Appendix

F

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.

F.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 F-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 and vegetated buffer strips.

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.

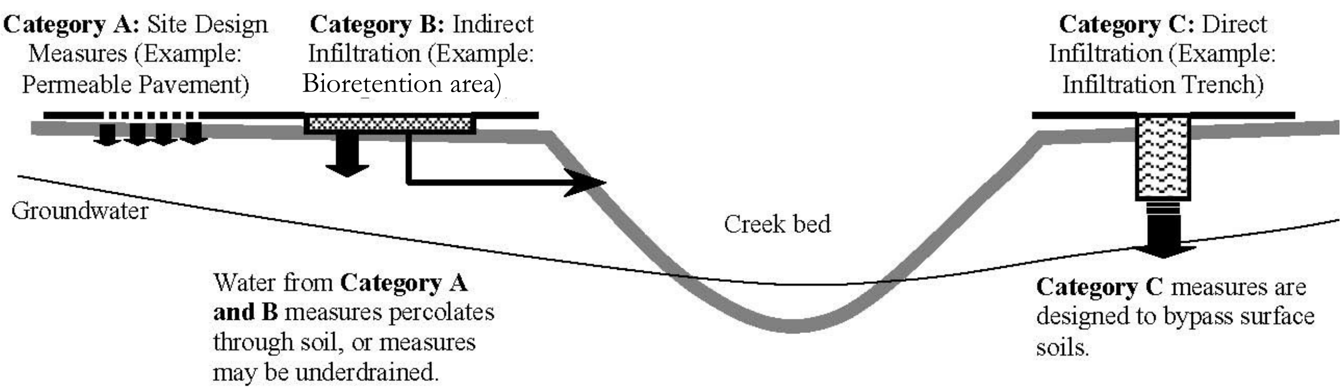

Figure F-1: Stormwater Infiltration Methods (Source: Contra Costa County Clean Water Program, 2005)

Table F-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 5 or 6 are given for stormwater controls that have specific technical guidance included in this handbook.

Table F-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
Category B: Indirect Infiltration		
Bioretention Area	Briefly ponds stormwater on the surface of a shallow depression and allows it to percolate through permeable soil. May require underdrain if native soils drain poorly.	6.1

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

Stormwater Control	**Description**	**Guidance in Section**
Category B: Indirect Infiltration (continued)		
Pervious Pavements	Special mixes of concrete and asphalt. Require a base course of crushed aggregate and installation by experienced crews.	6.6
Turf Block	A load-bearing, durable surface of impermeable blocks separated by spaces and joints in which soil is planted with turf.	6.7
Unit Pavers	Traditional bricks or other pavers on sand or fine crushed aggregate.	6.7
Cisterns	Above- or below-ground 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 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.		

F.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 following factors affecting the feasibility of infiltration. These factors are grouped according to whether they apply to "infiltration measures," which provide indirect infiltration, or "infiltration devices," which provide direct infiltration. The MRP defines "infiltration device" as any structure that is deeper than wide and designed to infiltrate stormwater into the subsurface and, as designed, bypass the natural groundwater protection afforded by surface soil. The MRP lists the following as examples of infiltration devices: dry wells, injection wells, infiltration trenches, and French drains.

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

The permeability of the underlying soil is a key factor in determining the feasibility of either direct or indirect infiltration. Additionally there are various factors that may preclude the use of both infiltration measures (indirect infiltration) and infiltration devices (direct infiltration). These include the following:

- 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.

F.2.2 Factors Affecting Feasibility of Direct Infiltration

Factors that specifically preclude the use of infiltration devices (direct infiltration) 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).

F.3 Dealing with Common Site Constraints

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

- Where conditions (such as steep slopes or high groundwater table) do not preclude infiltration, the design of bioretention areas should ***maximize infiltration to the underlying soil***, as shown in Section 6.1.
- 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.
- Green roofs, cisterns, flow-through planters, and other stormwater controls that are isolated from underlying soils are also appropriate for areas with ***steep slopes, 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) structural soils, grading

landscaping to a concave form, designing taller buildings with smaller footprints, and concentrating development on less sensitive portions of the site.

F.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."[1] 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. 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 the regional office of the USEPA. Instructions for submitting this information are available on the USEPA Region 9 website at http://www.epa.gov/uic/forms/underground-injection-wells-registration. 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.

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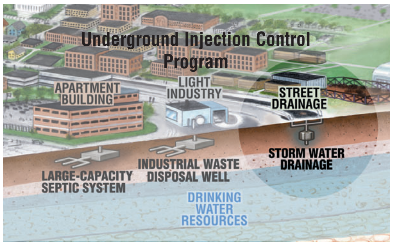
[1] USEPA Office of Ground Water and Drinking Water, "When Are Storm Water Discharges Regulated as Class V Wells?," June 2003.

United States
Environmental Protection
Agency

WHEN ARE STORM WATER DISCHARGES REGULATED AS CLASS V WELLS?



Audience: This fact sheet is for storm water managers that implement the National Pollutant Discharge Elimination System (NPDES) program.

Purpose: To increase awareness that storm water drainage wells are regulated as Class V injection wells and to ensure that NPDES regulators understand the minimum federal requirements under the Safe Drinking Water Act (SDWA) for the Underground Injection Control (UIC) program.

ARE STORM WATER DRAINAGE WELLS REGULATED BY THE UIC PROGRAM?

Yes. These wells are regulated by EPA and primacy states through the UIC program as Class V injection wells with requirements to protect underground sources of drinking water (USDWs). A USDW is defined as an aquifer that contains less than 10,000 mg/L total dissolved solids and is capable of supplying water to a public drinking water system.

Class V storm water drainage wells are typically shallow disposal wells designed to place rain water or melted snow below the land surface. By definition, a Class V injection well is 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.

Storm water management strategies that include subsurface drainage must comply with UIC program regulations.

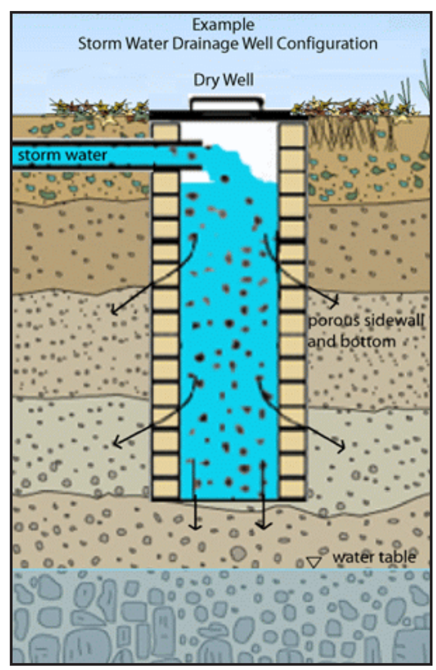
WHY ARE STORM WATER DRAINAGE WELLS A CONCERN?

State and federal UIC program representatives are concerned that there may be a dramatic increase in the use of Class V wells as an NPDES Best Management Practice (BMP) to dispose of storm water. Infiltration through storm water drainage wells has the potential to adversely impact USDWs. The runoff that enters storm water drainage wells may be contaminated with sediments, nutrients, metals, salts, fertilizers, pesticides, and microorganisms.

WHAT ARE SOME EXAMPLES OF STORM WATER DRAINAGE WELLS?

The broad definition of Class V wells covers a variety of storm water injection well configurations, including:

- Dry wells
- Bored wells
- Infiltration galleries



The underground injection well definition applies to any subsurface drainfields that release fluids underground. These can include French drains, tile drains, infiltration sumps, and percolation areas with vertical drainage. Improved sinkholes designed for storm water management are also considered Class V storm water drainage wells. These wells are natural karst depressions or open fractures that have been intentionally altered to accept and drain storm water runoff. The pictures on the back page illustrate an example of a Class V injection well that is subject to UIC requirements.

WHAT INFILTRATION SYSTEMS ARE NOT STORM WATER DRAINAGE WELLS?

Two types of infiltration systems are not considered storm water drainage wells:

- **Infiltration trenches** are excavated trenches filled with stone (no piping or drain tile) to create an underground reservoir. They are usually wider than they are deep.

- **Surface impoundments or ditches** are excavated ponds, lagoons, and ditches (lined or unlined, without piping or drain tile) with an opened surface. They are used to hold storm water. These devices **would be** considered Class V injection wells, however, if they include subsurface fluid distribution systems.

Picture and schematic drawing of parking lot infiltration (Source: Louisiana Department of Transportation)

Storm water drainage well designs can be as varied as the engineers who design them. A fluid distribution system that discharges underground through piping is typically the defining characteristic. If you are unsure about the classification of your infiltration system, contact your UIC program representative for clarification.

HOW ARE STORM WATER DRAINAGE WELLS REGULATED?

Under the minimum federal requirements, storm water drainage wells are "authorized by rule" (40 CFR 144). This means that storm water drainage wells do not require a permit if **they do not** endanger USDWs **and they comply with** federal UIC program requirements. The prohibition on endangerment means the introduction of any storm water contaminant must not result in a violation of drinking water standards or otherwise endanger human health. Primacy states may have more stringent requirements.

Federal program requirements include:

- Submitting basic inventory information about the storm water drainage wells to the state or EPA. (Contact your UIC program to learn what inventory information must be submitted and when.) In some cases, the information may be required prior to constructing the well.
- Constructing, operating, and closing the drainage well in a manner that does not endanger USDWs.
- Meeting any additional prohibitions or requirements (including permitting or closure requirements) specified by a primacy state or EPA region.

HOW CAN I HELP PREVENT NEGATIVE IMPACTS FROM STORM WATER DRAINAGE WELLS?

As an NPDES storm water manager, you can help to ensure that current and future storm water systems using Class V wells meet regulatory requirements under the UIC program. You can also help identify storm water drainage systems that may affect USDWs, and recommend BMPs to protect USDWs. BMPs for storm water drainage wells may address well siting, design, and operation, as well as education and outreach to prevent misuse.

For More Information...

EPA's Office of Ground Water and Drinking Water Web Site:
http://www.epa.gov/safewater

UIC Program Contacts:
http://www.epa.gov/safewater/uic/primacy.html

EPA's NPDES Web Site:
http://www.epa.gov/NPDES/Stormwater

Safe Drinking Water Hotline:
1-800-426-4791

Office of Ground Water and Drinking Water (4606M)

EPA 816-F-03-001

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