

A.4 ROCK INFILTRATION SWALE



Location: Seaside Ridge Development, Encinitas, California.

Figure A.4-1. Rock Infiltration Swale.

A.4.1 DESIGN

The design of rock infiltration swales can be broken down to a nine-step process. Table A.4-1 summarizes the steps, which this chapter describes in greater detail.

Table A.4-1. Rock infiltration swale iterative design step process

Design step		Design component/ consideration	General specification
1	Integrated Management Practice (IMP) Siting (A-51)	Layout and site incorporation	Based on available space and maintenance access, incorporate into parking lot islands, medians, and perimeter; install along the roadway right-of-way; incorporate as landscaped areas throughout the property.
2	Determine IMP Function and Configuration (A-52)	Impermeable liner	If noninfiltrating, use an impermeable clay layer, geomembrane liner, and concrete (as described in Common Design Elements).
		Underdrain (required if subsoil infiltration rate is less than 0.5 inches per hour [in/hr], as in hydrologic soil groups C and D [HSG C & D])	Schedule 40 PVC pipe with perforations (slots or holes) every 6 inches. The 4-inch diameter lateral pipes should join a 6-inch collector pipe, which conveys drainage to the downstream storm network. Provide cleanout ports/observation wells for each underdrain pipe (see Common Design Elements).
		Internal water storage (IWS)	If using underdrain and infiltration, elevate the outlet to create a sump for additional moisture retention to promote plant survival and enhanced treatment. Top of IWS should be greater than 18 inches below surface.
		No underdrain	If design is fully infiltrating, ensure that subgrade compaction is minimized.
		Lateral hydraulic restriction barriers	Use a geomembrane, concrete, or bentonite clay to restrict lateral flows to adjacent subgrades, foundations, or utilities.
3	Determine IMP Sizing Approach (A-54)	Flow-based (common SUSMP methodology)	Refer to chapters 2 and 4 of the County SUSMP for appropriate sizing factors to determine surface area, ponding depth, and media depth. Step 4 of this design guidance section can be skipped when using this method.
		Volume-based (water quality methodology)	Per the County SUSMP, the volume of the 24-hour 85th percentile storm is required for the water quality treatment method.
4	Size the System (A-54)	Temporary ponding depth	6 to 18 inches (6 to 12 inches near schools or in residential areas); average ponding depth of 9 inches is recommended.
		Soil media depth	1.5 to 4 feet (deeper for better pollutant removal, hydrologic benefits, and deeper rooting depths).
		Slope and grade control	If necessary, use check dams to maintain maximum 2.5 percent bed slope. Install a 4-inch-deep layer of ASTM No. 57 stone (underlain by filter fabric) extending 2 feet downslope from check dam to prevent erosion.
		Surface area (volume-based water quality)	Find surface area required to store treatment volume within temporary ponding depth, soil media depth, and gravel drainage layer depth (media porosity ≈ 0.35 and gravel porosity ≈ 0.4).

Design step		Design component/ consideration	General specification
5	Specify Soil Media (A-54)	Composition and texture (by volume)	65 percent sand, 20 percent sandy loam, and 15 percent compost (from vegetation-based feedstock). Animal wastes or by-products should not be applied.
		Permeability	5 in/hr infiltration rate for the flow-based SUSMP method (1–6 in/hr for alternative designs, as approved by local jurisdiction).
		Chemical composition	Total phosphorus < 15 parts per million (ppm); pH 6 to 8; cation exchange capacity > 5 milliequivalents per 100 grams (meq/100 g) of soil; organic matter content < 5 percent by weight.
		Drainage layer	Separate soil media from underdrain layer with 2 to 4 inches of washed sand, followed by 2 inches of choking stone (ASTM No. 8) over a 1.5-foot envelope of ASTM No. 57 stone.
6	Design Inlet and Pretreatment (A-54)	Inlet	Provide stabilized inlets (see Common Design Elements).
		Pretreatment	Install rock-armored forebay (concentrated flow), gravel fringe and vegetated filter strip (sheet flow), or vegetated swale.
7	Select and Design Overflow/Bypass Method (A-54)	Outlet configuration	<u>Online</u> : All runoff is routed through system; install an elevated overflow structure or weir at the elevation of maximum ponding. <u>Offline</u> : Only treated volume is diverted to system; install a diversion structure or allow bypass of high flows (see Common Design Elements).
		Hydromodification control	Provide additional storage and size an appropriate nonclogging orifice or weir to dewater detention volume.
8	Select Surface Material (A-55)	Cobble or gravel	Surface should be stabilized with gravel or decorative cobble.
9	Design for Multi-Use Benefits (A-55)	Additional benefits	Include features to enhance habitat, aesthetics, and public education.

A.4.1.1 STEP 1. IMP SITING

Rock infiltration swales can be incorporated in many places to help achieve more than one project-level or watershed-scale objective, including the following:

- Landscaped parking lot islands
- Between parking stalls in parking lots
- In rights-of-way along roads

A rock infiltration swale's configuration will determine the required components. Figure A.4-2 shows an example of the components of a typical rock infiltration swale. When siting, consideration must always be given to provide access for routine, intermittent, and rehabilitative maintenance activities.

Rock infiltration swales can be combined with other integrated management practices (IMPs) to form a treatment train that can enhance water quality treatment and reduce runoff volume and rate.

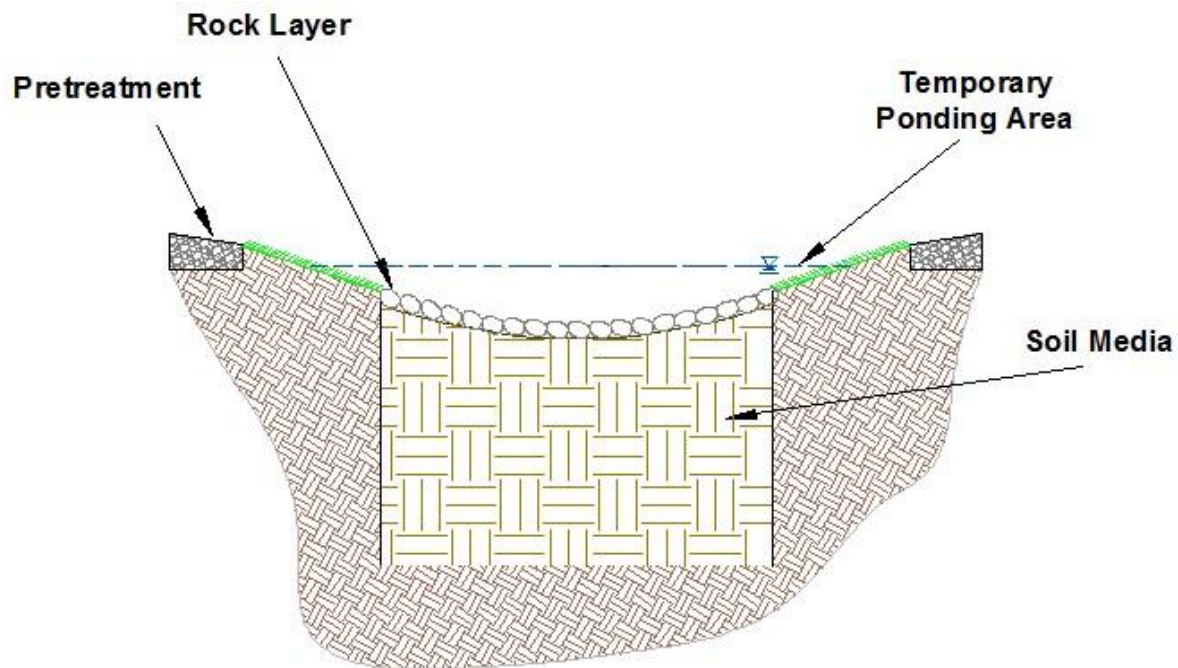


Figure A.4-2. Rock infiltration swale components.

A.4.1.2 STEP 2. DETERMINE IMP FUNCTION AND CONFIGURATION

Rock infiltration swale configuration selection should follow the selection matrix outlined in the Bioretention section (A.1.1.2). Figure A.4-3 through Figure A.4-6 illustrate the recommended configurations.

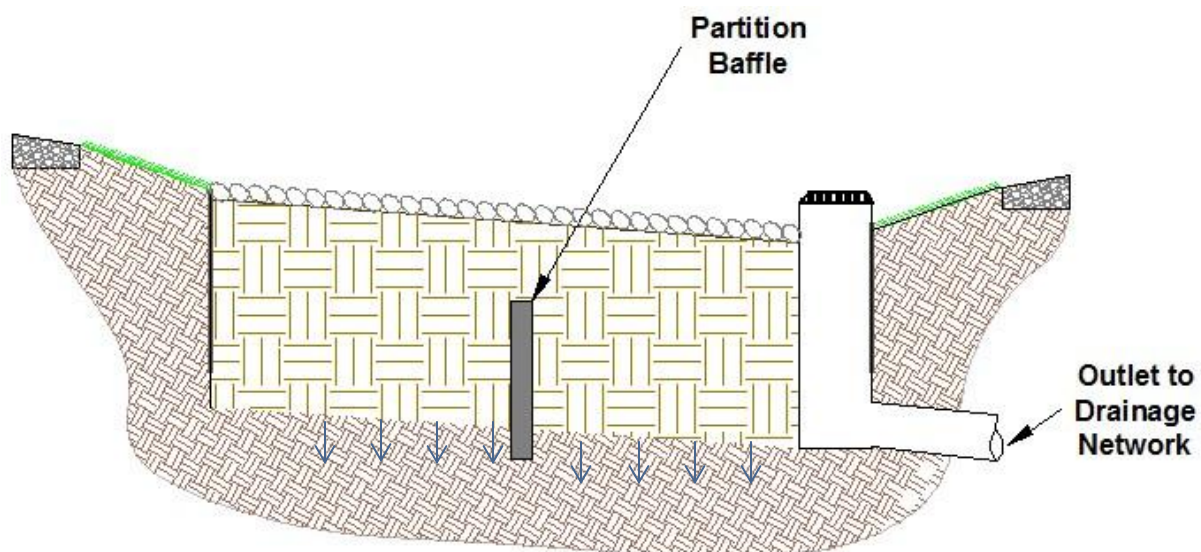


Figure A.4-3. Configuration 1 – Infiltration rock infiltration swale with no underdrain.

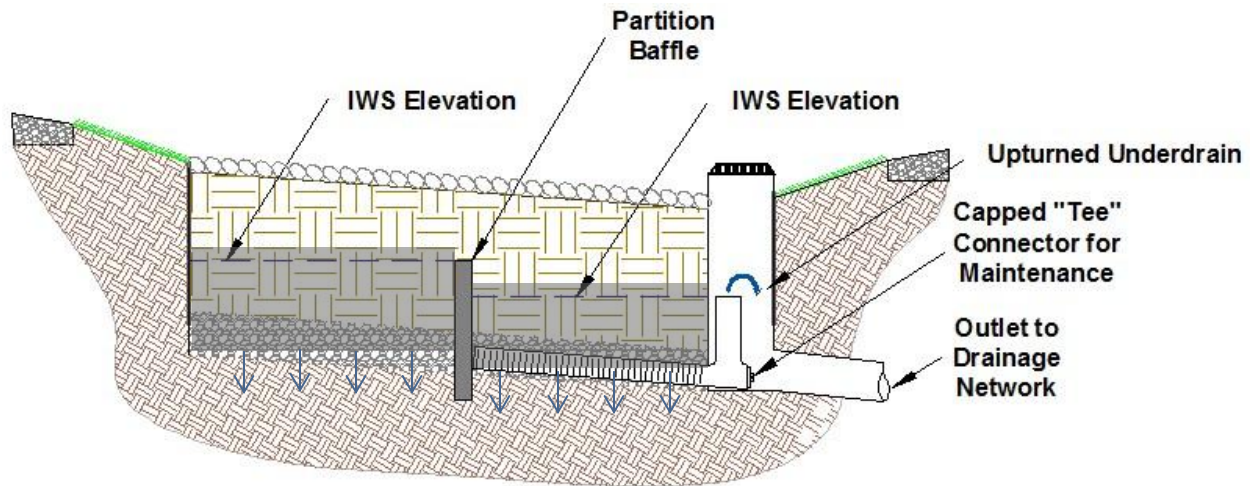


Figure A.4-4. Configuration 2 – Infiltration rock infiltration swale with upturned underdrain.

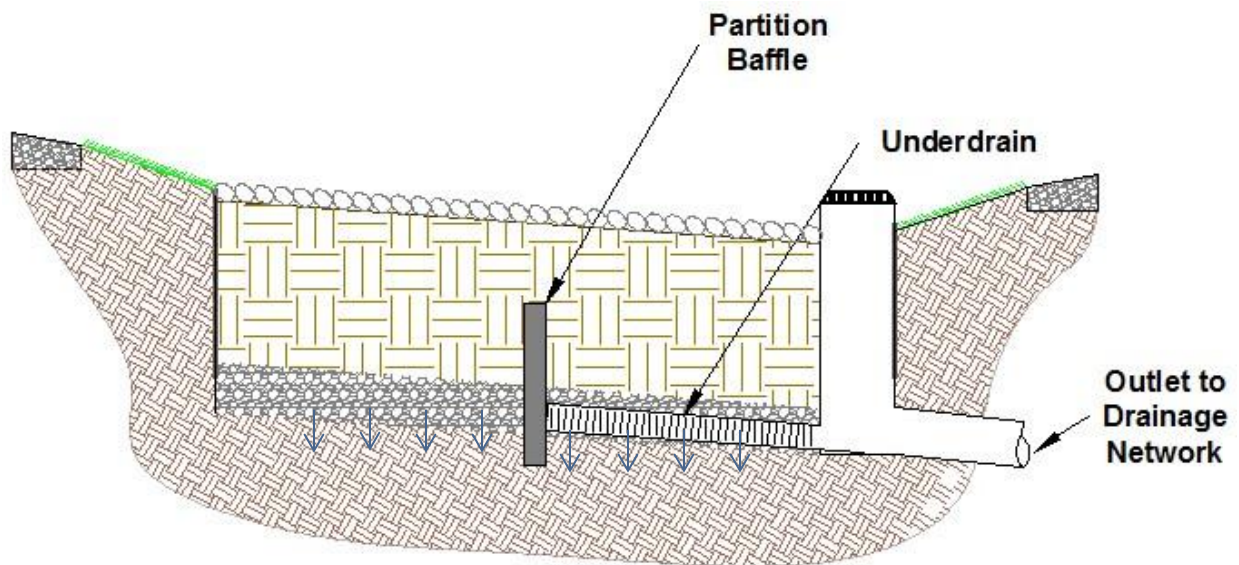


Figure A.4-5. Configuration 3 – Infiltration rock infiltration swale with underdrain on the subgrade.

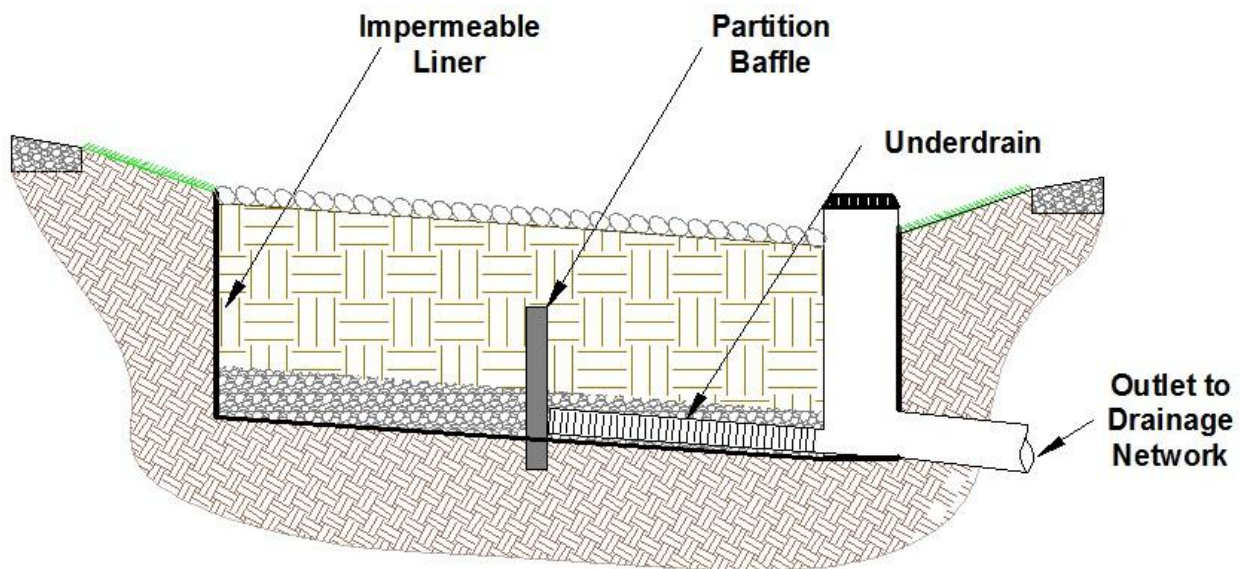


Figure A.4-6. Configuration 4 – Filtration rock infiltration swale with impermeable liner and underdrain on the subgrade.

A.4.1.3 STEP 3. DETERMINE IMP SIZING APPROACH

The rock infiltration swale must be sized according to the methods outlined in the County SUSMP. The SUSMP allows a flow-based sizing and volume-based sizing methodology. If sizing using the flow-based methodology, chapters 2 and 4 of the County SUSMP present relevant sizing regulatory requirements, and step 4 of this design guidance section can be bypassed. If sizing using the volume-based methodology, step 4 of this section presents relevant sizing requirements.

A.4.1.4 STEP 4. SIZE THE SYSTEM (VOLUME-BASED)

Rock infiltration swales should be sized following the methods outlined in the Bioretention swale section (A.2.1.4).

A.4.1.5 STEP 5. SPECIFY SOIL MEDIA

Soil media specifications should meet the requirements outlined in the Bioretention section (A.1.1.5).

A.4.1.6 STEP 6. DESIGN INLET AND PRETREATMENT CONFIGURATION

Inlet and pretreatment specifications should meet the requirements outlined in the Bioretention section (A.1.1.6).

A.4.1.7 STEP 7. SELECT THE APPROPRIATE OVERFLOW/BYPASS

Overflow/bypass methods should follow the guidance given in the Bioretention section (A.1.1.7).

A.4.1.8 STEP 8. SELECT SURFACE MATERIAL

Surface must be gravel or decorative stone that covers all exposed earth. Size is not specified, because most gravels and cobbles have naturally high infiltration capacity because of high available void space.

A.4.1.9 STEP 9. DESIGNING FOR MULTI-USE BENEFITS

Multi-use benefits are the same as those outlined in the Bioretention section (A.1.1.9).

A.4.2 CRITICAL CONSTRUCTION CONSIDERATIONS

Construction technique and sequencing should follow the Bioretention section (A.1.2) and chapter 4.

A.4.3 OPERATIONS AND MAINTENANCE

Operation and maintenance tasks follow those outlined in the Bioretention section (A.1.3), with the exception of items related to plant care.

A.4.4 REFERENCES

County of San Diego. 2012. *County of San Diego SUSMP: Standard Urban Stormwater Mitigation Plan Requirements for Development Applications*.

http://www.sdcountry.ca.gov/dpw/watersheds/susmp/susmppdf/susmp_manual_2012.pdf.