Appendix

E

Infiltration Guidelines

As a stormwater management method, infiltration means ***retaining or detaining water within soils*** to reduce runoff. Infiltration can be a cost-effective method to manage stormwater – if the conditions on your site allow. These infiltration guidelines identify categories of stormwater infiltration methods, and describe factors that affect the feasibility of their use.

E.1 Stormwater Controls that Promote Infiltration

A wide-range of site-design measures and stormwater treatment measures allow stormwater infiltration and can be categorized as described below and illustrated in Figure E-1.

A. ***Site design measures*** -- such as clustering development or otherwise laying out the site to reduce impervious area, routing drainage from building roofs to landscaped areas, and using pervious pavement.

B. ***Indirect infiltration methods***, which allow stormwater runoff to percolate into surface soils. The infiltrated water may either percolate down into subsurface soils and eventually reach groundwater, or it may be underdrained into subsurface pipes. Examples of indirect infiltration methods include bioretention areas.

C. ***Direct infiltration methods***, which are designed to bypass surface soils and transmit runoff directly to subsurface soils and eventually groundwater. These types of devices must be located and designed to limit the potential for groundwater contamination. Examples of direct infiltration methods include infiltration trenches, infiltration basins, and dry wells.

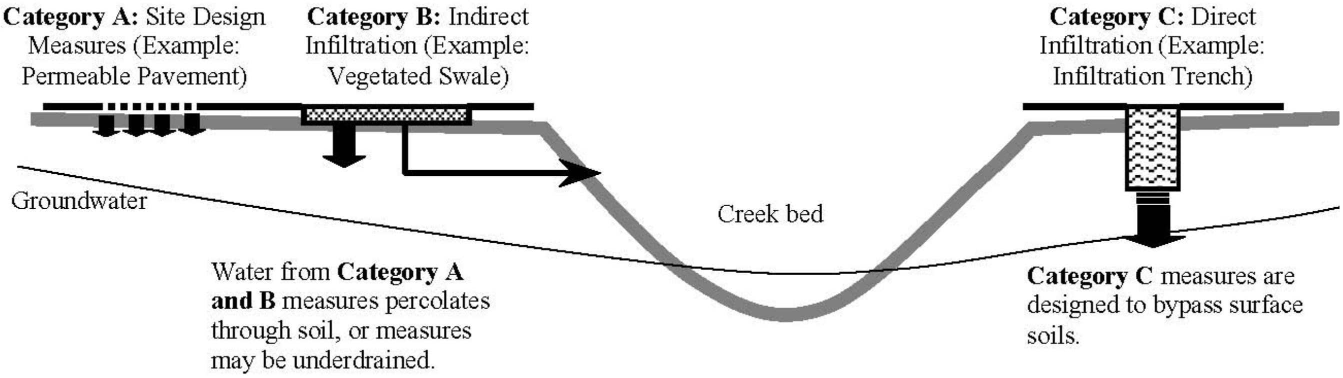

Figure E-1: Stormwater Infiltration Methods (Source: Contra Costa County Clean Water Program, 2005)

Table E-1 describes common stormwater controls and groups them according to whether they meet the above definitions of categories A, B and C. References to the applicable section of Chapter 4 or 6 are given for stormwater controls that have specific technical guidance included in this handbook.

Table E-1
Infiltration Methods in Commonly-Used Stormwater Controls

Stormwater Control	**Description**	**Guidance in Section**
	Category A: Site Design Measures	
Disconnected Downspouts	Instead of connecting directly to storm drains, roof runoff is directed away from the building to nearby landscaped areas.	N/A
Site Grading	Using gentler slopes and concave areas to reduce runoff and encourage infiltration.	N/A
Site Layout Practices	Examples: Use compact, multi-story buildings to reduce building footprint, cluster buildings to reduce street length and protect sensitive areas, design narrow streets, use sidewalks on one side of street.	N/A
Pavers	Traditional bricks, natural stones or other pavers over a bed of fine crushed aggregate with a reduced load-bearing surface.	N/A
Green Roofs	May be “extensive” with a 3-7 inch lightweight substrate and a few types of low-profile plants; or may be “intensive” with a thicker substrate, more varied plantings, and a more garden-like appearance.	6.8

Table E-1
Infiltration Methods in Commonly-Used Stormwater Controls

Stormwater Control	Description	Guidance in Section
	Category B: Indirect Infiltration ("Infiltration Measures")	
Bioretention Area	Briefly ponds stormwater on the surface of a shallow depression and allows it to percolate through permeable soil. Underdrain is typically required, but is elevated to maximize infiltration to underlying soils, where conditions allow.	6.1
Pervious Pavements	Special mixes of concrete and asphalt. Require a base course of crushed aggregate and installation by experienced crews.	6.6
Permeable Interlocking Concrete Pavers	A load-bearing, durable surface of impermeable concrete unit pavers separated by joints with crushed aggregate in the joints as well as underneath. A sub-type is constructed of pavers which are themselves permeable and separated by smaller joints with fine aggregate.	6.6
Grid Pavements	A load-bearing, durable surface of a grid of plastic cells or blocks separated by joints with aggregate or in which soil is planted with turf or other plants.	6.7
Cisterns	Storage vessels, sometimes with a manually operated valve, provide infiltration if runoff is stored for post-storm discharge to landscaping.	6.9
	Category C: Direct Infiltration ("Infiltration Devices")	
Infiltration Trench	A trench with no outlet, filled with rock or open graded aggregate.	6.4
Infiltration Basin	An excavation that exposes relatively permeable soils and impounds water for rapid infiltration.	N/A
Dry Well	Small, deep hole filled with open graded aggregate. Sides may be lined with filter fabric or may be structural (i.e., an open bottom box sunk below grade). Typically receives roof runoff.	N/A
Sources: Contra Costa Clean Water Program, 2005; CASQA, 2003; ACCWP, 2006.		

E.2 Factors Affecting Feasibility of Infiltration

The Harvest and Use, Infiltration and Evapotranspiration Feasibility/Infeasibility Criteria Report (Feasibility Report) submitted to the Regional Water Board by BASMAA on April 29, 2011, identified the factors listed below that affect the feasibility of infiltration. These factors are grouped according to whether they apply to both indirect and direct infiltration, or whether they apply only to direct infiltration.

As indicated in Table E-1, "***infiltration measures***" are stormwater treatment measures that provide indirect infiltration. Examples of infiltration measures include bioretention areas, self-treating and self-retaining areas and pervious pavement.

"***Infiltration devices***" [1]) are designed to bypass surface soils and transmit runoff directly to subsurface soils and eventually groundwater. These types of devices must be located and

[1] The reissued MRP defines "infiltration device" as any structure that is designed to infiltrate stormwater into the subsurface and, as designed, bypass the natural groundwater protection afforded by surface soil.

designed to limit the potential for groundwater contamination. Examples of direct infiltration methods include dry wells, injection wells, and infiltration trenches (includes French drains).

Infiltration measures and infiltration devices are referred to collectively as "***infiltration facilities***."

E.2.1 Factors Affecting Feasibility of Both Indirect and Direct Infiltration

The following factors are used to determine the feasibility of any infiltration facility, whether it provides indirect infiltration (infiltration measures) or direct infiltration (infiltration devices):

- The permeability of the underlying soil;
- Development sites where pollutant mobilization in the soil or groundwater is a documented concern;
- Locations with potential geotechnical hazards;
- Conflicts with the location of existing or proposed underground utilities or easements.

E.2.2 Factors Affecting Feasibility of Direct Infiltration

Factors that specifically preclude the use of direct infiltration (infiltration devices) include the following:

- Locations where policies of local water districts or other applicable agencies preclude infiltration.
- Locations within 100 feet of a groundwater well used for drinking water;
- Appropriate pollution prevention and source control measures, including a minimum of two feet of suitable soil to achieve a maximum of 5 inches/hour infiltration rate;
- Adequate maintenance is provided to maximize pollutant removal capabilities;
- Vertical distance from the base of any infiltration device to the seasonal high groundwater mark is at least 10 feet (or greater if the site has highly porous soils or there are other concerns for groundwater protection);
- Unless stormwater is first treated by a method other than infiltration, infiltration devices are not approved as a treatment measure for stormwater runoff from areas of industrial areas, areas of high vehicular traffic or land uses that pose a high threat to water quality;
- Infiltration devices are not placed in the vicinity of known contaminated sites; and
- Infiltration devices are located a minimum of 100 feet horizontally away from any known water supply wells, septic systems, and underground storage tanks (or greater if the site has highly porous soils or there are other concerns for groundwater protection).

E.3 Dealing with Common Site Constraints

The following tips are intended to help manage constraints to infiltration that are common in San Mateo County.

- Where infiltration of the C.3.d amount of runoff is infeasible, bioinfiltration or bioretention areas may be used if drainage is sufficient or underdrains are provided. The design should maximize infiltration to the underlying soil, as shown in Section 6.1. Some indirect infiltration to groundwater will occur and will enhance the effectiveness of these treatment measures. Site design measures such as disconnected downspouts and pervious paving may be used if soils are amended and positively drained.
- Infiltration is generally infeasible on ***steep or unstable slopes***. Site design measures that limit impervious area may be appropriate if approved by a geotechnical engineer. Consider detaining runoff in green roofs and cisterns, or using stormwater treatment measures that do not infiltrate water into the natural ground, such as flow-through planters or tree well filters.
- Green roofs, cisterns, flow-through planters, tree well filters, and other stormwater controls that are isolated from underlying soils are also appropriate for areas with ***high ground water*** and/or ***groundwater contamination***.
- A variety of ***site design measures*** can often be used even on sites with the constraints described above, including (but not limited to) amended soils, structural soils, grading landscaping to a concave form, designing taller buildings with smaller footprints, and concentrating development on less sensitive portions of the site.

E.4 Infiltration Devices and Class V Injection Well Requirements

In order to protect underground sources of drinking water, the USEPA regulates some infiltration devices as Class V wells under its Underground Injection Control (UIC) Program. A ***Class V injection well*** is defined as "… any bored, drilled, or driven shaft, or dug hole that is deeper than its widest surface dimension, or an improved sinkhole, or a subsurface fluid distribution system."[2] Infiltration trenches are typically not considered Class V injection wells because they are longer than they are wide. The USEPA's regulations state that stormwater drainage wells are "authorized by rule" (40 CFR 144), which means they do not require a permit if they do not endanger ***underground sources of drinking water***, and they comply with federal UIC requirements. For more information, see the USEPA's fact sheet, "When Are Storm Water Discharges Regulated as Class V Wells?" is included at the end of this appendix.

If your project includes one or more infiltration devices that are regulated as Class V injection wells, you will need to submit basic inventory information about the device(s) to

[2] USEPA Office of Ground Water and Drinking Water, "When Are Storm Water Discharges Regulated as Class V Wells?" June 2003.

the regional office of the USEPA. Instructions for submitting this information are available on the USEPA Region 9 website at https://www.epa.gov/uic/underground-injection-control-regulations-and-safe-drinking-water-act-provisions. Project sponsors are responsible for constructing, operating and closing the drainage well in a manner that does not risk contaminating underground sources of drinking water. The USEPA may place additional requirements on the infiltration device. Project sponsors should contact the appropriate USEPA staff, identified on the Internet link provided above, to learn what inventory information should be submitted, and when the submittal should be made.