible sheen and must not contain greater than a significant amount of oil and grease.

An explosive or flammable mixture is defined under state and federal pretreatment regulations, based on a flash point determination of the mixture. If contaminated stormwater is determined not to be explosive or flammable, then it could be conveyed to a sanitary sewer system, with written approval from the local sanitary sewer authority.

5.3.2 Loading and Unloading Areas for Liquid or Solid Material

Description of Pollutant Sources: Loading/unloading of liquid and solid materials at industrial and commercial facilities are typically conducted at shipping and receiving, outside storage, fueling areas, etc. Materials transferred can include products, raw materials, intermediate products, waste materials, fuels, scrap metals, etc. Leaks and spills of fuels, oils, powders, organics, heavy metals, salts, acids, alkalis, etc. during transfer are potential causes of stormwater contamination. Spills from hydraulic line breaks are a common problem at loading docks.

Pollutant Control Approach: Cover and contain the loading/unloading area, where necessary, to prevent run-on of stormwater and runoff of contaminated stormwater.

Applicable Structural Source Control BMPs:

At all Loading/ Unloading Areas:

- To the extent practicable, conduct unloading or loading of solids and liquids in a manufacturing building, under a roof, or lean-to, or other appropriate cover.
- Berm, dike, and(or) slope the loading/unloading area to prevent run-on of stormwater and to prevent the runoff or loss of any spilled material from the area.
- Pave and slope loading/unloading areas to prevent the pooling of water. The use of catch basins and drain lines within the interior of the paved area must be minimized as they will frequently be covered by material, or they should be placed in designated “alleyways” that are not covered by material, containers or equipment.

Recommended Structural Source Control BMP: For the transfer of pollutant liquids in areas that cannot contain a catastrophic spill, install an automatic shutoff system in case of unanticipated off-loading interruption (e.g., coupling break, hose rupture, overfill, etc.).

At Loading and Unloading Docks:

- Install/maintain overhangs, or door skirts that enclose the trailer end to prevent contact with rain water.
- Design the loading/unloading area with berms, sloping, etc. to prevent the run-on of stormwater .
- Retain on-site the necessary materials for rapid cleanup of spills.

At Tanker Truck Transfer Areas to Above/Below-Ground Storage Tanks:

- Pave the area on which the transfer takes place. If any transferred liquid, such as gasoline, is reactive with asphalt, pave the area with Portland cement concrete.

- Slope, berm, or dike the transfer area to a dead-end sump, spill containment sump, a spill control oil/water separator, or other spill control device. The minimum spill retention time should be 15 minutes at the greater flow rate of the highest fuel dispenser nozzle through-put rate, or the peak flow rate of the 6-month, 24-hour storm event over the surface of the containment pad, whichever is greater. The volume of the spill containment sump should be a minimum of 50 gallons with an adequate grit sedimentation volume.

5.3.3 Maintenance and Repair of Vehicles and Equipment

Description of Pollutant Sources: Pollutant sources include parts/vehicle cleaning, spills/leaks of fuel and other liquids, replacement of liquids, outdoor storage of batteries/liquids/parts, and vehicle parking.

Pollutant Control Approach: Control of leaks and spills of fluids using good housekeeping, and cover and containment BMPs.

Applicable Structural Source Control BMPs:

- Conduct all maintenance and repair of vehicles and equipment in a building or other covered impervious containment area sloped to prevent run-on of uncontaminated stormwater and runoff of contaminated stormwater.
- The maintenance of refrigeration engines in refrigerated trailers may be conducted in the parking area with due caution to avoid the release of engine or refrigeration fluids to storm drains or surface water.
- Park large mobile equipment, such as log stackers, in a designated contained area.

Applicable Treatment BMPs: Contaminated stormwater runoff from vehicle staging and maintenance areas must be conveyed to a Coalescing Plate or Baffle Type oil/water separator followed by a water quality treatment BMP (see Chapter 6), applicable filter, or other equivalent oil treatment system.

5.3.4 Manufacturing Activities – Outside

Description of Pollutant Sources: Manufacturing pollutant sources include outside process areas, stack emissions, and areas where manufacturing activity has taken place in the past, and significant pollutant materials remain and are exposed to stormwater.

Pollution Control Approach: Cover and contain outside manufacturing and prevent stormwater run-on and contamination, where feasible.

Applicable Structural Source Control BMPs:

- Enclose the activity, within a building if possible.
- Cover the activity and connect floor drains to a sanitary sewer, if approved by the local sanitary sewer authority. Berm or slope the floor, as needed, to prevent drainage of pollutants to outside areas.

- Isolate and segregate pollutants, as feasible. Convey the segregated pollutants to a sanitary sewer, process treatment or a dead-end sump, depending on available methods and applicable permit requirements.

5.3.5 Storage of Liquid, Food Waste, or Dangerous Waste Containers

Description of Pollutant Sources: Steel and plastic drums with volumetric capacities of 55 gallons or less are typically used at industrial facilities for container storage of liquids and powders. The BMPs specified below apply to container(s) located outside a building used for temporary storage of accumulated food wastes, vegetable or animal grease, used oil, liquid feedstock or cleaning chemical, or dangerous wastes (liquid or solid), unless the business is permitted by DEQ to store the wastes. Leaks and spills of pollutant materials during handling and storage are the primary sources of pollutants. Oil and grease, acid/alkali pH, and organics are potential pollutant constituents.

Pollutant Control Approach: Store containers in impervious containment under a roof or other appropriate cover, or in a building. For roll containers (for example, dumpsters) that are picked up directly by the collection truck, a filet can be placed on both sides of the curb to facilitate moving the dumpster. If a storage area is to be used on-site for less than 30 days, a portable temporary secondary system can be used in lieu of a permanent system as described above.

Applicable Structural Source Control BMPs:

- Keep containers with dangerous waste, food waste, or other potential pollutant liquids inside a building, unless this is impracticable due to site constraints or International Fire Code requirements.
- Store containers in a designated area, which is covered, bermed or diked, paved, and impervious, in order to contain leaks and spills. The secondary containment shall be sloped to drain into a dead-end sump for the collection of leaks and small spills.
- For liquid wastes, surround the containers with a dike of sufficient height to provide a volume of either: 10 percent of the total enclosed container volume or 110 percent of the volume contained in the largest container, whichever is greater, or, if a single container, 110 percent of the volume of that container.
- Where material is temporarily stored in drums, a containment system can be used as illustrated, in lieu of system above.
- Place containers mounted for direct removal of a liquid chemical for use by employees inside a containment area as described above. Use a drip pan during liquid transfer.

Applicable Treatment BMP:

- For contaminated stormwater in the containment area, connect the sump outlet to appropriate treatment, such as a coalescing plate or baffle

type oil/water separator, catch basin filter or other appropriate system (see Chapter 6). Discharge to the sanitary sewer requires written approval from the sanitary sewer authority. Equip the sump outlet with a normally closed valve to prevent the release of spilled or leaked liquids, especially flammables (compliance with Fire Codes), and dangerous liquids. This valve may be opened only for the conveyance of contaminated stormwater to treatment.

- Another option for discharge of contaminated stormwater is to pump it from a dead-end sump or catchment to a tank truck or other appropriate vehicle for off-site treatment and(or) disposal.

5.3.6 Washing and Steam Cleaning Vehicles/ Equipment/ Building Structures

Description of Pollutant Sources: Vehicles, aircraft, vessels, and transportation; restaurant cooking, carpet cleaning, and industrial equipment; and large buildings may be commercially cleaned with low or high pressure water or steam. This includes frequent “charity” car washes at gas stations and commercial parking lots. The cleaning can include hand washing, scrubbing, sanding, etc. Wash water from cleaning activities can contain oil and grease, suspended solids, heavy metals, soluble organics, soaps, and detergents that can contaminate stormwater.

Pollutant Control Approach: The preferred approach is to cover and(or) contain the cleaning activity, or conduct the activity inside a building, to separate the uncontaminated stormwater from the pollutant sources. Wash water must be conveyed to a sanitary sewer after approval by the local jurisdiction, temporarily stored before proper disposal, or recycled, with no discharge to the ground, to a storm drain, or to surface water.

Applicable Structural Source Control BMPs: Conduct vehicle/ equipment washing in one of the following locations:

- In a building constructed specifically for washing of vehicles and equipment, which drains to a sanitary sewer with appropriate pretreatment and written approval from the sanitary sewer authority.
- Conduct outside washing operation in a designated wash area with the following features:
 - In a paved area, constructed as a spill containment pad to prevent the run-on of stormwater from adjacent areas. Slope the spill containment area so that wash water is collected in a containment pad drain system with perimeter drains, trench drains, or catchment drains. Size the containment pad to extend out a minimum of four feet on all sides of the vehicles and(or) equipment being washed.
 - Convey the wash water to a sump for spill control and oil/water separation and then to a sanitary sewer (if permitted by the local sanitary sewer authority), or other appropriate wastewater treat-

ment or recycle system. An NPDES permit may be required for any wash water discharge to a storm drain or receiving water after treatment.

- If the wash water does not contain oils, soaps, or detergents then it could drain to soils that have sufficient natural attenuation capacity for dust and sediment.

CHAPTER 6

TREATMENT & FLOW

CONTROL BMPs

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6

6.1 INTRODUCTION

Water quality treatment and flow control facilities are designed to remove pollutants contained in stormwater runoff and mitigate the impacts of increased storm runoff volumes and flows to downstream conveyance systems and properties caused by land development.

Concentrations of pollutants can greatly vary. Methods of pollutant removal include sedimentation/settling, filtration, plant uptake, ion exchange, adsorption, and organic and inorganic decomposition. Floatable pollutants such as oil and debris can be removed with separator structures.

This chapter describes design criteria for water quality treatment facilities and flow control facilities. The sizing needs of these facilities may be reduced by applying low impact development site design techniques to reduce the amount of runoff and potential pollutants (see Chapter 10).

TABLE 6-1: Applicable Flow Control & Treatment BMPs

	Pretreatment (TSS)	Primary Treatment (TSS)	Oil Control (TPH)	Flow Control (Storage)
Low Impact Development	X	X	X	X
Bio-infiltration Swale	X	X	X	X
Infiltration Basin	X	X	X	X
Infiltration Trench/Gallery¹		X		X
Drywells¹		X		X
Bio-Filtration Channel	X	X		
Vegetated Filter Strip	X	X	X	
Oil/Water Separator	X ²		X	
Wetponds	X	X		X
Detention Pond	X	X	X	X
Evaporation Ponds	X	X	X	X
Emerging Technologies		X	X	X

¹ Infiltration facilities require soil beneath the facility to meet specific characteristics in order to provide primary treatment prior to infiltration into the subsurface. Additionally, pretreatment may be required.

² Only Baffle and Coalescing Plate Oil/Water Separators meet pretreatment requirements.

6.2 APPLICABILITY AND SIZING

See Table 2-1 for sizing criteria for treatment and flow control facilities. All projects that meet the regulatory threshold and are not exempt per Sections 2.2.5 and 2.2.6 must meet the flow control and treatment core element criteria (see Sections 2.3.6 and 2.3.7).

6.3 POLLUTANT LOADING

Pollutant Generating Surfaces (PGS) are considered to be significant sources of pollutants in stormwater runoff. These areas include surfaces subject to vehicular use, industrial activities, or storage of erodible or leachable materials that receive direct rainfall. A surface, whether paved or not, shall be considered a PGS area if it is regularly used by motor vehicles. The following are considered PGS:

- Roads;
- Un-vegetated road shoulders;
- Bike lanes adjacent to the traveled lane of a roadway;
- Parking lots;
- Fire lanes;
- Outdoor storage yards subject to frequent vehicular use;
- Railroads;
- Airport runways; and
- Other similar areas
- Roofs, including:
 - Metal roofs, unless coated with an inert, non-leachable material;
 - Roofs subject to venting or manufacturing, commercial or other indoor pollutants (such as restaurant oil);
 - Asphalt based roofs; and
 - Any roof area having electrical or mechanical equipment that is not hydraulically isolated from the remainder of the roof.

Note: Residential roofs are typically not considered PGS when the runoff does not mix or drain onto or across another impervious surface subject to vehicular use such as a driveway or road:

High Pollutant Loading/High Use Sites

- Any road with an expected ADT count equal to or greater than 30,000 (assumes a straight stretch of road, where intersecting ADTs are low). When oil control is required, the oil control BMPs must be applied to the portions of the site that exceed the oil control thresholds listed above. Refer to Table 6-1 for applicable oil control BMPs;
- Parking areas of commercial or industrial sites with daily trip end counts greater than 100 vehicles per 1,000 square feet gross building area or greater than 300 total trip ends;
- Road intersections with expected ADT count equal to or greater than 25,000 on the main roadway and equal to or greater than 15,000 on any intersecting roadway;
- A commercial or industrial site storing and/or transferring petroleum, not including locations where heating fuel is routinely delivered to end users;

- A commercial or industrial site subject to use, storage, or maintenance of a fleet of 25 or more vehicles that are over 10 tons gross weight (trucks, busses, trains, heavy equipment, etc). Note: this is not intended to encompass all-day parking areas;
- Fueling stations and facilities;
- Log storage and sorting yards;
- Construction businesses (paving, heaving equipment storage and maintenance, storage of petroleum products);
- Maintenance and repair facilities for vehicles, aircraft, construction equipment, railroad equipment or industrial machinery and equipment; and,
- Railroad yards;
- Commercial on-street parking areas located on streets with an expected total ADT count equal or greater than 7,500; and
- Outdoor storage yards and other sites subject to frequent use or storage of forklifts and/or other hydraulic equipment.

Moderate Pollutant Loading/Moderate Use Sites

- Primary access points for high-density residential apartments
- Intersections controlled by traffic signals
- Urban roads with expected ADT between 7,500 and 30,000
- Rural roads or freeways with expected ADT between 15,000 and 30,000
- Parking areas with > 40 -100 trip ends per 1,000 square feet of gross building area, or between 100 and 300 trip ends.

Low Pollutant Loading/Low Use Sites

- Parking areas with <40 trip ends/1000 sf building space or <100 total trip ends.
- This is intended to include most residential parking and employee-only parking areas for small office parks or other commercial buildings.
- City streets < 7500 ADT and limited access highways <15000 ADT.

6.4 REQUIREMENTS FOR ALL FACILITIES

6.4.1 PRETREATMENT

Pretreatment is strongly recommended prior to all stormwater facilities. Due to clogging, most stormwater facilities will fail without pretreatment.

Pretreatment of the water quality design storm is required prior to all infiltration facilities. It is also required when the primary treatment facility may be overwhelmed by a heavy load of targeted pollutants (e.g. suspended solids).

Pretreatment Sizing & BMP Selection

Pretreatment facilities should be sized to accommodate the Water Quality Storm. Flow-through pretreatment facilities (e.g. Oil/Water separators) shall have a high-flow bypass. See Table 6-1 for applicable pretreatment facilities.

Larger facilities may be required for flow through structures to minimize washout concerns. Many emerging technologies are intended to remove a significant amount of coarse silts and sands during low flows; their removal efficiency often is significantly reduced at high flows. They also require frequent maintenance and cleaning to limit the amount of previously accumulated sediment that is re-suspended and carried out of the structure during a storm event. Scour-reducing screens and baffles can also help limit washout of sediment.

As a result of being prone to washouts (especially with our fine soils), sediment manholes and sump catch basins are not appropriate pretreatment BMPs. Catchbasin inserts (unless approved for pretreatment or primary treatment by the Washington Department of Ecology's TAPE program) are also not appropriate pretreatment BMPs due to a demonstrated lack of performance.

Any of the primary treatment facilities can be used for pretreatment. Additionally, coalescing plate and baffle type oil/water separators may be used for pretreatment when they are installed "off-line" with a high flow bypass and as long as the influent suspended solids concentrations are not high. Frequent inspections are necessary to determine when accumulated solids exceed the depth at which clean-out is recommended.

6.4.2 WATER QUALITY DESIGN VOLUME AND FLOW

When calculating runoff flow rates for treatment facilities, designers must account for all the runoff from the PGS areas and any runoff from NPGS areas that co-mingles with runoff from a PGS area upstream of the treatment facility. Refer to Table 2-1 to determine the appropriate sizing requirement.

6.4.3 FLOW CONTROL DESIGN VOLUME AND FLOW

Flow control facilities must be sized based on the total developed site drainage area (both impervious and pervious areas), regardless of pollution generation. The NRCS Type II 24-hour storm event is the design storm utilized for all flow control facilities regardless of whether they use surface or subsurface discharge. Refer to Table 2-1 to determine the appropriate sizing requirement.

6.4.4 SEQUENCE OF FACILITIES

Treatment BMPs can be installed upstream or downstream of flow control facilities. However, some BMPs require special consideration before placement downstream of a flow control facility. Bioretention swales, vegetated filter strips and biofiltration channels are sensitive to saturation and continuous flow, so they are generally not practical downstream of a stormwater facility. Oil/water separators should be located upstream of other treatment BMPs and should be

located as close to the source of oil-generating activity as possible. They should be located upstream of flow control facilities wherever possible. All infiltration facilities shall have pretreatment facilities installed upstream of the infiltration facility in order to collect TSS before contact with the permeable soil layer.

6.4.5 BYPASSES

See Table 2-1 and Section 2.3.6 for basic requirements. For flow based treatment facilities, a flow splitter manhole or vault is typically located upstream of the treatment facility with an orifice or weir designed to divert only the desired flow into the facility. The splitter should be designed such that the maximum flow through the treatment facility is equal to or lower than the flow rate of the Water Quality Design storm. The bypass conveyance system is sized to handle the peak expected bypass flows.

For a volume based treatment facility, the bypass is typically an elevated outlet or other overflow structure located above the water quality design volume. The bypassed water may flow to another treatment facility or directly into a conveyance or infiltration facility.

6.4.6 SETBACKS, SLOPES, EMBANKMENTS & SPILLWAYS

Setbacks

Adequate room for maintenance equipment should be considered during site design. Pond overflow structures shall be located a minimum of 10 feet from any structure or property line. The toe of the berm shall be a minimum of 5 feet from any structure or property line. Evaluate all proposed overflow paths to ensure that runoff will not pose a danger to the public or cause any adverse impact to downstream properties or structures.

The following setbacks apply for stormwater infiltration and treatment facilities:

- Located at least 200' from water supply wells;
- Located at least 100' from streams and other open water features.
- Setback from septic and drain fields per state standards;
- Located at least 20' from building foundations (the local jurisdiction's engineer may approve facilities with smaller setbacks);
- Located at least 50' (or the height of the slope – whichever is greater) away from slopes over 15%. The GSC (see Chapter 3) must address the potential impact of any facilities sited on or near a steep slope;
- Shall not be located where they can impact a soil or groundwater contamination site as identified by DEQ; and
- Additional setback criteria for specific UIC facilities (e.g. dry wells and infiltration trenches/galleries) is provided in Section 6.6.

Side Slopes and Embankments

- Side slopes should not be steeper than a slope of 3H:1V. Recommend using 4H:1V if side slopes are to be grassed and mowed. Interior side slopes may be increased to a maximum of 2H:1V if the surrounding grade creates a cut or fill with no greater depth than 1.0 foot;
- City maintained ponds must have interior and exterior side slopes of 4:1 if they are to be mowed.
- Moderately undulating slopes are acceptable and can provide a more natural setting for the facility. In general, gentle side slopes improve the aesthetic attributes of the facility and enhance safety.
- Interior side slopes may be vertical retaining walls, with the following conditions:
 - Walls 2.5 feet or taller shall have a fence along the top of the wall;
 - The retaining wall design shall be prepared and sealed by a licensed civil engineer, when required by code; and
 - An access ramp (with slopes less than 4H:1V) to the bottom shall be provided.
- Exterior side slopes that are steeper than 2H:1V shall be analyzed for stability by a geotechnical engineer.
- The height of an embankment is measured from the top of the bank to the catch point of the native soil at the lowest elevation. Embankments shall meet the following minimum requirements:
 - Embankments 4 feet in height or more shall be constructed as recommended by a Geotechnical Engineer. Depending upon the site, geotechnical recommendations may be necessary for lesser embankment heights;
 - Embankments that impound over 50 acre feet of water or are 10 feet in height or more may need a Dam Construction permit from the Idaho Department of Water Resources.
 - Embankments constructed on native soil shall be consolidated, free of loose surface soil materials, roots, and other organic debris or as recommended by the Geotechnical Engineer;
 - Erosion control shall be provided to stabilize the bank and its over-flow during construction;
 - Energy dissipation measures (i.e., riprap pads) shall be installed where pipes discharge onto embankments;
 - Embankment compaction shall produce a dense, low permeability engineered fill that can tolerate post-construction settlements with a minimum of cracking. The embankment fill shall be placed on a stable subgrade and compacted to a minimum of 95 percent of the Modified Proctor Density, ASTM Procedure D1557. Placement moisture content should lie within 1 percent dry to 3 percent wet of the optimum moisture content;

- Seepage protection (e.g. collars) are required on all penetrations within the wetted perimeter;
- Embankment must be constructed by excavating a key. The key width shall equal 50 percent of the berm embankment cross-sectional width, and the key depth shall equal 50 percent of the berm height; and,
- The berm top width shall be a minimum of 4 feet.

Emergency Overflow Spillway

Emergency overflow spillways are used to direct overflows into the downstream conveyance system in the event of total failure or extreme inflows.

Emergency overflow spillways shall be provided for ponds with water depths over 2 feet in height or for ponds located on grades in excess of 5 percent. See Section 6.7.1.1 for design requirements.

Access

Maintenance access roads shall be provided to control and other drainage structures associated with the stormwater facility (i.e. inlet or bypass structures).

In ponds and swales, an access ramp is needed for the removal of sediment with a trackhoe and truck. The ramp should extend to the facility bottom if the bottom area is greater than 1,500 square feet. If the bottom area is less than 1,500 square feet, the ramp may end at an elevation 4 feet above the facility bottom. On large, deep ponds, truck access to the pond bottom via an access ramp is necessary so loading can be done in the pond bottom. On smaller facilities, the truck can remain on the ramp, facility edge, or internal berm for loading. (In most cases, trackhoes will be able to negotiate pond side slopes.)

If a fence is required, access should be limited by a double posted gate or by bollards – that is, two fixed bollards on each side of the access road and two removable bollards equally located between the fixed bollards. Access ramps and roads must meet the following design and construction requirements:

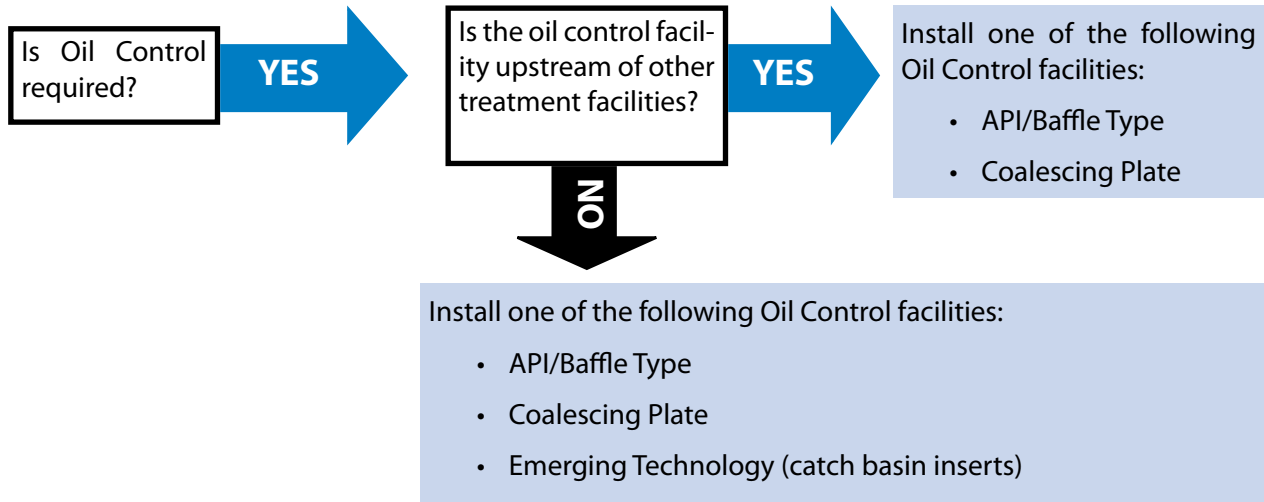
- Maximum grade shall be 15 percent;
- Outside turning radius should be a minimum of 50 feet;
- Minimum width should be 15 feet on curves and 12 feet on straight sections; and
- A paved apron must be provided where access roads connect to paved public roadways;

Planting Requirements

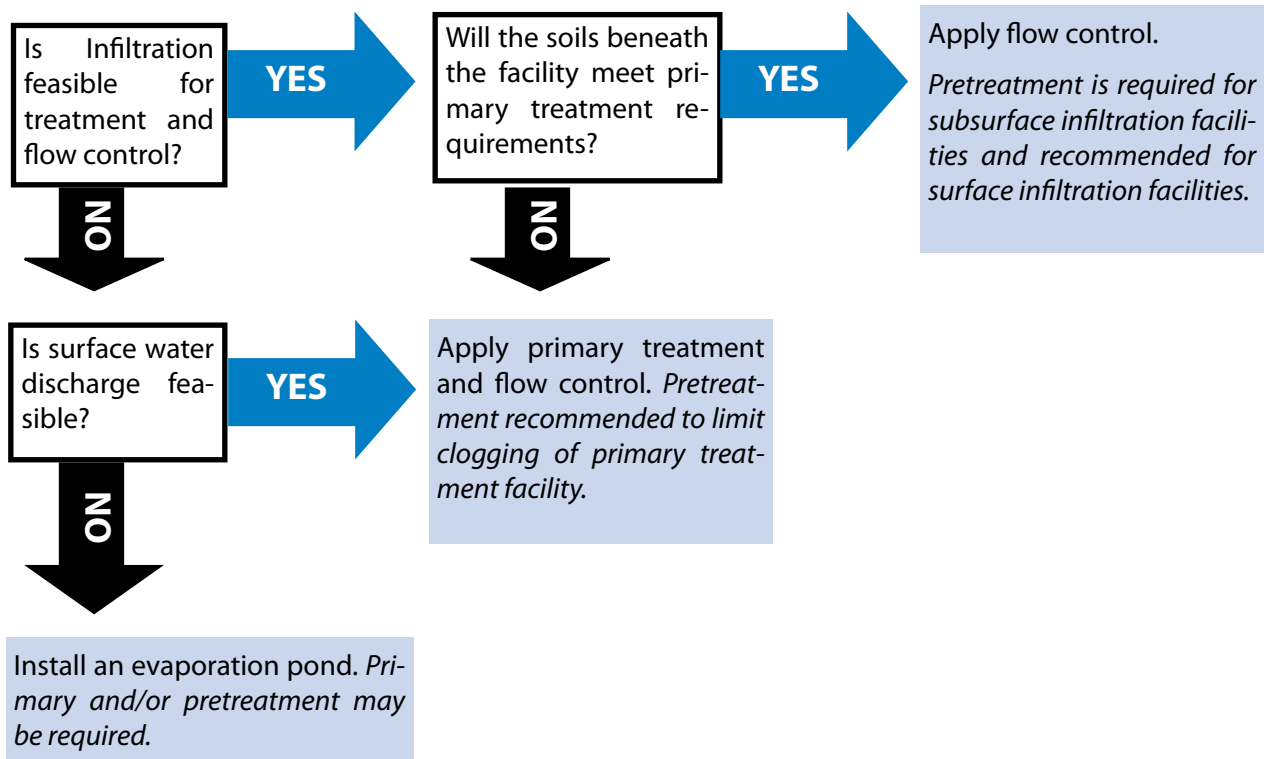
Exposed earth on the pond bottom and side slopes shall be vegetated or otherwise stabilized in a timely manner, taking into account the current climate/season. Unless a dryland grass is proposed, irrigation shall be provided. When possible, select native/adapted, drought-tolerant, pest-resistant species to reduce the need for irrigation, fertilizers, and pesticides. Refer to the Portneuf Valley Revegetation Guide for additional design criteria.

FIGURE 6-1: Treatment & Flow Control Facility Flow Chart

STEP 1



STEP 2



6.5 OIL/WATER SEPARATORS

Oil/Water Separators are BMPs used to remove oil and other water-insoluble hydrocarbons from stormwater runoff. Oil/water separators rely on passive mechanisms that take advantage of oil being lighter than water.

Oil/water separators typically consist of three bays: forebay, separator section, and the afterbay. For certain sites, a T elbow within a catch basin or manhole (i.e. a spill control manhole) can be used for oil removal.

A typical T-shaped oil/water separator structure is shown in Figure 6-2. Figures 6-3 and 6-4 show typical baffle and coalescing plate oil/water separators.

Applicability

Oil control shall be provided for all high pollutant loading sites. They are best located in areas where the drainage area is nearly all impervious and a fairly high load of petroleum hydrocarbons is likely to be generated (greater than 20 mg/L). Oil/water separators are not recommended for areas with very dilute concentrations of petroleum hydrocarbons (less than 20 mg/L) since their performance is not effective at low concentrations. Oil/water separators are required for high pollutant loading sites, but must precede another water quality treatment BMP to meet primary treatment goals.

Baffle and Coalescing Plate Oil/Water Separators are also approved for pretreatment when used in a treatment train with a primary treatment BMP.

Sizing

The following are sizing criteria applicable to both coalescing plate and baffle type oil/water separators:

- Design the surface area of the forebay at 20 square feet per 10,000 square feet of area draining to the separator;
- The length of the forebay should be $\frac{1}{3}$ to $\frac{1}{2}$ the length of the entire separator;
- Include roughing screens for the forebay to remove debris (screen openings should be about $\frac{3}{4}$ inch);
- Storm conveyance systems shall be designed so the Oil/Water Separator is sized for the Water Quality Design storm flow rate and the throat velocity is less than or equal to 0.5-feet per second.
- The tank(s) shall be located at the downstream end prior to the primary treatment/storage facility. A diversion manhole upstream of the oil/water separator shall divert the high flow around the oil/water separator.

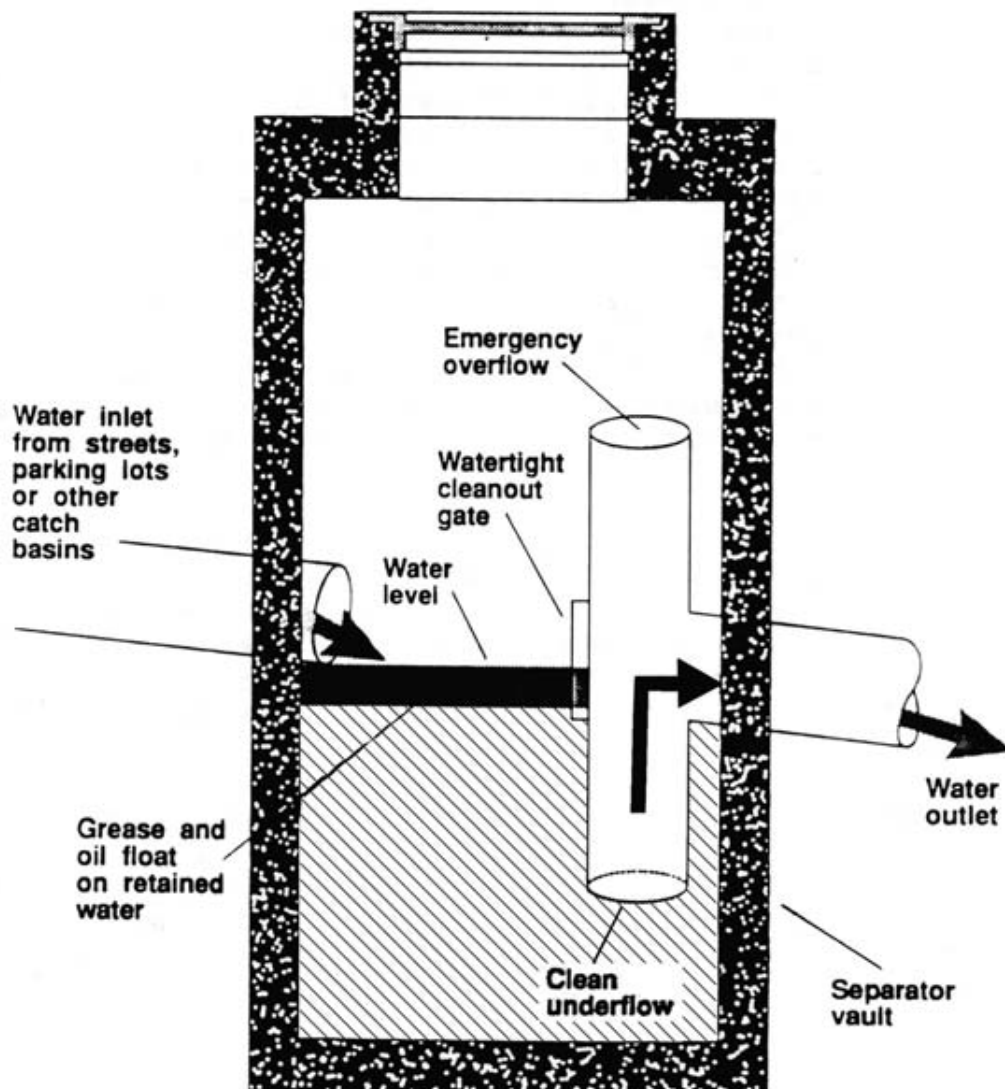
Design Criteria

Refer to BMP #18 – Oil Water Separators from the Idaho DEQ's BMP catalog.

Maintenance

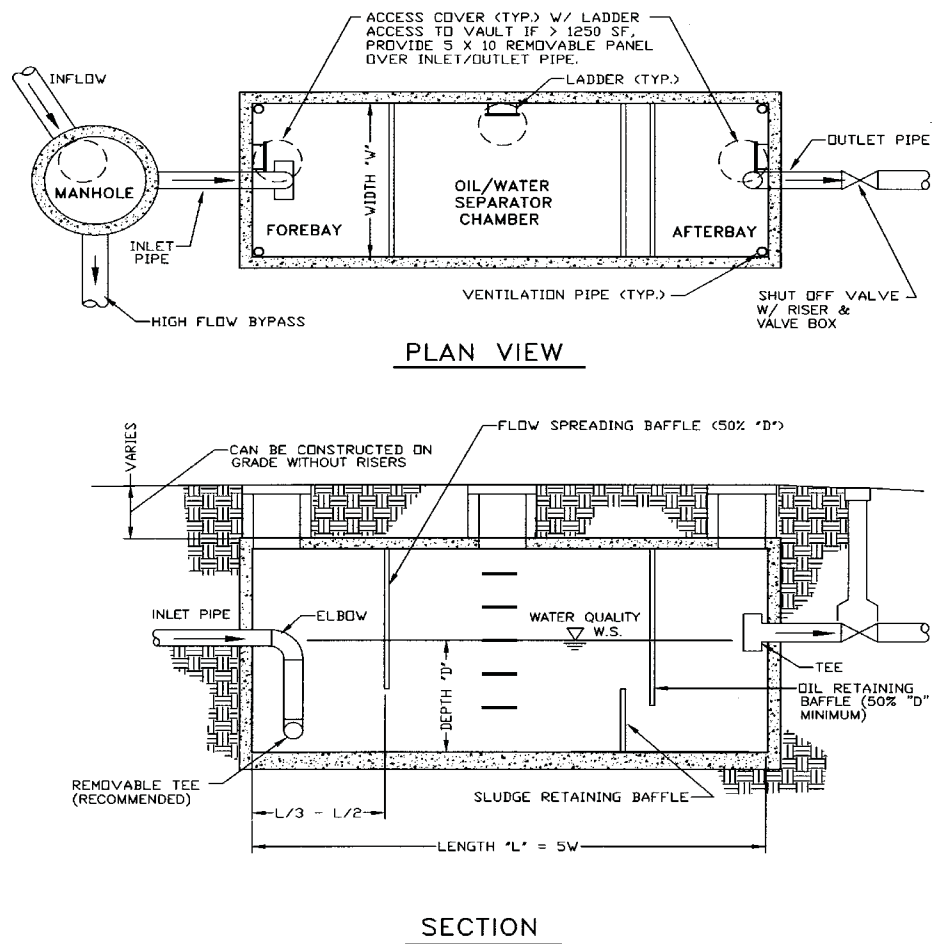
Oil/water separators are only effective in achieving oil and TPH removal and/or pretreatment for solids removal down to the required levels when regular maintenance is provided. Without proper maintenance (i.e. sludge, oil and sediment removal), there is a high potential for clogging which can impair the long-term efficiency of the separator.

Figure 6-2: Typical T-Shaped Oil/Water Separator



Source: Yakima Stormwater Manual 2010

Figure 6-3: Typical API (Baffle Type) Separator



Source: Boise Stormwater Design Manual 2010

PLAN VIEW
NTS

Labels for Plan View:

- ventilation pipes 12" min. at corners
- access cover over inlet
- coalescing plate pack
- access cover (over outlet)
- ladder (typ.) (KCRS Dwg. 7-006)
- 5' max
- shut off valve w/ riser & valve box
- outlet pipe (8' min.)
- access door allowing removal of plate pack or provide full length removable covers across entire cell.
- FOREBAY
- AFTERBAY
- inlet pipe (8" min.)
- high flow bypass
- 20' max (recommended)
- ladder and access

SECTION
NTS

Labels for Section View:

- varies (can be constructed on grade without risers)
- 8" tee
- oil retaining baffle (50% D min.)
- coalescing plate pack
- inlet weir-solids retaining baffle or window wall (see text)
- 1' min.
- 6" min.
- 1' min.
- 18" min.
- 6" min.
- 1' min.
- 8' min.
- (L/4 recomm.)
- L
- (L/2 recomm.)
- L/3 min.
- 7' min.
- 20' max
- submerged inlet pipe
- WQ water surface
- D

Portneuf Valley Stormwater Design Manual

Chapter 6 - Treatment & Flow Control BMPs

6.6 INFILTRATION FACILITIES

Stormwater infiltration facilities are the preferred method for stormwater disposal and treatment. They are an impoundment, typically a basins, trench, or infiltration swale whose underlying soil removes pollutants from stormwater. They can be designed in any shape. The geometry can be rectangular, long and thin, or naturally curved. Where possible, facilities should be designed to integrate into the surrounding landscape and conform to the natural topography of the site.

These facilities serve the dual purpose of removing pollutants (TSS, heavy metals, phosphates, and organics) from stormwater and recharging aquifers. Infiltration treatment soils must contain sufficient organic matter and/or clays to absorb, decompose, and/or filter stormwater pollutants. Pollutant/soil contact time, soil absorptive capacity, and soil aerobic conditions are important design considerations.

Subsurface infiltration facilities are drywells and infiltration trenches with perforated pipes. They are classified as Underground Injection Control (UIC) facilities AND include, but are not limited to, dry wells, infiltrator galleries and underground infiltration trenches with perforated pipes. UICs are regulated by the Idaho Department of Water Resources (IDWR) under Idaho Code and must be registered with the IDWR.

The infiltration BMPs described in this section include:

- Bio-Infiltration Basins (Vegetated) & Infiltration Basins (Non-Vegetated)
- Bio-Infiltration Swales (Vegetated) & Infiltration Swales (Non-Vegetated)
- Infiltration trenches & galleries
- Dry wells

6.6.1 SITE SUITABILITY FOR SURFACE INFILTRATION SYSTEMS

Not all sites are suitable for surface infiltration facilities. Refer to Section 3.1.1 to determine GSR analysis requirements. Use the following criteria to evaluate a site for its ability to utilize infiltration. Table 6-2 summarizes suitable soil criteria.

Setbacks:

Adequate room for maintenance equipment should be considered during site design. Additionally, stormwater infiltration and treatment facilities shall be setback at least:

- 100 feet from streams, open water features, septic tanks or drainfields.
- 200 feet from drinking water wells.
- 20 feet from building foundation. Local jurisdictions may reduce the setback requirements based on the proposed facility size and site conditions.

- 50' or the height of the slope (whichever is greater), from the top of a slope (for facilities that will be situated upslope from a structure or behind the toe of a slope in excess of 15%).

Table 6-2: Soil Criteria for Infiltration Systems¹

Requirements	
Vadose zone separation between ground water/impermeable layer and base of infiltration facility	>5-ft; Separation down to 3-ft may be allowed if mound-ing analysis determines no over topping into trench and overflow structure is adequate.
Depth of soil considered as treat-ment BMP ²	>6-inches (>18 inches if not vegetated on bottom). Can be a part of the required vadose zone thickness.
Treatment Soil Type ³	5 milliequivalents CEC/100 grams of dry soil and 1% minimum of organic content;
Infiltration Rate of Treatment Soil ^{3,4}	<2.5 in/hour for non-vegetated treatment soil; < 1.0 in/hr for vegetated treatment soil; 0.5 - 2.5 in/hr for infiltra-tion trenches.
Infiltration rate of Vadose zone	>0.5 in/hour (to a soil depth that is 2.5 times the pond-ing depth).

¹ Drywells and infiltrator galleries should use Table 6-3 instead of this table.

² Swales with underdrains that discharge to surface water shall have at least 12" of treatment soil.

³ Instead of testing the soil beneath a facility for CEC, organic content and infiltration rate, project proponents can use this manual's pre-approved Treatment Soil:

- 80% clean well graded sand having a maximum size of 1/8th -inch with less than 3% passing the 200 sieve.
- 20% compost by volume.

⁴ The measured (initial) infiltration rate should be under 12 in/hr.

Soil Infiltration Rate/Drawdown Time:

Design to completely drain basined runoff within 72 hours after flow to it has stopped. This will prevent mosquito breeding.

Surface infiltration facilities placed on loess soils will not meet the required long-term infiltration rate (Table 6-2) for the vadose soil and will generally require a layer of course sand or gravel placed beneath the treatment soil to achieve the desired infiltration rate. Facilities placed within the Michaud gravels in north Pocatello and Chubbuck will generally meet this infiltration rate.

Infiltration rates and safety factors shall be determined based on the criteria outlined in Chapter 4. Due to clogging, the long-term infiltration rate under the worst-case scenario should be accommodated by the design. Testing results should be documented in the GSC and calculations in the Drainage Submittal (see Chapter 3) should clearly state the infiltration rates and safety factors used in the facility design. Infiltration rate safety factors typically range from 1.5 to 3

depending on soil type (e.g. the expected long-term infiltration rate of local silt soils is ~30% of their demonstrated steady state infiltration rate). The safety factor should be noted in the GSR.

Sizing Criteria

Infiltration facilities shall be sized to fully infiltrate the post-development design storm per Table 2-1. The infiltration rate, safety factors, and size of the infiltrating area are used in conjunction with the storage volume to design the facility.

For facilities in Chubbuck that are not in Special Drainage Areas, no allowance for infiltration is permitted. The ponded depth (or void space for subsurface facilities) must accommodate the design storm.

Depth to Bedrock, Water Table, or Impermeable Layer:

The base of all infiltration basins, trench systems and swales should be ≥ 5 feet above the seasonal highwater mark, bedrock (or hardpan) or other low permeability layer. A minimum separation of 3 feet may be considered if the groundwater mounding analysis, volumetric receptor capacity, and the design of the overflow and/or bypass structures are judged by the professional engineer to be adequate to prevent overtopping and to meet the site suitability criteria specified in this section.

Previously Contaminated or Unstable Soils:

Infiltration facilities shall not be located where they can impact a soil or groundwater contamination site. The design professional should investigate whether the soil under the proposed infiltration facility has contaminants that could be transported from the facility. If so, measures should be taken to remediate the site prior to construction of the facility, or an alternative location should be chosen.

The designer should also determine if the soil beneath the proposed infiltration facility is unstable, due to improper placement of fill, subsurface geologic features, etc. If so, further investigation and planning should be undertaken before siting the facility.

Physical and Chemical Suitability for Treatment:

Surface infiltration facilities and infiltration trenches combine microbial action and soil properties to remove and degrade stormwater pollutants by biological, mechanical filtration, and chemical processes. Soil biological processes include the biodegradation of filtered and adsorbed organic pollutants by micro-organisms and invertebrates. Filtration is the removal of coarse and fine solids by the straining action of soils. The dominant chemical processes include adsorption and cation exchange.

The soil texture and design infiltration rates should be considered along with the physical and chemical characteristics specified below to determine if the soil is adequate for removing the target pollutants. The following soil properties should be carefully considered in making such a determination:

- Cation exchange capacity (CEC) of the treatment soil must be ≥ 5 milliequivalents CEC/100 g dry soil (USEPA Method 9081). Consider empirical testing of soil sorption capacity, if practicable. Ensure that soil CEC is sufficient for expected pollutant loadings, particularly heavy metals. CEC values of >5 meq/100g are expected in northern Bannock County's silty soils according to NRCS soils maps.
- Organic content of the treatment soil must be over 1%. Organic matter can increase the sorptive capacity of the soil for some pollutants.
- Waste fill materials should not be used as infiltration soil media nor should such media be placed over uncontrolled or non-engineered fill soils.

6.6.2 CONSTRUCTION MONITORING

During construction, infiltration ponds and swales also used for sediment control (See Chapter 8) should be excavated to within 1 foot of the final elevation of the pond bottom. Prevent compaction of soils in and around infiltration facilities by limiting heavy equipment operation in the area. While the construction site is still active, limit sediment entering the facility by first conveying runoff through a pre-settling basin, filter bag, or other sediment collection device.

Any accumulation of silt in the infiltration facility must be removed during final stabilization of the site. Excavate infiltration trenches and ponds to final grade only after construction has been completed and all upgradient soil has been stabilized.

Construction Inspections

In order to reduce the potential for compaction, construction equipment and vehicles shall be kept off the pond/swale bottom.

An infiltration test (per the requirements of Chapter 3) demonstrating the facility's conformance to the infiltrative rate criteria is required prior to construction certification if any of the following conditions apply:

- Construction equipment/vehicles were placed on/drove on the swale/pond area.
- During construction the swale/pond area was not protected from sediment runoff.
- When the material used to backfill the swale does not match the design infiltration rate.
- The facility must have vegetation established prior to passing final inspection. In addition, if during final inspection, it is found that the constructed infiltration facility does not conform to the accepted design, the system shall be reconstructed so that it does comply or another facility may need to be added.

6.6.3 INFILTRATION BASINS

Infiltration basins are earthen impoundments used for the collection, temporary storage, and infiltration of incoming stormwater runoff. With appropriate soil, infiltration basins can provide primary treatment. Infiltration basins must meet the requirements of Section 6.4.1 Site Suitability for Infiltration Facilities, as well as the requirements listed below.

Design Criteria

When not preceded by a primary treatment facility, infiltration swales/ponds shall be divided into two cells (a fore-bay and an infiltration cell), separated by a baffle or berm. The fore-bay shall be designed to contain the water quality design storm plus 15% for sediment storage. It is recommended that the forebay be preceded by a control structure to divert the water quality design storm flow to the forebay, with a high flow bypass going directly to the main pond. Refer to Figure 6.5 for a typical infiltration basin configuration.

The slope of the bottom of an infiltration pond shall be flat.

A minimum of one foot of freeboard is recommended when establishing the design ponded water depth. Special attention to freeboard should be taken into consideration for basins built with embankment to help protect downstream properties from flooding and to provide public safety for emergency situations. Freeboard is measured from the rim (top of basin) of the infiltration facility to the maximum ponding level or from the rim (top of basin) down to the overflow point if overflow or a spillway is included. The engineer of record shall use their professional judgment when determining an appropriate freeboard.

When overflow is provided by a drywell, the pond berm elevation shall be located a minimum of 6 inches above the drywell rim. Overflow drywells must be located adjacent to the pond berm (not at the low point of the facility) to reduce the likelihood of short circuiting, leakage, or erosion around the drywell barrel.

These facilities are best used for smaller drainage basins 10 acres or less.

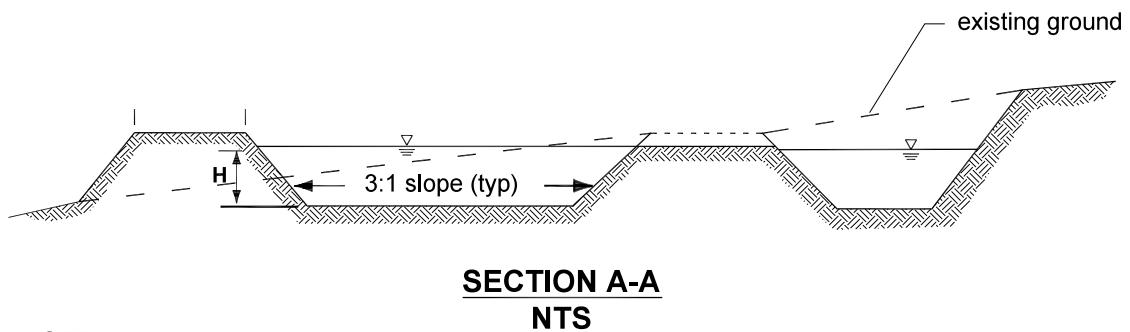
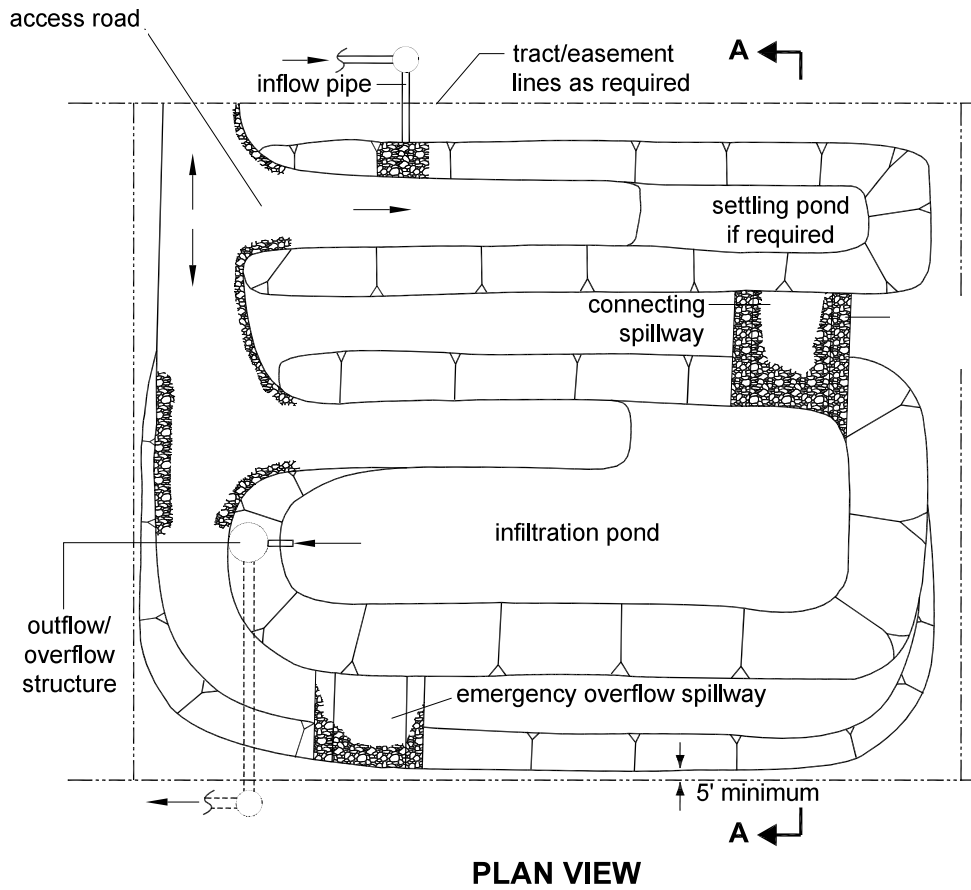
Location

If approved by the local jurisdiction, the distance between the bottom of the basin and the seasonally high groundwater level may be reduced to 3 feet if the infiltration rate safety factor is increased by 0.2 for each foot of separation less than 5 feet. In no case should the pond bottom be less than 3 feet from the seasonal high groundwater level or impermeable soil layer.

Pretreatment & Soil Criteria

Pretreatment prior to the forebay to remove additional sediment and floatables may be desired. Primary treatment is required prior to the facility if the forebay does not meet the soil criteria in Table 6.2.

Figure 6-5: Typical Infiltration Basin



NOTE:

Detail is a schematic representation only. Actual configuration will vary depending on specific site constraints and applicable design criteria. See Section 6.4.6 for design criteria.

Source: King County Surface Water Manual (2009)

6.6.4 BIO-INFILTRATION SWALES

Infiltration swales combine microbial action and soil properties to remove and degrade stormwater pollutants by biological, mechanical filtration, and chemical processes.

Sizing

Bio-infiltration swales shall be sized to fully contain the water quality design volume as outlined in Section 6.4.1. No allowance for infiltration during the 6-month storm event is allowed (the volume of the swale below the overflow level must be at least equal to the volume of the 6-month storm event runoff). Side slope volume can be used in treatment volume calculations to minimize swale size.

Bio-infiltration swales are best used for smaller drainage basins 10 acres or less.

Design

Swales shall have a minimum bottom width of 2 feet and a maximum water treatment depth (from swale bottom to elevation of first overflow/outflow mechanism) of 6 - 12 inches.

Swale bottom slopes shall be flat/sloped gently, with a maximum grade of 1-2%.

When a swale is adjacent to a sidewalk, a flat area at least one foot wide shall be maintained next to the sidewalk at the same elevation as the sidewalk. When this landing area is not provided, the side slope adjacent to the sidewalk shall be no steeper than 4:1.

Curb inlets discharging into infiltration swales shall be per the criteria specified in Section 7.8.2. A minimum separation of 3 inches shall be maintained between the gutter curb drop or swale inlet and the top of the overflow drywell grate. Pipe inlet areas must be protected from erosion by rock riprap, concrete, or other non-erodible material.

The high flow bypass or overflow structure should be located above the water quality treatment depth and at least 6 inches below the top of the swale bank.

Due to the high silt content in many Portneuf Valley Soils, it is recommended that bio-infiltration facilities with 6" of ponding be placed over 15" of ¼ inch pea gravel to aid infiltration into the native soil. No geotextile fabric should be placed between the treatment soil and the pea gravel. See Figures 6.6 and 6.7. Additionally, 1-2' of 2" drain rock can be placed beneath the pea gravel to further aid infiltration. Alternatively, where the infiltration rate of the subgrade is not sufficient, underdrains can be used to direct runoff to a detention or infiltration facility.

For additional design guidance, refer to the Eastern Washington LID Guidance Manual at: <http://www.wastormwatercenter.org/ew-lid-guidance-manual/>.

Pretreatment & Soil Criteria.

Pretreatment is recommended if the swale design doesn't include a forebay. See Table 6.2 for required soil criteria to provide primary treatment.

Figure 6.6: Typical Bio-infiltration Swale in a Planter Box

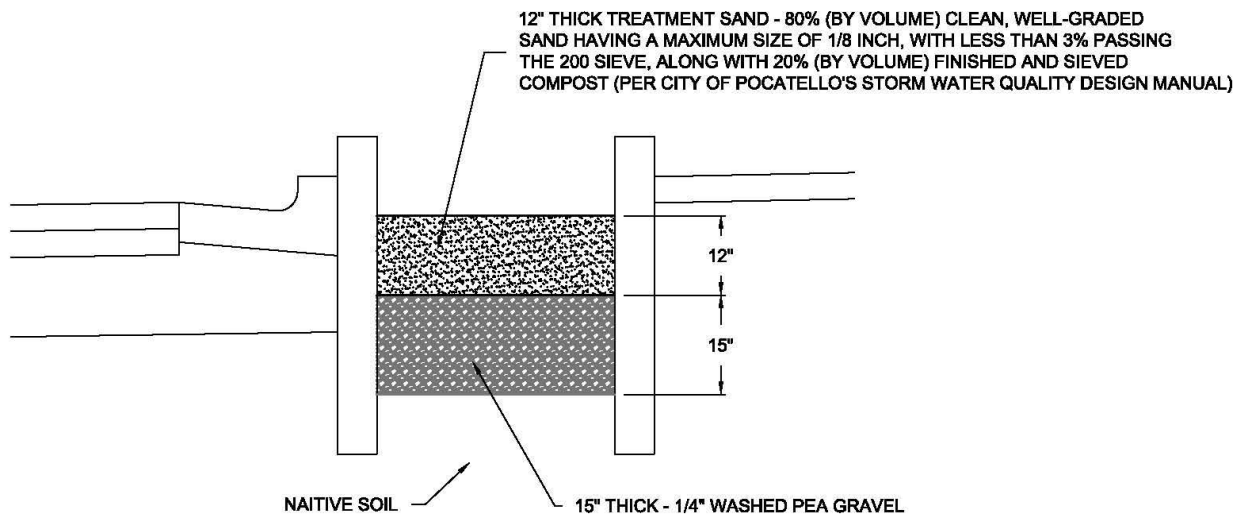


Figure 6.7: Typical Bio-infiltration Swale Cross-Section

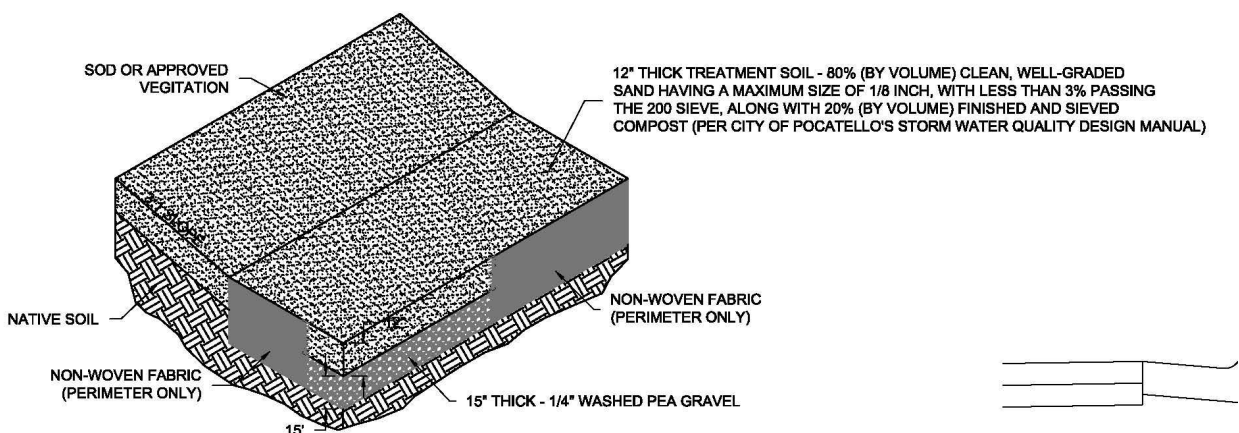


Figure 6.8 Local Bio-infiltration Swale Examples

Edson Fichter Nature Area parking lot, 2014



6.6.5 INFILTRATION TRENCHES AND GALLERIES

These subsurface infiltration systems are underground holding areas that receive and store stormwater from impervious areas such as roofs, driveways, and parking lots. Detained stormwater slowly infiltrates through the bottom and sides of the system into the surrounding sub-soil. These systems are typically filled with clean gravel surrounding a prefabricated product or corrugated pipe. Prefabricated systems are rigid structures that are wrapped with geotextile fabric, placed into the trench, and then backfilled with gravel.

Sizing

See Table 2-1. Sizing calculations must account for the infiltration rate safety factors outlined in Chapter 4.

Where space is limited, consider use of prefabricated subsurface storage chambers instead of gravel-filled infiltration trenches to increase stormwater storage capacity. Prefabricated systems typically have between 80 and 90 percent void space compared to 40 percent void space for gravel. This greater void space allows for more storage in a smaller footprint.

Design Criteria

Subsurface infiltration systems which will be load bearing shall be designed by a licensed professional civil engineer or other qualified professional to ensure structural integrity.

Subsurface installations, which utilize a prefabricated product, shall follow the manufacturer's specifications for design and installation. Additionally, inspection and clean out ports shall be installed in all subsurface infiltration systems.

The bottom of the system shall be flat to provide uniform infiltration across the surface area of the infiltration system.

Backfill Material – The aggregate material for the infiltration trench should consist of a clean aggregate with a minimum diameter of 1 inch. Void space for these aggregates should be in the range of 30 to 40 percent. For calculations assume a void space of 30 percent maximum.

Geotextile Fabric Liner – The aggregate fill material shall be completely encased in an engineering geotextile material. In the case of an aggregate surface, geotextile should surround all of the aggregate fill material except for the top one-foot, which is placed over the geotextile. Geotextile fabric with acceptable properties must be carefully selected to avoid plugging. Fabrics should generally be non-woven with a high percentage open area and a small to medium opening size. Woven geotextiles should not be used due to their susceptibility for plugging. During construction, the geotextile must be folded over the stone aggregate to form a 12 inch minimum longitudinal overlap. A bottom sand or geotextile fabric (shown in Figure 6-10) is optional.

Perforated Pipe – For infiltration trenches, provide a minimum of 8-inch perforated pipe should be provided to increase the storage capacity of the infiltration trench and to enhance conveyance of flows throughout the trench area.

Observation Well – An observation well shall be installed at the lower end of the infiltration trench to check water levels, drawdown time, sediment accumulation, and conduct water quality monitoring. It should consist of a perforated PVC pipe which is 4 to 6 inches in diameter and it should be constructed flush with the ground elevation. The top of the well should be capped to discourage vandalism and tampering.

Construction Criteria

Avoid excessive compaction of the bottom of the system during construction. Use lightweight equipment when excavating to protect the K_{sat} of the underlying soil. Place excavated material downslope from the infiltration system in a stable location to avoid washing material back into the trench should a runoff event occur.

Install subsurface infiltration systems after other pollutant sources have been stabilized to avoid clogging the trench from subsequent construction activities.

Soil Criteria & Pretreatment

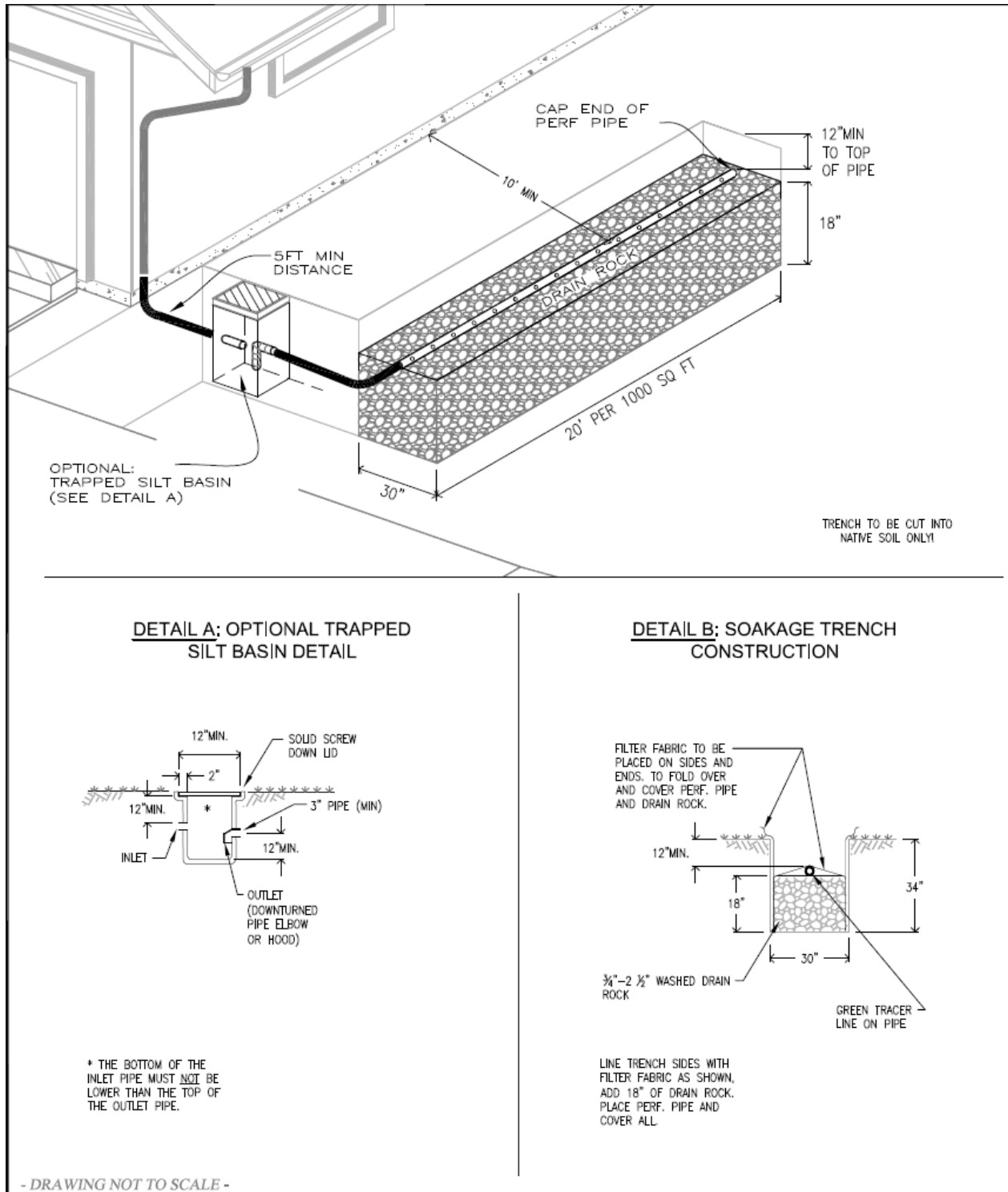
Pretreatment is required prior to all infiltration trenches (regardless of the soil beneath the facility) unless the facility is preceded by a primary treatment facility.

Primary treatment may be required depending on land use and the treatment capacity of the vadose zone beneath the facility. The criteria in Table 6.2 should be used to determine the primary treatment needs prior to infiltration trenches. Use Table 6.6 in Section 6.6.7 'Drywells' to determine the treatment capacity of the vadose zone and treatment requirements prior to infiltrator galleries.

Maintenance

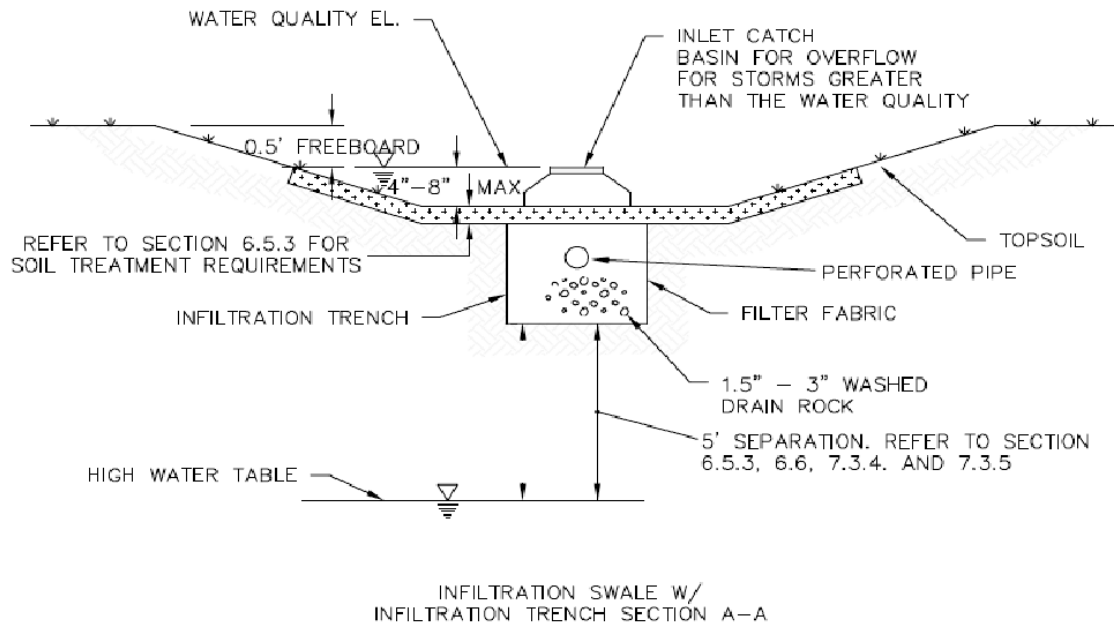
Sediment buildup in the top foot of stone aggregate or the surface inlet should be monitored on the same schedule as the observation well.

Figure 6-9 – Typical Infiltration Trench



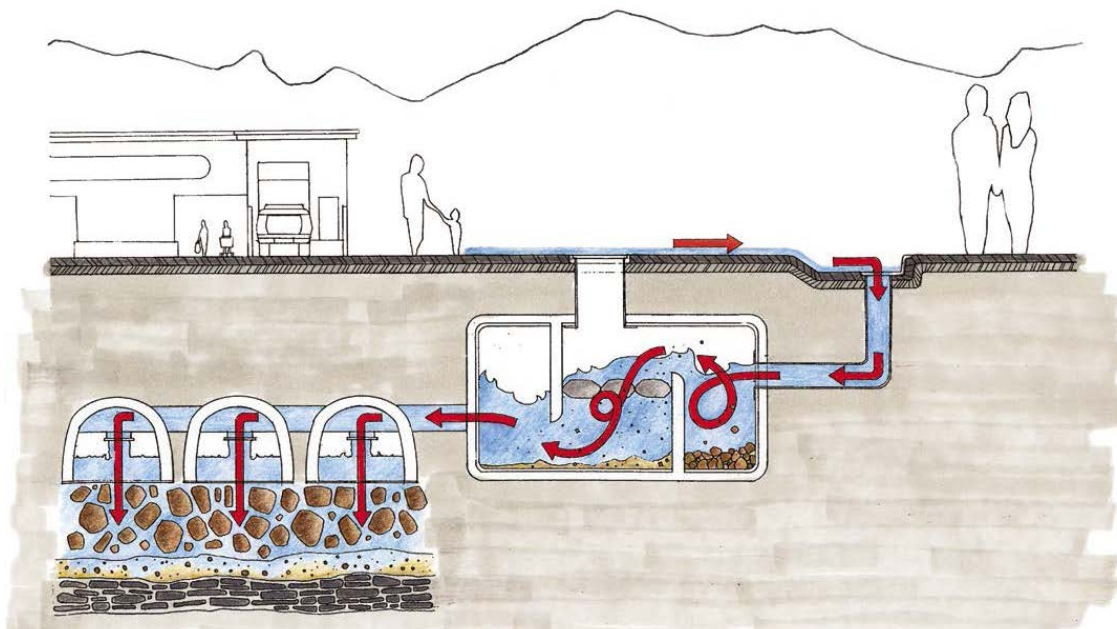
Source: City of Portland

Figure 6-10: Typical Bioretention Swale with Infiltration Trench Cross Section



Source: Yakima County Stormwater Manual

Figure 6-11: Typical Subsurface Infiltration System with Pretreatment



Water flows through a pretreatment system to remove pollutants prior to discharging to a subsurface infiltration system.

Source: Truckee BMP Handbook 2014

6.6.6 DRY WELLS

Drywells are subsurface structures that convey stormwater into the subsurface. They may be standalone structures or part of a larger drainage system (i.e., the overflow for an infiltration swale). This section defines site suitability, pretreatment requirements, and design criteria for discharges of stormwater to including drywells.

Drywells are subject to UIC regulations and also shall comply with the requirements for all facilities in Section 6.4.

Refer to Figure 6-12 for a typical drywell detail.

Sizing

Drywells are typically a minimum of 48 inches in diameter and at least 5 to 10 feet deep. Drywells have a limited life that can be extended by preventing sediment from accumulating in the facility.

See Table 2-1 for sizing needs. Sizing calculations must account for the infiltration rate safety factors outlined in Chapter 4 and should consider the interaction and/or connectivity in a drywell system.

Location & Setbacks

Adequate room for maintenance equipment should be considered during site design. Additionally, UIC facilities shall be setback at least:

- 100 feet from streams, open water features, septic tanks or drainfields.
- 200 feet from drinking water wells.
- 20 feet from building foundation. Local jurisdictions may reduce the setback requirements based on the proposed facility size and site conditions.

Drywells should not be installed on slopes steeper than 25 percent (4H:1V). Drywells may not be placed on or above slopes greater than 15 percent without evaluation by a professional Engineer with geotechnical expertise or a qualified geologist. Such conditions should be evaluated and reported in the GSC (Chapter 4).

UIC facilities shall not be located where they can impact a soil or groundwater contamination site, nor shall they be placed on unstable soil.

Drywells shall be placed at least 40 feet center to center or twice the depth of the drywell, whichever is greater.

The active barrel of the drywell shall be installed within the target soil strata analyzed.

When drywells are used as an overflow from a detention or infiltration pond, the distance between the drywell and the pond inlet shall be maximized to avoid short circuiting and allow for optimal water quality treatment. Overflow drywells shall not be located in the center or at the low point of a pond.

Separation Distance

At a minimum, the vertical separation is five feet between the base of a UIC well and the high seasonal water table, bedrock, hardpan, or other low permeability layer.

Design Criteria

Geotextile fabric shall be placed around the drain rock prior to backfilling (See Figure 6-12) to prevent migration of fines into the drain rock. The selection and placement of fabric is critical to avoid rapid plugging and failure of the dry well. Fabrics should generally be non-woven with a high percentage open area and a small to medium opening size. Woven geotextiles should not be used due to their susceptibility for plugging.

Construction Criteria

Drywells installed prior to final site stabilization shall be protected from construction site runoff by routing site runoff to an appropriate sediment control facility (See Chapter 9).

Drain rock installed around the drywell shall be clean and free from fines or debris. Consult the local jurisdiction for additional drain rock requirements.

Pretreatment & Soil Criteria

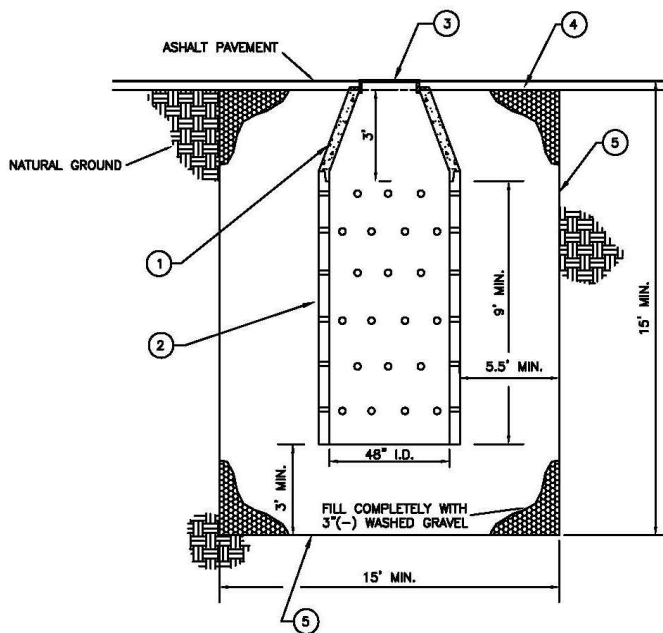
Pretreatment (in addition to applicable oil control) is required unless the facility is preceded by a primary treatment facility. Primary Treatment requirements vary depending on land use and the treatment capacity of the vadose zone beneath the UIC facility. Use Table 6.6 to determine the treatment capacity of the vadose zone and treatment requirements prior to the drywell facility. A site exploration will be required to obtain sufficient data to use this table.

Operation and maintenance

Frequent inspections and regular maintenance to remove debris will improve the long-term performance of the facilities by preventing the buildup of materials that could inhibit infiltration.

If inflowing pollutant loads are high, frequent maintenance will be necessary to maintain effectiveness.

Figure 6-12: Typical Drywell Detail



LEGEND

- ① STANDARD MANHOLE CONE.
- ② STANDARD 48" PERFORATED MANHOLE SECTION.
- ③ STANDARD 24" MANHOLE RING WITH STANDARD COVER.
- ④ 3/4"(-) BASE MATERIAL.
- ⑤ LINE SIDES, TOP, & BOTTOM OF AREA WITH AMOCO FILTER FABRIC STYLE 4545, OR EQUIV. (1' MIN. OVERLAP OF MATERIAL).

CITY OF CHUBBUCK STANDARDS
FOR PUBLIC WORKS CONSTRUCTION

TYPICAL
DRY WELL DETAIL

STANDARD DRAWING NO:
SD-600

Table 6-3: Design Criteria for Drywells, Infiltration Galleries/Chambers and other Subsurface Infiltration Facilities (UICs).¹

Requirements				
Treatment Capacity of Soil beneath UIC facility.	HIGH TREATMENT CAPACITY	MODERATE TREATMENT CAPACITY	LOW TREATMENT CAPACITY	NO TREATMENT CAPACITY
Required soil depth to groundwater/bedrock.	>5-ft;	>10-ft;	>25-ft;	N/A
Required Soil Type	Materials with median grain size < 0.125 mm. Having a sand to silt/clay ratio of less than 1:1 and sand plus gravel < 50%. Soil types include: Lean, fat, or elastic clay; Sandy or silty clay; Silt; Clayey or sandy silt; Sandy loam or loamy sand; Silt/clay with inter-bedded sand; Well-compacted, poorly-sorted materials. This category generally includes loess, till, hardpan, and caliche.	Materials with median grain size 0.125mm to 4mm. Sand to silt/clay ratio from 1:1 to 9:1 and % sand > % gravel. Soil types include: Fine, medium or coarse sand; Sand with interbedded clay and/or silt; and Poorly-compacted, poorly-sorted materials. This category includes some alluvium and outwash deposits.	Materials with median grain size > 4mm to 64mm. Having a sand to silt/clay ratio greater than 9:1 and % sand less than % gravel. Soil types include: Poorly-sorted, silty or muddy gravel; Sandy gravel, gravelly sand, or sand and gravel. This category includes some alluvium and outwash deposits.	Materials with median grain size > 4mm to 64mm. Having a sand to silt/clay ratio greater than 9:1 and % sand less than % gravel. Soil types include: Poorly-sorted, silty or muddy gravel; Sandy gravel, gravelly sand, or sand and gravel. This category includes some alluvium and outwash deposits.
Treatment Required? ^{2,3,4}	All sites: Pretreatment.	Low – moderate use sites: Pretreatment; High use sites: Primary Treatment.	Low use sites: Pretreatment; High- moderate use sites: Primary Treatment.	All sites: Primary Treatment.

¹ Not to be used for Infiltration Trenches. See Section 6.6.1 (Table 6-2).

² This table does not address oil control requirements. See Section 2.3.6.

³ See Section 6.3 for definitions of high, moderate and low-use sites.

⁴ See Table 6-1 for appropriate pre-treatment and treatment facilities; Primary treatment facilities that are an emerging technology and placed prior to UICs shall be approved by the Washington Department of Ecology TAPE program for 'Basic Treatment' or 'Pretreatment' at the Conditional or General Use Level.

6.7 DETENTION FACILITIES

A detention system is a low lying area that is designed to temporarily hold and slowly release stormwater. A detention facility is intended to control peak stormwater runoff rates, and as designed per the criteria in this Chapter, does not control volume (except to infiltrate the water quality design storm and the volume of the bottom 6" of the facility).

Stormwater runoff from a developed site shall leave the site in the same manner and location as it did in the pre-developed condition. Therefore, a detention system may be used only when a well-defined natural drainage course is present prior to development.

Detention facilities are designed to limit the release rate. The analysis of multiple design storms is needed to control and attenuate both low and high flow storm events. The total post-developed discharge rate (including bypass flow) shall be limited to the rates outlined in Table 2.1. The NRCS Type II 24-hour storm event is the design storm for all detention facilities.

6.7.1 DETENTION PONDS

Sizing

Detention ponds must be designed as flow-through systems. Developed flows must enter through a conveyance system separate from the control structure and outflow conveyance system. Maximizing the distance between the inlet and outlet is encouraged to promote plug flow and allow sediment to settle to the bottom of the pond.

Design Criteria

Detention ponds shall comply with the facility requirements in Section 6.3.

Pond bottoms should be level and located a minimum of 12" below the inlet and outlet to provide sediment storage.

Figures 6-13 and 6-14 are illustrations of this BMP. Control structures and overflows shall be designed following the guidelines in Section 6.7.1.1.

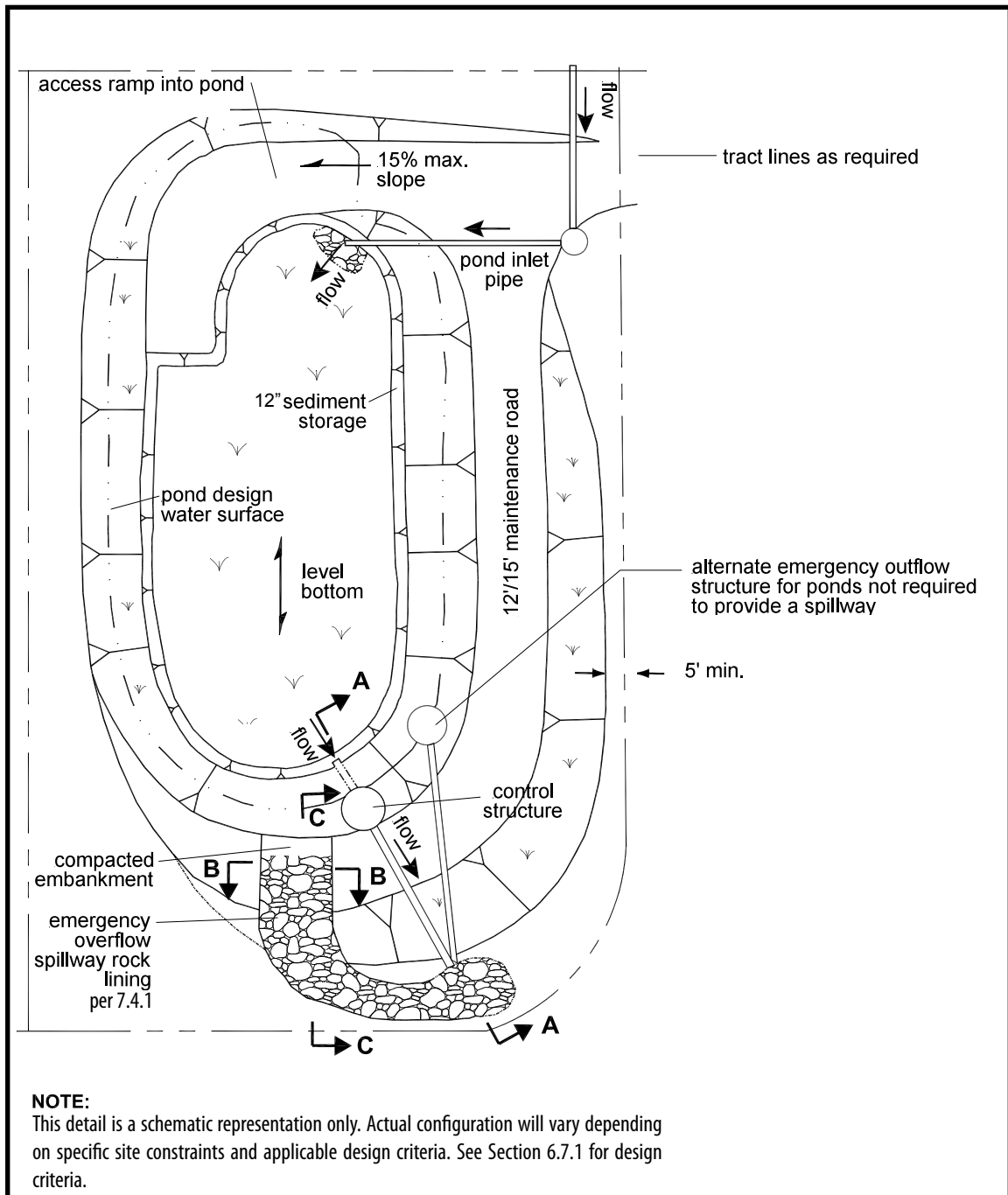
When not preceded by a primary treatment facility, detention ponds shall be divided into two cells (a forebay and detention cell), separated by a baffle or berm. The fore-bay shall be sized to contain the water quality treatment design storm plus 15% sediment storage. It is recommended that the forebay be preceded by a control structure to divert the water quality design storm flow to the forebay, with a high flow bypass going directly to the main pond.

Soil Criteria & Pretreatment

Pretreatment prior to the forebay to remove sediment may be desired.

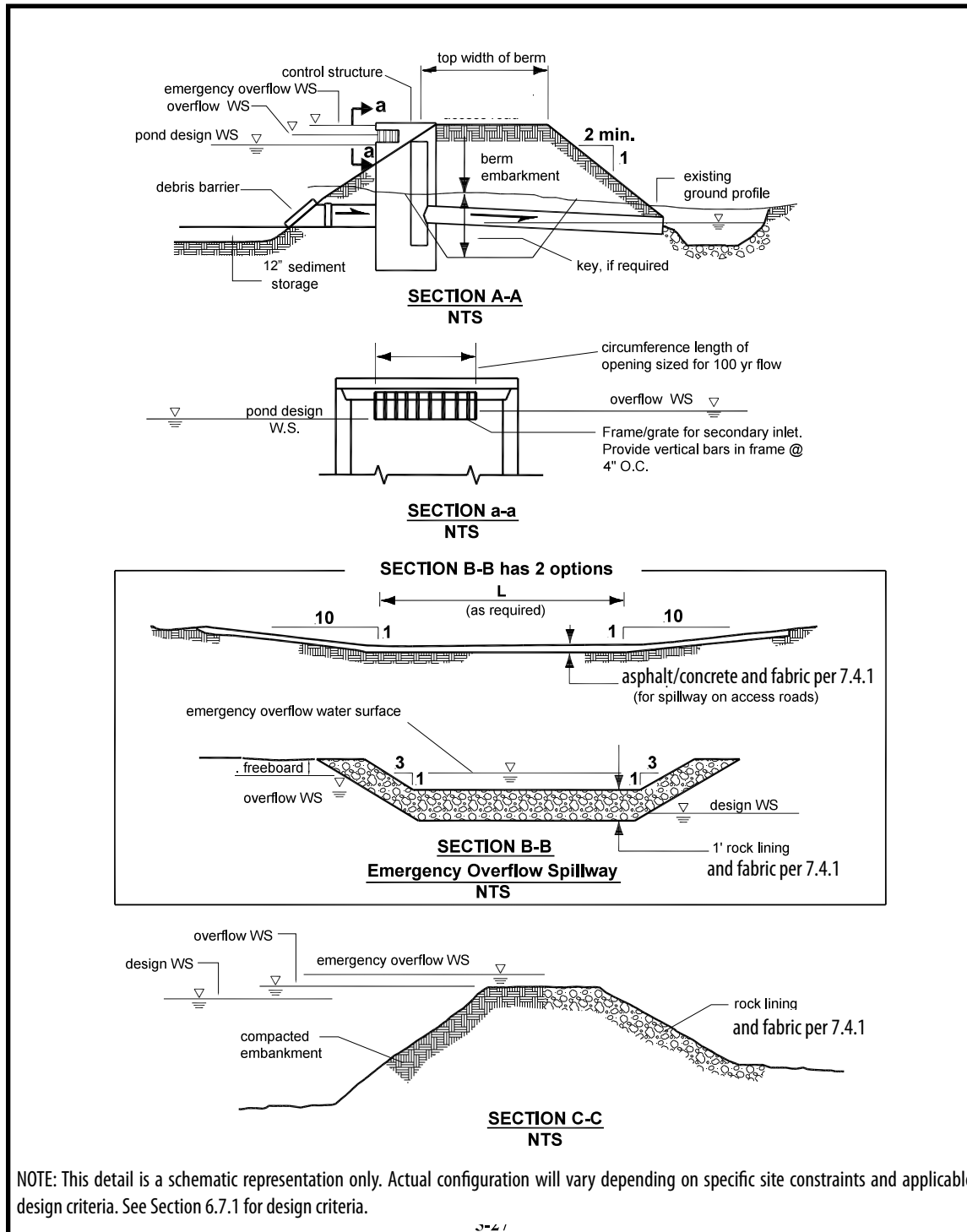
Since detention systems infiltrate the bottom 12" of water in their ponds, they shall adhere to the subgrade infiltrative criteria specified for infiltration basins. Primary treatment is required prior to the facility if the forebay does not meet the soil criteria in Table 6.2.

Figure 6-13 – Typical Detention Pond (forebay not shown)



Source: King County Surface Water Design Manual

Figure 6-14 – Typical Detention Pond Sections



Source: King County Surface Water Design Manual

6.7.1.1 OUTFLOW STRUCTURE DESIGN

Outflow structures are designed to control the release rate of flow from a detention facility to meet the required performance standard. Outflow structures should include a control structure, primary overflow, and emergency overflow.

Control Structures

Control structures include weirs, culverts, or catch basins or manholes with a restrictor device for controlling outflow from a detention facility. Riser type restrictor devices ("tees") or flow restrictor oil pollution control tees ("FROPTs") also provide some incidental oil/water separation to temporarily detain oil or other floatable pollutants. The restrictor device usually consists of multiple orifices and/or weir sections sized to meet the performance standards.

Control structures shall be selected taking into consideration the expected hydraulic heads. Table 6-4 presents typical control structures and their applicability:

TABLE 6-4: OPTIMAL APPLICATION OF CONTROL STRUCTURES

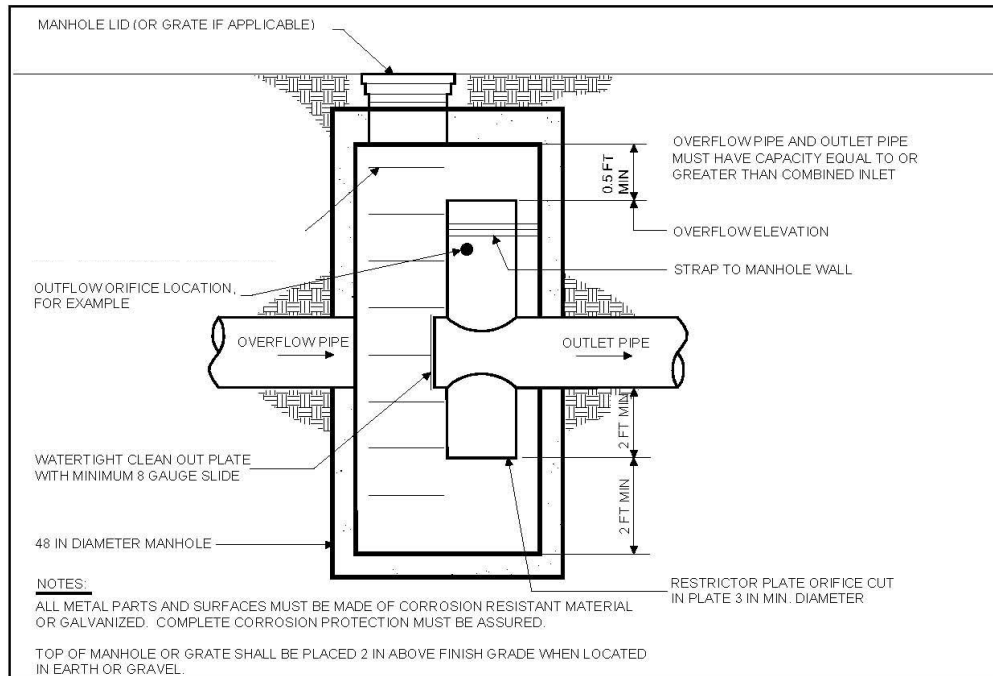
CONTROL STRUCTURE	POND HEAD
Outlet Pipe	Very Low
V-Notch Weir	Low
Slotted Weir	Moderate
Multi-Stage Orifice	High

Outflow control structures shall meet the following requirements:

- Circular orifices shall be at least 1.0 inch in diameter. Slotted weirs can be used in lieu of smaller orifices to reduce the occurrence of plugging. Note: The live storage depth need not be reduced to less than 3 feet to meet the performance standards;
- Orifices may be constructed on a tee section as shown in Figure 6-15, or on a baffle (internal wall) within the catch basin or manhole;
- In some cases, performance requirements may require the top orifice/elbow to be located too high on the riser to be physically constructed (e.g., a 13-inch diameter orifice positioned 0.5 feet from the top of the riser). In these cases, a notch weir in the riser pipe may be utilized to meet the performance requirements;
- A flow control structure utilizing a riser arrangement, shall conform to Figure 6-15 and shall include, as a minimum, a watertight cleanout, 200-lb test chains, an overflow riser with a 12-inch diameter or larger riser, and sump. At least three riser straps spaced no more than 2 feet on center shall be provided;

- Outlet structures shall be located where accessible for maintenance, preferably adjacent to access roads; and
- Manhole lids shall be locking/bolt down and the top of the manhole shall be placed 2 inches above the finished grade for detention ponds, unless the structure is placed in a parking lot, road, or shoulder.

Figure 6-15 – Typical Flow Control Structure



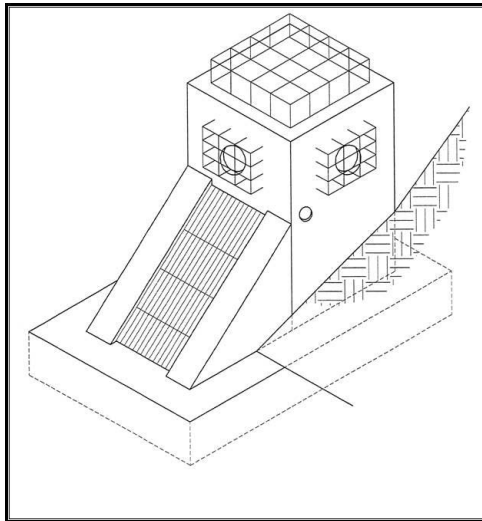
Primary Overflow

A primary overflow shall be provided to bypass the 100-year developed peak flow over or around the restrictor system. The primary overflow is intended to protect against breaching of a pond embankment in the event of plugged orifices or high flows.

An open topped riser can often serve as the primary overflow, provided the riser, inlet pipe, and outflow pipe both have capacity to carry the 100-year developed peak flow. The combined orifice and riser (or weir) overflow may be used to meet the performance requirements. However, the design must still provide primary overflow for the developed 100-year peak flow assuming all orifices are plugged.

In ponds, a secondary inlet to the control structure shall also be provided as additional protection against overtopping should the inlet pipe to the control structure become plugged. A grated opening ("jailhouse window") in the control structure manhole functions as a weir (see Figure 6-14) when used as a secondary inlet. Note: the maximum circumferential length of this opening shall not exceed one-half of the control structure circumference. The "birdcage" overflow structure shown in Figure 6-16 may also be used as a secondary inlet.

Figure 6-16 – Typical “Birdcage” Overflow Structure



Weir

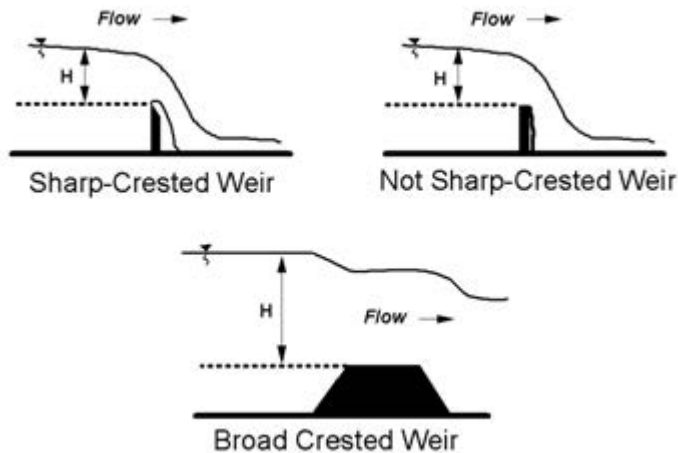
A weir is an obstruction in an open channel or in a detention facility at the point of discharge, typically used to limit and measure flow rates. Weirs should meet the following design requirements:

- A weir used as a flow control structure shall be made of non-erosive material that is resistant to alteration or vandalism, such as reinforced concrete or metal with a non-corrosive surface. An emergency overflow weir can be made of soil with revetment;
- Weir inverts should be set above the pond bottom a height of at least twice the maximum head; and
- The thickness of broad crested weirs should be at least 3 times the maximum head and preferably 4 times the maximum head, or more.

Two types of weirs, as depicted in Figure 6-17, are typically used for controlling outflow from detention facilities:

- Broad crested weirs have a crest that extends horizontally in the direction of flow far enough that the flow leaves the weir in essentially a horizontal direction. Typically, a weir is broadcrested, if the weir thickness is greater than half of the head, H). Broad crested weir equations are used to calculate the depth of flow through emergency spillways.
- Sharp crested weirs have a narrow crest and a sharp upstream edge so that water flows clear of the crest. The weir invert should be set above the pond bottom a height of at least twice the maximum head, preferably more. Sharp crested weir equations are used to calculate the flow through notches in a control structure riser or baffle wall and jailhouse openings.

Figure 6-17: Typical Weir Types



Source: FHWA

Table 6-5 provides equations for these weirs and orifices used for flow control.

TABLE 6-5: EQUATIONS FOR VARIOUS WEIR AND ORIFICE TYPES

WEIR/ORIFICE TYPE	EQUATION	C
Sharp Crested V-Notch Weir	$Q = C(\tan\theta/2)H^{5/2}$	0.60
Rectangular Sharp Crested Weirs ¹	$Q = C(L-0.2H)H^{3/2}$	$3.27 + 0.40 H/Y$
Broad Crested Trapezoidal Weir ²	$Q = C(2g)^{1/2}[2/3LH^{3/2} + 8/15(\tan\theta)H^{5/2}]$	0.60
Assuming C=0.6 and Tan Q=3 for 3:1 side slopes	$Q = 3.21[LH^{3/2} + 2.4H^{5/2}]$	
Orifice	$Q = CA(2gH)^{1/2}$	0.62^3

¹The weir inverts should be set above the pond bottom a height of at least twice the maximum head.

²The thickness of the weir shall be at least 3 times the maximum head and preferably 4 times the head or longer.

³ Coefficient for sharp edge orifices. Adjust coefficient if designing rounded edge orifices.

Where:

- Q = flow (cfs);
- C = coefficient of discharge;
- A = area of orifice (ft²);
- H = hydraulic head (ft);
- g = gravity (32.2 ft/sec²);
- θ = notch angle;
- Y = storage depth (ft); and,
- L = length or weir opening.

Riser

A riser typically consists of a circular pipe or box inlet with its opening oriented parallel to the water surface. In operation, a riser pipe operates under three hydraulic flow regimes in this order: weir, orifice, and full barrel. Full barrel flow occurs when the downstream conduit is undersized with respect to the riser capacity and when the water surface elevation rises high enough.

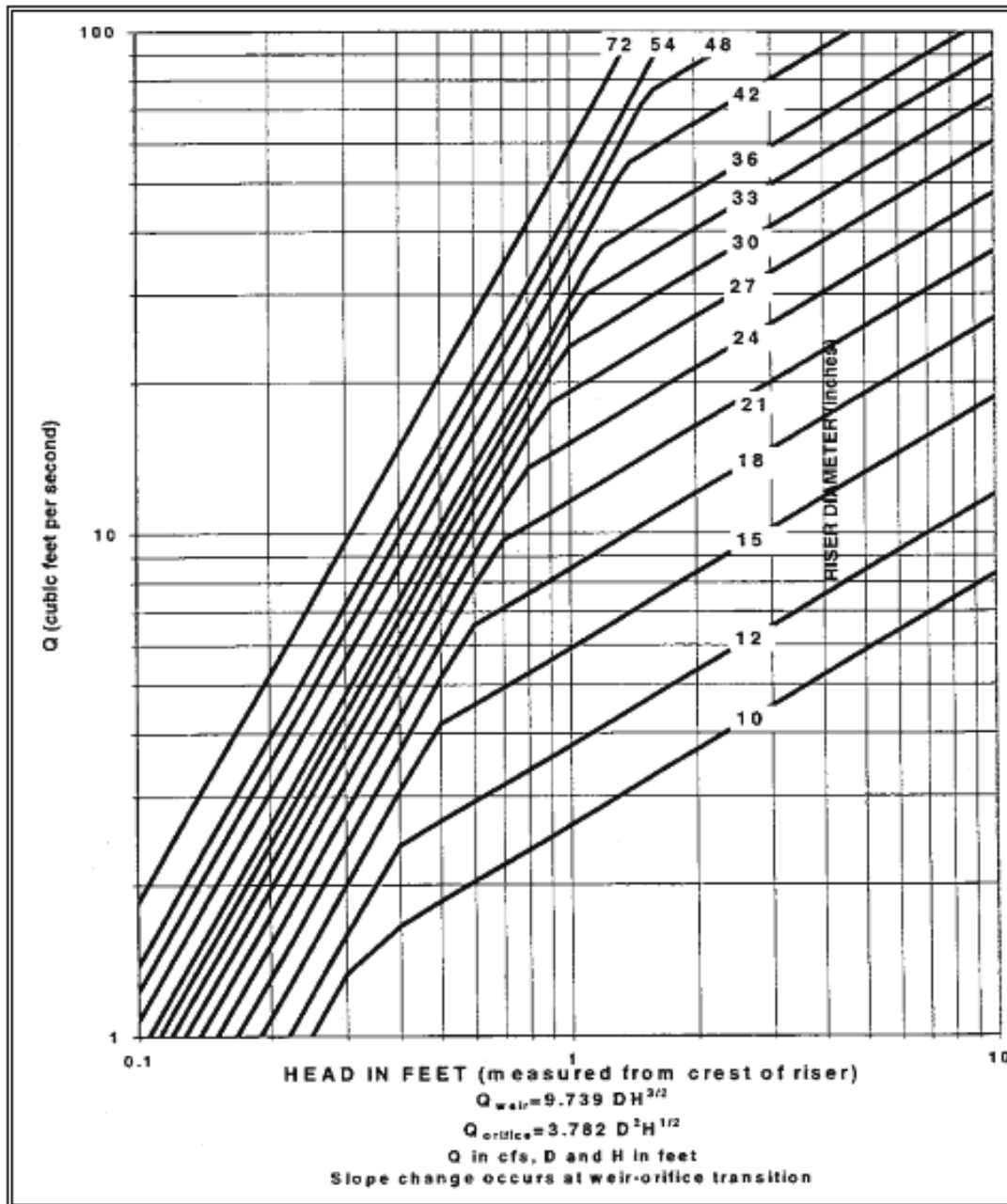
Figure 6-18 can be used to determine the head (in feet) above a riser of given diameter and for a given flow (usually the 100-year peak flow for developed conditions). Figure 6-18 is used to calculate the depth of flow through overflow risers and birdcage structures. For additional information, consult a hydraulics reference.

Emergency Overflow

A typical section is shown in Figure 6-14. The design shall comply with the following requirements:

- The spillway shall have the capacity to pass the 100 year-developed peak flow with 30 percent freeboard depth;
- The spillway shall be armored with riprap, full width, and extend downstream to where emergency overflows enter the conveyance system; and,
- Spillways shall be analyzed as broad crested trapezoidal weirs.
- The emergency overflow shall direct overflows safely towards the downstream conveyance system. If the overflow facility is located on an embankment, it shall be armored to a minimum of 10 feet beyond the toe of the embankment.
- The emergency overflow path shall be identified and noted on the construction plans.

Figure 6-18 – Flow Rates vs Head (riser)



6.7.2 WET PONDS

For design criteria, see BMPs 11-13 in the Idaho DEQ BMP catalog.

6.7.3 OTHER DETENTION OPTIONS

This section presents other options for detaining flows to meet flow control performance standards.

Use of Parking Lots for Additional Detention

Parking lots may be used to provide detention storage, provided all of the following are met:

- The depth of water detained does not exceed 1 foot (or other depth established by the permitting authority or local jurisdiction) at any location in the parking lot for runoff events up to and including the 100-year event.
- The gradient of the parking lot area subject to ponding is 1 percent or greater.
- The emergency overflow path is identified and noted on the engineering plans. The overflow must not create a significant adverse impact to downhill properties or drainage system.
- Fire lanes used for emergency equipment are free of ponding water for all runoff events up to and including the 100-year event.
- A downstream treatment facility with absorptive oil removal is needed prior to discharge to surface or ground water.

Note: Flows may be backed up into the parking lot by the control structure (i.e. the parking lot need not function as a flow through detention pond).

Use of Roofs for Detention

Roofs of structures may be used to meet flow control requirements provided all of the following conditions are met:

- The roof support structure is analyzed by a Structural Engineer to address the weight of the ponded water.
- The roof area subject to ponding is sufficiently waterproofed to achieve a minimum service life of 30 years.
- The minimum pitch of the roof area subject to ponding is ¼-inch per foot.
- An overflow system is included in the design to safely convey the 100-year peak flow from the roof.
- A mechanism is included in the design to allow the ponding area to be drained for maintenance purposes or in the event the restrictor device is plugged.

Structural Detention Facilities

Structural detention facilities such as underground tanks (oversized pipes) and vaults may be used to meet flow control requirements. Structural detention facilities are sized similar to detention ponds with a separate control structure manhole located immediately at the downstream end.

For detailed design guidelines, see BMP 17 'Wet Vault/Tank' in the Idaho DEQ BMP catalog.

6.8 BIOFILTRATION TREATMENT FACILITIES

Biofiltration treatment facilities are vegetated treatment systems (typically grass) that remove pollutants by means of sedimentation, filtration, soil sorption, and/or plant uptake. They are typically configured as swales or filter strips. These facilities are designed to remove low concentrations and quantities of total suspended solids (TSS), heavy metals, petroleum hydrocarbons, and/or nutrients from stormwater. Biofiltration treatment facilities can be used as a primary treatment BMP for contaminated runoff from roadways, driveway, parking lots, and highly impervious ultra-urban areas.

The biofiltration BMPs described in this section include:

- Biofiltration channels
- Vegetated filter strip

6.8.1 BIOFILTRATION CHANNELS/GRASSY SWALES

Biofiltration provides filtration, particle settling, adsorption, and biological uptake of pollutants in stormwater that occurs when runoff flows over and through vegetated areas. Biofiltration channels (also called grassy swales) are a sloped vegetated swale or ditch that provides both conveyance and water quality treatment. It does not provide stormwater flow control but can convey runoff to BMPs designed for flow control. An off-line location is preferred to avoid flattening vegetation and the erosive effects of high flows.

Geometry

The ideal cross-section is a trapezoid with sideslopes no steeper than 4:1. However, a rectangular shape can be proposed if there are topographical constraints or other construction concerns.

The channel slope shall be at least 1 percent and no greater than 5 percent. When slopes less than 2 percent are used, evaluate the need for under-drainage.

The bottom width shall be determined based on the desired flow depth. The minimum bottom width is 2 feet for private facilities and 4 feet for public. The depth of flow shall not exceed 4 inches for turf grass or 3 inches for dryland grasses during the design storm.

The maximum bottom width is 10 feet. If the calculated bottom width exceeds 10 feet, parallel grass channels shall be used in conjunction with a flow splitter device.

The biofiltration channel shall have a minimum residence time of 9 minutes during the water quality design flow. The minimum length, in any case, shall be no less than 100 feet.

Construction Criteria

Biofiltration channels should generally not receive construction-stage runoff.

If possible, divert runoff (other than necessary irrigation) during the period of vegetation establishment. Where runoff diversion is not possible, protect graded and seeded areas with suitable erosion control measures.

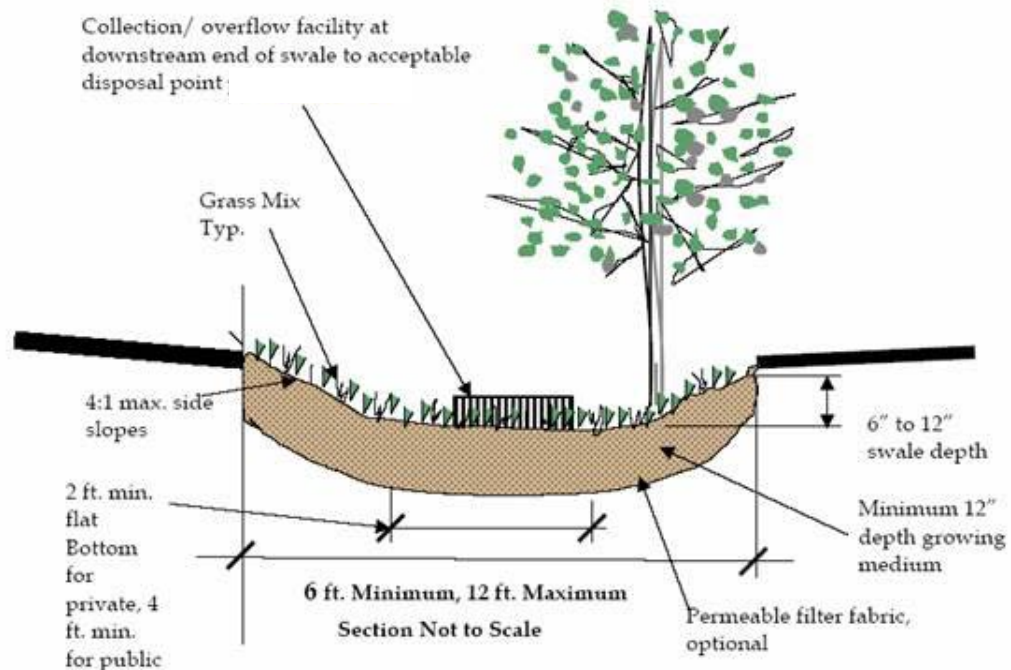
Vegetation

Biofiltration channels shall be planted with fine close-growing grasses (or other vegetation). It is important to maximize water contact with vegetation and the soil surface. Low water grasses are recommended.

Pretreatment

Pretreatment to remove additional sediment and floatables may be desired.

Figure 6.19: Typical Bio-filtration Channel Cross-Section



Source: City of Portland Storm Water Management Manual

Design Guidelines and Calculations

The following procedure shall be followed when designing biofiltration channels.

Determine the water quality design flow rate as outlined in Table 2-1;

Determine the bottom width of the swale using equation 6-2 or 6-3.

Calculate the cross sectional area of flow for the given channel and verify that the flow velocity is less than or equal to 1 foot per second; and,

Calculate the length of the channel and verify that the residence time is at least 9 minutes. The minimum channel length is 100 feet.

Commercially available software is most commonly used to compute many of the parameters associated with the sizing of a biofiltration swale. Equations:

$$Q = \frac{1.486AR^{2/3}S^{1/2}}{n}$$

Where: Q = flow (cfs);
A = cross-sectional area (ft²);
R = hydraulic radius (ft); and,
S = longitudinal slope of strip (ft/ft); and,
n = Manning's roughness coefficient (use n = 0.20 for turf lawn or n = 0.30 for natural ditch with less dense vegetation such as meadow or pasture).

For a trapezoidal channel with shallow flow, the hydraulic radius can be approximated to the depth of flow. Using this assumption, the following can be used to solve for the required width:

$$B = \frac{Q*n}{1.486y^{2/3}S^{1/2}} - Zy$$

Where: B = bottom width of the strip (ft);
y = depth of flow (ft);
S = longitudinal slope of strip (ft/ft);
Z = side slope of the strip in the form Z:1; and,
Q = flow (cfs).

6.8.2 VEGETATED FILTER STRIPS

Vegetated filter strips are primarily used adjacent and parallel to paved areas such as parking lots or driveways, and along rural roadways where sheet flow from the paved area will pass through the filter strip before entering a conveyance system or dispersing into areas where it can be infiltrated or evaporated. They slow runoff velocities, filter out sediment and other pollutants, and provide infiltration into underlying soils.

If space allows, vegetated filter strips can be successfully used for pretreatment prior to bio-infiltration swales, detention ponds, and infiltration facilities. In these instances, the downslope edge of the filter strip is the pond/basin/swale (shown as a collector ditch in Figure 6-20).

One challenge associated with vegetated filter strips is the difficulty in maintaining sheet flow. Concentrated flows can short circuit the filter strips which can then contribute to eroded rills or flow channels across the strips. This results in little or no treatment of stormwater runoff. In certain situations, a vegetated filter strip can be combined with a natural dispersion area to provide both water quality treatment and flow control.

Vegetated filter strips can be used when the general criteria listed below are met:

- The flow from the roadway must enter the filter strip as sheet flow. Thus, the vegetated filter strips must not receive concentrated flow discharges;
- A maximum flow path (paved width) of 30 feet can contribute to a filter strip designed via this method (i.e. vegetated filter strips should typically not be proposed for super-elevated roads, unless the 30 foot width is adhered to);
- The roadway ADT must be less than 30,000 vehicles;
- The longitudinal slope of the contributing drainage area parallel to the edge of the pavement shall be 4 percent or less; and
- The lateral slope (typically the cross-slope of the road) of the contributing drainage area perpendicular to the pavement edge or road cross slope shall be 5 percent or less.

Geometry

Refer to Figure 6-20. The minimum required filter strip width is: 4' for a 10' flow path; 4.5' for a 25' flow path; and 5.5' for a 30' flow path. Flow path is the distance of the paved surface discharging to the filter strip.

The cross-slope of the filter strip shall be no steeper than 6:1 or 17 percent.

Along roadways, filter strips should be placed at least 1 foot, but preferably 3 to 4 feet from the edge of pavement, to accommodate a vegetation free zone. The separation distance can include the energy dissipating trench described below.

Energy Dissipation

A shallow gravel trench shall be installed between the pavement surface and the filter strip to maintain sheet flow. This area serves as a flow spreader and shall consist of a shallow trench filled with crushed aggregate. The gravel area shall be a minimum of 6 inches deep and 12 inches wide.

Vegetation

Vegetated filter strips may be planted with turf grasses and native vegetation such as small herbaceous shrubs. This makes the system effective in treating runoff and providing root penetration into subsoils, thereby enhancing infiltration.

Construction

Vegetated filter strips shall be constructed after other portions of the project are completed. Care should be taken to avoid compaction of the area used for a filter strip. If the filter strip area has been compacted during construction, the soil shall be tilled and/or amended with compost prior to installing the filter strip.

Design

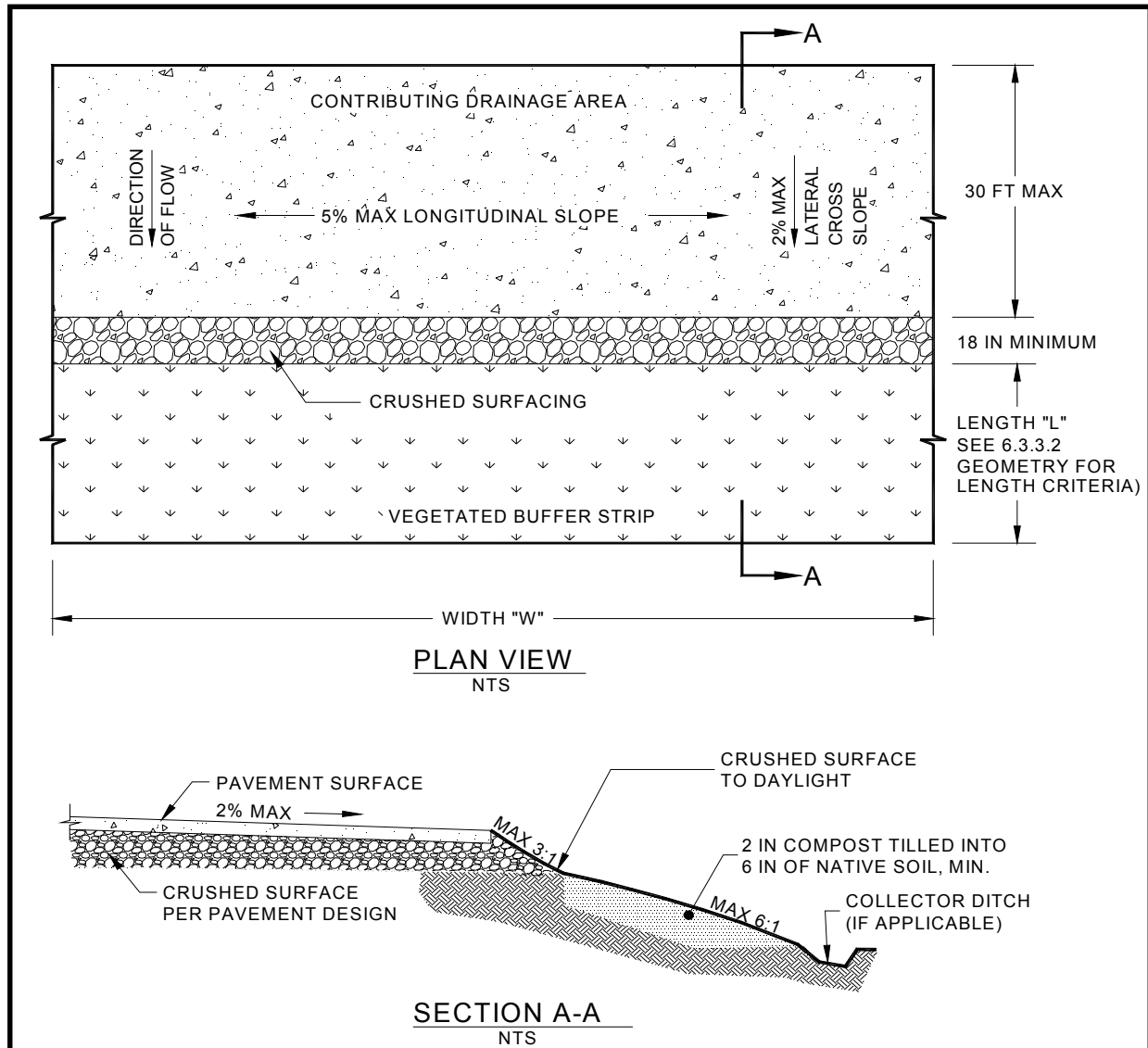
The sizing of the filter strip is based on the flow path distance draining to the filter strip and the cross slope of the filter strip itself (parallel to the flow path). The following design steps shall be followed:

Determine the flow path draining to the filter strip. Normally this is the width of the paved area draining to the strip, but if the site is sloped the flow path must be measured at an angle. For crowned roads, the flow path is the distance from the crown to the edge of pavement;

Determine the average lateral or cross slope of the filter strip. Calculate the cross slope of the filter strip (parallel to the flow path), averaged over the total width of the filter strip. If the slope is less than 2 percent, use 2 percent for sizing purposes. The maximum cross slope allowed is 6H:1V or 17 percent; and,

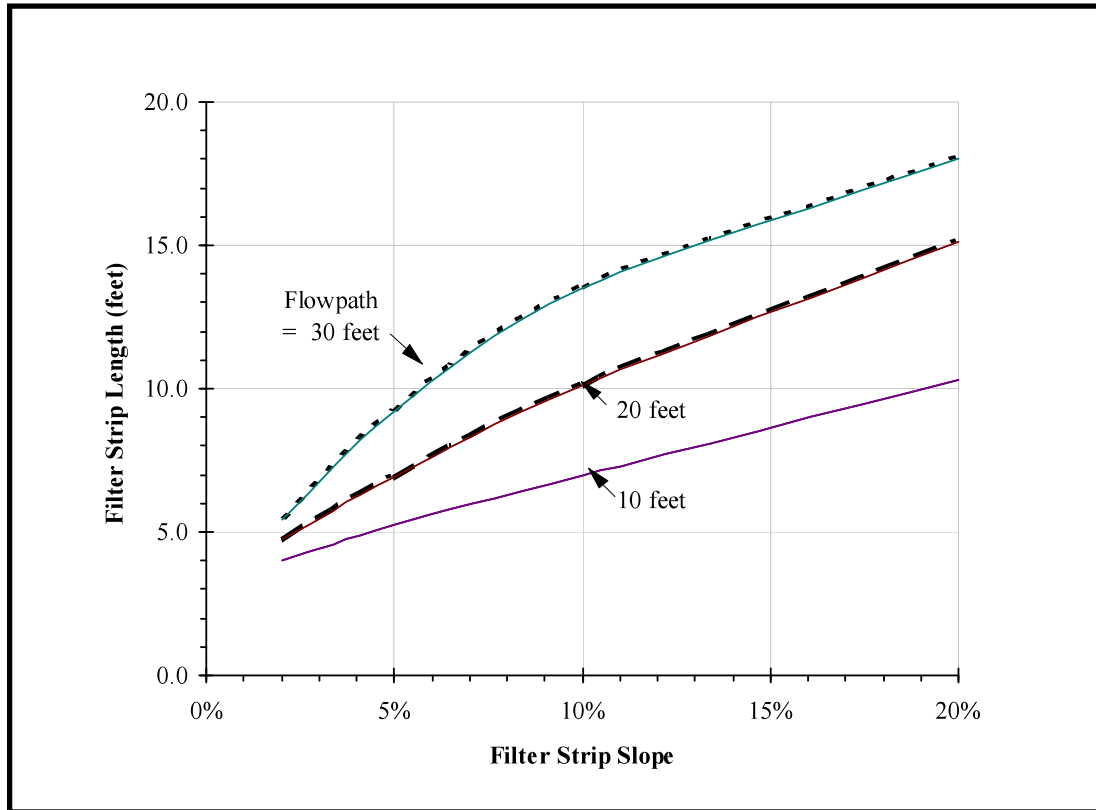
Determine required length of the filter strip. Use Figure 6-21 to size the filter strip. To use the figure, find the curve representing the appropriate flow path distance (interpolate between curves as necessary). Find the point along the curve where the design cross slope of the filter strip is directly below and read the filter strip length to the left on the y-axis. The filter strip must be designed to provide this minimum length, "L," parallel to the flow path along the entire stretch of pavement draining to it.

Figure 6.20 Typical Vegetated Filter Strip (details)



Source: Spokane Regional Stormwater Manual 2008

Figure 6.21 Filter Strip Slope



Source: King County Surface Water Manual 2009

6.9 PERMEABLE PAVEMENT

Properly designed, constructed, and maintained permeable pavement can be an effective design solution in cold weather climates. Permeable pavement use is geographically widespread throughout the United States and has been used in arid climates such as Tucson, Arizona, wet climates such as areas of western Washington and Florida, and areas with significant seasonal temperature variation such as Ohio and Minnesota.

The general categories of permeable paving systems include:

Porous hot or warm-mix asphalt pavement, a flexible pavement similar to standard asphalt that uses a bituminous binder to adhere aggregate together. However, the fine material (sand and finer) is reduced or eliminated and, as a result, voids form between the aggregate in the pavement surface and allow water to infiltrate.

Pervious Portland cement concrete, a rigid pavement similar to conventional concrete that uses a cementitious material to bind aggregate together. However, the fine aggregate (sand) component is reduced or eliminated in the gradation and, as a result, voids form between the aggregate in the pavement surface and allow water to infiltrate.

Permeable interlocking concrete pavements (PICP) and aggregate pavers. PICPs are solid, precast, manufactured modular units. The solid pavers are impervious, high-strength Portland cement concrete manufactured with specialized production equipment. Pavements constructed with these units create joints that are filled with permeable aggregates and installed on an open-graded aggregate bedding course. Aggregate pavers (sometime called pervious pavers) are a different class of pavers from PICP. These include modular precast paving units made with similar-sized aggregates bound together with Portland cement concrete with high-strength epoxy or other adhesives. Like PICP, the joints or openings in the units are filled with open-graded aggregate and placed on an open-graded aggregate bedding course. Aggregate pavers are intended for pedestrian use only.

Grid systems made of concrete or plastic. Concrete units are precast in a manufacturing facility, packaged and shipped to the site for installation. Plastic grids typically are delivered to the site in rolls or sections. The openings in both grid types are filled with topsoil and grass or permeable aggregate. Plastic grid sections connect together and are pinned into a dense-graded base, or are eventually held in place by the grass root structure. Both systems can be installed on an open-graded aggregate base as well as a dense-graded aggregate base.

Nomenclature for permeable paving systems varies among designers, installers, and geographic regions. For this Manual, permeable pavement is used to describe the general category of pavements that are designed to allow infiltration through the pavement section. The following terms are used throughout this Manual and represent the major categories of permeable pavements that carry vehicular as well as pedestrian traffic: pervious concrete, porous asphalt, permeable interlocking concrete pavements, and concrete and plastic grid pavements.

Pretreatment & Soil Criteria

Pretreatment is not required. Soils beneath the permeable pavement facility shall adhere to the subgrade infiltrative criteria specified for infiltration basins.

Applications & Limitations

Typical applications for permeable paving include industrial site employee parking, commercial parking, sidewalks, pedestrian and bike trails, driveways, residential access roads, and emergency and facility

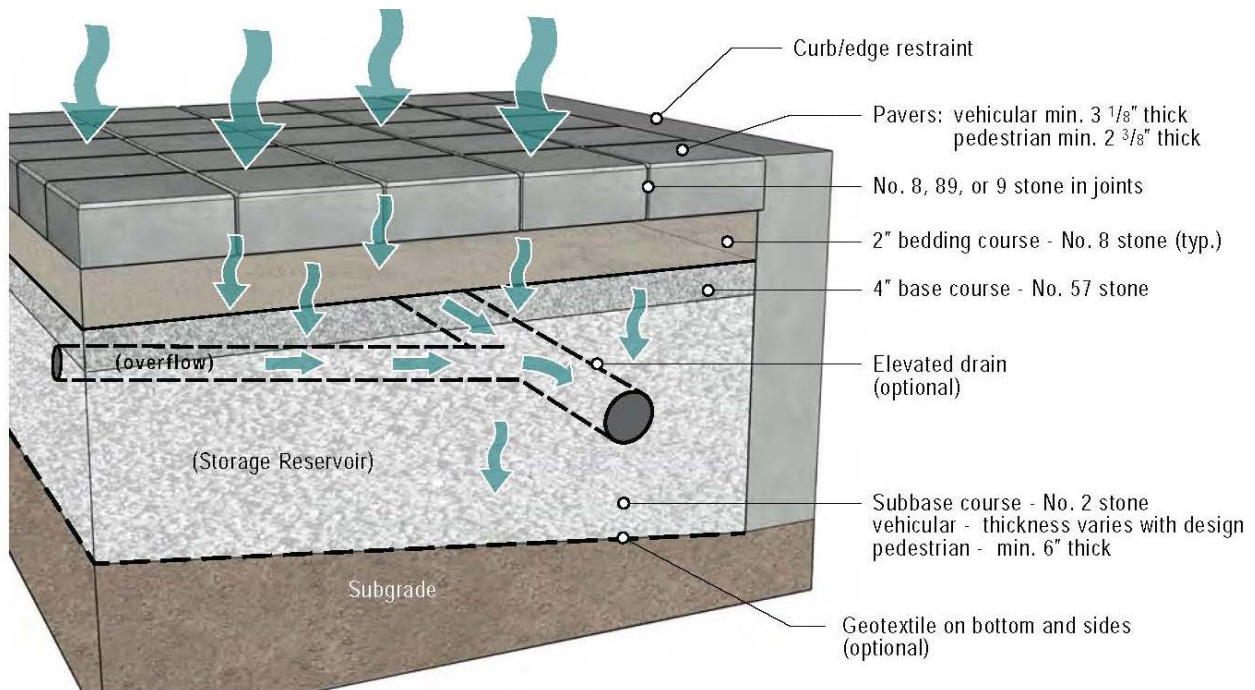
maintenance roads. Grid pavers are not intended for streets but are often used for emergency access lanes and intermittently used (overflow) parking areas. All other types of permeable paving can withstand loads from the number of trucks associated with local roads. Specialized engineering expertise is required for designs for heavy loads and cold weather considerations.

Permeable pavement should not be used (unless additional engineering analysis and design is conducted) where:

- Excessive sediment is deposited on the surface (e.g., construction and landscaping material yards).
- Steep erosion prone areas are upslope of the permeable surface and will likely deliver sediment and clog pavement on a regular basis, and where maintenance is not conducted regularly.
- Concentrated pollutant spills are possible, such as gas stations, truck stops and industrial chemical storage sites, and where infiltration will result in the transport of pollutants to deeper soil or groundwater.
- Seasonally high groundwater is within 1 foot of the bottom of the aggregate base (interface of the subgrade and aggregate base).
- Fill soils, when saturated, cannot be adequately stabilized.
- Sites receive regular, heavy applications of sand (such as weekly) for maintaining traction during winter.
- Steep slopes where water within the aggregate base layer or at the subgrade surface cannot be controlled by detention structures (e.g., check dams) and may cause erosion and structural failure, or where surface runoff velocities may preclude adequate infiltration at the pavement surface. Note that permeable pavement has been used successfully on slopes up to 10 percent with subsurface detention structures and at 8 percent slopes without subsurface structures.

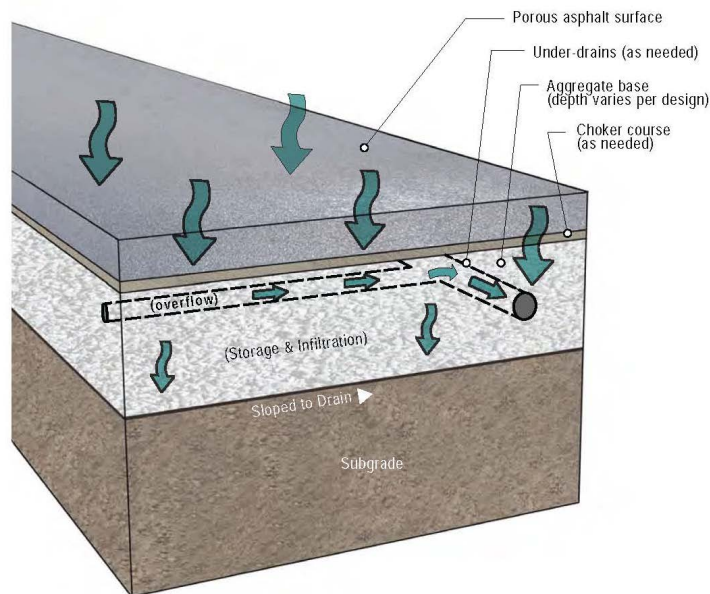
See the Eastern Washington LID Guidance Manual (2013) for additional design criteria. <http://www.wastormwatercenter.org/ew-lid-guidance-manual/>.

Figure 6.22 Typical Permeable Pavers



Source: Eastern Washington Low Impact Development Manual, 2013

Figure 6.23 Typical Porous Asphalt



Source: Eastern Washington Low Impact Development Manual, 2013

6.10 NATURAL DISPERSION

Natural dispersion attempts to minimize the hydrologic changes created by new impervious surfaces by restoring the natural drainage patterns of sheet flow and infiltration. There are three types of natural dispersion:

- Concentrated Flow Dispersion
- Sheet Flow Dispersion
- Full Dispersion

6.10.1 CONCENTRATED FLOW DISPERSION

Dispersion of concentrated flows from driveways or other pavement through a vegetated pervious area attenuates peak flow by slowing entry of the runoff into the conveyance system, allows for some infiltration, and provides some water quality benefits. Flow dispersion can be applied in any situation where concentrated flows can be dispersed through vegetation.

Dispersion for driveways will generally only be effective for single family residences on large lots and in rural short plats. Lots proposed in urban areas will generally be too small to provide effective dispersion of driveway runoff.

Design Guidelines

See the Eastern Washington LID Guidance Manual (2013) for additional design criteria.

6.10.2 SHEET FLOW DISPERSION

Sheet flow dispersion is the simplest method of runoff control. This BMP can be used for any impervious or pervious surface that is graded so as to avoid concentrating flows. Because flows are already dispersed as they leave the surface, they need only traverse a narrow band of adjacent vegetation for effective attenuation and treatment.

Sheet flow dispersion is most applicable in the following areas:

- Flat or moderately sloping (<15 percent slope) impervious surfaces such as driveways, sport courts, patios, and roofs without gutters;
- Sloping cleared areas that are comprised of bare soil, non-native landscaping, lawn, and/or pasture; or
- Any situation where concentration of flows can be avoided. See Figure 6-24 for details of sheet flow dispersion from driveways.

Design Guidelines

See the Eastern Washington LID Guidance Manual (2013) for additional design criteria.

6.10.3 FULL DISPERSION

This BMP allows for “fully dispersing” runoff from impervious surfaces and cleared areas of commercial and residential development sites that protect a portion of the site (or for large sites, a portion of an area within a sub-basin drainage on the site) in a natural, native vegetation cover condition. Natural vegetation is preserved and maintained in accordance with guidelines. Runoff from roofs, driveways, and roads within the development is dispersed within the site by utilizing the areas of preserved vegetation. This BMP is primarily intended for areas of new development. A sliding scale for the amount of preserved vegetated area is provided to allow application to other sites.

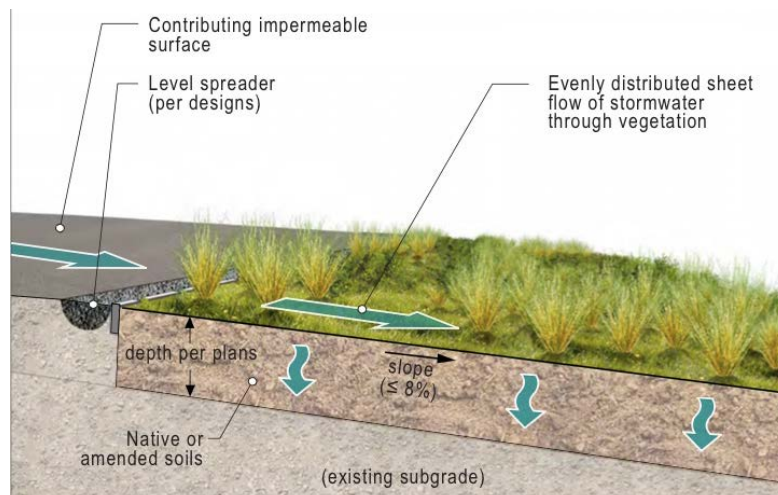
Applications and Limitations

- Up to 10% of the site that is impervious surface can be rendered non-effective impervious area by dispersing runoff from it into the native vegetation area. Any additional impervious areas (this BMP recommends limiting additional impervious areas to not more than another 10% for rural areas) are considered effective impervious surfaces with the exception of roofs served by drywells.
- Types of development that retain a percentage of the site (or for large sites, a portion of an area within a sub-basin drainage on the site) in a natural forested or other native vegetation cover condition may also use these BMPs to avoid triggering the flow control facility requirement or to minimize its use at the site.

Design Guidelines

See the Eastern Washington LID Guidance Manual (2013) for additional design criteria. <http://www.wastormwatercenter.org/ew-lid-guidance-manual/>.

Figure 6-24: Basic Dispersion Components



Source: Eastern Washington LID Manual

6.11 ADDITIONAL LID BMPS

The Low Impact Development (LID) BMPs in this Section include tools used for water quality treatment and/or flow control. These BMPs can be designed as landscape amenities that take advantage of site topography, existing soils and vegetation, and location in relation to impervious surfaces to reduce stormwater volume, attenuate and treat flows, and help mimic the natural site hydrologic patterns.

Recommended LID BMPs include:

- Amending Construction Site Soils
- Dispersion
- Trees
- Vegetated Roofs
- Rain Water Harvesting

See the Eastern Washington LID Guidance Manual (2013) for additional design criteria, including sizing for flow control and treatment. <http://www.wastormwatercenter.org/ew-lid-guidance-manual/>.

6.12 EMERGING TECHNOLOGIES

Emerging technologies are new technologies that have not been fully evaluated using approved protocols, but for which preliminary data indicate that they may provide an adequate level of stormwater pollutant removal. During the last 10 years, new technologies have been under development to meet the standards of urban stormwater pollutant control. Some examples of these technologies include vortex-enhanced settling or cylindrical screening catch basin inserts.

Some emerging technologies have already been installed as parts of treatment trains or stand-alone systems for specific applications. In some cases, emerging technologies are appropriate to remove metals, hydrocarbons, and nutrients. They are often used for retrofits where land is unavailable for larger treatment systems. Idaho does not have a standardized procedure for evaluating emerging technologies. However, the Washington State Department of Ecology (DOE) has developed protocols to evaluate the performance of emerging technologies and proprietary treatment devices. The Technology Assessment Protocol (TAPE) is intended for ultra-urban treatment technologies and those treatment technologies that do not have a chemical component for treatment. The Chemical Technology Assessment Protocol (CTAPE) is intended for construction site treatment technologies and any technology that uses a chemical component for treatment. Based on testing data, DOE determines a “level of development” for each of the new technologies and posts the information on their website: <http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html>

Project proponents should use the DOE approvals page as a guide in determining which technologies may be appropriate for use. In general, only those technologies that have received a General Use Level or Conditional Use Level designation should be considered. The Pilot Use Level designation indicates that a technology needs further testing to evaluate the effectiveness.

Where this manual requires primary treatment, facilities approved for ‘Basic Treatment’ by the DOE may be used. Prior to UICs (see Table 6-3), facilities approved for ‘Pre Treatment’ by the DOE may also be used to satisfy this manual’s Primary Treatment requirement.

With any emerging technology, the ultimate review and decision rests with the local jurisdiction as it reviews and approves the project. The local jurisdiction shall consider the treatment goals and exercise caution when reviewing applications for emerging technologies.

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CHAPTER 7

CONVEYANCE

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7.1 INTRODUCTION

A conveyance system is a natural or manmade component of a storm drain system that collects and conveys the runoff to a specific point. Conveyance systems minimize the chance for flooding and erosion.

Conveyance facilities consist of curbs and gutters, inlets, storm drains, catch basins, channels, ditches, pipes and culverts. The placement and hydraulic capacities of storm drain structures and conveyance systems, while taking into consideration the potential for damage to adjacent properties, should also attempt to reduce the degree of risk to traffic interruption due to flooding within the traveled roadway. The conveyance system shall also provide discharge capacity sufficient to convey the design flow at velocities that are self-cleansing without being destructive to the conveyance facilities.

A properly designed conveyance system also attempts to maximize the hydraulic efficiency by utilizing the proper material, slope and size. Constructed conveyance systems should emulate the natural, pre-developed conditions to the maximum extent feasible. Field-verified defined natural drainageways must be preserved and protected; filling them in or building on top of them is not acceptable practice. Additionally, some drainageways may be required for regional use.

Inflow to, and discharges from, the constructed system shall occur at the natural drainage points in the same manner as the existing conditions as determined by topography and existing drainage patterns.

7.2 APPLICABILITY

All projects shall comply with this Core Element, regardless of whether or not the project meets the regulatory threshold.

7.3 DESIGN FLOWS

See Section 2.3.4 and Table 2-1 for the design flow, and overflow requirements for each type of conveyance system. Either the NRCS Hydrograph Method or the Rational Method can be used to size the conveyance system. Additional design criteria and analysis requirements are outlined in the remaining sections of this chapter.

7.4 CHANNELS

7.4.1 OPEN CHANNEL FLOW

A channel analysis shall be performed for all constructed channels proposed for the project and for all field verified existing natural drainageways/channels present onsite. The following items shall be included in the drainage report and the road and drainage plans, when applicable:

- Complete channel calculations that state the design peak flow rates and design information, such as channel shape, slope, Manning's coefficient (Table 4-5).
- Calculations, including the velocity, capacity, and Froude number shall be provided for each distinct channel segment whenever the geometry of the channel changes (i.e. if the slope, shape or roughness change significantly);
- The centerline and direction of flow for all constructed drainage ditches or natural channels located within the project limits are to be clearly shown in the construction plans and basin map. For all proposed channels, locating information shall be provided at all angle points; and,
- Calculations shall support the riprap area, thickness, riprap size and gradation, filter blanket reinforcement for all channel protection, which shall be provided when permissible velocities are exceeded (see Table 7-1). This information shall be included in the plans;

TABLE 7-1 PERMISSIBLE CHANNEL VELOCITIES

Soil/Type of lining (Earth; No vegetation)	Maximum Permissible Velocities (ft/sec)		
	Clear Water	Water Carrying Fine Silts	Water Carrying Sand & Gravel
Fine Sand (non-colloidal)	1.5	2.5	1.5
Sandy Loam (non-colloidal)	1.7	2.5	2.0
Silt Loam (non-colloidal)	2.0	3.0	2.0
Ordinary Firm Loam	2.5	3.5	2.2
Volcanic Ash	2.5	3.5	2.0
Stiff Clay (very colloidal)	3.7	5.0	3.0
Graded, Loam to Cobbles (non-colloidal)	3.7	5.0	5.0
Graded, Silt to Cobbles (colloidal)	4.0	5.5	5.0
Alluvial Silts (non-colloidal)	2.0	3.5	2.0
Alluvial Silts (colloidal)	3.7	5.0	3.0
Course Gravel (non-colloidal)	4.0	6.0	6.5
Cobbles and Shingles	5.0	5.5	6.5
Shales and Hard Pans	6.0	6.0	5.0

Source: Special Committee on Irrigation Research, American Society of Civil Engineers, 1926. Based on uniform flow in continuously wet, aged channels with erodible linings.

The Froude number shall be checked near the beginning and near the end of a channel that has significantly different grade changes to determine if a hydraulic jump occurs (Froude number changes from <1 to >1 , or vice versa). Since it is difficult to correlate the location of a hydraulic jump to the actual location in the field, the Engineer shall propose evenly spaced riprap berms, checkdams, or

other protective measures to ensure that the jump does not erode the conveyance facility.

- When geosynthetics are used for channel stabilization, the plans shall clearly specify fabric type, placement, and anchoring requirements. Installation shall be per the manufacturer's recommendation; and,
- Plans for grass-lined channels shall specify seed mixture and irrigation, as applicable.

Slope

Minimum grades for constructed channels shall be the following:

- 1/2 percent (0.005 feet/feet) for cement concrete, graded earth or close-cropped grass; and
- 1 percent (0.010 feet/feet) for asphalt concrete or rip rap lined channels.

Note: Non-structured alternatives are preferred over asphalt and concrete channels whenever possible.

Side Slopes

Ditches may be "V" shaped or trapezoidal. However, V-ditches are not recommended in easily erodible soils or where problems establishing vegetation can be anticipated.

The side slope of roadside ditches shall conform to the requirements for clear zone of the local jurisdiction and/or ITD design standards.

Ditches or channels shall not have side slopes that exceed the natural angle of repose for a given material or per Table 7-2:

TABLE 7-2 MAXIMUM DITCH OR CHANNEL SIDE SLOPES

TYPE OF CHANNEL	SIDE SLOPE HORIZONTAL: VERTICAL
Firm Rock	Vertical to 1/4:1
Concrete-Lined Stiff Clay	1/2:1
Fissured Rock	1/2:1
Firm Earth With Stone Lining	1 1/2:1
Firm Earth, Large Channels	1 1/2:1
Firm Earth, Small Channels	2:1
Loose, Sandy Earth	2:1
Sandy, Porous Loam	3:1

Source: Civil Engineering Reference Manual, 8th Edition

Location

Constructed channels cannot be placed within or between residential lots. Ditches and channels shall be located within a drainage tract or within a border

easement. Large lot subdivisions (lots ≥ 1 acre) may be allowed to have ditches or channels traverse through the lot(s) and consideration may be given as to placement within an easement versus a tract. The local jurisdiction will review these proposals on a case by case basis.

Depth

See Table 2-2 for minimum depth requirements for constructed channels.

Velocity

Table 7-1 lists the maximum permissible mean channel velocities for various types of soil and ground cover. If mean channel velocities exceed these values during the design flow, channel protection is required. In addition, the following criteria shall apply:

- Where only sparse vegetative cover can be established or maintained, velocities should not exceed 3 feet/second;
- Where medium density vegetation can be established by seeding, velocities in the range of 3 to 4 feet/second are permitted;
- Where dense sod can be developed quickly or where the normal flow in the channel can be diverted until a vegetative cover is established, velocities of 4 to 5 feet/second are permitted; and,
- On well-established sod of good quality, velocities in the range of 5 to 6 feet/second are permitted.

Channel Capacity

Open channels shall be sized using the following variation of Manning's formula:

$$Q = VA = \frac{1.486AR^{2/3}S^{1/2}}{n}$$

Where:

Q=	rate of flow (cfs);
V =	mean velocity in channel (ft/s);
A =	cross-sectional area of flow in the channel (ft ²);
n =	Manning's coefficient (See Table 5-4);
S =	channel slope (ft/ft); and,
R =	hydraulic radius (ft) = Area/wetted perimeter

Note: The Manning equation will give a reliable estimate of velocity only if the discharge, channel cross section, roughness, and slope are constant over a sufficient distance to establish uniform flow conditions. Strictly speaking, uniform flow conditions seldom, if ever, occur in nature because channel sections change from point to point. For practical purposes, however, the Manning equation can be applied to most open channel flow problems by making judicious assumptions.

Energy Dissipation Design

An energy dissipater is useful in reducing excess velocity, as a means of preventing erosion below an outfall or spillway. Common types of energy dissipaters for small hydraulic works are: hydraulic jumps, stilling wells, riprap outfall pads, outlet aprons, and gabion weirs. Document that any hydraulic jump is located where it will not cause damage.

Channel Protection

Channel velocities shall be analyzed periodically throughout the channelized route, particularly at the following locations:

- At the first point that the stormwater runoff becomes concentrated into a natural or constructed channel;
- At all changes in channel configuration (grade, sideslopes, depth, shape, etc.); if an erosive velocity is determined at a change in channel configuration, the velocity shall be evaluated up the channel until the point at which the velocity is determined not to be erosive; and,
- At periodic locations along the entire channelized route.

A material shall be selected that has revetment and armoring capabilities, and the channel shall be analyzed using the Manning's "n" value for that material to determine if the material will reduce the velocity in the channel. In some cases, vegetative cover (natural grasses, etc.) may provide excellent protection without changing the flow characteristics and should be evaluated. If the calculations reveal that common materials such as matting or riprap are not adequate, stronger protection such as gabions and/or stilling pools may be necessary.

Riprap Protection at Outlets

If the flow velocity at a channel or culvert outlet exceeds the maximum permissible velocity for the soil or channel lining, channel protection is required. The protection usually consists of a reach, such between the outlet and the stable downstream channel lined with an erosion-resistant material such as riprap.

The ability of riprap revetment to resist erosion is related to size, shape and weight of the stones. Most riprap lined channels require either a gravel filter blanket or filter fabric under the riprap.

Riprap material shall be blocky in shape rather than elongated. The riprap stone shall have sharp, angular, clean edges. Riprap stone shall be reasonably well-graded.

Apron Dimensions: The length of an apron (L_a) as shown in Figure 7-1, is determined using the following empirical relationships that were developed for the U.S. Environmental Protection Agency (1976):

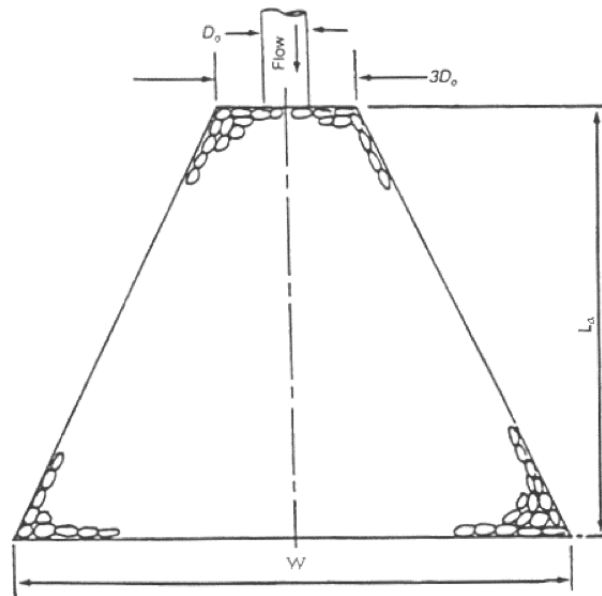
$$L_a = \left(\frac{1.8Q}{D_o^{3/2}} \right) + (7D_o) \quad \text{for } TW \geq \frac{D_o}{2}$$

OR

$$L_a = \left(\frac{3Q}{D_o^{3/2}} \right) + (7D_o) \quad \text{for } TW \geq \frac{D_o}{2}$$

Where: D_o = maximum inside culvert width (ft);
 Q = pipe discharge (cfs); and,
 TW = tailwater depth (ft).

Figure 7-1 – Riprap Revetment at Outfall Schematic



When there is no well-defined channel downstream of the apron, the width, W , of the apron outlet as shown in Figure 7-1, shall be as follows:

$$W = 3D_o + 0.4L_a \quad \text{for } TW \geq \frac{D_o}{2}$$

OR

$$W = 3D_o + L_a \quad \text{for } TW \geq \frac{D_o}{2}$$

When there is a well-defined channel downstream of the apron, the bottom width of the apron should be at least equal to the bottom width of the channel and the lining should extend at least one foot above the tailwater elevation.

The width of the apron at the culvert outlet should be at least 3 times the culvert width.

Apron Materials: The median stone diameter, D_{50} is determined from the following equation:

$$D_{50} = \frac{0.02Q^{4/3}}{TW(D_o)}$$

Where: D_{50} = the diameter of rock, for which 50% of the particles are finer.

The riprap should be reasonably well graded, within the following gradation parameters:

$$1.25 \leq \frac{D_{\max}}{D_{50}} \leq 1.50 \text{ and } \frac{D_{15}}{D_{50}} = 0.50 \text{ and } \frac{D_{\min}}{D_{50}} = 0.25$$

Where: $D_{\max}$ = the maximum particle size;
 $D_{\min}$ = the minimum particle size; and,
 D_{15} = the diameter of rock, for which 15% of the particles are finer.

Minimum Thickness: The minimum thickness of the riprap layer shall be 12-inches, $D_{\max}$ or $1.5D_{50}$, whichever is great.

Filter Blanket: A filter blanket under the riprap is normally needed. If a gravel or sand filter blanket is used, then it shall conform to the gradation parameters listed in Table 7-3.

TABLE 7-3 CRITERIA FOR GRAVEL OR SAND FILTER BLANKET GRADATION

Primary Criterion	$D_{15} < 5d_{85}$
Recommended Secondary Criterion	$5d_{15} < D_{15} < 40d_{15}$ $D_{50}/d_{50} < 50$

Guidelines for Stormwater Management, Spokane County, February 1998

The size of the filter blanket material is designated d_{xx} , the size of the riprap is designated D_{xx} , and the size of the subgrade is designated d'_{xx} . The thickness of each filter blanket should be one-half that of the riprap layer. If it is found that $D_{15}/d'_{85} < 2$ then no filter blanket is needed. Where very large riprap is used, it is sometime necessary to use two filter blanket layers between the subgrade and the riprap.

7.4.2 PRESERVATION OF NATURAL LOCATION OF DRAINAGE SYSTEMS

Projects shall be designed to protect natural drainage features that convey or store water or allow it to infiltrate into the ground in its natural location, including drainageways, floodplains, wetlands and streams (including classified streams), and natural closed depressions. These features are collectively referred to as the Natural Location of Drainage Systems (NLDS). Preserving the NLDS will help ensure that stormwater runoff can continue to be conveyed and disposed of at its natural location. Preservation will also increase the opportunity and ability to utilize the more predominant systems as regional stormwater facilities.

Protection

No cuts or fills shall be allowed in predominant drainageways except for perpendicular driveway or road crossings with engineering plans showing appropriately sized culverts or bridges. Predominant drainageways shall be preserved for stormwater conveyance in their existing location and state, and shall also be considered for use as regional facilities.

Stormwater leaving the site in the same manner shall be defined as replicating the way the stormwater left the site in its existing condition. If the drainageway is preserved in its existing location and is left undisturbed, this goal should be met.

7.5 CULVERTS

A culvert is a short pipe used to convey flow under a roadway or embankment. A culvert shall convey flow without causing damaging backwater flow constriction, or excessive outlet velocities. Factors to be taken into consideration in culvert design include design peak flow rates, allowable headwater elevation, the culvert's hydraulic performance, the economy of alternative pipe materials and sizes, horizontal and vertical alignment, and environmental concerns.

When applicable, the following items shall be included in the drainage report, or road and drainage plans:

- Complete culvert calculations that state the design peak flow rates, velocities at the inlet and outlet, flow control type (i.e. inlet or outlet control), flow depth, and design information for the chosen culvert such as size, slope, length, material type, Manning's coefficient (See Table 7-4);
- Headwater depths and water surface elevations for the design flow rate;
- Roadway cross-section and roadway profile;
- Location information for each of the culvert inverts and invert elevations;
- Type of end treatment (e.g., wingwall, flared end sections, etc); and,
- Wall thickness of headwalls.

Peak Flow Rate

Culverts shall be sized to handle the design peak flow rates described in Section 2.3.4 and Table 2-1. Flows shall be calculated using the methods described in Chapter 4.

To avoid saturation of the road base, culverts shall be designed such that the upstream water surface elevation for the design storm event does not exceed the elevation of the base course of the roadway.

**TABLE 7-4 MANNING'S ROUGHNESS COEFFICIENTS (n)
FOR CULVERTS OR CLOSED SYSTEMS**

Material Type	n ¹
Concrete Pipe	0.013
Ductile Iron	0.013
HDPE Smooth Interior	0.012
PVC	0.012
CMP	0.024

¹The "n" values presented in this table are the "Normal" values as presented in Chow (1959). For an extensive range and for additional values refer to Chow (1959). Additional or value information is often provided by pipe manufactures.

Allowable Headwater Elevation

Headwater is the depth of water at the culvert entrance at a given design flow. Headwater depth is measured from the invert of the culvert to the water surface.

Culverts shall be designed to carry the design runoff with a headwater depth less than 2 times the culvert diameter for culverts 18 inches and under, or 1.5 times the culvert diameter for culverts greater than 18 inches.

Velocity and Slope

To avoid silting, the minimum velocity of flow for culverts shall be 3 feet/second and the minimum slope shall be 0.5 percent.

Diameter

Table 7.5 lists required minimum culvert diameters.

TABLE 7-5: MINIMUM CULVERT SIZES

CULVERT LOCATION	MINIMUM SIZE (inches)
Under Public Roads	18
Under Private Roads	12
Under Driveways/Approaches	12

Material and Anchoring

For grades greater than or equal to 20 percent, anchors are required unless deemed not necessary by calculations and the manufacturer's recommendations.

Placement/Alignment

Generally, culverts shall be placed on the same alignment and grade as the drainageways. Consideration should also be given to changes of conditions over time, by using design measures such as:

- Cambering or crowning under high tapered fill zones;
- Raising intakes slightly above the flow line to allow for sedimentation;
- Using cantilevered outfalls away from road banks to allow for toe erosion; and
- Using drop inlets or manholes to reduce exit velocities on steep terrain.

Angle Points

The slope and alignment of a culvert shall remain constant throughout the entire length of the culvert. However, in situations where existing roadways are to be widened, it may be necessary to extend an existing culvert at a different slope; the location where the slope changes is referred to as the angle point. The change in slope tends to create a location in the culvert that catches debris and sediment. If an extension of a culvert is to be placed at different grade than the existing culvert, a manhole shall be provided at the angle point to facilitate culvert maintenance.

Outfalls

Outfalls shall conform to the requirements of all federal, state, and local regulations. Erosion control shall be provided at the culvert outfall.

Culvert Debris and Safety

The Engineer shall evaluate the site to determine whether debris protection shall be provided for culverts. Debris protection shall be provided in areas where heavy debris flow is a concern, for example dense wooded areas. Methods for protecting culverts from debris problems include: upsizing the culvert, debris deflectors, debris racks and debris basins.

Safety bars to prevent unauthorized individuals from entering the culvert shall be provided for culverts with a standpipe. The clear space between bars shall be 4 inches maximum.

When a trash rack is proposed, the effects of plugging shall be evaluated. Consideration should be given to the potential degree of damage to the roadway and adjacent property, potential hazard and inconvenience to the public, and the number of users of the roadway.

Structural Design

For culverts under roadways, the amount of cover over the culvert is defined as the distance from the top of the pipe to the bottom of the pavement. It does not include asphalt or concrete paving above the base. The minimum amount of cover is 2 feet for culverts unless the manufacturer recommends otherwise.

The minimum cover for culverts under private driveways is 1 foot from the top of the pipe to the finish grade of the driveable surface. Driveway culverts shall be a minimum of 12 inch diameter.

If the depth of cover is shallow (less than 1 foot) and truck wheel loads are present, it will be necessary to propose a design to prevent structural damage to the pipe or provide manufacturer's recommendations. Also, extreme fill heights (20 feet or greater) may cause structural damage to pipes and will require a special design or adherence to the manufacturer's recommendations.

End Treatments

The type of end treatment used on a culvert depends on many interrelated and often conflicting considerations:

- **Projecting Ends** is a treatment where the culvert is simply allowed to protrude out of the embankment. This is the simplest and most economical. There are several disadvantages such as susceptibility to flotation, erosion, safety when projecting in the clear zone, and aesthetic concerns;
- **Beveled End Sections** consist of cutting the end of the culvert at an angle to match the embankment slope surrounding the culvert. Beveled ends should be considered for culverts 6 feet in diameter or less. Structural problems may be encountered for larger culverts not reinforced with a headwall or slope collar;
- **Flared End Sections** are manufactured culvert ends that provide a simple transition from culvert to a drainage way. Flared end sections are typically only used on circular pipe or pipe arches. This end treatment is typically the most feasible option in smaller pipes up to 48 inches in diameter. Safety concerns generally prohibit their use in the clear zone for all but the smallest diameters;
- **Headwalls** are concrete frames poured around a beveled or projecting culvert. They provide structural support and eliminate the tendency for buoyancy. For larger diameter pipes (i.e. greater than 10 feet in diameter), a slope collar is recommended. A slope collar is a reinforced concrete ring that surrounds the exposed culvert end; or,
- **Wingwalls and Aprons** are common on larger reinforced concrete box culverts. Their purpose is to retain and protect the embankment, and provide a smooth transition between the culvert and the channel.

Culvert analysis is typically performed using commercially available computer software. If hand calculations are proposed, example calculations can be found in several technical publications and open channel hydraulics manuals.

7.6 STORM DRAIN SYSTEMS

A storm drain system is a network of pipes that convey surface drainage from catch basins or other surface inlets, through manholes, to an outfall.

The design of storm drain systems shall take into consideration runoff rates, pipe flow capacity, hydraulic grade line, soil characteristics, pipe alignment depth, pipe strength, potential construction problems, and potential impacts to downstream properties.

7.6.1 PIPE ANALYSIS

The following items shall be included in the drainage report, or road and drainage plans:

- A basin map showing onsite and offsite basins contributing runoff to each inlet, which includes a plan view of the location of the conveyance system;
- Complete pipe calculations that state the design peak flow rates, full pipe capacity, and design information for each pipe run, such as size, slope, length, material type, and Manning coefficient (see Table 7-4);
- Velocities at design flow for each of the pipe runs;
- The hydraulic grade line at each inlet, manhole, angle point, and outlet; and,
- A profile of the main line stormwater system (and connections, where applicable), showing size, material type, lengths of pipes (or culverts), and invert elevations, rim/finished grade elevations for manholes, catch basin, and other structures.

For lateral pipe connections to storm drain lines in existing rights-of-way (i.e. from a catch basin to a drywell, a main line stormwater system, a pond or a swale), fixed invert elevations are preferred but not required. The minimum depth from finish grade to pipe invert and the minimum pipe slope necessary to satisfy the freeboard and self-cleansing velocity requirements shall be provided. If necessary, invert elevations may be adjusted during construction to avoid potential conflicts with existing utilities in the right of way.

7.6.2 MINIMUM REQUIREMENTS

Peak Flow Rate

Closed pipe systems shall be sized to handle the design peak flow rates outlined in Section 2.34 and Table 2-1. These peak rates can be calculated using the methods described in Chapter 4.

Hydraulic Grade Line

The Hydraulic Grade Line (HGL) represents the free water surface elevation of

the flow traveling through the storm drain system. Pipes in closed systems will be sized by calculating the HGL in each catch basin or manhole. A minimum of 0.5 feet of freeboard shall be provided between the HGL in a catch basin or manhole and the top of grate or cover.

Pipe Velocities and Slope

Pipe velocities for closed pipe systems shall be designed to have a minimum self-cleaning velocity of 2 feet/second (fps) or greater at half full.

Pipe velocities should not be excessively high since high flow velocities (approaching and above 10 fps) cause abrasion of the pipes. When the design velocities are 10 fps or greater, manufacturer's recommendations demonstrating that the pipe material can sustain the proposed velocities shall be provided.

When the grade of a storm pipe is greater than or equal to 20%, then pipe anchors are required at the joints, at minimum, unless calculations and manufacturer's recommendations demonstrate that pipe anchors are not needed. Pipe anchor locations are to be defined in the plans, and a pipe anchor detail shall be referenced or provided. Table 7-6 shows minimum pipe anchor requirements.

Pipe material and testing requirements shall meet the local jurisdictional standard specifications for storm sewer pipe.

Table 7-6: Minimum Pipe Anchor Spacing

Pipe Slope	Minimum Anchor Spacing
20-35%	35 feet
35-50%	25 feet
>50%	15 feet

Inlets

All lines connected to storm sewers or drywells must be designed per the local jurisdiction standard plans.

Pipe Diameter and Length

The minimum pipe diameter shall be 12 inches; except for single pipe segments less than 50 feet long, which may be 8 inches in diameter. The maximum length of pipe between junctions shall be no greater than 400 feet. No pipe segment shall have a diameter smaller than the upstream segments.

Placement and Alignment

No storm drain pipe in a drainage easement shall have its centerline closer than 5 feet to a private rear or side property line or 10 feet from building foundations or other structures. For a storm drain located under the road, the storm drain shall be placed in accordance with the local jurisdiction requirements or standard plans.

If it is anticipated that a storm drain system may be expanded in the future, provisions for the expansion shall be incorporated into the current design.

Outfalls

Pipe outfalls shall be placed on the same alignment and grade as the drainage-way. Outfalls shall conform to the requirements of all federal, state, and local regulations. See Section 7.4.1 for additional information regarding outfall protection.

Storm Drain Debris and Safety

The Engineer shall evaluate the site to determine whether debris protection shall be provided for storm drain systems. Debris may consist of soil deposits (i.e. silt, sand, gravel, and boulders), limbs, sticks, trash, or other landscaping materials. In areas where heavy debris flow is a concern, for example dense wooded areas, debris protection shall be provided. Methods for protecting the storm drain systems from debris problems include: debris deflectors, debris racks and debris basins.

For an enclosed storm drain system located in urban locations, safety bars shall be provided for outfalls with a diameter 18 inch or greater to protect from unauthorized individuals entering the storm drain system. Outfalls within a fenced area are not required to have safety bars. The clear space between bars shall be 4 inches maximum.

Structural Design

The amount of cover over the pipe is defined as the distance from the top of the pipe to the bottom of the pavement. It does not include asphalt or concrete paving above the base. The minimum amount of cover is 2 feet unless the manufacturer recommends otherwise.

If the depth of cover is shallow (less than 1 foot) and truck wheel loads are present, it will be necessary to propose a design to prevent structural damage to the pipe or provide manufacturer's recommendations. Extreme fill heights (20 feet or greater) may also cause structural damage to pipes and will thus require a special design or adherence to the manufacturer's recommendations.

Inverts at Junctions

Whenever two pipes of the same size meet at a junction, the downstream pipe shall be placed 0.1 feet below the upstream pipe invert. When two different sizes of pipes are joined, pipe crowns shall be placed at the same elevation. The exception to this rule would be at drop manholes. Exceptions may be allowed by the local jurisdiction when topographic conditions will significantly impact the depth of the disposal location.

Combined Systems

Combined sanitary and stormwater sewer systems are prohibited.

7.6.3 PIPE DESIGN

To analyze the conveyance capacity of a closed pipe system, the following general steps may be followed when steady flow conditions exist, or conditions can be accurately approximated assuming steady flow conditions:

1. Estimate the size of the pipes assuming a uniform flow condition, using equation 7-1. Refer to Table 7-4 for Manning's coefficient for different pipe materials.
2. Under some conditions it also may be advisable to:
 - For the pipe sizes chosen, determine uniform and critical flow depth;
 - Determine if upstream (accelerated) flow conditions or downstream (retarded) flow conditions exist. Subcritical flow occurs when downstream conditions control, supercritical flow occurs when upstream conditions control. Then by comparing uniform flow depth, critical flow depth, and initial flow depth, determine what flow regime will occur. Identify hydraulic jump locations, and where any other discontinuity of flow depth will occur.
 - Conduct a more detailed analysis by computing the hydraulic grade line. The direct step method or standard step method is often used to calculate the hydraulic grade line. For supercritical flow, begin at the upstream end and compute flow downstream end and compute flow sections in consecutive order heading upstream.

The analysis of closed pipe systems is typically done using commercially available computer software packages. Example hand calculations can be found in several technical publications on open channel hydraulics, such as: "Handbook of Hydraulics", by Brater and King; and "Open-Channel Hydraulics" by French.

7.7 DRAINAGE INLETS

Drainage inlets are used to collect runoff and discharge it to a storm drainage system. They are typically located in gutter sections, paved medians, and road-side and median ditches.

- Grate Inlets consist of an opening in the gutter or ditch covered by a grate. They perform satisfactorily over a wide range of longitudinal slopes. Grate inlets generally lose capacity as the road/gutter/ditch grade increases.
- Curb Inlets are vertical openings in the curb. They are most effective on flat grades, in sags, and where flows are found to carry significant amounts of floating debris. Curb inlets lose interception capacity as the gutter grade increases; therefore, the use of curb inlets is recommended in sags and on grades less than 3 percent.
- Combination Inlets consist of both a curb-opening and a grate inlet. They offer the advantages of both grate and curb inlets, resulting in a high capacity inlet.

There are many variables involved in designing the number and placement of inlets, and in determining the hydraulic capacity of an inlet. The hydraulic capacity of a storm drain inlet depends upon its geometry as well as the characteristics of the gutter flow. Inlet capacity governs both the rate of water removal from the gutter and the amount of water that can enter the storm drainage system. Inadequate inlet capacity or poor inlet location may cause flooding on the roadway resulting in a hazard to the traveling public.

7.7.1 MINIMUM REQUIREMENTS

Peak Flow Rate

The capacity of drainage inlets shall be determined using the design peak flow rate. These rates can be calculated using the methods described in Chapter 5.

Bypass flow shall be limited to 0.1 cfs at intersections and at the project boundary.

Structures

Catch basins, inlets and storm manholes shall conform to the standard plans of the local jurisdiction.

Catch basins shall be used in all public and private roads unless utility conflicts prohibit their use.

Catch basins, inlets, and storm manholes shall be placed at all breaks in grade and horizontal alignments. Pipe runs shall not exceed 400 feet for all pipe sizes.

Horizontal and vertical angle points shall not be allowed in a storm system unless a manhole is provided for cleaning.

Structure locations shall consider maintenance access and future connection needs.

Grates

Refer to local jurisdictional standard plans and specifications for acceptable grate materials.

All grate inlets constructed at low points of roadways shall be combination inlets.

Grate inlets on grade shall have a minimum spacing of 20 ft to enable any bypass water to reestablish its flow against the face of curb between inlets. Drainage inlets shall not be located on the curved portion of a curb return.

Grates shall be depressed to ensure satisfactory operation; the maximum depression is 2 inches.

Curb Inlets

Refer to local jurisdictional standard plans and specifications for acceptable curb inlet requirements. Concrete curb inlets (i.e. aprons) are used at the entrances to all stormwater facilities to aid stormwater conveyance into the facility and to suppress vegetation growth at the inlet.

The curb inlet shall have a 2-inch depression at the curb line and a maximum length of 4 feet.

The finish grade of a swale/pond sideslope, where the concrete curb inlet apron ends, shall be a minimum of 2 inches below the finished elevation of the concrete curb apron extension. The intention is to allow stormwater runoff to enter the swale/pond unobstructed, without backing up into the street and gutter due to vegetation overgrowth at the inlet.

At a minimum (where space constraints allow), curb inlets shall be placed at the most upstream and downstream point along the road adjacent to the treatment or disposal facility, regardless of the flow directed to curb inlet. In many cases, when a long drainage facility is proposed, and the engineering calculations support it, additional intermediate curb inlets may be required.

Overflow structures, such as drywells or catch basins, shall be located away from the point or points where runoff flows into the facility. When the overflow structure is located within the facility, slopes around the inlet shall be no greater than 4:1.

CHAPTER 8

EROSION &

SEDIMENT CONTROL

PLANS

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8.1 INTRODUCTION

This chapter provides guidance on planning, design, and implementation of stormwater management practices at construction sites. Runoff from development project sites during the construction phase can contribute to sedimentation of streams and carry other contaminants sufficient to result in water quality violations in receiving waters. Controlling erosion and preventing sediment and other pollutants from leaving the project site during the construction phase is achievable through implementation of selected Best Management Practices (BMPs) that are appropriate both to the site and to the season during which construction activities take place. Minimization of stormwater flows, prevention of soil erosion, capture of water-borne sediment that has been unavoidably released from exposed soils, and protection of water quality from on-site pollutant sources are all readily achievable when the proper BMPs are planned, installed, and properly maintained.

All management practices and control facilities used in the course of construction should be of sufficient size, strength, and durability to readily outlast the longest possible construction schedule and the worst anticipated rainfall conditions.

The goal of an Erosion and Sediment Control Plan (ESC Plan) is to avoid immediate and long-term environmental loss and degradation typically caused by poorly managed construction sites. Prompt implementation of an ESC Plan, designed in accordance with this chapter, can provide a number of benefits. These include minimizing construction delays, reducing resources spent on repairing erosion, improving the relationship between the contractor and the permitting authority, and limiting adverse effects on the environment.

8.1.1 HOW TO USE THIS CHAPTER

This Chapter should be used in developing the ESC Plan, which is a required component of a Stormwater Site Plan (SSP) (See Chapter 3). This chapter includes lists of suggested BMPs to meet each Item of the construction stormwater pollution prevention. Based on these lists, the project proponent should refer to Section 8.3 to determine which BMPs should be included in the ESC Plan.

8.1.2 EROSION AND SEDIMENTATION PROCESS

Soil Erosion

Soil erosion is defined as the removal of soil from its original location by the action of water, ice, gravity, or wind. In construction activities, soil erosion is largely caused by the force of falling and flowing water. Erosion by water includes the following processes:

- **Raindrop Erosion:** The direct impact of falling drops of rain on soil dislodges soil particles so that they can then be easily transported by runoff.
- **Sheet Erosion:** The removal of a layer of exposed soil by the action of

raindrop splash and runoff, as water moves in broad sheets over the land and is not confined in small depressions.

- **Rill and Gully Erosion:** As runoff concentrates in rivulets, it cuts grooves called rills into the soil surface. If the flow of water is sufficient, rills may develop into larger gullies.
- **Stream and Channel Erosion:** Increased volume and velocity of runoff in an unprotected, confined channel may cause stream meander instability and scouring of significant portions of the stream or channel banks and bottom.

Soil erosion by wind creates a water quality problem when dust is blown into water. Dust control on paved streets using washdown waters, if not conducted properly, can also create water quality problems.

Sedimentation

Sedimentation occurs when the velocity of water in which soil particles are suspended is slowed for a sufficient time to allow particles to settle. The process is accelerated in facilities such as ponds. The settling rate is dependent on the soil particle size. Heavier particles, such as sand and gravel, can settle more rapidly than fine particles such as clay and silt.

Turbidity, an indirect measure of soil particles in water, is one of the primary water quality standards in Idaho law. Turbidity is increased when erosion carries soil particles into receiving waters. Treating stormwater to reduce turbidity can be an expensive, difficult process with limited effectiveness. Any actions or prevention measures that reduce the volume of water needing treatment for turbidity are beneficial.

8.1.3 FACTORS INFLUENCING EROSION POTENTIAL

The soil erosion potential of an area, including a construction site, is determined by four interrelated factors:

- Soil characteristics;
- Vegetative cover;
- Topography; and
- Climate.

Soil Characteristics: The vulnerability of soil to erode is determined by soil characteristics: particle size, organic content, soil structure, and soil permeability. *Soils in the Portneuf Valley are generally moderately well drained silty soils with low levels of organic matter. They are highly erodible and prone to clogging infiltration facilities.*

- **Particle Size:** Soils that contain high proportions of silt and very fine sand are generally the most erodible and are easily detached and carried away. The erodibility of soil decreases as the percentage of clay or organic matter increases; clay acts as a binder and tends to limit erodibility. Most

soils with a high silt content (common in the Portneuf Valley) are easily detached by rainfall and runoff. Once eroded, silts are easily suspended and settle out very slowly.

- **Organic Content:** Organic matter creates a favorable soil structure, improving its stability and permeability. This increases infiltration capacity, delays the start of erosion, and reduces the amount of runoff. The addition of organic matter increases infiltration rates (and, therefore, reduces surface flows and erodibility), water retention, pollution control, and pore space for oxygen.
- **Soil Structure:** Organic matter, particle size, and gradation affect soil structure, which is the arrangement, orientation, and organization of particles. When the soil system is protected from compaction, the natural decomposition of plant debris on the surface maintains a healthy soil food web. The soil food web in turn maintains the porosity both on and below the surface.
- **Soil Permeability:** Soil permeability refers to the ease with which water passes through a given soil. Well-drained and well-graded gravel and gravel mixtures with little or no silt are the least erodible soils. Their high permeability and infiltration capacity helps prevent or delay runoff.

Vegetative Cover

Vegetative cover plays an extremely important role in controlling erosion by:

- Shielding the soil surface from the impact of falling rain;
- Slowing the velocity of runoff, thereby permitting greater infiltration;
- Maintaining the soil's capacity to absorb water through root zone uptake and evapotranspiration; and
- Holding soil particles in place.

Erosion can be significantly reduced by limiting the removal of existing vegetation and by decreasing duration of soil exposure to rainfall events. Give special consideration to the preservation of existing vegetative cover on areas with a high potential for erosion such as erodible soils, steep slopes, drainage ways, and the banks of streams. When it is necessary to remove vegetation, such as for noxious weed eradication, the area should be revegetated at the earliest possible window for successful seeding.

Topography

The size, shape, and slope of a construction site influence the amount and rate of stormwater runoff. Each site's unique dimensions and characteristics provide both opportunities for and limitations on the use of specific control measures to protect vulnerable areas from high runoff amounts and rates. Slope length, steepness, and surface texture are key items in determining the volume and velocity of runoff. As slope length and/or steepness increase the rate of runoff and the potential for erosion increases. Slope orientation is also a factor in de-

termining erosion potential. For example, a slope that faces south and contains droughty soils may provide such poor growing conditions that vegetative cover will be difficult to re-establish.

Climate

Seasonal temperatures and the frequency, intensity, and duration of rainfall are fundamental factors in determining amounts of runoff. As the volume and the velocity of runoff increase, the likelihood of erosion increases. Where storms are frequent, intense, or of long duration, erosion risks are high. Seasonal changes in temperature, as well as variations in rainfall, help to define the period of the year when there is high erosion risk. When precipitation falls as snow, no erosion occurs. In the spring, melting snow adds to the runoff, and erosion potential will be higher. If the ground is still partially frozen, infiltration capacity is reduced. The Portneuf Valley is characterized in fall, winter, and spring by storms that are mild and long lasting. The fall and early winter events may saturate the soil profile and fill stormwater detention ponds, increasing the amount of runoff leaving the construction site. Shorter-term, more intense storms occur in the summer. These storms can cause problems if adequate BMPs have not been installed on-site.

8.2 LOCAL ESC PLAN

This section provides an overview of the important components of, and the process for, developing and implementing an Erosion and Sediment Control Plan (ESC Plan).

- Section 8.2.1 contains general guidelines with which site planners should become familiar. It describes criteria for plan format and content and ideas for improved plan effectiveness.
- Section 8.2.3 outlines and describes a recommended step-by-step procedure for developing an ESC Plan from data collection to finished product. This procedure is written in general terms to be applicable to all types of projects.
- Appendix 8A includes notes that must be on any ESC Plan.

The ESC Plan may be a subset of the SSP or construction plan set. Full details on how to integrate the ESC Plan with the SSP are provided in Chapter 3.

8.2.1 GENERAL GUIDELINES

The ESC Plan is a document that describes the potential for pollution problems on a construction project. The ESC Plan includes a narrative report, drawings and details that explains and illustrates the measures to be taken on the construction site to control those problems.

As site work progresses, the plan must be modified to reflect changing site conditions, subject to the rules for plan modification by the jurisdiction. The owner

or lessee of the land being developed has the responsibility for ESC Plan preparation and submission to local authorities. The owner or lessee may designate someone (i.e., an engineer, architect, contractor, etc.) to prepare the ESC Plan, but he/she retains the ultimate responsibility.

Required Components

The ESC Plan must contain sufficient information to satisfy the local jurisdiction that the problems of pollution have been adequately addressed for the proposed project. Each of the 12 items in Section 8.1.2 must be included in the ESC Plan unless an item is determined not to be applicable to the project (in which case the exemption is justified in the narrative). The step-by-step procedure outlined in Section 8.2.3 is recommended for the development of the ESC Plans.

An adequate ESC Plan includes a narrative and drawings:

- The narrative is a written statement to explain and justify the pollution prevention decisions made for a particular project. The narrative contains concise information about existing site conditions, construction schedules, and other pertinent items that are not contained on the drawings.
- The drawings and notes describe where and when the various BMPs should be installed, the performance the BMPs are expected to achieve, and actions to be taken if the performance goals are not achieved. If the construction schedule or other site specific information is not available or unknown during initial ESC Plan preparation, the information can be added to the ESC Plan at a later date.

Idaho DEQ Catalogue of Stormwater Best Management Practices

For design and installation guidance of BMPs, refer to the Idaho DEQ's Stormwater BMP Catalogue, or follow manufacturer's instructions.

General Principles

The following general principles should be applied to the development of the ESC Plan.

- The duff layer, native topsoil, and natural vegetation should be retained in an undisturbed state to the maximum extent practicable.
- Prevent pollutant release. Select source control BMPs as a first line of defense. Prevent erosion rather than treat turbid runoff.
- Select BMPs depending on site characteristics (topography, drainage, soil type, ground cover, and critical areas) and the construction plan.
- Divert runoff away from exposed areas wherever possible. Keep clean water clean.
- Limit the extent of clearing operations and phase construction operations.
- Before seeding or planting permanent vegetation on an area where the topsoil has been stripped or compacted, the area should be recondi-

tioned using the original topsoil and/or soil amendments such as compost to restore soil quality and promote successful revegetation.

- Incorporate natural drainage features whenever possible, using adequate buffers and protecting areas where flow enters the drainage system.
- Minimize slope length and steepness.
- Reduce runoff velocities to prevent channel erosion.
- Minimize the tracking of sediment off-site.
- Select appropriate BMPs for the control of pollutants other than sediment.
- Be realistic about the limitations of controls that you specify and the operation and maintenance of those controls. Anticipate what can go wrong, how you can prevent it from happening, and what will need to be done to fix it.

8.2.2 MINIMUM BMP PERFORMANCE STANDARDS

The performance standards established below are intended to provide a minimum threshold for controlling soil erosion and sedimentation caused by land-disturbing activities and will be used to determine if the requirements of this chapter have been met. Individual projects may have additional requirements beyond those listed in this Manual.

Minimize Tracking onto Roadways

This performance standard has not been met if soil, dirt, mud or debris is visibly tracked onto the road area and a reasonable attempt to control it through the use of ESC BMPs is not evident.

Protection of Roadways, Properties and Stormwater Facilities

This performance standard has not been met if there is visible downstream deposition of soil, dirt, mud or debris, originating from the project site, onto adjacent and/or downstream roads, properties and/or a stormwater system including the permanent system being built for the project.

Proper Washout of Concrete Trucks and Equipment

This performance standard has not been met if there is observation or evidence of concrete washout outside the area designated for concrete washout on the accepted ESC Plan.

Protection of Water Bodies, Streams, Canals and Wetlands

This performance standard has not been met if there is obvious turbidity or deposition of soil, dirt, mud, or debris from the project site into adjacent water bodies and/or into sensitive areas and their buffers. In addition, the performance standard requires that no construction activity, materials or equipment encroaches into sensitive areas.

8.2.3 STEP BY STEP PROCEDURE

There are three basic steps in producing an ESC Plan

- Step 1 - Data Collection
- Step 2 - Data Analysis
- Step 3 - ESC Plan Development and Implementation

Steps 1 and 2 described below are for projects that are disturbing one acre or more. Local jurisdictions permit most single-family home construction projects to prepare a simpler ESC Plan, consisting of a pre-prepared site drawing (see 2.3.2 for additional guidance).

Step 1 - Data Collection

Evaluate existing site conditions and gather information that will help develop the most effective ESC Plan. The information gathered should be explained in the narrative and shown on the drawings.

Topography: Prepare a topographic drawing of the site to show the existing contour elevations at intervals of 1 to 5 feet depending upon the slope of the terrain.

Drainage: Locate and clearly mark existing drainage swales and patterns on the drawing, including existing storm drain pipe systems.

Soils: Identify and label soil type(s) and erodibility (low, medium, high or an index value from the NRCS manual) on the drawing. Soil permeability, percent organic matter, and effective depth should be expressed in average or nominal terms for the subject site or project. This information can be characterized by a qualified soil professional or engineer. Some soils information can be obtained from the NRCS' web Soil Survey at: websoilsurvey.nrcs.usda.gov/

Ground Cover: Label existing vegetation on the drawing. Such features as tree clusters, grassy areas, and unique or sensitive vegetation should be shown. Unique vegetation may include existing trees above a given diameter. Local requirements regarding tree preservation should be investigated. In addition, existing denuded or exposed soil areas should be indicated.

Critical Areas: Delineate critical areas adjacent to or within the site on the drawing. Such features as steep slopes, streams, floodplains, lakes, wetlands, sole source aquifers, and geologic hazard areas, etc., should be shown. Delineate set backs and buffer limits for these features on the drawings. The local jurisdiction may have the critical areas largely established by local ordinance and the drawing should reflect those in addition to features identified by site inspection. Federal Emergency Management Agency (FEMA) base floodplain should also be shown on the drawings.

Adjacent Areas: Identify existing buildings, roads, and facilities adjacent to or within the project site on the drawings. Identify existing and proposed utility locations, construction clearing limits and erosion and sediment control BMPs on the drawings.

Existing Encumbrances: Identify wells, existing and abandoned septic drain-field, utilities, and site constraints.

Refer to Chapter 4 to determine the required rainfall records and the method of analysis for design of BMPs.

Step 2 - Data Analysis

Consider the data collected in Step 1 to visualize potential problems and limitations of the site. Determine those areas that have critical erosion hazards. The following are some important factors to consider in data analysis:

Topography: The primary topographic considerations are slope steepness and slope length. Because of the effect of runoff, the longer and steeper the slope, the greater the erosion potential. Erosion potential should be determined by a qualified engineer, soil professional, or certified erosion control specialist.

Drainage: Natural drainage patterns that consist of overland flow, swales and depressions should be used to convey runoff through the site to avoid constructing an artificial drainage system. Man-made ditches and waterways will become part of the erosion problem if they are not properly stabilized. Care should also be taken to ensure that increased runoff from the site will not erode or flood the existing natural drainage system. Possible sites for temporary stormwater retention and detention should be considered at this point. Direct construction away from areas of saturated soil - areas where ground water may be encountered - and critical areas where drainage will concentrate. Preserve natural drainage patterns on the site.

Soils: Develop the ESC Plan based on known soil characteristics. Infiltration sites should be properly protected from clay and silt which will reduce infiltration capacities. Where necessary, evaluate soil properties such as surface and sub-surface runoff characteristics, depth to impermeable layer, depth to seasonal ground water table, permeability, shrink-swell potential, texture, settleability, and erodibility.

Ground Cover: Ground cover is the most important factor in terms of preventing erosion. Existing vegetation that can be saved will prevent erosion better than constructed BMPs. Trees and other vegetation protect the soil structure. If the existing vegetation cannot be saved, consider such practices as phasing construction, temporary seeding, and mulching. Phasing of construction involves stabilizing one part of the site before disturbing another. In this way, the entire site is not disturbed at once.

Critical Areas: Critical areas may include flood hazard areas, mine hazard areas, slide hazard areas, sole source aquifers, wetlands, streambanks, fish-bearing streams, and other water bodies. Any critical areas within or adjacent to the development should exert a strong influence on land development decisions. Critical areas and their buffers shall be delineated on the drawings and clearly marked in the field. Only unavoidable work should take place within critical areas and their buffers. Such unavoidable work will require special BMPs, permit restrictions, and mitigation plans.

Adjacent Areas: An analysis of adjacent properties should focus on areas upslope and downslope from the construction project. Water bodies that will receive direct runoff from the site are a major concern. The types, values, and sensitivities of and risks to downstream resources, such as private property, stormwater facilities, public infrastructure, or aquatic systems, should be evaluated. Erosion and sediment controls should be selected accordingly.

Precipitation Records: Refer to Chapter 4 to determine the required rainfall records and the method of analysis for design of BMPs.

Timing of the Project: An important consideration in selecting BMPs is the timing and duration of the project. Projects that will proceed during the wet season and projects that will last through several seasons must take all necessary precautions to remain in compliance with the water quality standards.

Step 3 - ESC Plan Development and Implementation

After collecting and analyzing the data to determine the site limitations, the project proponent can then develop an ESC Plan. Each of the twelve items below must be considered and included in the ESC Plan unless site conditions render the Item unnecessary and the exemption from that Item is clearly justified in the narrative of the ESC Plan; the project proponent is granted flexibility in selecting appropriate BMPs (suggested BMPs are from the Idaho DEQ Catalog of Stormwater BMPs for Idaho Cities and Counties, <http://www.deq.idaho.gov/media/622263-Stormwater.pdf>) to implement each Item.

Item #1: Mark Clearing Limits

- Prior to beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area. These shall be clearly marked, both in the field and on the plans, to prevent damage and offsite impacts.
- Plastic, metal or wire fence may be used to mark the clearing limits.
- Suggested BMPs:
 - BMP 3: Preserving Natural Vegetation
 - BMP 4: Clearing Limits

Item #2: Establish Construction Access

- Construction vehicle access and exit shall be limited to one route if possible, while linear projects (e.g., roadways) should be limited to as few as possible.
- Access points shall be stabilized with quarry spalls or crushed rock to minimize the tracking of sediment onto public roads.
- Wheel wash or tire baths should be located on site, if applicable.
- If sediment is tracked off the construction site, roads shall be cleaned thoroughly at the end of each day. Sediment shall be removed from roads

by shoveling or pickup sweeping and shall be transported to a controlled sediment disposal area. Street washing will be allowed only after sediment is removed in this manner.

- Street wash wastewater shall be controlled by pumping back on site or otherwise be prevented from discharging into systems tributary to state surface waters.
- Construction access restoration shall be equal to or better than the pre-construction condition.
- Suggested BMPs:
 - BMP 5: Stabilized Construction Entrance
 - BMP 6: Erosion Prevention on Temporary Roads

Item #3: Control Flow Rates

- Properties and waterways downstream from development sites shall be protected from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site, as required by local jurisdiction.
- Downstream analysis is necessary if changes in offsite flows could impair or alter conveyance systems, streambanks, bed sediment, or aquatic habitat. Refer to Chapter 3 for additional details on how to perform a downstream analysis.
- The jurisdiction may require pond designs that provide additional or different stormwater flow control. This may be necessary to address local conditions or to protect properties and waterways downstream from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.
- If permanent infiltration ponds are used for flow control during construction, these facilities should be protected from siltation during the construction phase.
- Suggested BMPs:
 - BMP 38: Sedimentation Trap
 - BMP 40: Temporary Swale

Item #4: Install Sediment Controls

- The duff layer, native top soil, and natural vegetation shall be retained in an undisturbed state to the maximum extent practicable.
- Prior to leaving a construction site or prior to discharge to an infiltration facility, stormwater runoff from disturbed areas shall pass through a sediment pond or other appropriate sediment removal BMP. Runoff from fully stabilized areas may be discharged without a sediment removal BMP, but must meet the flow control performance standard of Item #3, bullet #1. Full stabilization means concrete or asphalt paving; quarry spalls used as

ditch lining; or the use of rolled erosion products, a bonded fiber matrix product, or vegetative cover in a manner that will fully prevent soil erosion.

- BMPs intended to trap sediment on site shall be constructed as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
- Earthen structures such as dams, dikes, and diversions shall be stabilized as per Item #5.
- BMPs intended to trap sediment on site shall be located in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages, often during nonstorm events, in response to rain event changes in stream elevation or wetted area.
- Suggested BMPs:
 - BMP 34: Biofilter Bag
 - BMP 36: Silt Fence
 - BMP 37: Vegetated Strip
 - BMP 35: Fiber Rolls/Straw Wattles
 - BMP 38: Sedimentation Trap
 - BMP 40: Temporary Swale

Item #5: Stabilize Soils

- Exposed and unworked soils shall be temporarily or permanently stabilized as soon as practicable by application of effective BMPs that protect the soil from the erosive forces of raindrops, flowing water, and wind.
- Control fugitive dust from construction activity. Note that dust control must be continuous, particularly during the dry season (i.e. not limited to the 14 calendar day limit listed below);
- No soils should remain exposed and unworked for more than 14 days to prevent wind and water erosion. This stabilization requirement applies to all soils on site, whether at final grade or not. This time limit may be adjusted by the jurisdiction if it can be shown that local precipitation data justifies a different standard.
- Soil stabilization BMPs shall be appropriate for the site conditions, time of year, and the duration of the project.
- Soil stockpiles shall be stabilized and protected with erosion and sediment control BMPs.
- Linear construction activities such as right-of-way and easement clearing, road construction, pipeline and utility installation, shall be conducted in accordance with this Item.
- Suggested BMPs:
 - BMP 7: Dust Control

- BMP 9: Stockpile Management
- BMP 21: Seeding
- BMP 15: Mulching
- BMP 16: Hydromulching
- BMP 17: Geotextiles
- BMP 18: Matting
- BMP 19: Soil Binders/Tackifier
- BMP 20: Topsoiling
- BMP 22: Sodding
- BMP 23: Planting
- BMP 25: Slope Roughening
- BMP 26: Gradient Terraces

Item #6: Protect Slopes

- Design, construct, and phase cut and fill slopes in a manner that will minimize erosion.
- Consider soil type and its potential for erosion.
- Reduce slope runoff velocities by reducing continuous length of slope with terracing and diversions, reduce slope steepness, and roughen slope surface.
- Divert upslope drainage and run-on waters with interceptors at top of slope. Stormwater from off site should be handled separately from stormwater generated on the site. Diversion of off-site stormwater around the site may be a viable option. Diverted flows shall be redirected to the natural drainage location at or before the property boundary.
- Contain downslope collected flows in pipes, slope drains, or protected channels. Check dams shall be used within channels that are cut down a slope.
- Provide drainage to remove ground water intersecting the slope surface of exposed soil areas.
- Excavated material shall be placed on the uphill side of trenches, consistent with safety and space considerations.
- Stabilize soils on slopes, as specified in Item #5.
- Suggested BMPs:
 - BMP 21: Seeding
 - BMP 25: Slope Roughening
 - BMP 26: Gradient Terraces
 - BMP 30: Rip Rap Slope and Outlet Protection
 - BMP 32: Check Dams BMP 40: Temporary Swale
 - BMP 41: Earth Dike

- BMP 42: Perimeter Dike/Swale
- BMP 43: Temporary Berms

Item #7: Protect Drain Inlets

- Storm drain inlets operable during construction shall be protected so that stormwater runoff does not enter the conveyance system without first being filtered or treated to remove sediment.
- Approach roads shall be kept clean. Sediment and street wash water shall not be allowed to enter storm drains without prior and adequate treatment unless treatment is provided before the storm drain discharges to waters of the U.S.
- Inlets should be inspected weekly at a minimum and daily during storm events. Inlet protection devices shall be cleaned or removed and replaced before sediment can accumulate to one-half the height for internal devices and one-third the height for external devices or as specified by the manufacturer.
- Suggested BMP:
 - BMP 31: Storm Drain Inlet Protection

Item #8: Stabilize Channels and Outlets

- Temporary on-site conveyance channels shall be designed, constructed, and stabilized to prevent erosion from the expected peak flow velocity of the 6-month design storm for the developed condition.
- Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches shall be provided at the outlets of all conveyance systems.
- Suggested BMPs:
 - BMP 28: Temporary Channel Lining
 - BMP 30: Rip Rap Slope and Outlet Protection

Item #9: Control Pollutants

- All pollutants, including waste materials and demolition debris, that occur on site during construction shall be handled and disposed of in a manner that does not cause contamination of stormwater. Woody debris may be chopped and spread on site.
- Cover, containment, and protection from vandalism shall be provided for all chemicals, liquid products and petroleum products present on the site.
- Maintenance and repair of heavy equipment and vehicles involving oil changes, hydraulic system drain down, solvent and de-greasing cleaning operations, fuel tank drain down and removal, and other activities which may result in discharge or spillage of pollutants to the ground or into stormwater runoff must be conducted using spill prevention measures,

such as drip pans. Contaminated surfaces shall be cleaned immediately following any discharge or spill incident. Emergency repairs may be performed on-site using temporary plastic placed beneath and, if raining, over the vehicle.

- Wheel wash or tire bath wastewater shall be discharged to a separate on-site treatment system or to the sanitary sewer.
- Application of agricultural chemicals including fertilizers and pesticides shall be conducted in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Manufacturers' recommendations for application rates and procedures shall be followed.
- BMPs shall be used to prevent or treat contamination of stormwater runoff by pH modifying sources. These sources include bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, and concrete pumping and mixer washout waters. Stormwater discharges shall not cause a violation of the water quality standard for pH in the receiving water.
- Suggested BMPs: *See also Chapter 5 – Source Control*
 - BMP 8: Cover for Materials and Equipment
 - BMP 10: Spill Control and Prevention
 - BMP 11: Vehicle/Equipment Washing and Maintenance
 - BMP 12: Waste Management
 - BMP 13: Concrete Waste Management
 - BMP 14: Sanitary Septic Waste Management

Item #10: Control De-Watering

- Foundation, vault, and trench de-watering water shall be discharged into a controlled conveyance system prior to discharge to a sediment pond. Channels shall be stabilized, as specified in Item #8.
- Clean, non-turbid de-watering water, such as well-point ground water, can be discharged to systems tributary to state surface waters, as specified in Item #8, provided the de-watering flow does not cause erosion or flooding of receiving waters. These clean waters should not be routed through stormwater sediment ponds.
- Highly turbid or contaminated dewatering water from construction equipment operation, clamshell digging, concrete tremie pour, or work inside a cofferdam shall be handled separately from stormwater.
- Other disposal options, depending on site constraints, may include:
 - Infiltration.
 - Transport off site in vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.
 - On-site treatment using chemical treatment or other suitable

treatment technologies.

- Sanitary sewer discharge with local sewer district approval, or use of a sedimentation bag with outfall to a ditch or swale for small volumes of localized dewatering.
- Suggested BMP:
 - BMP 46: Dewatering

Item #11: Maintain BMPs

- Temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to assure continued performance of their intended function. Maintenance and repair shall be conducted in accordance with BMP standards and specifications.
- Sediment control BMPs shall be inspected by project personnel every day when there is a discharge from the site (stormwater or nonstormwater), and at least weekly when there is no discharge. The inspection frequency for stabilized, inactive sites may be reduced to once every month.
- Temporary erosion and sediment control BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil resulting from removal of BMPs or vegetation shall be permanently stabilized.

Item #12: Manage the Project

Phasing of Construction

Development projects shall be phased where feasible in order to prevent, to the maximum extent practicable, the transport of sediment from the development site during construction. Revegetation of exposed areas and maintenance of that vegetation shall be an integral part of the clearing activities for any phase.

Clearing and grading activities for developments will be permitted only if conducted pursuant to an approved site development plan (e.g., subdivision approval) that establishes permitted areas of clearing, grading, cutting, and filling. When establishing these permitted clearing and grading areas, consideration shall be given to minimizing removal of existing trees and minimizing disturbance and compaction of native soils except as needed for building purposes. These permitted clearing and grading areas and any other areas required to preserve critical or sensitive areas, buffers, native growth protection easements, or tree retention areas as may be required by local jurisdictions, shall be delineated on the site plans and the development site.

Coordination with Utilities and Other Contractors

The primary project proponent shall evaluate, with input from utilities and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the ESC Plan.

Inspection and Monitoring

All BMPs shall be inspected, maintained, and repaired as needed to assure continued performance of their intended function. A certified ESC Responsible person (contact the local jurisdiction for certification requirements and local training opportunities) shall be identified in the ESC Plan and shall be on-site or on-call at all times.

Sampling and analysis of the stormwater discharges from a construction site may be necessary on a case-by-case basis to ensure compliance with standards. The jurisdiction may establish monitoring and reporting requirements when necessary. Whenever inspection and/or monitoring reveals that the BMPs identified in the ESC Plan are inadequate, due to the actual discharge of or potential to discharge a significant amount of any pollutant, the ESC Plan shall be modified, as appropriate, in a timely manner.

Maintenance of the ESC Plan

The ESC Plan shall be retained on-site or within reasonable access to the site. The ESC Plan shall be modified whenever there is a significant change in the design, construction, operation, or maintenance of any BMP.

8.2.4 MAINTENANCE RESPONSIBILITY

The proponent is responsible to ensure that BMPs are used, maintained, and repaired so that the performance standards continue to be met. After all land-disturbing activity is complete and the site has been permanently stabilized, maintenance and the prevention of erosion and sedimentation is the responsibility of the property owner.

8.3 CONSTRUCTION GENERAL PERMIT (CGP)

The United States Environmental Protection Agency (USEPA) implements the Federal Clean Water Act in Idaho. This federal law requires project proponents to obtain a CGP for certain construction activities. Permit coverage is required before local jurisdictions can issue project permits. Project proponents must obtain permit coverage directly from the USEPA when the project meets the following thresholds:

1. Disturbs one or more acres of land area
- OR
2. Is "part of a larger common plan of development or sale" that will ultimately disturb one or more acres of land
- AND
3. Discharge stormwater from the site into state surface water(s) or into storm drainage systems, which discharge to state surface waters.

If the project does not meet the above threshold for a construction stormwater general permit, it still must adhere to the core items identified in this Man-

ual. Therefore, a project may still be required to prepare an ESC Plan but not be required to obtain CGP coverage and prepare a Stormwater Protection Plan (SWPPP) from USEPA. Refer to

Additionally, sites may be eligible to obtain a **low erosivity waiver** rather than obtaining permit coverage under the CGP if the project meets certain conditions. Guidance and the erosivity waiver form is available online at: <http://water.epa.gov/polwaste/npdes/stormwater/Welcome-to-the-Rainfall-Erosivity-Factor-Calculator.cfm>

Finally, it is not required to have the SWPPP completed before application for CGP permit coverage. However, the SWPPP must be completed before issuance of permit and must be posted on-site in accordance with the permit requirements.

APPENDIX 8A – EROSION AND SEDIMENT CONTROL (ESC) STANDARD PLAN NOTES

The following ESC Standard Plan Notes are the basis of the guidelines in Section 8.2.3. These notes are an overall set; use only what applies to the given project.

- The following construction sequence shall be followed in order to best minimize the potential for erosion and sedimentation control problems:
 1. Fence or flag areas to be protected or left undisturbed during construction;
 2. Clear and grub sufficiently for installation of temporary ESC BMPs;
 3. Install temporary ESC BMPs, constructing sediment trapping BMPs as one of the first steps prior to grading;
 4. Clear, grub and rough grade for roads, temporary access points and utility locations;
 5. Stabilize roadway approaches and temporary access points with the appropriate construction entry BMP;
 6. Clear, grub and grade individual lots or groups of lots;
 7. Temporarily stabilize, through re-vegetation or other appropriate BMPs, lots or groups of lots in situations where substantial cut or fill slopes are a result of the site grading;
 8. Construct roads, buildings, permanent stormwater facilities (i.e. inlets, ponds, UIC facilities, etc.);
 9. Protect all permanent stormwater facilities utilizing the appropriate BMPs;
 10. Remove temporary ESC controls when:
 - Permanent stormwater facilities have been installed;
 - All land-disturbing activities that have the potential to cause erosion or sedimentation problems have ceased; and,
 - Vegetation had been established in the areas noted as requiring vegetation on the accepted ESC plan on file with the local jurisdiction.
- Retain the duff layer, native topsoil, and natural vegetation in an undisturbed state to the maximum extent and duration practical.
- Inspect, and clean if necessary, at the end of each day, all roadways adjacent to the construction access route if sediment has been tracked offsite and/or beyond the roadway approach.
- Cover all dump truck loads leaving the construction site.
- Restore construction access route equal to or better than the pre-construction condition.
- Control fugitive dust from construction activity.
- Stabilize exposed unworked soils (including stockpiles), whether at final grade or not, within 14 calendar days.

- Protect inlets, drywells, catch basins and other stormwater management facilities from sediment, whether or not facilities are operable.
- Keep roads adjacent to inlets clean.
- Inspect inlets weekly at a minimum and daily during storm events. Clean or remove and replace inlet protection devices before six inches of sediment can accumulate.
- Whenever possible, construct stormwater control facilities (detention/retention storage pond or swales) before grading begins. These facilities should be operational before the construction of impervious site improvements.
- Stockpile materials (such as topsoil) onsite, keeping off of roadway and sidewalks.
- Cover, contain and protect all chemicals, liquid products, petroleum product, and non-inert wastes present onsite from vandalism. Maintain a supply of materials on hand to address and contain spills.
- Site designated vehicle and equipment service areas, fuel, and materials away from drainage inlets, watercourses, and canals. Properly contain areas using berms, sandbags, or other barriers. Regularly inspect and maintain equipment, especially for damaged hoses and leaky gaskets.
- Conduct maintenance and repair of heavy equipment and vehicles (i.e. oil changes, fuel tank drain down, etc) that may result in discharge or spillage of pollutants using spill prevention measures, such as drip pans. Clean all contaminated surfaces immediately following any discharge or spill incident. Perform repairs onsite using temporary plastic or oil absorbing blankets beneath the vehicle.
- Designate an area for cleaning painting equipment and tools. Never clean brushes or rinse containers into the street, gutter, drainage inlet, or waterway.
- Apply landscaping or agricultural chemicals, including fertilizers and pesticides, in such a manner, and at application rates, that inhibits the loss of chemicals into stormwater runoff facilities.
- Inspect on a regular basis (at a minimum weekly, and daily during/after a runoff producing storm event) and maintain all erosion and sediment control BMPs to ensure successful performance of the BMPs.
- Remove temporary ESC BMPs within 30 days after the temporary BMPs are no longer needed. Permanently stabilize areas that are disturbed during the removal process.

CHAPTER 9

OPERATIONS & MAINTENANCE

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9.1 MAINTENANCE

9.1.1 INTRODUCTION

Insufficient maintenance of stormwater control facilities can lead to poor performance, shortened life, increased maintenance and replacement costs, and property damage. The local jurisdiction maintains the stormwater system structures located within the public road right of way and structures located within border easements that serve public road runoff, unless a separate agreement exists whereby the homeowner, property owner or other independent entity is responsible for the maintenance. Drainage tracts created by public projects will be maintained by the local jurisdiction.

The project proponent is to provide for the perpetual maintenance of all elements of the stormwater system located outside the public right of way. The high-frequency maintenance of vegetated cover, turf grass and other landscaping within the public right of way and within border easements that accommodate public road runoff is the responsibility of the adjacent property owner.

The key goals of Operations and Maintenance (O&M) plans and specifications are to:

- Relay information between the designer/engineer and those actually providing the maintenance.
- Identify all facilities, runoff sources, stormwater conveyance including pipes and discharge points.
- Provide long-term guidance on items to address in order to prevent system deterioration and failure.
- Define the visual indicators of diminished performance and maintenance requirements for each stormwater management facility that comprises the onsite stormwater system.
- Provide a schedule for inspection and maintenance.
- Designate property owners responsible for long-term ownership and O&M of the onsite stormwater management system.
- Provide inspection and maintenance logs to be filled out by maintenance personnel.

9.1.2 APPLICABILITY

All projects that meet the regulatory threshold and that propose drainage facilities or structures shall comply with the basic requirement for operation and maintenance. All projects that propose UIC facilities also must comply with the operation and maintenance requirements, regardless of whether they meet the regulatory threshold.

9.1.3 HOMEOWNERS' AND PROPERTY OWNERS' ASSOCIATIONS

For privately maintained stormwater systems in residential neighborhoods, a homeowner's association, or alternate entity acceptable to the local jurisdiction, shall be formed to maintain the facilities located outside of the public right of way. Alternatively, the homeowner's association (HOA), property owner's association (POA) or other legal entity may contract with the local jurisdiction to maintain the facilities for an agreed upon reimbursement rate.

A draft copy of the CC&Rs for the HOA/POA in charge of operating and maintaining the facilities associated with the stormwater system shall be submitted as part of the Drainage Submittal review package. The CC&Rs shall summarize the maintenance and fiscal responsibilities of the HOA/POA, reference the O&M Manual (Section 9.1.4), and include a copy of the Maintenance Agreement formalizing the maintenance obligations of the HOA/POA (see Appendix 9A for a sample Operations and Maintenance Agreement).

Annual HOA dues shall provide funding for the annual operation and maintenance of all facilities associated with the stormwater system and for the eventual replacement of these facilities.

For commercial/industrial and multi-family residential developments with joint stormwater systems and multiple owners, a property owners' association (POA) or similar entity such as a business shall be formed, or a reciprocal-use agreement executed.

Homeowners' associations and property owners' associations are to be non-profit organizations accepted by the Idaho Secretary of State. A standard business license is not acceptable for this purpose.

9.1.4 O&M MANUAL REQUIREMENTS

The following maintenance-related items shall be submitted with the Stormwater Site Plan (refer to Chapter 3) for all projects:

- A copy of the conditions, covenants and restrictions (CC&Rs) for the homeowners' association (HOA) or other legal entity in charge of operating and maintaining all elements of the stormwater system;
- A Financial Plan outlining the funding mechanism for the operation, maintenance, repair, and replacement of the private stormwater system, including contingencies;
- An Operations and Maintenance (O&M) Manual (see Appendix 9A), which includes an Operations and Maintenance Agreement (formalizing the maintenance responsibility for privately owned facilities), Specifications, and an Inspection Form.

The O&M Agreement must include:

- All legal property owners' names, addresses, and phone numbers;

- The site address;
- Site legal description of the property served by the stormwater management
- Facilities the financial method used to cover future O&M parties responsible for inspecting and maintaining the facility
- Size and sources of runoff entering the facility and ultimate stormwater discharge point
- Site Plan which identifies:
 - Type and size of all stormwater facilities on the site;
 - Location of the facilities, using reference to an easily identified permanent point or geo-coordinates;
 - All property lines and dimensions for the impervious area managed by the stormwater management facilities;
 - All plumbing, associated storm utilities, connections to public or offsite systems and outfalls that lead to or from stormwater management facilities;
 - A North arrow and labeled cross streets.

Unless otherwise approved by the local jurisdiction, the submitted O&M Specifications shall be one of the provided O&M specifications provided in Appendix 9A. Proprietary facilities shall provide the manufacturer's specifications for O&M.

The submitted O&M specifications shall include a schedule for routine inspection, including post storm post storm inspections. The O&M log shall be available to local jurisdiction staff upon request.

- Local jurisdictions require facility owners to keep inspection and maintenance logs. In general, the log must note all inspection dates, the facility components inspected, and any maintenance or repairs made. The logs must document deficiencies and corrective actions taken to keep structural and vegetative components in good working order. Appendix 9B provides an example of an inspection and maintenance log.

9.1.5 MAINTENANCE ACCESS REQUIREMENTS

Access for O&M

Stormwater facilities must be accessible for monitoring and maintenance. Maintain paths, gates, and covers to ensure access is adequate to safely and efficiently locate and enter facilities. Public facilities must have access routes at least 8 feet wide, less than 10 percent in slope, and located adjacent to the public right-of-way wherever feasible.

Where structural surfaces are needed to support maintenance vehicles, access routes must be constructed of gravel or other permeable paving surface where possible. Public facility vehicular access routes must be designed for H-20 loading.

9.2 EASEMENTS

Flow control and treatment facilities must be located within the right of way, or an easement.

A drainage easement for access, maintenance, operation, inspection and repair shall be granted to the entity in charge of the maintenance and operation of the stormwater system. The easement shall grant to the local jurisdiction the right to ingress/egress over the easement for purposes of inspection or emergency repair. If not in a tract, the following infrastructure shall be placed within drainage easements:

- Elements of a stormwater system, such as a pipe, located outside the public right of way. Easements for stormwater conveyance pipes shall be of sufficient width to allow construction of all improvements, including any associated site disturbances, and access to maintain, repair or replace the pipe and appurtenances without risking damage to adjacent structures or incurring additional costs for shoring or special equipment. No storm pipe in a drainage easement shall have its centerline closer than 5 feet to a private rear or side property line. The storm drain shall be centered in the easement. The minimum drainage easement shall be 20 feet;
- For drainage ditches and natural drainageways, the easement width shall be wide enough to contain the runoff from a 50-year/24-hour storm event for the contributing stormwater basin, plus a 30% freeboard of total depth or a minimum of 1 foot, whichever is greater. Natural drainageways (refer to Section 7.4.2)-may be placed in an easement; and,
- Easements for access roads and turnarounds shall be at least 20 feet wide.

Easement documents shall be drafted by the project proponent for review by the local jurisdiction and recorded by the project proponent. Easements shall be recorded along with a maintenance agreement outlining the longterm maintenance obligations of the property owner. A sample Maintenance Agreement is provided in Appendix 9A.

9.2.1 OFF-SITE EASEMENTS

When a land action proposes infrastructure outside the property boundaries, an offsite easement shall be recorded separately from plat documents, with the auditor's recording number placed on the face of the plat. The easement document shall include language prescribed by the local jurisdiction. The easement language shall grant the local jurisdiction the right to ingress and egress for purposes of routine or emergency inspection and maintenance. The following will be submitted to the local jurisdiction for review:

- A legal description of the site stamped and signed by a surveyor;
- An exhibit showing the entire easement limits and easement bearings, stamped and signed by a surveyor;
- Proof of ownership for the affected parcel and a list of signatories; and,

- Copy of the draft easement.

The legal exhibit and description shall have 1-inch margins for all four sides of the page. All text shall be legible and at least 8 point.

For plats and binding site plans, the off-site drainage facility must be clearly identified on the plans and operation and maintenance responsibilities must be clearly defined prior to acceptance of the project.

Appendix 9A - Operations & Maintenance Manual

Operations and Maintenance Agreement

Owner:

Owner's Name: _____

Phone (including Area Code): _____

Mailing Address (for records return): _____

City/State/Zip: _____

Storm Water Facility Site Address: _____

City/State/Zip: _____

Site legal description (or note and append):

Responsible Party for maintenance (circle one)

Homeowner Association

Property Owner

Other (Describe) _____

Contact information for Responsible Party if other than owner:

Contact Name: _____

Contact Address: _____

City/State/Zip: _____

Daytime Phone: ____ - ____ - ____ Emergency/After Hours Phone: ____ - ____ - ____

Operations and Maintenance Specifications

Use one of the standard plans provided, or provide a site-specific O&M plan.

Site Plan

- Show all facility locations in relation to labeled streets, buildings, or other permanent features.
- Show the sources of runoff water entering the facility and the final onsite/offsite discharge point.

Maintaining the storm water management facility identified on this site plan is a required condition of building permit approval and subdivision development approval for the identified property. The property owner is required to operate and maintain this facility in accordance with the O&M specifications on the plan on file with the local jurisdiction. That requirement is binding on all current and future owners of the property. Failure to comply with the O&M specifications or plan may result in enforcement actions, including penalties. The O&M specifications or plan may be modified by written consent of new owners and written approval by re-filing with the appropriate local jurisdiction.

☐ I have attached a Site Plan

Complete the table below

Facility Type	Size (sf)	Drainage is from:	Impervious Area Treated (sf):	Discharge Point (description and lat/long)

Local jurisdiction of record

Complete and Recorded O&M Forms shall be submitted to the appropriate local jurisdiction.

Maintenance practices and schedule

The maintenance practices and schedule for the storm water facility are included in the O&M plan filed with the appropriate local jurisdiction circled above, and are attached to this document. The operations and maintenance practices are based on the current version of the Portneuf Valley Stormwater Design Manual.

Preparation Date: ____/____/____

Prepared By: _____ Contact Phone No.: _____ - _____ - _____

for official use only

Date: _____

Expected Construction
Completion

Date: _____

Permit No.: _____

BY SIGNING BELOW: *Applicant accepts and agrees to the terms and conditions contained in the O&M Manual and in any document executed by filer and recorded with it.* **TO BE SIGNED IN THE PRESENCE OF A NOTARY.**

Applicant Signature _____

Applicant Signature _____

INDIVIDUAL Acknowledgement

STATE of IDAHO, Bannock County;

This instrument was acknowledged before me on ____/____/____

By: _____

Notary Signature: _____

My Commission Expires: _____

for notary seal

CORPORATE Acknowledgement:

STATE of IDAHO, Bannock County;

This instrument was acknowledged before me on ____/____/____

By: _____

As (Title): _____

Of (Corporation): _____

Notary Signature: _____

My Commission Expires: _____

for notary seal

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Operations & Maintenance Plan: Bio-Infiltration Swales

Facility Description: Bio-infiltration swales are extended, gently sloping depressions with relatively dense vegetation. Native vegetation slows, filters, and infiltrates storm water. Check dams and angular rock placed at inlets slow flow and prevent erosion. A swale may include an overflow to another storm water management feature.

What to Look For

What to Do

Structural Components, including the inlet and outlets/overflows, shall freely and cleanly pass storm water.

- | | |
|--|--|
| <ul style="list-style-type: none">• Clogged inlets or outlets• Rip rap displaced/rundown• Cracked pipes• Check dams missing, scattered or with gaps | <ul style="list-style-type: none">• Remove sediment and debris from catch basins, trench drains, curb inlets and pipes to maintain 90% conveyance capacity at all times. Jet cleaning may be required of underdrain pipes. Use rock at inlets and overflow grates to catch coarse sediment and debris.• Repair/replace as necessary. Remove sediment.• Replace when cracks are greater than 1 inch.• Add or re-configure rock check dams 3"-5" high, perpendicular to the flow of water at 12-foot intervals. |
|--|--|

Vegetation and mulch, including plants on the Portneuf Valley Revegetation Guide plant lists, shall cover 90% of the facility. Drought tolerant species encouraged.

- | | |
|--|---|
| <ul style="list-style-type: none">• Dead or strained vegetation.• Overgrown vegetation.• Weeds | <ul style="list-style-type: none">• Replant per planting plan or use the plant list in the Portneuf Valley Revegetation Guide.• Irrigate as needed. Limit fertilizer use.• Prune shrubs and other vegetation as needed. Remove all plant debris.• Manually remove weeds if possible. Follow adopted Integrated Pest Management Plan for any herbicide use. |
|--|---|

Growing/Filter Medium, including soil, compost, pea gravel, or like material, shall sustain healthy plant cover and infiltrate storm water within 72 hours.

- | | |
|---|---|
| <ul style="list-style-type: none">• Exposed Soil• Gullies• Slope slippage• Ponding | <ul style="list-style-type: none">• Cover with plants• Fill, lightly compact, and place rock or plant vegetation to disperse flow and prevent erosion. Install and/or repair check dams• Stabilize 3:1 slopes with plantings from Portneuf Valley Revegetation Guide.• Remove top 2-4" of sediment. Till and amend soil (compost) to restore infiltration. |
|---|---|

Inspection & Maintenance Schedule: *Facilities will be inspected at least annually. Additionally, inspections and required maintenance will be completed following each 1" rain event (the design storm) and as noted below:*

Summer: Make necessary structural repairs. Clear inlets and drains. Irrigate as necessary. All repairs should be scheduled based on priority needs.

Fall: Replant exposed soil and replace dead plants per planting plan or use the Portneuf Valley Revegetation Guide plant list. Remove sediment and plant debris.

Winter: Monitor infiltration rate and other potential problem areas.

Spring: Remove sediment & plant debris. Remove weeds/prune as necessary. Replant exposed soil areas.

Maintenance Records: Record the date and description (and cost and contractor if hired work) for all structural repairs, landscape maintenance, and cleaning activities. Keep contracts and receipts for maintenance work on file and available to City and County inspectors upon request.

Monitoring Log:

Access: Maintenance equipment and laborers shall have safe access to facilities at all appropriate times.

Pollution Prevention: All sites should implement best management practices to prevent contaminating storm water. For immediate assistance responding to an oil or chemical spill, contact Dispatch at 208-234-6100 (Pocatello) or 208-237-7172 (Chubbuck). Record the nature and extent of a spill and the response if it impacts storm water.

Mosquitoes: Storm water facilities shall not harbor mosquito larvae. Contact the Bannock County Mosquito Abatement District for assistance at 208- 233-9591.

Inspection Checklist: Bio-Infiltration Swales

DATE _____ Insepector _____

Property/Subdivision/HOA/POA Name: _____

Storm Water Facility Site Address/Name: _____

Type of inspection New Periodic Follow-up Rainfall Rain Date/Amt _____

What	Condition	Inspection Results		
		Yes	No	Notes
Structural Components				
Inlets	Is there clogging/damage?			
Outlets	Is there clogging/damage?			
RipRap	Is it displaced or rundown			
CheckDams	Are they missing, scattered or have gaps?			
Vegetation and Mulch				
Desired vegetation	Is it dead, strained, or over-grown? Are their patches of exposed soil?			
Weeds	Do they exist?			
Mulch	Is it displaced?			
Trash	Is there trash?			
Growing/Filter Medium				
Soil	Are there gullies?			
Slopes	Have any slopes slipped?			
Infiltration	Is the water ponding and not infiltrating well?			
Contaminents	Is there evidence of oil?			
Sediment	Is there evidence of sediment build up?			

Overall Rating Excellent Good Fair Poor

Summary of corrective work to be completed: _____

Operations & Maintenance Plan: Bio-Infiltration Planters

Facility Description: Bio-infiltration planters include flow-through, infiltration and contained planters. Flow through and infiltration planters are typically concrete boxes abutting building foundations with a rock reservoir beneath soil and plants. They typically receive runoff from rain drains and overflow to the storm sewer. Infiltration planters are **not** lined on the bottom and drain to the ground. Contained planters are placed on impervious surfaces to filter stormwater as it percolates through the planter and out weep holes.

What to Look For

What to Do

Structural Components, including the inlet and outlets/overflows, shall freely and cleanly pass storm water. Protect building foundations abutting planters.

- | | |
|--|--|
| <ul style="list-style-type: none">• Clogged inlets or outlets/overflow drains• An overflow pipe at an inappropriate elevation• Cracked pipes or planter box• A loose or damaged liner | <ul style="list-style-type: none">• Remove sediment and debris to maintain 90% conveyance capacity at all times.• Adjust the height of the overflow. The opening should be approximately 6" above the soil surface and 2" below the waterproof liner.• Replace when cracks are greater than 1 inch.• Secure the liner against the planter walls. Planters abutting building foundations should be water tight to protect against moisture damage. |
|--|--|

Vegetation and mulch, including plants on the Portneuf Valley Revegetation Guide plant lists, shall cover 90% of the facility. Drought tolerant species encouraged.

- | | |
|--|---|
| <ul style="list-style-type: none">• Dead or strained vegetation.• Overgrown vegetation.• Weeds | <ul style="list-style-type: none">• Replant per planting plan or use the plant list in the Portneuf Valley Revegetation Guide.• Irrigate as needed. Limit fertilizer use.• Prune shrubs and other vegetation as needed. Remove all plant debris.• Manually remove weeds if possible. Follow adopted Integrated Pest Management Plan for any herbicide use. |
|--|---|

Growing/Filter Medium, including soil, compost, pea gravel, or like material, shall sustain healthy plant cover and infiltrate/drain storm water within 72 hours.

- | | |
|---|--|
| <ul style="list-style-type: none">• Exposed soil• Scouring at inlets• Ponding | <ul style="list-style-type: none">• Cover with plants or pea gravel.• Add splash block/rock pads at inlet(s).• Remove top 2-4" of sediment. Till and amend soil with compost and sand to restore infiltration rates. |
|---|--|

Inspection & Maintenance Schedule: *Facilities will be inspected at least annually. Additionally, inspections and required maintenance will be completed following each 1" rain event (the design storm) and as noted below:*

Summer: Make necessary structural repairs. Clear inlets and drains. Irrigate as necessary. All repairs should be scheduled based on priority needs.

Fall: Replant exposed soil and replace dead plants.

Winter: Monitor infiltration rate and other potential problem areas.

Spring: Remove sediment and plant debris. Remove weeds and prune vegetation as necessary. Replant exposed soil areas.

Maintenance Records: Record the date and description (and cost and contractor if hired work) for all structural repairs, landscape maintenance, and cleaning activities. Keep contracts and receipts for maintenance work on file and available to City and County inspectors upon request.

Monitoring Log:

Access: Maintenance equipment and laborers shall have safe access to facilities at all appropriate times.

Pollution Prevention: All sites should implement best management practices to prevent contaminating storm water. For immediate assistance responding to a spill, contact Dispatch at 208-234-6100 (Pocatello) or 208-237-7172 (Chubbuck). Record the nature and extent of a spill and the response if it impacts storm water.

Mosquitoes: Storm water facilities shall not harbor mosquito larvae. Contact the Bannock County Mosquito Abatement District for assistance at 208- 233-9591.

Inspection Checklist: Bio-Infiltration Planters

DATE _____ Insepector _____

Property/Subdivision/HOA/POA Name: _____

Stormwater Facility Site Address/Name: _____

Type of inspection (circle): New Periodic Follow-up Rainfall Rain Date/Amt _____

What	Condition	Inspection Results		
		Yes	No	Notes
Structural Components				
Inlets	Is there clogging/damage?			
Outlets	Is there clogging/damage?			
Pipes/planter box	Is there any cracking?			
Liner	Is it loose or damaged?			
Vegetation and Mulch				
Desired vegetation	Is it dead, strained, or overgrown? Are their patches of exposed soil?			
Weeds	Do they exist?			
Mulch	Is it displaced?			
Trash	Is there trash?			
Growing/Filter Medium				
Soil	Are there gullies? Is there scouring at the inlet?			
Infiltration	Is the water ponding and not infiltrating well?			
Contaminents	Is there evidence of oil?			
Sediment	Is there sediment build up?			

Overall Rating (circle) Excellent Good Fair Poor

Summary of corrective work to be completed: _____

Operations & Maintenance Plan: Basins and Ponds

Facility Description: A basin is a densely planted, gently sloping depression. It receives runoff from a pipe or curb cut. Some basins include an overflow to a drywell or storm sewer. They should infiltrate within 24 hrs. Ponds have greater capacity than basins to treat and manage the volume of runoff. Wet ponds have a permanent pool of water and dry ponds drain over a number of hours to an approved disposal point. Most ponds have a pipe for an inlet and a grated overflow to storm sewer. Some ponds have forebays that trap sediment near the inlet to confine the accumulation of sediment and protect plants from sediment loading

What to Look For What to Do

Structural Components, including the inlet and outlets/overflows, shall freely and cleanly pass storm water.

- | | |
|---|---|
| <ul style="list-style-type: none">• Clogged inlets or outlets• Rip rap displaced or rundown• Pipe/subgrade/concrete damage/cracking | <ul style="list-style-type: none">• Remove sediment and debris to maintain at least 50% conveyance capacity at all times.• Repair/replace as necessary. Remove sediment.• Repair/replace. |
|---|---|

Vegetation & mulch shall cover 90% of the facility.

- | | |
|--|---|
| <ul style="list-style-type: none">• Dead or strained vegetation.• Overgrown vegetation.• Weeds | <ul style="list-style-type: none">• Replant per planting plan or use the plant list in the Portneuf Valley Revegetation Guide.• Irrigate as needed. Limit fertilizer use.• Prune shrubs and other vegetation as needed. Remove all plant debris.• Manually remove weeds if possible. Follow adopted Integrated Pest Management Plan for any herbicide use. |
|--|---|

Growing/Filter Medium, including soil, compost, pea gravel, or like material, shall sustain healthy plant cover.

- | | |
|---|---|
| <ul style="list-style-type: none">• Exposed Soil• Gullies• Slope slippage• Ponding | <ul style="list-style-type: none">• Cover with plants• Fill, lightly compact, and place rock or plant vegetation to disperse flow and prevent erosion. Install and/or repair check dams• Stabilize 3:1 slopes with plantings from Portneuf Valley Revegetation Guide.• Remove top 2-4" of sediment. Till and amend soil (compost) to restore infiltration rates. |
|---|---|

Inspection & Maintenance Schedule: *Facilities will be inspected at least annually. Additionally, inspections and required maintenance will be completed following each 1" rain event (the design storm) and as noted below:*

Summer: Make necessary structural repairs. Clear inlets and drains. Irrigate as necessary. All repairs should be scheduled based on priority needs.

Fall: Replant exposed soil and replace dead plants per planting plan or use the Portneuf Valley Revegetation Guide plant list. Remove sediment and plant debris.

Winter: Monitor infiltration/flow through rate and other potential problem areas.

Spring: Remove sediment and plant debris. Remove weeds and prune vegetation as necessary. Replant exposed soil areas with approved species.

Maintenance Records: Record the date and description (and cost and contractor if hired work) for all structural repairs, landscape maintenance, and cleaning activities. Keep contracts and receipts for maintenance work on file and available to City and County inspectors upon request.

Monitoring Log:

Access: Maintenance equipment and laborers shall have safe access to facilities at all appropriate times.

Pollution Prevention: All sites should implement best management practices to prevent contaminating storm water. For immediate assistance responding to a spill, contact Dispatch at 208-234-6100 (Pocatello) or 208-237-7172 (Chubbuck). Record the nature and extent of a spill and the response if it impacts storm water.

Mosquitoes: Storm water facilities shall not harbor mosquito larvae. Contact the Bannock County Mosquito Abatement District for assistance at 208- 233-9591.

Inspection Checklist: Basins and Ponds

DATE _____ Insepector _____

Property/Subdivision/HOA/POA Name: _____

Storm Water Facility Site Address/Name: _____

Type of inspection (circle): New Periodic Follow-up Rainfall Rain Date/Amt _____

What	Condition	Inspection Results		
		Yes	No	Notes
Structural Components				
Inlets	Is there clogging/damage?			
Outlets	Is there clogging/damage?			
RipRap	Is it displaced or rundown?			
Pipes/concrete	Is their cracking/damage?			
Vegetation and Mulch				
Desired vegetation	Is it dead, strained, or overgrown? Are their patches of exposed soil?			
Weeds	Do they exist?			
Mulch	Is it displaced?			
Trash	Is there trash?			
Growing/Filter Medium				
Soil	Are there gullies?			
Slopes	Have any slopes slipped?			
Infiltration	Is the water ponding and not infiltrating well?			
Contaminents	Is there evidence of oil?			
Sediment	Is there sediment build up?			

Overall Rating Excellent Good Fair Poor

Summary of corrective work to be completed: _____

Operations & Maintenance Plan: Spill Control type Oil/Water Separators

Facility Description: Spill control manholes trap sediment, oil, and debris in a chamber before conveying stormwater to a disposal point. They may have a valve to close the outlet to a disposal point in the event of a spill. They have a 90° down-turned pipe ("elbow"), "T", or BMP snout on the outlet that prevents oil and floating debris from exiting the manhole. ONLY professionals with OSHA confined space certification should enter these manholes.

What to Look For What to Do

Structural Components, including concrete chambers, pipes and covers.

- | | |
|--|---|
| <ul style="list-style-type: none">• Missing elbow or "T".• Damaged snout• Clogged inlets or diminished capacity of manhole• Cracked drain pipe or concrete. | <ul style="list-style-type: none">• Install elbow or "T" on outlet• Repair/replace• Vactor oil and sediment every 1-4 years or when sediment is 1 1/2 feet deep or oil is 1 inch deep. Clean catch basins and gutter to water quality manholes annually.• Repair with grout or the like, or replace when cracks are 1" wide or more. |
|--|---|

Vegetation, including nearby plantings.

- | | |
|--|--|
| <ul style="list-style-type: none">• Large shrubs and trees | <ul style="list-style-type: none">• Remove to prevent large root systems from damaging subsurface structural components. |
|--|--|

Growing/Filter Medium N/A

Inspection & Maintenance Schedule: *Facilities will be inspected at least annually. Additionally, inspections and required maintenance will be completed following each 1" rain event (the design storm) and as noted below:*

Summer: Make necessary structural repairs. Vactor oil and sediment from catch basins and manholes

Fall: Clean water quality manholes.

Winter: Monitor water level and sediment level.

Maintenance Records: Record the date and description (and cost and contractor if hired work) for all structural repairs and facility cleanout activities. Keep contracts and receipts for maintenance work on file and available to City and County inspectors upon request.

Monitoring Log:

Access: Maintenance equipment and labor shall have safe access to facilities at all times

Pollution Prevention: All sites should implement best management practices to prevent hazardous or solid wastes, or excessive oil and sediment from contaminating storm water. For immediate assistance responding to a spill, contact Dispatch at 208-234-6100 (Pocatello) or 208-237-7172 (Chubbuck). Record the nature and extent of a spill and the response if it impacts storm water.

Inspection Checklist: Spill Control Type Oil/Water Separators

DATE _____ Insepctor _____

Property/Subdivision/HOA/POA Name: _____

Storm Water Facility Site Address/Name: _____

Type of inspection (circle): New Periodic Follow-up Rainfall Rain Date/Amt _____

What	Condition	Inspection Results		
		Yes	No	Notes
Structural Components				
Elbows, Ts or snouts	Is there damage?			
Inlets	Is there clogging/damage?			
Pipes/concrete	Is their cracking/damage?			
Vegetation and Mulch				
Large trees	Will root systems damage sub-surface structure?			
Growing/Filter Medium				

Overall Rating Excellent Good Fair Poor

Summary of corrective work to be completed: _____

Operations & Maintenance Plan: Baffle/Coalescing Plate Oil Water Separators

Facility Description: Oil/Water Separators are typically underground vaults with baffles or coalescing plates that trap sediments and retain floating oils before stormwater is discharged to sewer or storm lines. ONLY professionals with OSHA confined space certification should enter water quality manholes and vaults.

What to Look For

What to Do

Structural Components, including the inlet and outlets/overflows, shall freely and cleanly pass storm water.

- | | |
|---|---|
| <ul style="list-style-type: none">• Clogged inlets or diminished capacity of vault.• Saturated absorbent pads or socks• Missing elbow or “t”• Cracked drain pipe or vault. | <ul style="list-style-type: none">• Remove sediment and oil from catch basins twice a year.• Vactor vault biannually or when sediment is 4” deep/oil 2” deep• Clean coalescing plates upstream or in the facility. Use low pressure, cool temperature, and biodegradable chemicals (if necessary).• Change absorbent pads quarterly• Install elbow or “t” on outlet• Fill or replace when cracks are greater than 1” |
|---|---|

Vegetation, including nearby plantings.

- | | |
|--|--|
| <ul style="list-style-type: none">• Large shrubs and trees | <ul style="list-style-type: none">• Remove to prevent large root systems from damaging subsurface structural components. |
|--|--|

Growing/Filter Medium N/A

Inspection & Maintenance Schedule: *Facilities will be inspected at least annually. Additionally, inspections and required maintenance will be completed following each 1” rain event (the design storm) and as noted below:*

- Summer:* Make necessary structural repairs.
- Fall:* Clean vault or coalescing plates. Change absorbent pads.
- Winter:* Monitor.
- Spring:* Clean vault or coalescing plates. Change absorbent pads.

Maintenance Records: Record the date and description (and cost and contractor if hired work) for all structural repairs and facility cleanout activities. Keep contracts and receipts for maintenance work on file and available to City and County inspectors upon request.

Monitoring Log:

- Access:* Maintain ingress/egress to design standards.
- Pollution Prevention:* All sites should implement best management practices to prevent hazardous or solid wastes, or excessive oil and sediment from contaminating storm water. For immediate assistance responding to a spill, contact Dispatch at 208-234-6100 (Pocatello) or 208-237-7172 (Chubbuck). Record the nature and extent of a spill and the response if it impacts storm water.

Inspection Checklist: Oil Water Separators

DATE _____ Insepector _____

Property/Subdivision/HOA/POA Name: _____

Storm Water Facility Site Address/Name: _____

Type of inspection (circle): New Periodic Follow-up Rainfall Rain Date/Amt _____

What	Condition	Inspection Results		
			No	Notes
Structural Components				
Inlets	Is there clogging/damage?			
Capacity	Is system capacity diminished?			
Elbows, Ts or snouts	Is there damage?			
Pipes/vaults	Are they cracked or damaged?			
Vegetation and Mulch				
Large trees	Will root systems damage sub-surface structure?			
Growing/Filter Medium				

Overall Rating Excellent Good Fair Poor

Summary of corrective work to be completed: _____

Operations & Maintenance Plan: Infiltrators (Interceptor Chambers), Detention Pipes, Vaults, Tanks & Drywells

Facility Description: Drywells and soakage trenches are Underground Injection Control systems (UICs). both facilities infiltrate stormwater below ground. A typical drywell is a perforated concrete manhole 20 to 40 feet in depth. A typical soakage trench consists of a perforated pipe over a rock and sand reservoir. Often residential roof drains feed directly into these facilities. When treatment is required, a bio-infiltration swale, water quality manhole, or silt trap is located up gradient from a UIC to trap sediment and other contaminants in runoff to prevent clogging the perforations and reducing infiltration. ONLY professionals with OSHA confined space certification should enter infiltrators.

What to Look For What to Do

Structural Components, including inlets, outlets, pipes, vaults, and/or tanks.

- Clogged inlets or outlets or diminished pipe, vault or tank capacity.
- Cracked drain pipe or manhole.
- Annually vacuum oil and sediment or when sediment is 1 1/2 feet deep or oil is 2 inches deep. Clean drains twice a year.
- Fill or replace when cracks are greater than 1".

Vegetation, including nearby plantings.

- Large shrubs and trees
- Remove to prevent large root systems from damaging subsurface structural components.

Growing/Filter Medium N/A

Inspection & Maintenance Schedule: *Facilities will be inspected at least annually. Additionally, inspections and required maintenance will be completed following each 1" rain event (the design storm) and as noted below:*

Summer: Make necessary structural repairs. Remove oil and sediment.

Fall: Clean drains.

Winter: Monitor flow through rate.

Spring: Clean drains.

Maintenance Records: Record the date and description (and cost and contractor if hired work) for all structural repairs and facility cleanout activities. Keep contracts and receipts for maintenance work on file and available to City and County inspectors upon request.

Monitoring Log:

Access: Maintain ingress/egress to design standards.

Pollution Prevention: All sites should implement best management practices to prevent hazardous or solid wastes, or excessive oil and sediment from contaminating storm water. For immediate assistance responding to a spill, contact Dispatch at 208-234-6100 (Pocatello) or 208-237-7172 (Chubbuck). Record the nature and extent of a spill and the response if it impacts storm water.

Inspection Checklist: Interceptor Chambers, Drywells, etc.

DATE _____ Inspector _____

Property/Subdivision/HOA/POA Name: _____

Storm Water Facility Site Address/Name: _____

Type of inspection (circle): New Periodic Follow-up Rainfall Rain Date/Amt _____

What	Condition	Inspection Results		
		Yes	No	Notes
Structural Components				
Inlets	Is there clogging/damage?			
Outlets	Is there clogging/damage?			
Capacity	Is system capacity diminished?			
Pipes/ manholes	Are they cracked or damaged?			
Vegetation and Mulch				
Large trees	Will root systems damage sub-surface structure?			
Growing/Filter Medium				

Overall Rating Excellent Good Fair Poor

Summary of corrective work to be completed: _____

Operations & Maintenance Plan: Pervious Pavement

Facility Description: Pervious pavement may include any surface material designed to infiltrate storm water. It may resemble asphalt, concrete or pavers and is used in lieu of these conventional materials to allow rain to percolate into the subsurface rock reservoir and native soils.

What to Look For What to Do

Structural Components, including surface material, shall evenly infiltrate storm water.

- | | |
|--|---|
| <ul style="list-style-type: none">• Sediment/fines on pervious surface.• Water ponding on pervious surface with sand or gravel grid.• Cracked pervious pavement. | <p>Sweep (leaf blower, push broom or hose) quarterly. Vacuum sweepers are recommended for high traffic areas.</p> <p>Remove top 2" of grid material and replace with clean material</p> <p>Repair per manufacturer's specifications</p> |
|--|---|

Vegetation, including nearby plantings.

- | | |
|--|--|
| <p>Large shrubs and trees.</p> <p>Weeds.</p> | <ul style="list-style-type: none">• Sweep leaf litter and sediment to prevent surface clogging/ponding.• Manually remove weeds. Do not use herbicide. |
|--|--|

Growing/Filter Medium N/A

Inspection & Maintenance Schedule: *Facilities will be inspected at least annually. Additionally, inspections and required maintenance will be completed following each 1" rain event (the design storm) and as noted below:*

Summer: Sweep. Make necessary structural repairs and perform major maintenance activities during dry weather.

Fall: Sweep.

Winter: Sweep. Monitor infiltration rate.

Spring: Weed. Sweep.

Maintenance Records: Record the date and description (and cost and contractor if hired work) for all structural repairs and facility cleanout activities. Keep contracts and receipts for maintenance work on file and available to City and County inspectors upon request.

Monitoring Log:

Access: Maintain ingress/egress to design standards.

Infiltration/Flow Control: All facilities should drain within 24 hours.

Pollution Prevention: All sites should implement best management practices to prevent hazardous or solid wastes, or excessive oil and sediment from contaminating storm water. For immediate assistance responding to a spill, contact Dispatch at 208-234-6100 (Pocatello) or 208-237-7172 (Chubbuck). Record the nature and extent of a spill and the response if it impacts storm water.

Inspection Checklist: Pervious Pavement

DATE _____ Inspector _____

Property/Subdivision/HOA/POA Name: _____

Storm Water Facility Site Address/Name: _____

Type of inspection (circle): New Periodic Follow-up Rainfall Rain Date/Amt _____

What	Condition	Inspection Results		
			No	Notes
Structural Components				
Material surface	Is there sediment on top of it or water ponding?			
Pavement/pavers/concrete	Is there cracking?			
Vegetation and Mulch				
Large trees & shrubs	Is leaf litter covering pervious pavement?			
Weeds	Do they exist?			
Growing/Filter Medium				

Overall Rating Excellent Good Fair Poor

Summary of corrective work to be completed: _____

Appendix 9B - Sample Inspection & Maintenance Log

Inspection Log – Record the date and the personnel who conducted the site inspection.

1. Record the infiltration rate if greater than 48 hours, a description of any and all spills and vector issues, sediment & oil depth, the percentage of vegetation coverage (desirable and undesirable), and the condition of the system components every quarter for the first 2 years of operation and twice a year after a major storm event thereafter.

Infiltration/Flow Control - All facilities shall drain within 48 hours. Time/date, weather, and site conditions when ponding occurs shall be recorded.

Pollution Prevention - All sites shall implement BMPs to prevent hazardous wastes, litter, or excessive oil and sediment from contaminating stormwater. Contact City of Pocatello at (208) 234-6100 or City of Chubbuck at (208) 237-7172 for immediate assistance with responding to spills. Record time/date, weather, and site conditions if site activities are found to contaminate stormwater.

Vectors (mosquitoes and rodents) - Stormwater facilities shall not harbor mosquito larvae or rats that pose a threat to public health or that undermine the facility structure. Monitor standing water for small wiggling sticks perpendicular to the water's surface. Note holes/burrows in and around facilities. Call Bannock County Mosquito Control at 208-236-7409 for immediate assistance with eradicating vectors. Record time/date, weather, and site conditions when vector activity is observed.

Depth of Sediment & Oil – Take and record measurement at catch basins, conveyance systems, inlets, outlets and within the facility itself. Compare to capacity thresholds defined in the Stormwater Management Manual Section 3.2.4, Summary of Thresholds for Maintenance, or the site-specific O&M Plan.

Percent Vegetation Coverage – Record percent cover of desirable, dead, and invasive vegetation.

Condition of Structural Components – Record type and size of missing or broken components (i.e., width of cracks and/or extent of settling).

Maintenance:

Record date, description, and contractor (if applicable) for all structural repairs, landscape maintenance, and facility cleanout activities.

SAMPLE MAINTENANCE LOG

Date: <u>10/1/14</u>	Initial <u>BJK</u>
Work performed by: <u>AAA Landscaper under 3 yr contract.</u>	
Work performed: <u>Replanted parking lot swale with sedges & rushes.</u>	
Work Area or specific stormwater facility: _____	
Details: *Work Order on file and available upon request. _____	

Date: _____	Initials: _____
Work performed by: _____	
Work performed: _____	
Work area or specific stormwater facility area: _____	
Details: _____	

Date: _____	Initials: _____
Work performed by: _____	
Work performed: _____	
Work area or specific stormwater facility area: _____	
Details: _____	

Date: _____	Initials: _____
Work performed by: _____	
Work performed: _____	
Work area or specific stormwater facility area: _____	
Details: _____	

Date: _____	Initials: _____
Work performed by: _____	
Work performed: _____	
Work area or specific stormwater facility area: _____	
Details: _____	

CHAPTER 10

LOW IMPACT DEVELOPMENT

10.1 INTRODUCTION	2
10.2 STRATEGIES AND PRACTICES	2

10.1 INTRODUCTION

Low impact development (LID) is a stormwater management process that focuses on the reduction of impervious surfaces, conservation of existing vegetation, the use of smaller scale stormwater facilities and controls that try to replicate natural hydrologic patterns.

The LID approach can be applied in a variety of settings including: large lots in rural areas; low, medium, and high-density development within urban growth boundaries; redevelopment of highly urbanized areas; and commercial and industrial development. LID applications can be designed for use on various soil types.

LID represents a new set of tools to improve how to develop land and manage runoff and can reduce the need for costly permanent controls that require maintenance over the life of the project. In many cases, LID projects are less expensive to construct and maintain.

10.2 STRATEGIES AND PRACTICES

For more information on LID practices and strategies, see the Eastern Washington LID Guidance Manual <http://www.wastormwatercenter.org/ew-lid-guidance-manual>

This Manual consists of 4 chapters. Chapter 1 (Introduction) sets the context for the LID approach with an introduction to eastern Washington climate and hydrology (which is very similar to the climate in eastern Idaho) and the effects of urban development on water resources. Chapter 1 also establishes the goals and objectives for LID in the context of Phase II NPDES Municipal Stormwater General Permits.

Chapter 2 (Planning for LID) describes the LID planning principles, site analysis, site inspection, and composite map that form the foundation for an LID design. Chapter 3 (Designing for LID) builds on the planning and site map development and provides guidance for site design. Chapter 4 (LID BMPs) provides design guidance describing the use, applications and limitations, design factors, maintenance, and construction considerations associated with the design of the following BMPs:

- Amending construction site soils.
- Dispersion.
- Bioretention, infiltration planters and flow through planters.
- Trees.
- Permeable pavement.
- Vegetated roofs.
- Minimal excavation foundations.
- Rain water harvesting

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