ATTACHMENT I

Addendum

Retention/Irrigation

TC-12

Design Considerations

- Soil for Infiltration
- Area Required
- Slope
- Environmental Side-effects

Description

Retention/irrigation refers to the capture of stormwater runoff in a holding pond and subsequent use of the captured volume for irrigation of landscape of natural pervious areas. This technology is very effective as a stormwater quality practice in that, for the captured water quality volume, it provides virtually no discharge to receiving waters and high stormwater constituent removal efficiencies. This technology mimics natural undeveloped watershed conditions wherein the vast majority of the rainfall volume during smaller rainfall events is infiltrated through the soil profile. Their main advantage over other infiltration technologies is the use of an irrigation system to spread the runoff over a larger area for infiltration. This allows them to be used in areas with low permeability soils.

Capture of stormwater can be accomplished in almost any kind of runoff storage facility, ranging from dry, concrete-lined ponds to those with vegetated basins and permanent pools. The pump and wet well should be automated with a rainfall sensor to provide irrigation only during periods when required infiltration rates can be realized. Generally, a spray irrigation system is required to provide an adequate flow rate for distributing the water quality volume (LCRA, 1998). Collection of roof runoff for subsequent use (rainwater harvesting) also qualifies as a retention/irrigation practice.

This technology is still in its infancy and there are no published reports on its effectiveness, cost, or operational requirements. The guidelines presented below should be considered tentative until additional data are available.

Targeted Constituents

☑ Sediment	■
☑ Nutrients	■
☑ Trash	■
☑ Metals	■
☑ Bacteria	■
☑ Oil and Grease	■
☑ Organics	■

Legend *(Removal Effectiveness)*

● Low ■ High ▲ Medium

California Experience

This BMP has never been implemented in California, only in the Austin, Texas area. The use there is limited to watersheds where no increase in pollutant load is allowed because of the sensitive nature of the watersheds.

Advantages

- Pollutant removal effectiveness is high, accomplished primarily by: (1) sedimentation in the primary storage facility; (2) physical filtration of particulates through the soil profile; (3) dissolved constituents uptake in the vegetative root zone by the soil-resident microbial community.

The hydrologic characteristics of this technique are effective for simulating pre-developed watershed conditions through: (1) containment of higher frequency flood volumes (less than about a 2-year event); and (2) reduction of flow rates and velocities for erosive flow events.

- Pollutant removal rates are estimated to be nearly 100% for all pollutants in the captured and irrigated stormwater volume. However, relatively frequent inspection and maintenance is necessary to assure proper operation of these facilities.
- This technology is particularly appropriate for areas with infrequent rainfall because the system is not required to operate often and the ability to provide stormwater for irrigation can reduce demand on surface and groundwater supplies.

Limitations

- Retention-irrigation is a relatively expensive technology due primarily to mechanical systems, power requirements, and high maintenance needs.
- Due to the relative complexity of irrigation systems, they must be inspected and maintained at regular intervals to ensure reliable system function.
- Retention-irrigation systems use pumps requiring electrical energy inputs (which cost money, create pollution, and can be interrupted). Mechanical systems are also more complex, requiring skilled maintenance, and they are more vulnerable to vandalism than simpler, passive systems.
- Retention-irrigation systems require open space for irrigation and thus may be difficult to retrofit in urban areas.
- Effective use of retention irrigation requires some form of pre-treatment of runoff flows (i.e., sediment forebay or vegetated filter) to remove coarse sediment and to protect the long-term operating capacity of the irrigation equipment.
- Retention/irrigation BMPs capture and store water that, depending on design may be accessible to mosquitoes and other vectors for breeding.

Design and Sizing Guidelines

- Runoff Storage Facility Configuration and Sizing - Design of the runoff storage facility is flexible as long as the water quality volume and an appropriate pump and wet well system can be accommodated.
- Pump and Wet Well System - A reliable pump, wet well, and rainfall or soil moisture sensor system should be used to distribute the water quality volume. These systems should be similar to those used for wastewater effluent irrigation, which are commonly used in areas where "no discharge" wastewater treatment plant permits are issued.
- Detention Time - The irrigation schedule should allow for complete drawdown of the water quality volume within 72 hours. Irrigation should not begin within 12 hours of the end of rainfall so that direct storm runoff has ceased and soils are not saturated. Consequently, the length of the active irrigation period is 60 hours. The irrigation should include a cycling factor of ½, so that each portion of the area will be irrigated for only 30 hours during the

total of 60 hours allowed for disposal of the water quality volume. Irrigation also should not occur during subsequent rainfall events.

- Irrigation System - Generally a spray irrigation system is required to provide an adequate flow rate for timely distribution of the water quality volume.
- Designs that utilize covered water storage should be accessible to vector control personnel via access doors to facilitate vector surveillance and control if needed.
- Irrigation Site Criteria – The area selected for irrigation must be pervious, on slopes of less than 10%. A geological assessment is required for proposed irrigation areas to assure that there is a minimum of 12 inches of soil cover. Rocky soils are acceptable for irrigation; however, the coarse material (diameter greater than 0.5 inches) should not account for more than 30% of the soil volume. Optimum sites for irrigation include recreational and greenbelt areas as well as landscaping in commercial developments. The stormwater irrigation area should be distinct and different from any areas used for wastewater effluent irrigation. Finally, the area designated for irrigation should have at least a 100-foot buffer from wells, septic systems, and natural wetlands.
- Irrigation Area - The irrigation rate must be low enough so that the irrigation does not produce any surface runoff; consequently, the irrigation rate may not exceed the permeability of the soil. The minimum required irrigation area should be calculated using the following formula:

$$A = \frac{12 \times V}{T \times r}$$

where:

A = area required for irrigation (ft2)

V = water quality volume (ft3)

T = period of active irrigation (30 hr)

r = Permeability (in/hr)

- The permeability of the soils in the area proposed for irrigation should be determined using a double ring infiltrometer (ASTM D 3385-94) or from county soil surveys prepared by the Natural Resource Conservation Service. If a range of permeabilities is reported, the average value should be used in the calculation. If no permeability data is available, a value of 0.1 inches/hour should be assumed.
- It should be noted that the minimum area requires intermittent irrigation over a period of 60 hours at low rates to use the entire water quality volume. This intensive irrigation may be harmful to vegetation that is not adapted to long periods of wet conditions. In practice, a much larger irrigation area will provide better use of the retained water and promote a healthy landscape.

Performance

This technology is still in its infancy and there are no published reports on its effectiveness, cost, or operational requirements.

Siting Criteria

Capture of stormwater can be accomplished in almost any kind of runoff storage facility, ranging from dry, concrete-lined ponds to those with vegetated basins and permanent pools. Siting is contingent upon the type of facility used.

Additional Design Guidelines

This technology is still in its infancy and there are no published reports on its effectiveness, cost, or operational requirements.

Maintenance

Relatively frequent inspection and maintenance is necessary to verify proper operation of these facilities. Some maintenance concerns are specific to the type or irrigation system practice used.

BMPs that store water can become a nuisance due to mosquito and other vector breeding. Preventing mosquito access to standing water sources in BMPs (particularly below-ground) is the best prevention plan, but can prove challenging due to multiple entrances and the need to maintain the hydraulic integrity of the system. Reliance on electrical pumps is prone to failure and in some designs (e.g., sumps, vaults) may not provide complete dewatering, both which increase the chances of water standing for over 72 hours and becoming a breeding place for vectors. BMPs that hold water for over 72 hours and/or rely on electrical or mechanical devices to dewater may require routine inspections and treatments by local mosquito and vector control agencies to suppress mosquito production. Open storage designs such as ponds and basins (see appropriate fact sheets) will require routine preventative maintenance plans and may also require routine inspections and treatments by local mosquito and vector control agencies.

Cost

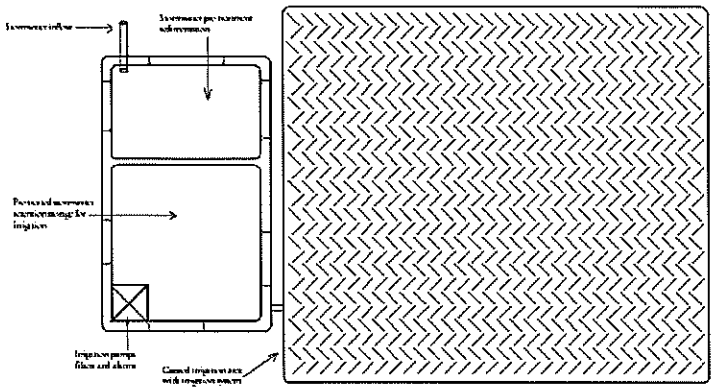
This technology is still in its infancy and there are no published reports on its effectiveness, cost, or operational requirements. However, O&M costs for retention-irrigation systems are high compared to virtually all other stormwater quality control practices because of the need for: (1) frequent inspections; (2) the reliance on mechanical equipment; and (3) power costs.

References and Sources of Additional Information

Barrett, M., 1999, Complying with the Edwards Aquifer Rules: Technical Guidance on Best Management Practices, Texas Natural Resource Conservation Commission Report RG-348. http://www.tnrcc.state.tx.us/admin/topdoc/rg/348/index.html

Lower-Colorado River Authority (LCRA), 1998, Nonpoint Source Pollution Control Technical Manual, Austin, TX.

Metzger, M. E., D. F. Messer, C. L. Beitia, C. M. Myers, and V. L. Kramer. 2002. The dark side of stormwater runoff management: disease vectors associated with structural BMPs. Stormwater 3(2): 24-39.



Infiltration Trench

TC-10

Design Considerations

- Accumulation of Metals
- Clogged Soil Outlet Structures
- Vegetation/Landscape Maintenance

Description

An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. Runoff is stored in the void space between the stones and infiltrates through the bottom and into the soil matrix. Infiltration trenches perform well for removal of fine sediment and associated pollutants. Pretreatment using buffer strips, swales, or detention basins is important for limiting amounts of coarse sediment entering the trench which can clog and render the trench ineffective.

California Experience

Caltrans constructed two infiltration trenches at highway maintenance stations in Southern California. Of these, one failed to operate to the design standard because of average soil infiltration rates lower than that measured in the single infiltration test. This highlights the critical need for appropriate evaluation of the site. Once in operation, little maintenance was required at either site.

Advantages

- Provides 100% reduction in the load discharged to surface waters.
- An important benefit of infiltration trenches is the approximation of pre-development hydrology during which a significant portion of the average annual rainfall runoff is infiltrated rather than flushed directly to creeks.
- If the water quality volume is adequately sized, infiltration trenches can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

Targeted Constituents

☑	Sediment	■
☑	Nutrients	■
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

- As an underground BMP, trenches are unobtrusive and have little impact of site aesthetics.

Limitations

- Have a high failure rate if soil and subsurface conditions are not suitable.
- May not be appropriate for industrial sites or locations where spills may occur.
- The maximum contributing area to an individual infiltration practice should generally be less than 5 acres.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C and D.
- If infiltration rates exceed 2.4 inches/hour, then the runoff should be fully treated prior to infiltration to protect groundwater quality.
- Not suitable on fill sites or steep slopes.
- Risk of groundwater contamination in very coarse soils.
- Upstream drainage area must be completely stabilized before construction.
- Difficult to restore functioning of infiltration trenches once clogged.

Design and Sizing Guidelines

- Provide pretreatment for infiltration trenches in order to reduce the sediment load. Pretreatment refers to design features that provide settling of large particles before runoff reaches a management practice, easing the long-term maintenance burden. Pretreatment is important for all structural stormwater management practices, but it is particularly important for infiltration practices. To ensure that pretreatment mechanisms are effective, designers should incorporate practices such as grassed swales, vegetated filter strips, detention, or a plunge pool in series.
- Specify locally available trench rock that is 1.5 to 2.5 inches in diameter.
- Determine the trench volume by assuming the WQV will fill the void space based on the computed porosity of the rock matrix (normally about 35%).
- Determine the bottom surface area needed to drain the trench within 72 hr by dividing the WQV by the infiltration rate.

$$d = \frac{WQV + RFV}{SA}$$

- Calculate trench depth using the following equation:

where:

D = Trench depth

WQV	=	Water quality volume
RFV	=	Rock fill volume
SA	=	Surface area of the trench bottom

- The use of vertical piping, either for distribution or infiltration enhancement shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).
- Provide observation well to allow observation of drain time.
- May include a horizontal layer of filter fabric just below the surface of the trench to retain sediment and reduce the potential for clogging.

Construction/Inspection Considerations

Stabilize the entire area draining to the facility before construction begins. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction. Stabilize the entire contributing drainage area before allowing any runoff to enter once construction is complete.

Performance

Infiltration trenches eliminate the discharge of the water quality volume to surface receiving waters and consequently can be considered to have 100% removal of all pollutants within this volume. Transport of some of these constituents to groundwater is likely, although the attenuation in the soil and subsurface layers will be substantial for many constituents.

Infiltration trenches can be expected to remove up to 90 percent of sediments, metals, coliform bacteria and organic matter, and up to 60 percent of phosphorus and nitrogen in the infiltrated runoff (Schueler, 1992). Biochemical oxygen demand (BOD) removal is estimated to be between 70 to 80 percent. Lower removal rates for nitrate, chlorides and soluble metals should be expected, especially in sandy soils (Schueler, 1992). Pollutant removal efficiencies may be improved by using washed aggregate and adding organic matter and loam to the subsoil. The stone aggregate should be washed to remove dirt and fines before placement in the trench. The addition of organic material and loam to the trench subsoil may enhance metals removal through adsorption.

Siting Criteria

The use of infiltration trenches may be limited by a number of factors, including type of native soils, climate, and location of groundwater table. Site characteristics, such as excessive slope of the drainage area, fine-grained soil types, and proximate location of the water table and bedrock, may preclude the use of infiltration trenches. Generally, infiltration trenches are not suitable for areas with relatively impermeable soils containing clay and silt or in areas with fill.

As with any infiltration BMP, the potential for groundwater contamination must be carefully considered, especially if the groundwater is used for human consumption or agricultural purposes. The infiltration trench is not suitable for sites that use or store chemicals or hazardous materials unless hazardous and toxic materials are prevented from entering the trench. In these areas, other BMPs that do not allow interaction with the groundwater should be considered.

The potential for spills can be minimized by aggressive pollution prevention measures. Many municipalities and industries have developed comprehensive spill prevention control and countermeasure (SPCC) plans. These plans should be modified to include the infiltration trench and the contributing drainage area. For example, diversion structures can be used to prevent spills from entering the infiltration trench. Because of the potential to contaminate groundwater, extensive site investigation must be undertaken early in the site planning process to establish site suitability for the installation of an infiltration trench.

Longevity can be increased by careful geotechnical evaluation prior to construction and by designing and implementing an inspection and maintenance plan. Soil infiltration rates and the water table depth should be evaluated to ensure that conditions are satisfactory for proper operation of an infiltration trench. Pretreatment structures, such as a vegetated buffer strip or water quality inlet, can increase longevity by removing sediments, hydrocarbons, and other materials that may clog the trench. Regular maintenance, including the replacement of clogged aggregate, will also increase the effectiveness and life of the trench.

Evaluation of the viability of a particular site is the same as for infiltration basins and includes:

- Determine soil type (consider RCS soil type 'A, B or C' only) from mapping and consult USDA soil survey tables to review other parameters such as the amount of silt and clay, presence of a restrictive layer or seasonal high water table, and estimated permeability. The soil should not have more than 30 percent clay or more than 40 percent of clay and silt combined. Eliminate sites that are clearly unsuitable for infiltration.
- Groundwater separation should be at least 3 m from the basin invert to the measured ground water elevation. There is concern at the state and regional levels of the impact on groundwater quality from infiltrated runoff, especially when the separation between groundwater and the surface is small.
- Location away from buildings, slopes and highway pavement (greater than 6 m) and wells and bridge structures (greater than 30 m). Sites constructed of fill, having a base flow or with a slope greater than 15 percent should not be considered.
- Ensure that adequate head is available to operate flow splitter structures (to allow the basin to be offline) without ponding in the splitter structure or creating backwater upstream of the splitter.
- Base flow should not be present in the tributary watershed.

Secondary Screening Based on Site Geotechnical Investigation

- At least three in-hole conductivity tests shall be performed using USBR 7300-89 or Bouwer-Rice procedures (the latter if groundwater is encountered within the boring), two tests at different locations within the proposed basin and the third down gradient by no more than approximately 10 m. The tests shall measure permeability in the side slopes and the bed within a depth of 3 m of the invert.
- The minimum acceptable hydraulic conductivity as measured in any of the three required test holes is 13 mm/hr. If any test hole shows less than the minimum value, the site should be disqualified from further consideration.

- Exclude from consideration sites constructed in fill or partially in fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.
- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Maintenance

Infiltration trenches required the least maintenance of any of the BMPs evaluated in the Caltrans study, with approximately 17 field hours spent on the operation and maintenance of each site. Inspection of the infiltration trench was the largest field activity, requiring approximately 8 hr/yr.

In addition to reduced water quality performance, clogged infiltration trenches with surface standing water can become a nuisance due to mosquito breeding. If the trench takes more than 72 hours to drain, then the rock fill should be removed and all dimensions of the trench should be increased by 2 inches to provide a fresh surface for infiltration.

Cost

Construction Cost

Infiltration trenches are somewhat expensive, when compared to other stormwater practices, in terms of cost per area treated. Typical construction costs, including contingency and design costs, are about $5 per ft^3 of stormwater treated (SWRPC, 1991; Brown and Schueler, 1997). Actual construction costs may be much higher. The average construction cost of two infiltration trenches installed by Caltrans in southern California was about $50/ft^3; however, these were constructed as retrofit installations.

Infiltration trenches typically consume about 2 to 3 percent of the site draining to them, which is relatively small. In addition, infiltration trenches can fit into thin, linear areas. Thus, they can generally fit into relatively unusable portions of a site.

Maintenance Cost

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly sited or maintained, infiltration trenches have a high failure rate. In general, maintenance costs for infiltration trenches are estimated at between 5 percent and 20 percent of the construction cost. More realistic values are probably closer to the 20-percent range, to ensure long-term functionality of the practice.

References and Sources of Additional Information

Caltrans, 2002, BMP Retrofit Pilot Program Proposed Final Report, Rpt. CTSW-RT-01-050, California Dept. of Transportation, Sacramento, CA.

Brown, W., and T. Schueler. 1997. *The Economics of Stormwater BMPs in the Mid-Atlantic Region.* Prepared for the Chesapeake Research Consortium, Edgewater, MD, by the Center for Watershed Protection, Ellicott City, MD.

Galli, J. 1992. *Analysis of Urban BMP Performance and Longevity in Prince George's County, Maryland.* Metropolitan Washington Council of Governments, Washington, DC.

Maryland Department of the Environment (MDE). 2000. *Maryland Stormwater Design Manual*. http://www.mde.state.md.us/environment/wma/stormwatermanual. Accessed May 22, 2001.

Metzger, M. E., D. F. Messer, C. L. Beitia, C. M. Myers, and V. L. Kramer. 2002. The Dark Side Of Stormwater Runoff Management: Disease Vectors Associated With Structural BMPs. Stormwater 3(2): 24-39.

Schueler, T. 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*. Metropolitan Washington Council of Governments, Washington, DC.

Southeastern Wisconsin Regional Planning Commission (SWRPC). 1991. *Costs of Urban Nonpoint Source Water Pollution Control Measures*. Southeastern Wisconsin Regional Planning Commission, Waukesha, WI.

Watershed Management Institute (WMI). 1997. *Operation, Maintenance, and Management of Stormwater Management Systems*. Prepared for U.S. Environmental Protection Agency, Office of Water, Washington, DC.

Information Resources

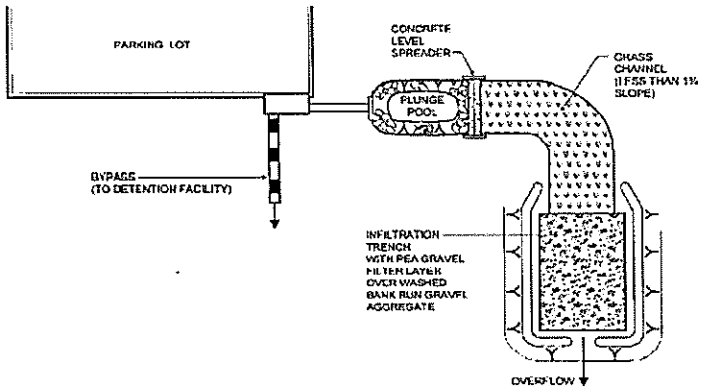
Center for Watershed Protection (CWP). 1997. *Stormwater BMP Design Supplement for Cold Climates*. Prepared for the U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds, Washington, DC, by the Center for Watershed Protection, Ellicott City, MD.

Ferguson, B.K. 1994. *Stormwater Infiltration*. CRC Press, Ann Arbor, MI.

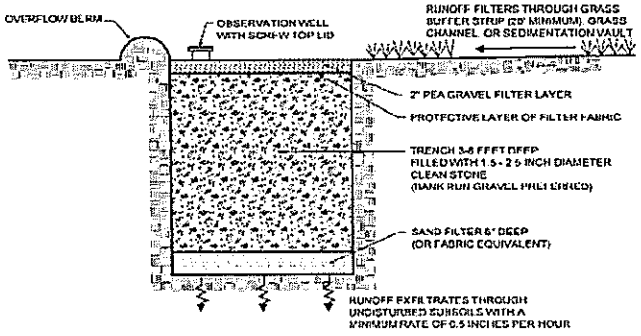
Minnesota Pollution Control Agency. 1989. *Protecting Water Quality in Urban Areas: Best Management Practices*. Minnesota Pollution Control Agency, Minneapolis, MN.

USEPA. 1993. *Guidance to Specify Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. EPA-840-B-92-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

Infiltration Trench TC-10

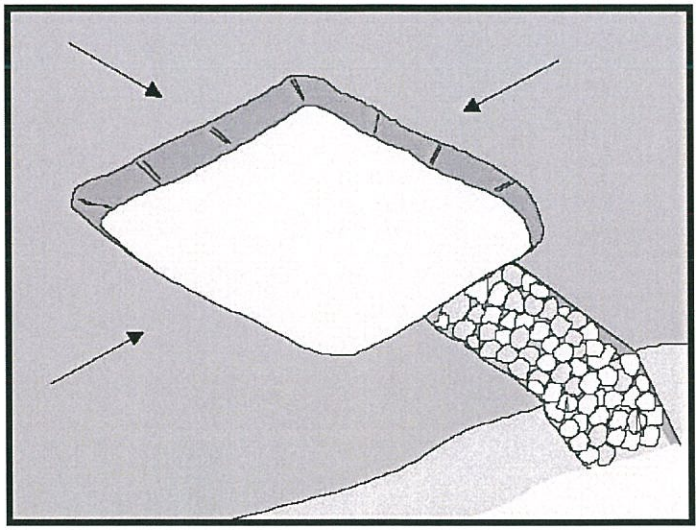


PLAN VIEW



SECTION

Sediment Trap SE-3



Description and Purpose

A sediment trap is a containment area where sediment-laden runoff is temporarily detained under quiescent conditions, allowing sediment to settle out or before the runoff is discharged. Sediment traps are formed by excavating or constructing an earthen embankment across a waterway or low drainage area.

Suitable Applications

Sediment traps should be considered for use:

- At the perimeter of the site at locations where sediment-laden runoff is discharged offsite.
- At multiple locations within the project site where sediment control is needed.
- Around or upslope from storm drain inlet protection measures.
- Sediment traps may be used on construction projects where the drainage area is less than 5 acres. Traps would be placed where sediment-laden stormwater may enter a storm drain or watercourse. SE-2, Sediment Basins, must be used for drainage areas greater than 5 acres.
- As a supplemental control, sediment traps provide additional protection for a water body or for reducing sediment before it enters a drainage system.

Objectives

EC	Erosion Control	
SE	Sediment Control	☑
TR	Tracking Control	
WE	Wind Erosion Control	
NS	Non-Stormwater Management Control	
WM	Waste Management and Materials Pollution Control	

Legend:

☑ **Primary Objective**

☒ **Secondary Objective**

Targeted Constituents

Sediment	☑
Nutrients	
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	

Potential Alternatives

SE-2 Sediment Basin (for larger areas)

SE-3 Sediment Trap

Limitations

- Requires large surface areas to permit infiltration and settling of sediment.
- Not appropriate for drainage areas greater than 5 acres.
- Only removes large and medium sized particles and requires upstream erosion control.
- Attractive and dangerous to children, requiring protective fencing.
- Conducive to vector production.
- Should not be located in live streams.

Implementation

Design

A sediment trap is a small temporary ponding area, usually with a gravel outlet, formed by excavation or by construction of an earthen embankment. Its purpose is to collect and store sediment from sites cleared or graded during construction. It is intended for use on small drainage areas with no unusual drainage features and projected for a quick build-out time. It should help in removing coarse sediment from runoff. The trap is a temporary measure with a design life of approximately six months to one year and is to be maintained until the site area is permanently protected against erosion by vegetation and/or structures.

Sediment traps should be used only for small drainage areas. If the contributing drainage area is greater than 5 acres, refer to SE-2, Sediment Basins, or subdivide the catchment area into smaller drainage basins.

Sediment usually must be removed from the trap after each rainfall event. The SWPPP should detail how this sediment is to be disposed of, such as in fill areas onsite, or removal to an approved offsite dump. Sediment traps used as perimeter controls should be installed before any land disturbance takes place in the drainage area.

Sediment traps are usually small enough that a failure of the structure would not result in a loss of life, damage to home or buildings, or interruption in the use of public roads or utilities. However, sediment traps are attractive to children and can be dangerous. The following recommendations should be implemented to reduce risks:

- Install continuous fencing around the sediment trap or pond. Consult local ordinances regarding requirements for maintaining health and safety.
- Restrict basin side slopes to 3:1 or flatter.

Sediment trap size depends on the type of soil, size of the drainage area, and desired sediment removal efficiency (see SE-2, Sediment Basin). As a rule of thumb, the larger the basin volume the greater the sediment removal efficiency. Sizing criteria are typically established under the local grading ordinance or equivalent. The runoff volume from a 2-year storm is a common design criteria for a sediment trap. The sizing criteria below assume that this runoff volume is 0.042 acre-ft/acre (0.5 in. of runoff). While the climatic, topographic, and soil type extremes make it difficult to establish a statewide standard, the following criteria should trap moderate to high amounts of sediment in most areas of California:

Sediment Trap SE-3

- Locate sediment traps as near as practical to areas producing the sediment.
- Trap should be situated according to the following criteria: (1) by excavating a suitable area or where a low embankment can be constructed across a swale, (2) where failure would not cause loss of life or property damage, and (3) to provide access for maintenance, including sediment removal and sediment stockpiling in a protected area.
- Trap should be sized to accommodate a settling zone and sediment storage zone with recommended minimum volumes of 67 yd^3/acre and 33 yd^3/acre of contributing drainage area, respectively, based on 0.5 in. of runoff volume over a 24-hour period. In many cases, the size of an individual trap is limited by available space. Multiple traps or additional volume may be required to accommodate specific rainfall, soil, and site conditions.
- Traps with an impounding levee greater than 4.5 ft tall, measured from the lowest point to the impounding area to the highest point of the levee, and traps capable of impounding more than 35,000 ft^3, should be designed by a Registered Civil Engineer. The design should include maintenance requirements, including sediment and vegetation removal, to ensure continuous function of the trap outlet and bypass structures.
- The outlet pipe or open spillway must be designed to convey anticipated peak flows.
- Use rock or vegetation to protect the trap outlets against erosion.
- Fencing should be provided to prevent unauthorized entry.

Installation

Sediment traps can be constructed by excavating a depression in the ground or creating an impoundment with a small embankment. Sediment traps should be installed outside the area being graded and should be built prior to the start of the grading activities or removal of vegetation. To minimize the area disturbed by them, sediment traps should be installed in natural depressions or in small swales or drainage ways. The following steps must be followed during installation:

- The area under the embankment must be cleared, grubbed, and stripped of any vegetation and root mat. The pool area should be cleared.
- The fill material for the embankment must be free of roots or other woody vegetation as well as oversized stones, rocks, organic material, or other objectionable material. The embankment may be compacted by traversing with equipment while it is being constructed.
- All cut-and-fill slopes should be 3:1 or flatter.
- When a riser is used, all pipe joints must be watertight.
- When a riser is used, at least the top two-thirds of the riser should be perforated with 0.5 in. diameter holes spaced 8 in. vertically and 10 to 12 in. horizontally. See SE-2, Sediment Basin.
- When an earth or stone outlet is used, the outlet crest elevation should be at least 1 ft below the top of the embankment.

- When crushed stone outlet is used, the crushed stone used in the outlet should meet AASHTO M43, size No. 2 or 24, or its equivalent such as MSHA No. 2. Gravel meeting the above gradation may be used if crushed stone is not available.

Costs

Average annual cost per installation and maintenance (18 month useful life) is $0.73 per ft^3 ($1,300 per drainage acre). Maintenance costs are approximately 20% of installation costs.

Inspection and Maintenance

- Inspect BMPs prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.
- Inspect outlet area for erosion and stabilize if required.
- Inspect trap banks for seepage and structural soundness, repair as needed.
- Inspect outlet structure and spillway for any damage or obstructions. Repair damage and remove obstructions as needed.
- Inspect fencing for damage and repair as needed.
- Inspect the sediment trap for area of standing water during every visit. Corrective measures should be taken if the BMP does not dewater completely in 72 hours or less to prevent vector production.
- Sediment that accumulates in the BMP must be periodically removed in order to maintain BMP effectiveness. Sediment should be removed when the sediment accumulation reaches one-third of the trap capacity. Sediment removed during maintenance may be incorporated into earthwork on the site or disposed of at an appropriate location.
- Remove vegetation from the sediment trap when first detected to prevent pools of standing water and subsequent vector production.
- BMPs that require dewatering shall be continuously attended while dewatering takes place. Dewatering BMPs shall be implemented at all times during dewatering activities.

References

Brown, W., and T. Schueler. The Economics of Stormwater BMPs in the Mid-Atlantic Region. Prepared for Chesapeake Research Consortium, Edgewater, MD, by the Center for Watershed Protection, Ellicott City, MD, 1997.

Draft – Sedimentation and Erosion Control, an Inventory of Current Practices, USEPA, April 1990.

Manual of Standards of Erosion and Sediment Control Measures, Association of Bay Area Governments, May 1995.

Metzger, M.E., D.F. Messer, C.L. Beitia, C.M. Myers, and V.L. Kramer, The Dark Side of Stormwater Runoff Management: Disease Vectors Associated with Structural BMPs, 2002.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, United States Environmental Protection Agency, 2002.

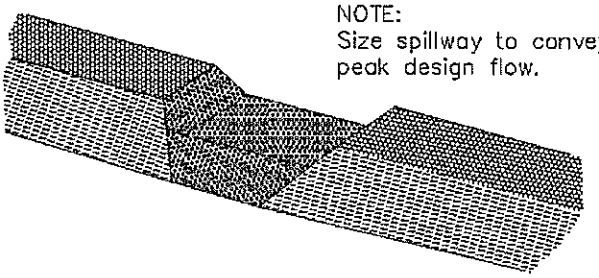
Proposed Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, Work Group-Working Paper, USEPA, April 1992.

Stormwater Quality Handbooks - Construction Site Best Management Practices (BMPs) Manual, State of California Department of Transportation (Caltrans), November 2000.

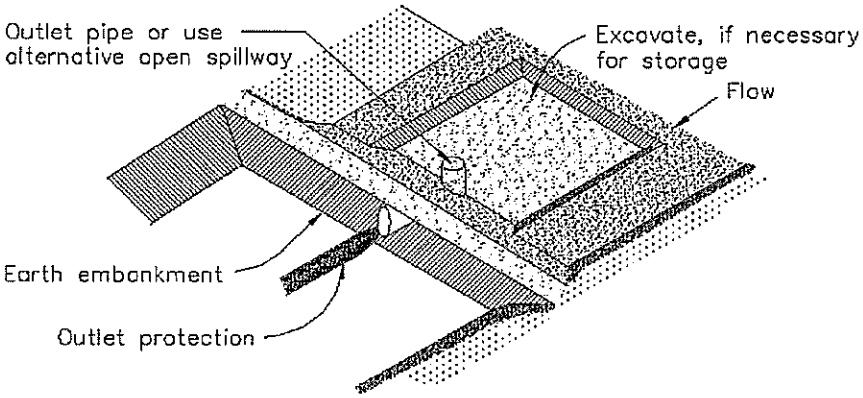
Stormwater Management Manual for The Puget Sound Basin, Washington State Department of Ecology, Public Review Draft, 1991.

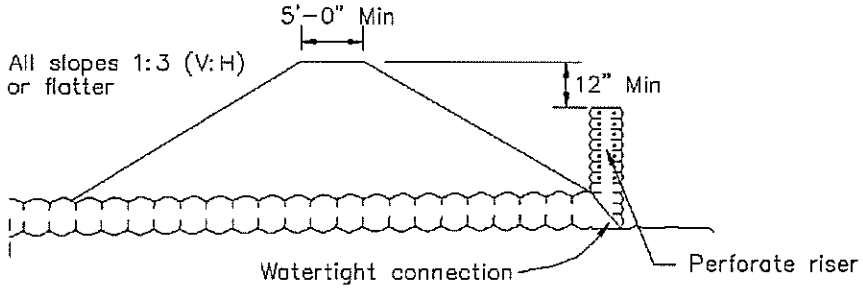
U.S. Environmental Protection Agency (USEPA). Guidance Specifying Management Measures for Nonpoint Pollution in Coastal Waters. EPA 840-B-9-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC, 1993.

Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Management Practices, Tahoe Regional Planning Agency, November 1988.



TYPICAL OPEN SPILLWAY

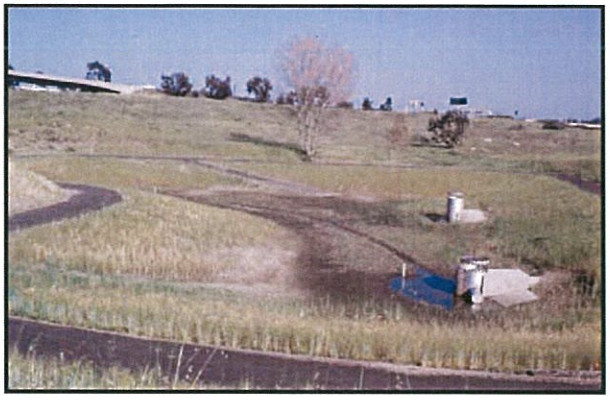




EMBANKMENT SECTION THRU RISER

TYPICAL SEDIMENT TRAP
NOT TO SCALE

Extended Detention Basin TC-22



Design Considerations

- Tributary Area
- Area Required
- Hydraulic Head

Description

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (e.g., 48 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	■
☑	Metals	▲
☑	Bacteria	▲
☑	Oil and Grease	▲
☑	Organics	▲

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored 5 extended detention basins in southern California with design drain times of 72 hours. Four of the basins were earthen, less costly and had substantially better load reduction because of infiltration that occurred, than the concrete basin. The Caltrans study reaffirmed the flexibility and performance of this conventional technology. The small headloss and few siting constraints suggest that these devices are one of the most applicable technologies for stormwater treatment.

Advantages

- Due to the simplicity of design, extended detention basins are relatively easy and inexpensive to construct and operate.
- Extended detention basins can provide substantial capture of sediment and the toxics fraction associated with particulates.
- Widespread application with sufficient capture volume can provide significant control of channel erosion and enlargement caused by changes to flow frequency

relationships resulting from the increase of impervious cover in a watershed.

Limitations

- Limitation of the diameter of the orifice may not allow use of extended detention in watersheds of less than 5 acres (would require an orifice with a diameter of less than 0.5 inches that would be prone to clogging).
- Dry extended detention ponds have only moderate pollutant removal when compared to some other structural stormwater practices, and they are relatively ineffective at removing soluble pollutants.
- Although wet ponds can increase property values, dry ponds can actually detract from the value of a home due to the adverse aesthetics of dry, bare areas and inlet and outlet structures.

Design and Sizing Guidelines

- Capture volume determined by local requirements or sized to treat 85% of the annual runoff volume.
- Outlet designed to discharge the capture volume over a period of hours.
- Length to width ratio of at least 1.5:1 where feasible.
- Basin depths optimally range from 2 to 5 feet.
- Include energy dissipation in the inlet design to reduce resuspension of accumulated sediment.
- A maintenance ramp and perimeter access should be included in the design to facilitate access to the basin for maintenance activities and for vector surveillance and control.
- Use a draw down time of 48 hours in most areas of California. Draw down times in excess of 48 hours may result in vector breeding, and should be used only after coordination with local vector control authorities. Draw down times of less than 48 hours should be limited to BMP drainage areas with coarse soils that readily settle and to watersheds where warming may be determined to downstream fisheries.

Construction/Inspection Considerations

- Inspect facility after first large to storm to determine whether the desired residence time has been achieved.
- When constructed with small tributary area, orifice sizing is critical and inspection should verify that flow through additional openings such as bolt holes does not occur.

Performance

One objective of stormwater management practices can be to reduce the flood hazard associated with large storm events by reducing the peak flow associated with these storms. Dry extended detention basins can easily be designed for flood control, and this is actually the primary purpose of most detention ponds.

Extended Detention Basin TC-22

Dry extended detention basins provide moderate pollutant removal, provided that the recommended design features are incorporated. Although they can be effective at removing some pollutants through settling, they are less effective at removing soluble pollutants because of the absence of a permanent pool. Several studies are available on the effectiveness of dry extended detention ponds including one recently concluded by Caltrans (2002).

The load reduction is greater than the concentration reduction because of the substantial infiltration that occurs. Although the infiltration of stormwater is clearly beneficial to surface receiving waters, there is the potential for groundwater contamination. Previous research on the effects of incidental infiltration on groundwater quality indicated that the risk of contamination is minimal.

There were substantial differences in the amount of infiltration that were observed in the earthen basins during the Caltrans study. On average, approximately 40 percent of the runoff entering the unlined basins infiltrated and was not discharged. The percentage ranged from a high of about 60 percent to a low of only about 8 percent for the different facilities. Climatic conditions and local water table elevation are likely the principal causes of this difference. The least infiltration occurred at a site located on the coast where humidity is higher and the basin invert is within a few meters of sea level. Conversely, the most infiltration occurred at a facility located well inland in Los Angeles County where the climate is much warmer and the humidity is less, resulting in lower soil moisture content in the basin floor at the beginning of storms.

Vegetated detention basins appear to have greater pollutant removal than concrete basins. In the Caltrans study, the concrete basin exported sediment and associated pollutants during a number of storms. Export was not as common in the earthen basins, where the vegetation appeared to help stabilize the retained sediment.

Siting Criteria

Dry extended detention ponds are among the most widely applicable stormwater management practices and are especially useful in retrofit situations where their low hydraulic head requirements allow them to be sited within the constraints of the existing storm drain system. In addition, many communities have detention basins designed for flood control. It is possible to modify these facilities to incorporate features that provide water quality treatment and/or channel protection. Although dry extended detention ponds can be applied rather broadly, designers need to ensure that they are feasible at the site in question. This section provides basic guidelines for siting dry extended detention ponds.

In general, dry extended detention ponds should be used on sites with a minimum area of 5 acres. With this size catchment area, the orifice size can be on the order of 0.5 inches. On smaller sites, it can be challenging to provide channel or water quality control because the orifice diameter at the outlet needed to control relatively small storms becomes very small and thus prone to clogging. In addition, it is generally more cost-effective to control larger drainage areas due to the economies of scale.

Extended detention basins can be used with almost all soils and geology, with minor design adjustments for regions of rapidly percolating soils such as sand. In these areas, extended detention ponds may need an impermeable liner to prevent ground water contamination.

The base of the extended detention facility should not intersect the water table. A permanently wet bottom may become a mosquito breeding ground. Research in Southwest Florida (Santana et al., 1994) demonstrated that intermittently flooded systems, such as dry extended detention ponds, produce more mosquitoes than other pond systems, particularly when the facilities remained wet for more than 3 days following heavy rainfall.

A study in Prince George's County, Maryland, found that stormwater management practices can increase stream temperatures (Galli, 1990). Overall, dry extended detention ponds increased temperature by about 5°F. In cold water streams, dry ponds should be designed to detain stormwater for a relatively short time (i.e., 24 hours) to minimize the amount of warming that occurs in the basin.

Additional Design Guidelines

In order to enhance the effectiveness of extended detention basins, the dimensions of the basin must be sized appropriately. Merely providing the required storage volume will not ensure maximum constituent removal. By effectively configuring the basin, the designer will create a long flow path, promote the establishment of low velocities, and avoid having stagnant areas of the basin. To promote settling and to attain an appealing environment, the design of the basin should consider the length to width ratio, cross-sectional areas, basin slopes and pond configuration, and aesthetics (Young et al., 1996).

Energy dissipation structures should be included for the basin inlet to prevent resuspension of accumulated sediment. The use of stilling basins for this purpose should be avoided because the standing water provides a breeding area for mosquitoes.

Extended detention facilities should be sized to completely capture the water quality volume. A micropool is often recommended for inclusion in the design and one is shown in the schematic diagram. These small permanent pools greatly increase the potential for mosquito breeding and complicate maintenance activities; consequently, they are not recommended for use in California.

A large aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W) where feasible. Basin depths optimally range from 2 to 5 feet.

The facility's drawdown time should be regulated by an orifice or weir. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes. The outlet design implemented by Caltrans in the facilities constructed in San Diego County used an outlet riser with orifices

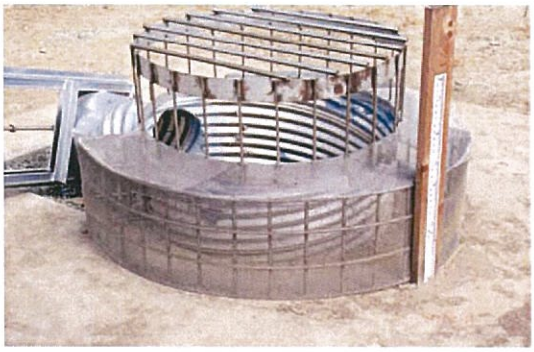


Figure 1
Example of Extended Detention Outlet Structure

sized to discharge the water quality volume, and the riser overflow height was set to the design storm elevation. A stainless steel screen was placed around the outlet riser to ensure that the orifices would not become clogged with debris. Sites either used a separate riser or broad crested weir for overflow of runoff for the 25 and greater year storms. A picture of a typical outlet is presented in Figure 1.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure can be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed.

Summary of Design Recommendations

(1) Facility Sizing - The required water quality volume is determined by local regulations or the basin should be sized to capture and treat 85% of the annual runoff volume. See Section 5.5.1 of the handbook for a discussion of volume-based design.

Basin Configuration – A high aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W). The flowpath length is defined as the distance from the inlet to the outlet as measured at the surface. The width is defined as the mean width of the basin. Basin depths optimally range from 2 to 5 feet. The basin may include a sediment forebay to provide the opportunity for larger particles to settle out.

A micropool should not be incorporated in the design because of vector concerns. For online facilities, the principal and emergency spillways must be sized to provide 1.0 foot of freeboard during the 25-year event and to safely pass the flow from 100-year storm.

(2) Pond Side Slopes - Side slopes of the pond should be 3:1 (H:V) or flatter for grass stabilized slopes. Slopes steeper than 3:1 (H:V) must be stabilized with an appropriate slope stabilization practice.

(3) Basin Lining – Basins must be constructed to prevent possible contamination of groundwater below the facility.

(4) Basin Inlet – Energy dissipation is required at the basin inlet to reduce resuspension of accumulated sediment and to reduce the tendency for short-circuiting.

(5) Outflow Structure - The facility's drawdown time should be regulated by a gate valve or orifice plate. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure should be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed. This same valve also can be used to regulate the rate of discharge from the basin.

The discharge through a control orifice is calculated from:

$$Q = CA(2g(H-H_o))^{0.5}$$

where: Q = discharge (ft^3/s)
C = orifice coefficient
A = area of the orifice (ft^2)
g = gravitational constant (32.2)
H = water surface elevation (ft)
H_o = orifice elevation (ft)

Recommended values for C are 0.66 for thin materials and 0.80 when the material is thicker than the orifice diameter. This equation can be implemented in spreadsheet form with the pond stage/volume relationship to calculate drain time. To do this, use the initial height of the water above the orifice for the water quality volume. Calculate the discharge and assume that it remains constant for approximately 10 minutes. Based on that discharge, estimate the total discharge during that interval and the new elevation based on the stage volume relationship. Continue to iterate until H is approximately equal to H_o. When using multiple orifices the discharge from each is summed.

(6) Splitter Box - When the pond is designed as an offline facility, a splitter structure is used to isolate the water quality volume. The splitter box, or other flow diverting approach, should be designed to convey the 25-year storm event while providing at least 1.0 foot of freeboard along pond side slopes.

(7) Erosion Protection at the Outfall - For online facilities, special consideration should be given to the facility's outfall location. Flared pipe end sections that discharge at or near the stream invert are preferred. The channel immediately below the pond outfall should be modified to conform to natural dimensions, and lined with large stone riprap placed over filter cloth. Energy dissipation may be required to reduce flow velocities from the primary spillway to non-erosive velocities.

(8) Safety Considerations - Safety is provided either by fencing of the facility or by managing the contours of the pond to eliminate dropoffs and other hazards. Earthen side slopes should not exceed 3:1 (H:V) and should terminate on a flat safety bench area. Landscaping can be used to impede access to the facility. The primary spillway opening must not permit access by small children. Outfall pipes above 48 inches in diameter should be fenced.

Maintenance

Routine maintenance activity is often thought to consist mostly of sediment and trash and debris removal; however, these activities often constitute only a small fraction of the maintenance hours. During a recent study by Caltrans, 72 hours of maintenance was performed annually, but only a little over 7 hours was spent on sediment and trash removal. The largest recurring activity was vegetation management, routine mowing. The largest absolute number of hours was associated with vector control because of mosquito breeding that occurred in the stilling basins (example of standing water to be avoided) installed as energy dissipaters. In most cases, basic housekeeping practices such as removal of debris accumulations and vegetation

management to ensure that the basin dewaters completely in 48-72 hours is sufficient to prevent creating mosquito and other vector habitats.

Consequently, maintenance costs should be estimated based primarily on the mowing frequency and the time required. Mowing should be done at least annually to avoid establishment of woody vegetation, but may need to be performed much more frequently if aesthetics are an important consideration.

Typical activities and frequencies include:

- Schedule semiannual inspection for the beginning and end of the wet season for standing water, slope stability, sediment accumulation, trash and debris, and presence of burrows.
- Remove accumulated trash and debris in the basin and around the riser pipe during the semiannual inspections. The frequency of this activity may be altered to meet specific site conditions.
- Trim vegetation at the beginning and end of the wet season and inspect monthly to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and re-grade about every 10 years or when the accumulated sediment volume exceeds 10 percent of the basin volume. Inspect the basin each year for accumulated sediment volume.

Cost

Construction Cost

The construction costs associated with extended detention basins vary considerably. One recent study evaluated the cost of all pond systems (Brown and Schueler, 1997). Adjusting for inflation, the cost of dry extended detention ponds can be estimated with the equation:

$$C = 12.4V^{0.760}$$

where: C = Construction, design, and permitting cost, and
V = Volume (ft^3).

Using this equation, typical construction costs are:

$ 41,600 for a 1 acre-foot pond

$ 239,000 for a 10 acre-foot pond

$ 1,380,000 for a 100 acre-foot pond

Interestingly, these costs are generally slightly higher than the predicted cost of wet ponds (according to Brown and Schueler, 1997) on a cost per total volume basis, which highlights the difficulty of developing reasonably accurate construction estimates. In addition, a typical facility constructed by Caltrans cost about $160,000 with a capture volume of only 0.3 ac-ft.

An economic concern associated with dry ponds is that they might detract slightly from the value of adjacent properties. One study found that dry ponds can actually detract from the

perceived value of homes adjacent to a dry pond by between 3 and 10 percent (Emmerling-Dinovo, 1995).

Maintenance Cost

For ponds, the annual cost of routine maintenance is typically estimated at about 3 to 5 percent of the construction cost (EPA website). Alternatively, a community can estimate the cost of the maintenance activities outlined in the maintenance section. Table 1 presents the maintenance costs estimated by Caltrans based on their experience with five basins located in southern California. Again, it should be emphasized that the vast majority of hours are related to vegetation management (mowing).

Table 1 Estimated Average Annual Maintenance Effort

Activity	Labor Hours	Equipment & Material ($)	Cost
Inspections	4	7	183
Maintenance	49	126	2282
Vector Control	0	0	0
Administration	3	0	132
Materials	-	535	535
Total	**56**	**$668**	**$3,132**

References and Sources of Additional Information

Brown, W., and T. Schueler. 1997. *The Economics of Stormwater BMPs in the Mid-Atlantic Region.* Prepared for Chesapeake Research Consortium. Edgewater, MD. Center for Watershed Protection. Ellicott City, MD.

Denver Urban Drainage and Flood Control District. 1992. *Urban Storm Drainage Criteria Manual - Volume 3: Best Management Practices.* Denver, CO.

Emmerling-Dinovo, C. 1995. Stormwater Detention Basins and Residential Locational Decisions. *Water Resources Bulletin 31(3):* 515-521

Galli, J. 1990. *Thermal Impacts Associated with Urbanization and Stormwater Management Best Management Practices.* Metropolitan Washington Council of Governments. Prepared for Maryland Department of the Environment, Baltimore, MD.

GKY, 1989, *Outlet Hydraulics of Extended Detention Facilities* for the Northern Virginia Planning District Commission.

MacRae, C. 1996. Experience from Morphological Research on Canadian Streams: Is Control of the Two-Year Frequency Runoff Event the Best Basis for Stream Channel Protection? In *Effects of Watershed Development and Management on Aquatic Ecosystems.* American Society of Civil Engineers. Edited by L. Roesner. Snowbird, UT. pp. 144 162.

Maryland Dept of the Environment, 2000, Maryland Stormwater Design Manual: Volumes 1 & 2, prepared by MDE and Center for Watershed Protection. http://www.mde.state.md.us/environment/wma/stormwatermanual/index.html

Metzger, M. E., D. F. Messer, C. L. Beitia, C. M. Myers, and V. L. Kramer. 2002. The Dark Side Of Stormwater Runoff Management: Disease Vectors Associated With Structural BMPs. Stormwater 3(2): 24-39.

Santana, F., J. Wood, R. Parsons, and S. Chamberlain. 1994. Control of Mosquito Breeding in Permitted Stormwater Systems. Prepared for Southwest Florida Water Management District, Brooksville, FL.

Schueler, T. 1997. Influence of Ground Water on Performance of Stormwater Ponds in Florida. *Watershed Protection Techniques* 2(4):525-528.

Watershed Management Institute (WMI). 1997. *Operation, Maintenance, and Management of Stormwater Management Systems*. Prepared for U.S. Environmental Protection Agency, Office of Water. Washington, DC.

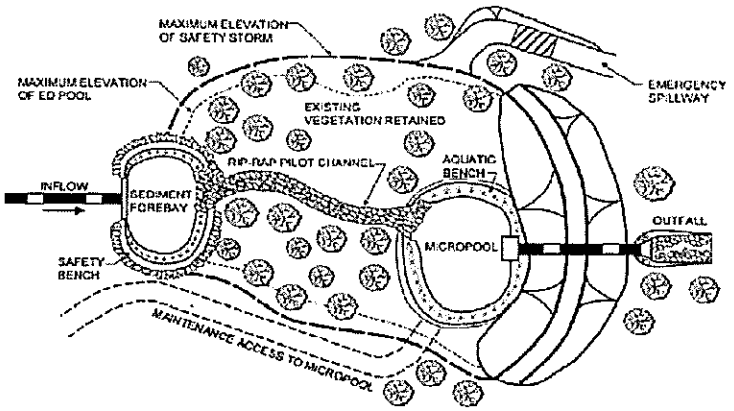
Young, G.K., et al., 1996, *Evaluation and Management of Highway Runoff Water Quality*, Publication No. FHWA-PD-96-032, U.S. Department of Transportation, Federal Highway Administration, Office of Environment and Planning.

Information Resources

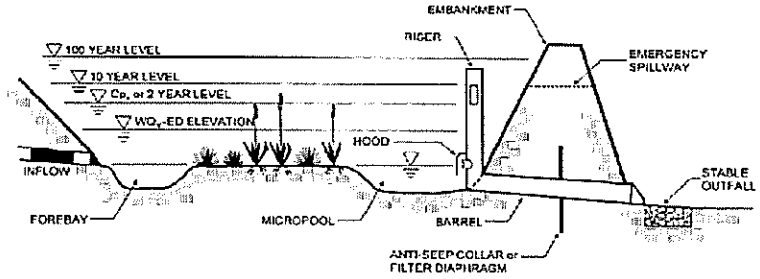
Center for Watershed Protection (CWP), Environmental Quality Resources, and Loiederman Associates. 1997. *Maryland Stormwater Design Manual*. Draft. Prepared for Maryland Department of the Environment, Baltimore, MD.

Center for Watershed Protection (CWP). 1997. *Stormwater BMP Design Supplement for Cold Climates*. Prepared for U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds. Washington, DC.

U.S. Environmental Protection Agency (USEPA). 1993. *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*. EPA-840-B-92-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.



PLAN VIEW



PROFILE

Schematic of an Extended Detention Basin (MDE, 2000)

ADVANCED GEOTECHNICAL SOLUTIONS, INC.
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12275 El Camino Real, Suite 220
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March 22, 2012
P/W 1102-01
Report No. 1102-01-B-11

Attention: Mr. Jon Rilling

Subject: Preliminary Infiltration Rates, Lilac Hills Ranch, Valley Center Community Planning Area, County of San Diego, California

Reference: *Feasibility Level Geotechnical Report, Las Lilas Project, Valley Center Area, San Diego, California, prepared by Pacific Soils Engineering, Inc. dated May 23, 2007 (PSE W.O. 401120)*

Gentlemen:

Pursuant to a request from representatives of Landmark Consulting, transmitted herein is Advanced Geotechnical Solutions, Inc.'s (AGS) estimated infiltration rates for use in the preliminary design of infiltration basins for the Lilac Hills Ranch project, Valley Center Community Planning Area, County of San Diego, California. Site specific testing has not been conducted onsite for the determination of infiltration rates. The rates presented herein are based upon USDA Natural Resource Conservation Service (NCRS) mapping, information provided by the County of San Diego, Department of Public Works, and the characteristics of the onsite soils and bedrock.

We have provided you preliminary mapping of the site showing the approximate location of the various geologic units onsite. Based upon the geologic units the following estimated infiltration rates are presented:

- **Artificial Fill, Compacted** (no map symbol)- Soil Group D (rates 0 to 0.05 inches per hour)
- **Artificial Fill, Undocumented** (map symbol afu)- Soil Group D (rates 0 to 0.05 inches per hour)
- **Alluvium** (map symbol Qal)- Soil Group C (rates 0.05 to 0.15 inches per hour)
- **Older Alluvium** (map symbol Qoal)- Soil Group C (rates 0.05 to 0.15 inches per hour)
- **Granitic Rock** (map symbol Kgr)- Soil Group D (rates 0 to 0.05 inches per hour)

The aforementioned rates are highly dependent upon the depth to the underlying relatively impermeable granitic rock and whether the area has been subjected to loading from grading or farming equipment as this will tend to densify the soils and reduce the infiltration rates. Infiltration basins should be located such that the infiltration water is located down gradient from all structural building pads.

Should you desire more accurate design rates than these general rates presented herein, additional testing can be conducted. This testing should be conducted utilizing a Double Ring Infiltrometer apparatus.

Rates determined with the Double Ring Infiltrometer are considered to be more accurate by the local Water Quality Control Board than other methods.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to contact the undersigned.

Respectfully Submitted,
Advanced Geotechnical Solutions, Inc.

JEFFREY A. CHANEY, Vice President
RCE 46544/ GE 2314

Distribution: (4) Addressee
(1) Landmark Consulting, Attn: Mark Brencick

will significantly reduce off-site trash truck trips to regional waste system facilities. This facility may be operated by an entity licensed as necessary and the facility will also have the necessary operating permits. This facility will be available for use by properties in the surrounding area east of Interstate 15 and will significantly reduce off-site trips generated by residences and businesses within the Community and adjoining properties.

d. Water Reclamation Facility

Disposal of wastewater is provided by the Valley Center Municipal Water District which will determine the manner in which such services are provided and will ultimately be responsible for the approval of the Water Recycling Plan. As described in more detail in the Water and Sewer Plan portion of this chapter, a Major Use Permit is being processed concurrently with the Specific Plan for construction of a Water Reclamation Facility (WRF) located on a 2.4-acre site in the southwestern portion of the site. Wastewater generated by the Community (as well as the 16 existing home sites and six not-a-part parcels) may be treated at the proposed on-site WRF, which would accommodate up to 353,474 gallons per day of wastewater from the development (see **Figures 57**, **58** and **59**). Recycled water may be used pursuant to VCMWD policy on reclaimed water use (Article 190.7 Conservation and Local Supply Use Requirements section (c)). Recycled water distribution pipelines may be installed within the Community roadways to deliver the recycled water to the targeted on-site areas.

The WRF requires the processing and approval of a Major Use Permit and issuance of permits from other Regulatory Agencies. As detailed more completely in the Major Use Permit, the WRF facility is designed to be consistent with the design standards of the Valley Center Design Review Guidelines. The Lilac Hills Ranch EIR and supporting technical documents contain details of the construction and operation of the WRF.

e. Institutional

Phase 5 includes an Institutional Use site located near the southern boundary of the Community. It is anticipated that any ultimate use or uses will, under the County Zoning Ordinance, require the approval of a Major Use permit.

C. Open Space and Recreation Plan

1. Biological Open Space

The Biological Open Space Preserve consists of 104.1 acres and includes environmentally sensitive habitats and buffer areas (including existing agriculture) that preserve wildlife corridors and linkages (see **Figure 18 - Biological Open Space**).

a) Trails as may be refined or relocated on each implementing tentative and final maps shown on the Specific Plan map will be allowed within the dedicated Biological Open Space easements. These trails will avoid sensitive plant populations. Best Management Practice's (BMP's) will be implemented to avoid water run-off that would cause the adjacent wetlands to degrade. In addition, agricultural uses within the areas identified as existing on-going agriculture or disturbed land and maintenance of existing wells and water lines will be allowed.

b) Only passive recreation activities such as hiking, biking, horseback riding, and bird watching will be allowed on the trail easements within biological open space. Horseback riding is allowed and provided for on the two Multi-Use trails which cross the property as shown on the County Master Trails Plan and the Ranch Multi-Use Trail that connects all the trails in the Community. Horseback riding is not allowed on any of the Community trails, bike paths, and bikeways within Lilac Hills Ranch unless specifically designed and designated.

c) Prior to recordation of the first final map, the Resource Management Plan (RMP) shall be approved for the biological open space areas within Lilac Hills Ranch to the satisfaction of the Director of PDS. The main goal of the RMP shall be to maintain the biological functions and values of the natural open space. The RMP shall minimize intrusion due to management and monitoring activities. Monitoring by a public agency may be allowed if the biological open space is part of an overall regional integrated preserve system or required by a governmental permit. Provisions shall be made for the repair and maintenance of public and private trails and project-related infrastructure, with requirements for re-vegetation if disturbance of existing natural vegetation is necessary.

d) Prior to recordation of each final map, a re-vegetation plan shall be approved to the satisfaction of the Director of PDS for areas where re-vegetation is proposed as mitigation for project impacts shown on such map.

e) Biological open space as shown on the Master Tentative Map may be dedicated in phases as shown on the Master Tentative Map. Biological open space shall be protected through recordation of a conservation easement to the County.

f) As a condition of approval, project subdivision maps will be conditioned to dedicate into Open Space easements as shown on the Tentative Map upon completion of construction of each Tentative Map.

g) Access to existing agricultural roads and trails shall be allowed for the following activities: (a) access and maintenance of the Community trail system; and (b) maintenance and service to wells within the Biological Open Space easements.

2. Manufactured Open Space

The Lilac Hills Ranch Home Owners Association ("HOA") will own, manage and maintain additional open space, within the Community boundaries as follows:

c. **Interim Agricultural Uses**: The project developers may allow new agricultural uses in certain areas including:

   i. Selected project areas prior to their development for planned uses (e.g. interim agricultural uses); and

   ii. Within planning areas slated for development, new agricultural uses will be an allowed use within implementing project non- biological open space areas.

   iii. Lilac Hills Ranch will use commercially acceptable farming practices for on-site agriculture that are consistent with surrounding uses and County Ordinances.

d. **Community Gardens:** The HOA may authorize community gardens in each Phase as they deem appropriate on HOA owned lots. The HOA shall adopt and enforce maintenance and operations procedures as required.

3. Biological Habitat Maintenance Areas

The biologically sensitive areas identified in the project EIR which are to be conserved will be placed into open space easements as a condition of approval for the implementing subdivision maps. The process of establishing these easements requires that arrangements be made to ensure that the resources are managed by qualified and licensed professionals and that the easements include a provision for endowments that will assure their continued maintenance over time.

The County Biology Report Guidelines and Format identifies the following as acceptable Resource Managers:

Section 2.1 Resource Manager Qualifications and Responsible Parties

Proposed Resource Manager:

The resource manager shall be one of the following:

a) Conservancy group Natural resources land manager

b) Natural resources consultant

c) County Department of Parks and Recreation

d) County Department of Public Works

e) Federal or State Wildlife Agency (U.S. Fish and Wildlife Service, California Department of Fish and Game)

f) Federal Land Manager such as Bureau of Land Management

g) City Land Managers, including but not limited to Department of Parks and Recreation, Watershed Management or Department of Public Works;

h) Home Owners Association

i) Community Service Organization

j) Non-profit or Tax-exempt Public Benefit Organization

Maintenance Area Standards

1. The resource manager shall be approved by the Director of Planning and Development Services (PDS).
2. Management and maintenance of biological resources, natural and restored/enhanced, will be in accordance with the Lilac Hills Ranch Resource Management Plan.
3. The Lilac Hills Ranch trail system includes several trails through the Biological Habitat Maintenance Areas. These trails are on existing, graded dirt roads ways which have existed for many years. Because the trail system has been located on the existing dirt roads no mitigation for their use will be required.
4. The Lilac Hills Ranch HOA will be responsible for maintenance and management of the agricultural resources and trail located within the Biological Open Space areas subject to an approved Management Plan.
5. Each tentative map that includes any of the areas shown on the Biological Open Space area (see Figure 18 – Biological Open Space) will be conditioned to dedicate to the County of San Diego, or a mutually agreed upon entity and maintained by an appropriate private interest organization authorized by the County of San Diego as acceptable resource managers any and all areas shown as Biological Open Space on **Figure18**.

K. EIR Performance Standards

1. Agricultural Performance Standards

a. Pursuant to the EIR Section 2.4, each tentative map and its implementing Site Plan located on the exterior boundary of the community will incorporate 50-foot-wide agricultural buffers planted with two rows of the appropriate tree crop (e.g., citrus, avocado) along the exterior Community boundary. These buffers will be located where residential uses in Lilac Hills Ranch abut existing, adjacent orchards and will be used to create a transition and buffer between the two uses. (Mitigation Measure M-AG-2)

b. Pursuant to the EIR Section 2.4, each implementing Site Plan located on the exterior boundary of the community will be conditioned to include a 6-foot-

a) Trails as may be refined or relocated on each implementing tentative and final maps shown on the Specific Plan map will be allowed within the dedicated Biological Open Space easements. These trails will avoid sensitive plant populations. Best Management Practice's (BMP's) will be implemented to avoid water run-off that would cause the adjacent wetlands to degrade. In addition, agricultural uses within the areas identified as existing on-going agriculture or disturbed land and maintenance of existing wells and water lines will be allowed.

b) Only passive recreation activities such as hiking, biking, horseback riding, and bird watching will be allowed on the trail easements within biological open space. Horseback riding is allowed and provided for on the two Multi-Use trails which cross the property as shown on the County Master Trails Plan and the Ranch Multi-Use Trail that connects all the trails in the Community. Horseback riding is not allowed on any of the Community trails, bike paths, and bikeways within Lilac Hills Ranch unless specifically designed and designated.

c) Prior to recordation of the first final map, the Resource Management Plan (RMP) shall be approved for the biological open space areas within Lilac Hills Ranch to the satisfaction of the Director of PDS. The main goal of the RMP shall be to maintain the biological functions and values of the natural open space. The RMP shall minimize intrusion due to management and monitoring activities. Monitoring by a public agency may be allowed if the biological open space is part of an overall regional integrated preserve system or required by a governmental permit. Provisions shall be made for the repair and maintenance of public and private trails and project-related infrastructure, with requirements for re-vegetation if disturbance of existing natural vegetation is necessary.

d) Prior to recordation of each final map, a re-vegetation plan shall be approved to the satisfaction of the Director of PDS for areas where re-vegetation is proposed as mitigation for project impacts shown on such map.

e) Biological open space as shown on the Master Tentative Map may be dedicated in phases as shown on the Master Tentative Map. Biological open space shall be protected through recordation of a conservation easement to the County.

f) As a condition of approval, project subdivision maps will be conditioned to dedicate into Open Space easements as shown on the Tentative Map upon completion of construction of each Tentative Map.

g) Access to existing agricultural roads and trails shall be allowed for the following activities: (a) access and maintenance of the Community trail system; and (b) maintenance and service to wells within the Biological Open Space easements.

2. Manufactured Open Space

The Lilac Hills Ranch Home Owners Association ("HOA") will own, manage and maintain additional open space, within the Community boundaries as follows:

manufactured and landscaped slopes, recreational open space (parks, trails, etc.), on-site agriculture (including that in the buffers), and detention basins (see **Figure 19 – Open Space and Parks**).

The Community will retain and promote agriculture uses in the project's common areas to include community gardens. Existing agriculture uses will be allowed to continue, but not expand into non-disturbed land within the Biological open space easements. As noted, a portion of the agricultural uses are located within the RPO buffers. These are existing groves and they will be allowed to remain. The adjacent RPO wetlands are generally dependent upon the water runoff from the groves as they have mostly developed over the past several decades subsequent to creation of the groves. Within the manufactured open space system the project will, where feasible, retain existing agricultural operations and allow new agricultural crops. In addition, agriculture restoration within biological open space including maintenance of irrigation systems, fencing, or crop rotation is allowed.

3. Community Recreational Elements

a. Parks

As described above, Lilac Hills Ranch includes many private parks and one large public park 13.5 acre) site in the middle of the Community, serving the Lilac Hills Ranch residents and the surrounding communities. Section III describes the parks in more detail and includes conceptual graphics for both private and public parks.

b. Trails

The County's Regional Trail System is established in this area by the Community to provide for jogging, hiking, mountain bike riding and horseback riding (which is also allowed on the Ranch Multi-Use Trail) and enjoyment of the rural areas surrounding the Community by the general public. Two east-west County Regional Trails traverse the Community: One Type D – Pathway Multi-Use trail traverses Lilac Hills Ranch along the right-of-way for West Lilac Road which forms the northern boundary of the Community and continues westerly on West Lilac Road to Old Highway 395; and the other is included as part of the Ranch Multi-Use Trail in the southern portion of Lilac Hills Ranch. The Ranch Multi-Use Trail provides links between the Regional Trails within the vicinity of the Community and the Community trail system. Both of these public trail segments assist the County to achieve the County Master Trails Plan.

c. Community Trail Network

The Community Trail Plan (see **Figure 20 – Trails Plan & Biological Open Space Signage**) creates a trail network with over 16 miles of trails designed to serve the Community and surrounding area residents. The trail network is

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403.6 (3)

Table 7 - Allocation and Transfer of Residential Units

SF 1	Single Family	31.2	175		
SF 2	Single Family	14.4	89		
SF 3	Single Family	15.1	88		
		121.5	352		

The Site Plan number for the Planning Area receiving the density shall be entered on the appropriate line, and the new total number of units permitted for the Planning Area, and the new, increased total for the Phase shall be entered, and the new total for the Phase entered. The Planning Area where the units are being taken from shall likewise be modified with the decrease entered on the appropriate line along with the Site Plan number and the new reduced total for that phase entered for the appropriate Phase Table. The granting section of the Site Plan Form of Decision shall note the increase and which Planning Area was the source for the increase.

Each subsequent Site Plan requesting any transfer of units into a planning area, must follow the same procedure and provide an updated **Table 6** on the cover sheet of the Site Plan showing all previously approved residential Site Plans within Lilac Hills Ranch, the Site Plan number and the number of units authorized by the Site Plan.

D. Landscape Design Guidelines and Standards

1. Landscape Concept

The existing environmental setting of Lilac Hills Ranch includes field agriculture and orchards, minor riparian corridors, and native oaks. This setting provides the inspiration for a California foothills landscape theme that proposes the conservation and integration of the existing environment with these open space resources. Grove and pasture-like plantings are planned along major streetscapes and adjoining slopes. Accent plantings of Oaks and Sycamores will occur at channel crossings and drainages. Traditional materials such as stone and wood, that complement the natural and rural landscape, will be used.

The Valley Center and Bonsall Design Guidelines include site design and landscape design standards (including suggested planting pallets) for developments subject to their review authority. For this specific plan that would include; the commercial, and mixed-use development applications in the areas subject to the C34 Use Regulations (Town Center and two Neighborhood Centers), and the civic and institutional uses (Group Care, Group Residential, Senior Center, K-8 School site, the 'Institutional site, Parks, and Private Recreational use site) permitted by this specific plan in the RU Use Regulation.

Along the three public parkways landscaping will consist of pedestrian scaled plantings with accent plantings of Olives, Sycamores, and Oaks. All median landscape planting shall conform to County regulations regarding “line of site” and “sight distance.” The fencing and informal pedestrian trails will complement the streetscapes and reinforce the rural character intended for these corridors. A combination of walls and landscaped berms will be used for noise attenuation and visual screening of vehicular use and service areas. At the Community entries and public use areas the landscape will transition to a more village-like theme with accent plantings, decorative stone walls, vine arbors, and sensitively designed signs. Drought tolerant and native plant materials will be used where feasible. Low scale plantings will be used adjacent to driveway entrances and street corners to maintain visibility for safety. Common area landscapes and recreational areas will be linked by a network of trails serving both pedestrian and equestrian users.

Plant materials will be selected and located to prevent the rapid spread of brush fires in accordance with the Fire Protection Plan prepared by Firewise 2000 Inc. This plan consists of Fuel Management Zones designed to create defensible spaces around structures to prevent the spread of fire. Perimeter Fuel Management Zones are depicted on **Figure 142 – Fire Protection Plan**. A consistent landscape theme will thread throughout the Community, serving as a cohesive link for the various Community land-uses. A series of low scaled entry monuments, fencing, lighting and pedestrian paths, designed to reinforce the rural landscape theme, will provide further design continuity for the Community. These elements will be designed to reflect the Community enhancements while referencing the rural, agricultural themed setting.

The Specific Plan guidelines provide a framework to ensure consistency with the related portions of these documents by:

a) Preserving visually dominant ridgelines, and scenic high quality open space resources; and,

b) Incorporating "best practice" guidelines to site design, lighting, landscaping, and architecture.

This consistency will minimize visual impacts and improve visual compatibility with the surrounding area. Architecture is designed to vary massing, encourage shadow patterns, and relate in color to elements in the natural surroundings. The Community landscaping utilizes native and low water plant materials that are similar in color and texture to the surrounding natural hillsides, and manufactured slopes will contain masses of plant materials of varying heights to relate in texture and pattern with those visible on the steep natural slopes surrounding the Community.

Additionally, trees will be planted on slopes, along streets, and within HOA open space areas to visually buffer the Community from view. Native trees and shrubs such as

Sycamores, Oaks, Madrone, Currant and Toyon as well as local Apricot, Lemon, Orange, Guava, and Avocado may be planted along parkways. Natural materials, rural styled fencing, and grove-like plantings of trees will be utilized throughout the Community to relate to and enhance the rural visual setting consistent with the applicable provisions of the Design Guidelines of this Specific Plan.

Figure 70 – The Master Landscape Concept Plan depicts the generalized locations of landscape zones and features described below.

Community landscaping shall comply with the applicable requirements of the Valley Center and Bonsall Design Guidelines, and the Design Guidelines of this Specific Plan for commercial and mixed-use planting areas. All proposed planting and improvements within the public right-of-way for streets within the Community are subject to approval by the County of San Diego's Department of Public Works.

2. General Landscaping Guidelines

a) All landscape and irrigation plans shall be prepared by a licensed California landscape architect, California Registered Architect or Civil Engineer and shall be submitted to the County of San Diego and to the Master Developer for review and approval prior to the start of construction. All submissions shall demonstrate compliance with these guidelines. Plans shall be in compliance with the County's Water Conservation Landscaping Ordinance, the Water Efficient Landscape Design Manual, the Design Guidelines of the Specific Plan, the County's Grading Ordinance, the Off Street Parking Design Manual and the VCMWD policy Article 190.7 regarding Conservation and Local Supply Use Requirements.

b) Landscape design shall be used to define areas by creating focus at entries, screening unsightly areas, softening expanses of pavement and large buildings and providing transitions and separations between Lilac Hills Ranch and the surrounding community.

c) Landscaping should be in scale with adjacent buildings and be of appropriate size at maturity to accomplish its intended goals. Larger specimen trees should be used at entries and at key locations within the development.

d) Landscaping shall be in conformance with the County's requirements for sight lines and access.

e) Areas around buildings shall incorporate a mixture of trees, shrubs, vines, and groundcovers designed to complement the design theme of the Community.

f) Fruit trees shall be properly maintained on a regular schedule maintenance program and will be maintained by the HOA along with the other trees on the planting palette.

g) An encroachment permit will be applied for all irrigation and planting within public street right-of-ways.

3. Road Landscaping Standards

a. West Lilac Road and Town Center Landscape Zone

Description: The parkways and adjoining slopes of West Lilac Road will reflect the agricultural history of the site and California Foothills landscape theme of the Community. Formal groves trees, with informal accent groupings of Oak and Sycamores, will form the primary landscapes of these roadways. Adjoining slopes will additionally be planted with native and drought tolerant species. Details such as rural themed rail fences vine arbors, low stone walls, and decomposed granite trails will be used to further reinforce the design theme along this corridor. As discussed above the Valley Center Design Guidelines includes landscape design standards including suggested planting pallets for developments subject to their review authority which includes both the West Lilac Road frontage and the Town Center Landscape zone. The plant selection list (see VC Guidelines Section 4-H) includes 'recommended' species, but also allows other species when they are drought tolerant and have low flame spread potential. The list below includes both plants on the Design Guideline list and others which meet these criteria.

Maintenance of the pathway landscaping for this on-site public road segment will require the formation of a County Landscape Maintenance District.

Acceptable Species:

Botanical Name Common Name Specifications

Primary Street Trees:

Olea europea 'Wilsoni' Fruitless Olive Tree 20'H x 20'W
Platanus racemosa California Sycamore 75'H x 40'W
Tabebuia impetiginosa Pink Trumpet Tree 35'H x 25'W

Slope and Erosion Control Trees:

Juglans californica California Black Walnut 25'H x 20'W
Metrosideros exelsus New Zealand Christmas Tree 30'H x30'W
Cercis Occidentalis Western Redbud 20'H x 18'W

Parkway and Slope Shrubs and Groundcovers:

Gazania splendens Sunrise Yellow 6"H x 4"W
Rosmarinus officinalis prostrates 18"H x 3'W
Vinca major Periwinkle 12"H x 2' W
Encelia Californica Lilac 5'H x 7'W
Heteromeles arbutifolia Toyon 7"H x 10'WHydroseed Mix "A"

Rhaphiolepis spp India Hawthorn 4'H x 5'W

Salvia ssp Sage 3'H x 4'W

Fruit Trees:

Citrus spp.– Orange and Lemon Trees 20'-25' H x 20'W

Olea spp. – Olive Trees

Percea spp. – Avocado Tree 25'H x 20'W

Psidium spp. – Guava Tree 15'H x 10'W

Table 8 - Hydroseed Mix "A"

Minimum % Pur/Germ		Lbs/acre	Species, common name
2	55	2	Diplacus puniceus, Red Monkey
40	60	4	Encelia californica, Bush Sunflower
N/A	2		Eschscholzia californica, California Poppy
N/A	2		Helianthemum mutabile, Sun Rose
40	60	4	Lotus scoparius, Deerweed
95	80	2	Lupinus bicolor, Lupine
95	85	2	Lupinus succlentus, Arroyo Lupine
N/A	1		*Phacelia parryi*, Parry's Phacella
70	50	4	Salvia apiana, White Sage
40	30	2	*Stipa pulchra*, Purple Needle Grass
N/A	2		*Vulpia myuoros*, Zorro Fescue

b. Lilac Hills Ranch Road and Interior Slopes

Description: Lilac Hills Ranch Road is designed as a Community Promenade and features a landscaped parkway. This parkway contains a 5-foot meandering concrete Town Center Pathway. The parkway and adjoining slopes are designed to reflect the rural agricultural history of the site and California foothill design theme established for the Community. Formal grove rows of trees (including fruiting varieties and pasture, interrupted occasionally with informal accent tree groupings of Sycamores, Western Redbud and Oaks will compose the primary landscapes of this roadway. Adjoining slopes will be planted with native and drought tolerant species. Details such as rail fences, vine arbors, low stone walls, and decomposed granite trails will further reinforce the California foothill theme of this corridor. Interior slopes share similar characteristics with slopes adjacent to the Promenade parkway. These slopes serve as a transition between streets and adjoining neighborhoods and provide opportunities for screening, buffering, and visual softening of manufactured slopes and neighborhoods.

Acceptable Species:

Botanical Name Common Name Specifications

Primary Street Tree:

Olea europea 'Wilsoni' Fruitless Olive Tree 20'H x 20'W

Background and Accent Trees:

Arbutus unedo Strawberry Tree 25'H x 25'W
Chionanathus retusus Chinese Fringe Tree 20'H x 15'W

Parkway, Vines, and Groundcovers:

Gazania splendens Sunrise Yellow 6"H x 4" W,
Vinca major Periwinkle 12"H x 2' W,
Lantana spp Lantana 2'H x 3'W,
Eucelia californica Coast Sunflower 3'H x 4'W,
Rhapniolepis spp Inida Hawthorn 4'H x 5'W,
Rosa californica California Wild Rose 10'W
Vitis spp. – Grapevines

Fruit Trees:

Citrus spp.– Orange and Lemon Trees 20'-25' H x 20'W
Olea spp. – Olive Trees
Percea spp. – Avocado Tree 25'H x 20'W
Psidium spp. – Guava Tree 15'H x 10'W

c. Naturalized Transitional Landscape Zone

Description: Significant areas of open space are adjacent to portions of the Community's perimeter, offering opportunities to create blended transitions between the developed, ornamental portions of the Community and the surrounding agriculture or natural open space. Primarily native and naturalizing drought tolerant plant species will be used in these areas with possible addition of groves of fruit trees.

Fuel modification/brush management may also occur within this zone

Acceptable Species:

Botanical Name Common Name Specifications

Primary Tree

Quercus agrifolia Coast Live Oak 60'H x 60'W

Accent Tree

Platanus racemosa California Sycamore 75'H x 40'W

Brush Management Zones 2 and 3: Slope/ Erosion Control Trees:

Cercis occidentalis Western Redbud 18'H x 12'W,

Metrosideros exelsus New Zealand Christmas Tree 30'H x 30'W Quercus agrifolia Coast Live 60'H x 60'W

Brush Management Zone 1: Shrubs, Groundcover and Vines:

Carex pansa California Meadow Sedge 4"H x 8"W

Ceanothus 'Centernial' Centernial Ceanothus 12"H x 60"W

Vitis spp. – Grapevines

Brush Management Zones 2 and 3: Shrubs and Groundcovers:

Carex buchananii Red Clump Grass 24"H x 24"W

Carex pansa California 4"H x 8"W

Fruit Trees:

Citrus spp.– Orange and Lemon Trees 20'-25' H x 20'W

Olea spp. – Olive Trees

Percea spp. – Avocado Tree 25'H x 20'W

Psidium spp. – Guava Tree 15'H x 10'W

Table 9 - Hydroseed Mix "B"

Minimum % Pur/Germ		Lbs/acre	Species, common name
5	40	0.5	*Baccharis pil.*ssp consanguinea, Chaparral
2	55	2	*Diplacus puniceus*, Red Monkey Flower
40	60	1.5	Encelia californica, Bush Sunflower
35	75	3	Eriophylium confertiflorum, Golden Yarrow
75	95	2	Eschscholzia californica, California Poppy
75	80	1.5	Lasthenia californica, Goldfields
95	70	2	Lupinus hirsutissiumus, Stinging Lupine
95	85	2	Lupinus succlentus, Arroyo Lupine
50	50	2	Orthocarupus purpurascens, Owl's Clover
N/A			Phacelia grandiflora, Giant Phacelia
95	75	2	Plantago insularis, NCN
95	75	3	Sisyrinchium bellum, Blue Eyed Grass
60	30	1	Stipa coronate, Giant Stipa

Table 9 - Hydroseed Mix "B"

Minimum % Pur/Germ	Lbs/acre	Species, common name
40 30	3	*Stipa pulchra*, Purple Needle Grass

4. Neighborhood Landscaping Standards

a. Single Family Residential Areas:

Street Trees:

Gleditsia Triacanthus Honey Locust 35'H x 25'W

b. Single Family Attached and Mixed-Use Areas:

Street Trees:

Arbutus Marina Madrone 25'H x 20'W

Accent Trees:

Tabebuia impetigionosa Pink Trumpet Tree 35'H x 25'W
Chionanthus retusus Chinese Fringe Tree 20'H x 15'W.

Fruit Trees:

Citrus spp.– Orange and Lemon Trees 20'-25' H x 20'W
Olea spp. – Olive Trees
Percea spp. – Avocado Tree 25'H x 20'W
Psidium spp. – Guava Tree 15'H x 10'W

Shrubs Vines and Groundcovers:

Coprosma kirkii Mirrow Plan 18"H x 3'W
Gazania splendens Sunrise Yellow 6'H x 4' W
Vinca major Periwinkle 12'H x 2'W
Ceanothus spp California Lilac 5'H x 7 'W
Lantana spp Lantana 2'H x 3'W
Mahonia spp Barberry 5'H x 6'W
Rhaphiolepis spp India Hawthorn 4'H x 5'W
Salvia spp Sage 3'H x 4'W
Vitis spp. – Grapevines

5. Monumentation Landscaping Standards

a. Primary Lilac Hills Ranch Entry

The primary entry monuments are located on the west and east end of Main Street where it meets West Lilac Road. It provides a welcoming gateway to Lilac Hills Ranch and introduces the design theme (see **Figure 127 - Project Entry Monuments**).The entry is located near groves, pasture, riparian habitat, and boulder-strewn hillsides. Elements from these landscapes will be incorporated into this shared entry. An informal grove of Sycamores will relate to the riparian landscape, foreground groves of Olives and vine arbors will reflect the areas agricultural past and stone walls will reflect the boulder speckled hillsides. Theme walls, signage, and accent plantings will reinforce the design theme.

b. Secondary Lilac Hills Ranch Entry

The secondary Community Entry is located at the south end of Lilac Hills Ranch Road (see **Figure 127**). This entry serves as a gateway unique to the Lilac Hills Ranch Community. While it will share elements common to the primary entry monument it is smaller in scale and more subtle in design.

c. Entry Monument Plant Material List

Primary and Accent Tree

Platanus racemosa California Sycamore 75' H x 40' W
Quercus agrifolia Coast Live Oak 60' H x 60' W
Lagerstroemia indica Crape Myrtle 25'H x 20' W
Tabebuia impetiginosa Purple Trumpet Tree 35' H x 40' W
Olea europaea Wilsoni Fruitless Olive Tree 20" H x 20'W

Shrubs, Vines and Groundcovers

Coprosma kirkii species 5' H x 5' W
Rhaphiolepis indica species 4' H x 4' W
Gazania splendens S. R. 6" H x 8" W
Hemerocalis hybrid Day Lily 4' H x 3" W
Vitis spp. – Grapevines

6. Community Park Landscaping Standards

Lilac Hills Ranch is designed as a rural, pedestrian-prioritized Community whereby a central Town Center and Neighborhood centers are located within a half mile radius (10 minute walk) of the residential use areas. Primary streetscapes are designed at a pedestrian scale and orientation including tree-shaded walkways, on-street parking to increase pedestrian safety, pedestrian scaled lighting, (See **Figure 140**) and shortened or enhanced crosswalks. The street system design has been specifically designed to

maximize the use of pedestrian and bicycle transportation within the Community as recommended by the recent Complete Streets Report by SANDAG. Streets are designed to narrow the field of vision of the automobile driver with landscaping and building placement to reduce vehicle speeds while providing maximum pedestrian visibility and safety. The Open Space, Parks, and Trails Plan, and associated cross sections show the locations and composition of the Lilac Hills Ranch trail network.

a. Parks

The Community's park system is designed to provide both active and passive recreational opportunities for Lilac Hills Ranch residents (see **Figure 17 – Park Plan**) and the public. The public park and the private parks that receive park credit towards the obligations set forth in the Park Lands Dedication Ordinance will be designed in conformance with County Department of Parks and Recreation requirements. The following describes the Lilac Hills Ranch recreational facilities.

b. Public Parks

Lilac Hills Ranch will dedicate a public park (P7) as located and configured on the Specific Plan map to the County and provide those amenities described herein in accordance with the County's Park Lands Dedication Ordinance. The major park site will be located adjacent to the future school and private recreation sites that will ensure its location near other Community oriented public facilities (**Figure 136**). The park site will include ball fields, multipurpose fields, tot lots, basketball courts, open play area and family picnic areas with barbeque pits, and other amenities. The facility will be both dedicated to the County and constructed as a 'turnkey' facility by the Lilac Hills Ranch developers and maintained by the HOA as a County public recreational facility.

c. Private Parks

A private park system with a minimum of 10 private parks is included in the Specific Plan. The private parks are located throughout the Community primarily to serve the Single Family neighborhoods and the Senior Citizen Neighborhood in Phases 4 and 5. As noted elsewhere in this specific plan the private parks in the Senior Citizen Neighborhood will not be available to the public since this neighborhood will be gated. **Figure 17 – Park Plan** shows the general areas planned for the public and private parks in the Community. The precise location of all the private parks will be established by the Implementing Tentative and Final Maps for each phase.

Concepts for these parks are illustrated in Section III. These parks will have a variety of uses which may include tot lots, open play areas, half-court basketball, sand volleyball, dog-runs/ bark-parks, picnic areas with barbeques, passive sitting areas and other uses and groves of trees for shade. These private park

dedications will count towards the developer's obligation under the County's Park Land Dedication Ordinance.

The Village Green is an HOA lot, and is not counted as a park in the above calculations It is however envisioned as an integral component of the "Town Square" which will provide the Community a place to come together and hold social gatherings, recreational activities, fall and spring festivals etc. The facility will be owned, operated, and maintained privately.

d. Park Plant Material List

Primary and Accent Tree

Agonis flexuosa Peppermint Tree 35' H x 25" W
Arbutus menziesii Madrone 25' H x 20' W
Cercis occidentalis Western Redbud 20' H x 18' W
Chionanthus rutusus Chinese Fringe Tree 20' H x 15' W
Juglans califorica California Black Walnut 25' H x 20' W
Lagerstroemia indica Cape Myrtle 25' H x 20' W
Platanus racemosa California Sycamore 75' H x 40' W
Quercus agrifolia Coast Live Oak 60' H x 60' W
Quercus douglasii Blue Oak 50' H x 50' W
Quercus engelmannii Mesa Oak 50' H x 50' W
Tristania conferta Brisbane Box 50' H x 35' W

Shrubs, Vines and Groundcover

Arctostaphylos densiflora Sonoma Manzanita 6' H x 8' W
Callistemon viminalis 'Little John' 3' H x 3' W
Ceanothus 'Concha' NCN 7' H x 10' W
Cotoneaster lactens Red Clustering 10' H x 12' W
Heteromeles arbutifolia Toyon 12' H x 18' W
Leptospermum scoparium 'Ruby' 6'H x 8' W
Mahonia aquifolium Oregon Grape 5' H x 4' W
Rhaphiolepis indica species India Hawthorn 5' H x 5' W
Ribes speciosum Fuschia Flowering Gooseberry 6' H x 8' W
Coprosma kirkii NCN 2' H x 5' W
Ceanothus griseus Horizonal Carmel Creeping 2' H x 10' W
Cotoneaster horizontalis rock Cotoneaster 2' H x 12' W
Gazania species 12' H x 18" W

Myoporum parvifolium Prostrate Myoporum 2' H x 15' W

Vitis spp. – Grapevines

7. Fence Guidelines

A comprehensive system of walls and fences is planned for Lilac Hills Ranch. The walls and fences included in the specific plan meet the general design requirements found in Section 5-Architectural Character (E. Walls, Fences, and Accessory Structures) in the Valley Center Design Guidelines and include the materials encouraged by the Guidelines. These walls and fences are designed using traditional materials, such as stone and wood-rail fences that complement the natural landscape while reflecting the Community enhancements and California foothill themed landscape. Walls and fences will be minimized to enhance the pedestrian experience in the Community however they will be used throughout the Community to provide screening, sound attenuation, security and Community identity. They will be constructed of masonry with rustic pilasters (see **Figure 137 –Fence & Wall Concepts**). **Figure 137** includes the detailed Fence and Wall Plan for the Implementing TM (Phase 1). All Site Plans shall include a similarly detailed, comprehensive Fence and Wall Plan for the development.

Biological Habitat Areas; All development which share property lines with the Biological Habitat Areas (**Figure 18**) are required to include fencing along the shared property line. At appropriate locations signs will be placed on the fencing stating that the area on the other side is a protected habitat area (see **Figure 19 –Open Space and Parks**).

All fencing located within five feet of a building will be constructed of non-combustible materials.

8. Lighting Guidelines

Exterior lighting of the landscape and built structures will play a significant role in the character and mood of a community. In keeping with the vision of Lilac Hills Ranch, the lighting will be designed to be subdued and understated.

Lilac Hills Ranch lighting design concept focuses on the quality of light along specific corridors and areas. Light standards must have a distinctive character to relate to the corridors they serve. Lighting along pedestrian corridors must be more human in scale, closer spaced, and lower than is typically found on an urban street. Light standards shall be manufactured of high-quality materials that are visually pleasing. The base, pole, and light fixture must be attractive and suitable to the design theme of each village and its specific function.

Community lighting will be designed to provide adequate illumination for safety, security, and architectural accents without over lighting. Light fixtures will direct light to use areas and avoid light intrusion into adjacent land use areas. Light shields will be

N/A