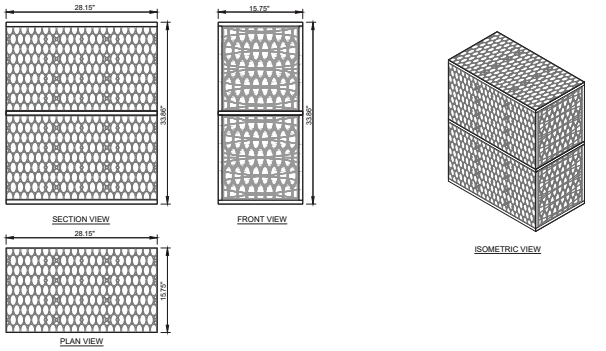
TYPICAL DESIGN

MODULE DRAWING - DOUBLE



MODULE DATA

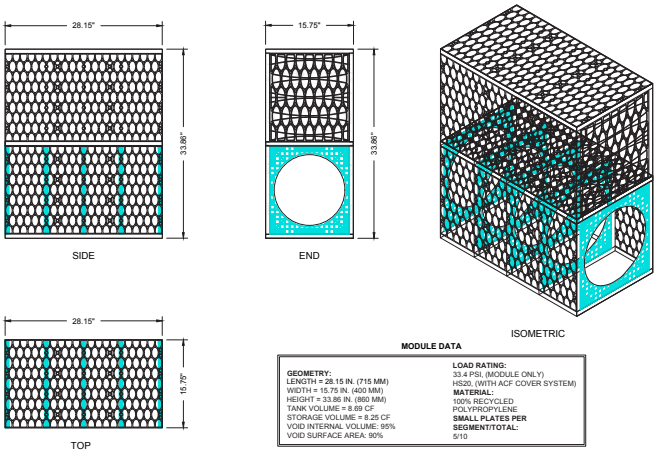
GEOMETRY: LENGTH = 28.15 IN. (715 MM)
WIDTH = 15.75 IN. (400 MM)
HEIGHT = 33.86 IN. (860 MM)
TANK VOLUME = 8.69 CF
STORAGE VOLUME = 8.25 CF
VOID INTERNAL VOLUME: 95%
VOID SURFACE AREA: 90%

LOAD RATING: 33.4 PSI, (MODULE ONLY)
HS25, (WITH ACF COVER SYSTEM)

MATERIAL: 100% RECYCLED POLYPROPYLENE

SMALL PLATES PER SEGMENT/TOTAL: 5/10

MAINTENANCE MODULE - DOUBLE

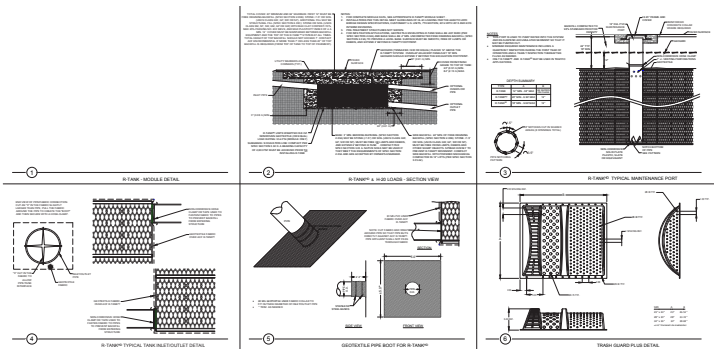


MODULE DATA

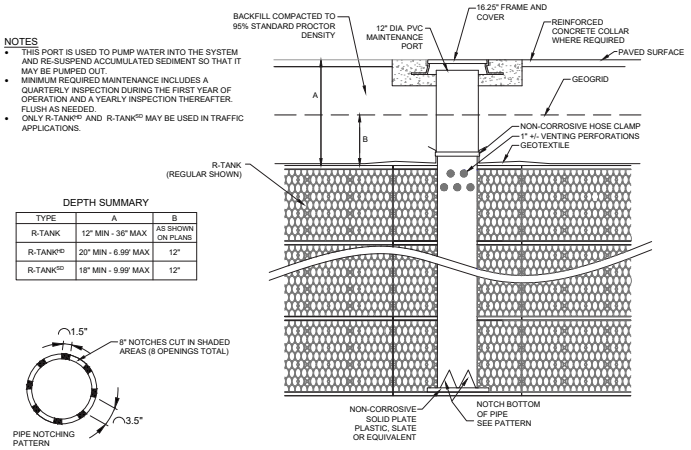
GEOMETRY:
LENGTH = 28.15 IN. (715 MM)
WIDTH = 15.75 IN. (400 MM)
HEIGHT = 33.86 IN. (860 MM)
TANK VOLUME = 8.69 CF
STORAGE VOLUME = 8.25 CF
VOID INTERNAL VOLUME: 95%
VOID SURFACE AREA: 90%

LOAD RATING:
33.4 PSI, (MODULE ONLY)
HS20, (WITH ACF COVER SYSTEM)
MATERIAL:
100% RECYCLED POLYPROPYLENE
SMALL PLATES PER SEGMENT/TOTAL:
5/10

COMPOSITE DETAILS



MAINTENANCE PORT



SELECTING THE RIGHT R-TANK MODULE

Cover Depth (inches)*	LD	HD	SD	UD	XD
Min. 6"	Green Space - No Traffic	Green Space - No Traffic	Green Space - No Traffic	Green Space - No Traffic	HS-20
12"	Green Space - No Traffic	Green Space - No Traffic	Green Space - No Traffic	HS-20**	HS-20
14"	Green Space - No Traffic	Green Space - No Traffic	Green Space - No Traffic	HS-20	HS-20
18"	Green Space - No Traffic	Green Space - No Traffic	HS-20	HS-20	HS-20
20"	Green Space - No Traffic	HS-20	HS-20	HS-20	HS-20
24"	Green Space - No Traffic	HS-20	HS-20	HS-20	HS-20
36"	Green Space - No Traffic	HS-20	HS-20	HS-20	HS-20
48"		HS-20	HS-20	HS-20	HS-20
60"		HS-20	HS-20	HS-20	HS-20
72"		HS-20	HS-20		HS-20
84"			HS-20		HS-20
120"			HS-20		HS-20
160"					HS-20
Max. 200"					HS-20

HS-20 designation based on AASHTO LRFD Bridge Design Spec for single lane traffic. HS-25 loading is available. Call ACF for details.
*Cover depth is measured from top of module to finished grade or top of pavement
**The UD module requires STONE backfill (not soil) on sides at this depth

R-TANK SPECIFICATIONS

LD HD

DIMENSIONS & CAPACITY

Module (Segments)	Width (inch)	Length (inch)	Height (in/ft)	Volume (cf)	Capacity (cf)	Weight* (lbs)
Mini	15.75	28.15	9.45”/0.79’	2.42	2.30	10.1/10.9
Single(1)	15.75	28.15	17.32”/1.44’	4.44	4.22	15.7/17.3
Single + Mini(1.5)	15.75	28.15	25.98”/2.17’	6.67	6.33	23.6/25.9
Double (2)	15.75	28.15	33.86”/2.82’	8.69	8.25	29.1/32.3
Double + Mini(2.5)	15.75	28.15	42.52”/3.54’	10.91	10.36	37.0/41.0
Triple (3)	15.75	28.15	50.39”/4.20’	12.93	12.28	42.5/47.4
Triple + Mini(3.5)	15.75	28.15	59.06”/4.92’	15.15	14.39	50.4/56.0
Quad(4)	15.75	28.15	66.93”/5.58’	17.17	16.31	55.9/62.4
Quad + Mini(4.5)	15.75	28.15	75.59”/6.30’	19.39	18.42	63.8/71.0
Pent(5)	15.75	28.15	83.46”/6.96’	21.41	20.34	69.3/77.4

*Weights shown are for LD/HD modules.

SD

DIMENSIONS & CAPACITY

Module (Segments)	Width (inch)	Length (inch)	Height (in/ft)	Volume (cf)	Capacity (cf)	Weight (lbs)
Single (1)	15.75	28.15	9.45”/0.79’	2.42	2.30	10.95
Double (2)	15.75	28.15	18.12”/1.51’	4.64	4.41	19.58
Triple (3)	15.75	28.15	26.79”/2.23’	6.86	6.52	28.21
Quad (4)	15.75	28.15	35.46”/2.96’	9.08	8.63	36.84
Pent (5)	15.75	28.15	44.13”/3.68’	11.30	10.74	45.47
Hex (6)	15.75	28.15	52.80”/4.40’	13.52	12.84	54.10
Septa (7)	15.75	28.15	61.47”/5.12’	15.74	14.95	62.73
Octo (8)	15.75	28.15	70.14”/5.85’	17.96	17.06	71.36
Nono (9)	15.75	28.15	78.81”/6.57’	20.18	19.17	79.99
Decka (10)	15.75	28.15	87.48”/7.29’	22.40	21.28	88.62

UD

DIMENSIONS & CAPACITY

Module (Segments)	Width (inch)	Length (inch)	Height (in/ft)	Volume (cf)	Capacity (cf)	Weight (lbs)
Single (1)	23.62	23.62	14.17”/1.18’	4.57	4.35	21.2
Double (2)	23.62	23.62	27.17”/2.26’	8.77	8.33	39.0
Triple (3)	23.62	23.62	40.16”/3.35’	12.97	12.32	56.8
Quad (4)	23.62	23.62	53.15”/4.43’	17.16	16.30	74.6
Pent (5)	23.62	23.62	66.14”/5.5’	21.35	20.29	92.4

XD

DIMENSIONS & CAPACITY

Module (Segments)	Width (inch)	Length (inch)	Height (inch)	Volume (cf)	Capacity (cf)	Weight (lbs)
Single (1)	19.68	23.62	1.97	0.53	0.48	4
Double (2)	19.68	23.62	3.94	1.06	0.95	8
Triple (3)	19.68	23.62	5.91	1.59	1.43	12
Quad (4)	19.68	23.62	7.87	2.12	1.91	16
Pent (5)	19.68	23.62	9.84	2.65	2.38	20

Note: XD modules may be stacked up to 10’ tall (60 layers).

SPECIFICATIONS

Item	Description	LD	HD	SD	UD	XD
		Value	**Value**	**Value**	**Value**	**Value**
Void Area	Volume available for water storage	95%	95%	95%	95%	90%
Surface Area Void	% of exterior available for infiltration	90%	90%	90%	90%	90%
Compressive Strength	ASTM D 2412/ ASTM F 2318	30.0 psi	33.4 psi	42.9 psi	134.2 psi	240.2 psi
Unit Weight	Weight of plastic per cubic foot of tank	3.29 lbs/cf	3.62 lbs/cf	3.96 lbs/cf	4.33 lbs/cf	7.55 lbs/cf
Rib Thickness	Thickness of load-bearing members	0.18”	0.18”	0.18”	-	-
Service Temperature	Safe temperature range for use	-14 - 167º F	-14 - 167º F	-14 - 167º F	-14 - 167º F	-14 - 167º F
Recycled Content	Use of recycled polypropylene	100%	100%	100%	100%	100%
Minimum Cover	Cover required for HS-20 loading	Not traffic rated	20”	18”	12” - 14”	6”
	Cover required for HS-25 loading	Not traffic rated	24”	18”	15” - 17”	6”
Maximum Cover	Maximum allowable cover depth	36”	6.99’	9.99’	5.0’	16.7’

R-TANK & HS-20 LOADS

The R-Tank system is capable of easily supporting AASHTO HS-20 and HS-25 loads with safety factors of 1.75 or higher. The system has been used in a variety of applications around the world with tremendous success. Read on and we'll explain how the R-Tank handles heavy loads, and why it will work under HS-20 loads for your project.

Bearing Capacity

The R-Tank's ultimate design load comes from the results of a compression test performed according to ASTM D 2412 & ASTM F 2418, which are the industry standard tests for loading of underground detention systems. Testing was performed by TRI Environmental, and their report along with a technical note about the test methodology is available to supplement this document.

R-Tank has been chosen for tough applications all over the world.

Typical Load Calculation

The AASHTO HS-20 Standard uses a 32,000 lbs axle as the design load (two axles at 25,000 lbs each at depths greater than 38"). To conservatively model the R-Tank's performance under these types of traffic loads, several steps are taken and additional factors considered:

- The axle load is distributed to two sets of dual wheels, each 10" x 20" at 80 psi
- The tire contact area is transferred down through the cover layers at a conservative 1:2 angle (33%) to determine the Area of Applied Load on the top of the R-Tank
- An impact factor is added to account for the movement of the load
- Weight of cover material in a saturated condition is added (130 lbs/cf)

Unconfined Compression Test

With these factors in place, the HS-20 load can be modeled and the resulting safety factor determined. The table on page 2 shows how the R-Tank performs at various depths of cover, and it suggests which module should be used. Since most projects are designed for HS-20 loads in parking lots, this table is ideal for most installations.

If you are designing for HS-25 loads, or if you are considering applications with multiple HS-20 loads regularly travelling in multiple parallel lanes (for example, active roadways or shipping terminals), tables for these specific circumstances are available.

R-TANK & HS-20 LOADS

Third Party Verification

Modeling product performance using engineering equations to ensure a successful project is important. But what really matters is product performance in the field. That's why we've done real-world testing with third party agencies who have installed the R-Tank and subjected it to brutal testing.

One test involved installing 18" of sand cover over an R-Tank^{LD} module (an R-Tank^{SD} should have been used at this depth) without geogrid, and driving a 31 ton dump truck over the system. Even in these harsh conditions, the R-Tank has supported the loads, passing every field test that's been done.

R-Tank field testing.

Real World Performance

Your project REQUIRES a proven system. With thousands of installations around the world, R-Tank has proven itself again and again as one of the strongest systems available for underground detention/retention. Specify R-Tank and you can be confident your system will support the traffic loads above. Call ACF today to discuss your project's requirements.

Truck (31 tons) backing over R-Tank.

HS-20 & LRFD Design Tandem Loading - Single Lane Traffic

	Cover Depth (inches)													
Item	**6**	**12**	**18**	**20**	**30**	**38**	**48**	**60**	**72**	**84**	**96**	**108**	**120**	**144**
Axle Load (lbs)	32,000	32,000	32,000	32,000	32,000	25,000*	25,000*	25,000*	25,000*	25,000*	25,000*	25,000*	25,000*	25,000*
Wheel Load (lbs)	16,000	16,000	16,000	16,000	16,000	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500
Tire Contact Area (10" x 20" = 200 inch^2)	200	200	200	200	200	200	200	200	200	200	200	200	200	200
Area of Applied Load at 33% Angle of Repose (inch^2)	416	704	1,064	1,200	2,000	2,784	3,944	5,600	7,544	9,776	12,296	15,104	18,200	25,256
Unfactored Wheel Loading Applied to R-Tank (psi)	38.46	22.73	15.04	13.33	8.00	8.98	6.34	8.93	6.63	5.11	4.07	3.31	2.75	1.98
Factored Wheel Loading Applied to R-Tank** (psi)	50.36	29.29	19.07	16.82	9.82	10.77	7.38	10.03	7.17	5.33	4.07	3.31	2.75	1.98
Cover Material Pressure at 130 lbs/cf (psi)	0.45	0.90	1.35	1.50	2.26	2.86	3.61	4.51	5.42	6.32	7.22	8.13	9.03	10.83
Total Load Applied to R-Tank (psi)	**50.81**	**30.19**	**20.42**	**18.32**	**12.07**	**13.63**	**11.00**	**14.55**	**12.59**	**11.64**	**11.29**	**11.44**	**11.78**	**12.81**
Ultimate Bearing Capacity of R-Tank Unit (psi)	240.20	134.20	42.90	33.40	33.40	33.40	33.40	33.40	33.40	42.90	42.90	42.90	240.20	240.20
Safety Factor***	**4.73**	**4.44**	**2.10**	**1.82**	**2.77**	**3.04**	**3.04**	**2.30**	**2.65**	**3.68**	**3.80**	**3.75**	**20.40**	**18.75**

R-Tank^{HD}
R-Tank^{SD}
R-Tank^{UD}
R-Tank^{XD}

* *LRFD Tandem Loading controls at depths of 38" or more.*

** *Includes Dynamic Loading Allowance in Accordance with AASHTO LRFD.*

*** *In leiu of Live and Dead Load factors, a minimum "Safety Factor" of 1.75 is maintained.*

ACF ENVIRONMENTAL
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R-TANK OPERATION, INSPECTION & MAINTENANCE

Operation

Your ACF R-Tank System has been designed to function in conjunction with the engineered drainage system on your site, the existing municipal infrastructure, and/or the existing soils and geography of the receiving watershed. Unless your site included certain unique and rare features, the operation of your R-Tank System will be driven by naturally occurring systems and will function autonomously. However, upholding a proper schedule of Inspection & Maintenance is critical to ensuring continued functionality and optimum performance of the system.

Inspection

Both the R-Tank and all stormwater pre-treatment features incorporated into your site must be inspected regularly. Inspection frequency for your system must be determined based on the contributing drainage area, but should never exceed one year between inspections (six months during the first year of operation).

Inspections may be required more frequently for pre-treatment systems. You should refer to the manufacturer requirements for the proper inspection schedule.

With the right equipment your inspection and measurements can be accomplished from the surface without physically entering any confined spaces. If your inspection does require confined space entry, you MUST follow all local/regional requirements as well as OSHA standards.

R-Tank Systems may incorporate Inspection Ports, Maintenance Ports, and/or adjoining manholes. Each of these features are easily accessed by removing the lid at the surface. With the cover removed, a visual inspection can be performed to identify sediment deposits within the structure. Using a flashlight, ALL access points should be examined to complete a thorough inspection.

Inspection Ports
Usually located centrally in the R-Tank System, these perforated columns are designed to give the user a base-line sediment depth across the system floor.

Maintenance Ports
Usually located near the inlet and outlet connections, you'll likely find deeper deposits of heavier sediments when compared to the Inspection Ports.

Manholes
Most systems will include at least two manholes - one at the inlet and another at the outlet. There may be more than one location where stormwater enters the system, which would result in additional manholes to inspect.

Bear in mind that these manholes often include a sump below the invert of the pipe connecting to the R-Tank. These sumps are designed to capture sediment before it reaches the R-Tank, and they should be kept clean to ensure they function properly. However, existence of sediment in the sump does NOT necessarily mean sediment has accumulated in the R-Tank.

After inspecting the bottom of the structure, use a mirror on a pole (or some other device) to check for sediment or debris in the pipe connecting to the R-Tank.

R-TANK OPERATION INSPECTION & MAINTENANCE

If sediment or debris is observed in any of these structures, you should determine the depth of the material. This is typically accomplished with a stadia rod, but you should determine the best way to obtain the measurement.

All observations and measurements should be recorded on an Inspection Log kept on file. We've included a form you can use at the end of this guideline.

Maintenance

The R-Tank System should be back-flushed once sediment accumulation has reached 6" or 15% of the total system height. Use the chart below as a guideline to determine the point at which maintenance is required on your system.

R-Tank Unit	Height	Max Sediment Dept
Mini	9.5"	1.5"
Single	17"	3"
Double	34"	5"
Triple	50"	6"
Quad	67"	6"
Pent	84"	6"

Before any maintenance is performed on your system, be sure to plug the outlet pipe to prevent contamination of the adjacent systems.

To back-flush the R-Tank, water is pumped into the system through the Maintenance Ports as rapidly as possible. Water should be pumped into ALL Maintenance Ports. The turbulent action of the water moving through the R-Tank will suspend sediments which may then be pumped out.

If your system includes an Outlet Structure, this will be the ideal location to pump contaminated water out of the system. However, removal of back-flush water may be accomplished through the Maintenance Ports, as well.

For systems with large footprints that would require extensive volumes of water to properly flush the system, you should consider performing your maintenance within 24 hours of a rain event. Stormwater entering the system will aid in the suspension of sediments and reduce the volume of water required to properly flush the system.

Once removed, sediment-laden water may be captured for disposal or pumped through a Dirtbag™ (if permitted by the locality).

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Step-By-Step Inspection & Maintenance Routine

1) **Inspection**
    a. Inspection Port
        i. Remove Cap
        ii. Use flashlight to detect sediment deposits
        iii. If present, measure sediment depth with stadia rod
        iv. Record results on Maintenance Log
        v. Replace Cap
    b. Maintenance Port/s
        i. Remove Cap
        ii. Use flashlight to detect sediment deposits
        iii. If present, measure sediment depth with stadia rod
        iv. Record results on Maintenance Log
        v. Replace Cap
        vi. Repeat for ALL Maintenance Ports
    c. Adjacent Manholes
        i. Remove Cover
        ii. Use flashlight to detect sediment deposits
        iii. If present, measure sediment depth with stadia rod, accounting for depth of sump (if present)
        iv. Inspect pipes connecting to R-Tank
        v. Record results on Maintenance Log
        vi. Replace Cover
        vii. Repeat for ALL Manholes that connect to the R-Tank

2) **Maintenance**
    a. Plug system outlet to prevent discharge of back-flush water
    b. Determine best location to pump out back-flush water
    c. Remove Cap from Maintenance Port
    d. Pump water as rapidly as possible (without over-topping port) into system until at least 1”
    of water covers system bottom
    e. Replace Cap
    f. Repeat at ALL Maintenance Ports
    g. Pump out back-flush water to complete back-flushing
    h. Vacuum all adjacent structures and any other structures or stormwater pre-treatment systems that require attention
    i. Sediment-laden water may be captured for disposal or pumped through a Dirtbag™.
    j. Replace any remaining Caps or Covers
    k. Record the back-flushing event in your Maintenance Log with any relevant specifics

R-Tank Maintenance Log

Site Name:_____

Location:_____

System Owner:_____

Company Responsible for Maintenance:_____

Contact:_____

Phone Number:_____

Date	Location	Depth to Bottom	Depth to Sediment	Sediment Depth	Observations/Notes	Initials

For more information about our products, contact Inside Sales at 800.448.3636 or email at info@acfenv.com

Appendix D

DCV and HCOC Calculations

Design Capture Volume Calculations
Phase 1

There are two (2) Drainage Areas (DA-1 and DA-2) for the Site
There are five (5) DMA's within DA-1
There is one (1) DMA's within DA-2

Total Area =	1,441,806	sf
	33.10	ac
DA-1 Total Area =	1,324,630	sf
	30.41	ac
DA-1 Total DCV =	77,194	cf
DA-2 Total Area =	117,176	sf
	2.69	ac
DA-2 Total DCV =	8,990	cf

- Step 1 – Compute the area, in square feet, for each Project Site DA
- Step 2 – Compute the DA runoff coefficient as a function of DA imperviousness (i), using the following regression equation (ASCE and WEF, 1998):

$$C = 0.858 * i^3 - 0.78 * i^2 + 0.774 * i + 0.04$$

- Step 3 – Identify the 2-year, 1-hour rainfall depth for the DA from the NOAA Atlas 14 isohyet map. The following webpage can be used to extract interpolated point rainfall from NOAA Atlas 14 isohyets:

http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

- Step 4 – Compute the P6 mean storm rainfall depth in inches for the DA by multiplying the 2 year, 1-hr rainfall depth by the appropriate coefficient (a_1) for the San Bernardino County climatic region (Valley = 1.4807, Mountain = 1.909, or Desert = 1.2371):

$$P_6 = P_{2yr,1hr} * a_1$$

- Step 5 – Calculate the design capture volume (DCV), in cubic feet, as a function of the total DA, in square feet; the runoff coefficient (C), the P6 rainfall depth, in inches; and the regression constant to account for drawdown time (a_2 = 1.582 for 24-hr drawdown, or 1.963 for 48-hr drawdown). Drawdown time is the maximum amount of time that runoff can be stored in a BMP to ensure sufficient capacity to treat subsequent storm events. The following equation computes the DCV:

$$DCV = DA * C * a_2 * P_6 / 12$$

Phase 1

Drainage Area		DMA-A1	
Area of DMA	A	627,670	sf
Area of DMA	A	**14.41**	ac
Imperviousness Ratio	i	70%	%
DA Runoff Coefficient	C	**0.49**	
2-YR, 1-HR Rainfall Depth	$P_{2yr,1hr}$	0.48	in
Coefficient(Valley, Mountain, Desert)	a_1	1.48	
Mean Storm Rainfall Depth	P_6	**0.71**	in
Drawdown Time(24-hr, 48-hr)	a_2	1.96	
Design Capture Volume	DCV	**35,967**	cf

Drainage Area		DMA-B	
DA-1 Drains to Almond Avenue			
Area of DMA	A	114,563	sf
Area of DMA	A	**2.63**	ac
Imperviousness Ratio	i	85%	%
DA Runoff Coefficient	C	**0.66**	
2-YR, 1-HR Rainfall Depth	$P_{2yr,1hr}$	0.48	in
Coefficient(Valley, Mountain, Desert)	a_1	1.48	
Mean Storm Rainfall Depth	P_6	**0.71**	in
Drawdown Time(24-hr, 48-hr)	a_2	1.96	
Design Capture Volume	DCV	**8,790**	cf

Drainage Area		DMA-C	
DA-1 Drains to Almond Avenue			
Area of DMA	A	138,521	sf
Area of DMA	A	**3.18**	ac
Imperviousness Ratio	i	0%	%
DA Runoff Coefficient	C	**0.04**	
2-YR, 1-HR Rainfall Depth	$P_{2yr,1hr}$	0.48	in
Coefficient(Valley, Mountain, Desert)	a_1	1.48	
Mean Storm Rainfall Depth	P_6	**0.71**	in
Drawdown Time(24-hr, 48-hr)	a_2	1.96	
Design Capture Volume	DCV	**643**	cf

Phase 1

Drainage Area		DMA-D	
DA-1 Drains to Almond Avenue			
Area of DMA	A	31,363	sf
Area of DMA	A	**0.72**	ac
Imperviousness Ratio	i	0%	%
DA Runoff Coefficient	C	**0.04**	
2-YR, 1-HR Rainfall Depth	$P_{2yr,1hr}$	0.48	in
Coefficient(Valley, Mountain, Desert)	a_1	1.48	
Mean Storm Rainfall Depth	P_6	**0.71**	in
Drawdown Time(24-hr, 48-hr)	a_2	1.96	
Design Capture Volume	DCV	**146**	cf

Drainage Area		DMA-E	
DA-1 Drains to Almond Avenue			
Area of DMA	A	412,513	sf
Area of DMA	A	**9.47**	ac
Imperviousness Ratio	i	85%	%
DA Runoff Coefficient	C	**0.66**	
2-YR, 1-HR Rainfall Depth	$P_{2yr,1hr}$	0.48	in
Coefficient(Valley, Mountain, Desert)	a_1	1.48	
Mean Storm Rainfall Depth	P_6	**0.71**	in
Drawdown Time(24-hr, 48-hr)	a_2	1.96	
Design Capture Volume	DCV	**31,649**	cf

Drainage Area		DMA-A2	
DA-2 Drains to Lugonia Avenue			
Area of DMA	A	117,176	sf
Area of DMA	A	**2.69**	ac
Imperviousness Ratio	i	85%	%
DA Runoff Coefficient	C	**0.66**	
2-YR, 1-HR Rainfall Depth	$P_{2yr,1hr}$	0.48	in
Coefficient(Valley, Mountain, Desert)	a_1	1.48	
Mean Storm Rainfall Depth	P_6	**0.71**	in
Drawdown Time(24-hr, 48-hr)	a_2	1.96	
Design Capture Volume	DCV	**8,990**	cf

BMP Sizing Calculations

Phase 1

Note: DMA's C and D in DA-1 contain zero existing or proposed impervious and do not com-mingle with un-mitigated flow from other DMA's within DA-1

Bioretention with no underdrain	$V_{ret} = (P_{design} / 12 * SA_{inf} * T_{fill}) + (SA_{ponded} * d_{ponded}) + (SA_{soil} * d_{soil} * n_{soil}) + (SA_{gravel} * d_{gravel} * n_{gravel})$ where $d_{ponded} < T_{drawdown} * P_{design} / 12$	P_{design} = design percolation rate (in/hr), field measured infiltration divided by safety factor $SA_{inf,ponded,soil,gravel}$ = surface area (ft^2) of bioretention bottom, soil and gravel layers, and surface ponding $T_{drawdown}$ = drawdown time for stored runoff (hrs), default is 48 hours T_{fill} = duration of storm when infiltration is occurring as basin is filling (hrs), default is 3 hours $d_{ponded,gravel}$ = depth (ft) of ponding and gravel layers n_{gravel} = porosity of gravel layer	Riverside County LID BMP Manual[2] Orange County TGD for Project WQMPs Appendix XIV[1]

BMP	DMA-A1	
DA-1		
P_{design}	0.50	in/hr
SA_{inf}	22,232	sf
SA_{ponded}	22,232	sf
SA_{soil}	22,232	sf
SA_{gravel}	22,232	sf
$T_{drawdown}$	48	hours
T_{fill}	3	hours
d_{ponded}	1.0	ft
d_{gravel}	1.0	ft
d_{soil}	2.0	ft
n_{gravel}	0.40	
n_{soil}	0.40	
V_{ret}	**51,689**	cf
DCV	35,967	cf

BMP	DMA-B	
DA-1		
P_{design}	0.50	in/hr
SA_{inf}	4,200	sf
SA_{ponded}	4,200	sf
SA_{soil}	4,200	sf
SA_{gravel}	4,200	sf
$T_{drawdown}$	48	hours
T_{fill}	3	hours
d_{ponded}	1.0	ft
d_{gravel}	1.0	ft
d_{soil}	2.0	ft
n_{gravel}	0.40	
n_{soil}	0.40	
V_{ret}	**9,765**	cf
DCV	8,790	cf

Phase 1

BMP	DMA-E	
DA-1		
P_{design}	0.50	in/hr
SA_{inf}	14,000	sf
SA_{ponded}	14,000	sf
SA_{soil}	14,000	sf
SA_{gravel}	14,000	sf
$T_{drawdown}$	48	hours
T_{fill}	3	hours
d_{ponded}	1.0	ft
d_{gravel}	1.0	ft
d_{soil}	2.0	ft
n_{gravel}	0.40	
n_{soil}	0.40	
V_{ret}	**32,550**	cf
DCV	31,649	cf

BMP	DMA-A2	
DA-2		
P_{design}	0.50	in/hr
SA_{inf}	6,035	sf
SA_{ponded}	6,035	sf
SA_{soil}	6,035	sf
SA_{gravel}	6,035	sf
$T_{drawdown}$	48	hours
T_{fill}	3	hours
d_{ponded}	1.0	ft
d_{gravel}	1.0	ft
d_{soil}	2.0	ft
n_{gravel}	0.40	
n_{soil}	0.40	
V_{ret}	**14,031**	cf
DCV	8,990	cf

Runoff Volume Calculations (2-year, 24-hour)

Phase 1

Refer to San Bernardino Hydrology Manual for Curve Numbers (Figure C-3)
Project Site Hydrologic Soil Type A
EX developed portion of the site assumed 85% impervious and 15% commercial landscape; remaining portion assumed open brush
PR entire site developed at 85% impevious and 15% commercial landscape

Phase 1

Total DA-1			
Total Area	A	1,324,630	sf
Total Area	A	30.41	ac
2-YR, 24-HR Rainfall Depth	$P_{2yr,24hr}$	2.07	in
Rootop Curve Number	CN	98	AMC-II
Pavement Curve Number	CN	98	AMC-II
Urban Cover Comm. Landscape	CN	32	AMC-II
Open Brush w/Good Cover	CN	41	AMC-II
Existing Area @ CN 98	A	292,825	sf
Existing Area @ CN 32	A	51,675	sf
Existing Area @ CN 41	A	980,130	sf
EX. Area-Weighted CN	CN_{EX}	53	
Storage Capacity	S	8.78	
Initial Abstraction	Ia	1.76	
EX. Runoff Volume	**VOL_{EX}**	**1,198**	cf
Proposed Area @ CN 98	A	887,502	sf
Proposed Area @ CN 32	A	437,128	sf
Proposed Area @ CN 41	A	0	sf
PR. Area-Weighted CN	CN_{PR}	76	
Storage Capacity	S	3.12	
Initial Abstraction	Ia	0.62	
PR. Runoff Volume	**VOL_{PR}**	**50,551**	**cf**

Required Volume Reduction	**VOL_{HCOC}**	**46,826**	**cf**

Total Site DCV =	DCV	77,194	cf

Provided Volume Retention	**VOLprov**	**94,004**	**cf**

Phase 1

Total DA-2			
Total Area	A	117,176	sf
Total Area	A	2.69	ac
2-YR, 24-HR Rainfall Depth	$P_{2yr,24hr}$	2.07	in
Rootop Curve Number	CN	98	AMC-II
Pavement Curve Number	CN	98	AMC-II
Urban Cover Comm. Landscape	CN	32	AMC-II
Open Brush w/Good Cover	CN	41	AMC-II
Existing Area @ CN 98	A	0	sf
Existing Area @ CN 32	A	0	sf
Existing Area @ CN 41	A	117,176	sf
EX. Area-Weighted CN	CN_{EX}	41	
Storage Capacity	S	14.39	
Initial Abstraction	Ia	2.88	
EX. Runoff Volume	**VOL_{EX}**	**469**	cf
Proposed Area @ CN 98	A	99,600	sf
Proposed Area @ CN 32	A	17,576	sf
Proposed Area @ CN 41	A	0	sf
PR. Area-Weighted CN	CN_{PR}	88	
Storage Capacity	S	1.35	
Initial Abstraction	Ia	0.27	
PR. Runoff Volume	**VOL_{PR}**	**10,040**	**cf**

Required Volume Reduction	**VOL_{HCOC}**	**9,069**	**cf**

Total Site DCV =	DCV	8,990	cf

Provided Volume Retention	**VOLprov**	**14,031**	**cf**

Design Capture Volume Calculations
Phase 2 (Sized for Ultimate Condition)

There are two (2) Drainage Areas (DA-1 and DA-2) for the Site
There are three (3) DMA's within DA-1
There is one (1) DMA's within DA-2

Total Area (sf) =	1,584,894
Total Area (ac) =	36.38
DA-1 Total Area (sf) =	1,432,894
DA-1 Total Area (ac) =	32.89
DA-1 Total DCV (cf)	109,935
DA-2 Total Area (sf) =	152,000
DA-2 Total Area (ac) =	3.49
DA-2 Total DCV (cf)	11,662

- Step 1 – Compute the area, in square feet, for each Project Site DA
- Step 2 – Compute the DA runoff coefficient as a function of DA imperviousness (i), using the following regression equation (ASCE and WEF, 1998):

$$C = 0.858 * i^3 - 0.78 * i^2 + 0.774 * i + 0.04$$

- Step 3 – Identify the 2-year, 1-hour rainfall depth for the DA from the NOAA Atlas 14 isohyet map. The following webpage can be used to extract interpolated point rainfall from NOAA Atlas 14 isohyets:

http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

- Step 4 – Compute the P6 mean storm rainfall depth in inches for the DA by multiplying the 2 year, 1-hr rainfall depth by the appropriate coefficient (a_1) for the San Bernardino County climatic region (Valley = 1.4807, Mountain = 1.909, or Desert = 1.2371):

$$P_6 = P_{2yr,1hr} * a_1$$

- Step 5 – Calculate the design capture volume (DCV), in cubic feet, as a function of the total DA, in square feet; the runoff coefficient (C), the P6 rainfall depth, in inches; and the regression constant to account for drawdown time (a_2 = 1.582 for 24-hr drawdown, or 1.963 for 48-hr drawdown). Drawdown time is the maximum amount of time that runoff can be stored in a BMP to ensure sufficient capacity to treat subsequent storm events. The following equation computes the DCV:

$$DCV = DA * C * a_2 * P_6 / 12$$

Phase 2/Ultimate Condition

Drainage Area		DMA-A1	
DA-1 Drains to Almond Avenue			
Area of DMA	A	1,197,394	sf
Area of DMA	A	**27.49**	ac
Imperviousness Ratio	i	85%	%
DA Runoff Coefficient	C	**0.66**	
2-YR, 1-HR Rainfall Depth	$P_{2yr,1hr}$	0.48	in
Coefficient(Valley, Mountain, Desert)	a_1	1.48	
Mean Storm Rainfall Depth	P_6	**0.71**	in
Drawdown Time(24-hr, 48-hr)	a_2	1.96	
Design Capture Volume	DCV	**91,866**	cf

Drainage Area		DMA-B	
DA-1 Drains to Almond Avenue			
Area of DMA	A	126,200	sf
Area of DMA	A	**2.90**	ac
Imperviousness Ratio	i	85%	%
DA Runoff Coefficient	C	**0.66**	
2-YR, 1-HR Rainfall Depth	$P_{2yr,1hr}$	0.48	in
Coefficient(Valley, Mountain, Desert)	a_1	1.48	
Mean Storm Rainfall Depth	P_6	**0.71**	in
Drawdown Time(24-hr, 48-hr)	a_2	1.96	
Design Capture Volume	DCV	**9,682**	cf

Phase 2/Ultimate Condition

Drainage Area		DMA-C	
DA-1 Drains to Almond Avenue			
Area of DMA	A	109,300	sf
Area of DMA	A	**2.51**	ac
Imperviousness Ratio	i	85%	%
DA Runoff Coefficient	C	**0.66**	
2-YR, 1-HR Rainfall Depth	$P_{2yr,1hr}$	0.48	in
Coefficient(Valley, Mountain, Desert)	a_1	1.48	
Mean Storm Rainfall Depth	P_6	**0.71**	in
Drawdown Time(24-hr, 48-hr)	a_2	1.96	
Design Capture Volume	DCV	**8,386**	cf

Drainage Area		DMA-A2	
DA-2 Drains to Lugonia Avenue			
Area of DMA	A	152,000	sf
Area of DMA	A	**3.49**	ac
Imperviousness Ratio	i	85%	%
DA Runoff Coefficient	C	**0.66**	
2-YR, 1-HR Rainfall Depth	$P_{2yr,1hr}$	0.48	in
Coefficient(Valley, Mountain, Desert)	a_1	1.48	
Mean Storm Rainfall Depth	P_6	**0.71**	in
Drawdown Time(24-hr, 48-hr)	a_2	1.96	
Design Capture Volume	DCV	**11,662**	cf

BMP Sizing Calculations

Phase 2 (Sized for Ultimate Condition)

Phase 2/Ultimate Condition

Drywell / Permeable pavement / Underground infiltration	$V_{ret} = (P_{design} / 12 * SA_{inf} * T_{fill}) + (SA_{resevoir} * d_{resevoir} * n_{aggregate})$ where $d_{resevoir} < T_{drawdown} * P_{design} / 12$	P_{design} = design percolation rate (in/hr), field measured infiltration divided by safety factor $SA_{inf,reservoir}$ = surface area (ft^2) of reservoir for drywell or permeable pavement, include weep holes for drywell SA_{inf} $T_{drawdown}$ = drawdown time for stored runoff (hrs), default is 48 hours T_{fill} = duration of storm when infiltration is occurring as basin is filling (hrs), default is 3 hours $d_{reservoir}$ = depth (ft) of drywell $n_{aggregate}$ = porosity of aggregate , if none then 1.0	Riverside County LID BMP Manual[2] Orange County TGD for Project WQMPs Appendix XIV[1]

BMP	DMA-A1	
DA-1		
Pdesign	0.50	in/hr
SAinf	44,500	sf
SAreservoir	44,500	sf
Tfill	3	hours
dreservoir	2.0	ft
naggregate	1.0	
Vret	**94,563**	cf
DCV	91,866	cf

Phase 2/Ultimate Condition

Bioretention with no underdrain	$V_{ret} = (P_{design} / 12 * SA_{inf} * T_{fill}) + (SA_{ponded} * d_{ponded}) + (SA_{soil} * d_{soil} * n_{soil}) + (SA_{gravel} * d_{gravel} * n_{gravel})$ where $d_{ponded} < T_{drawdown} * P_{design} / 12$	P_{design} = design percolation rate (in/hr), field measured infiltration divided by safety factor $SA_{inf,ponded,soil,gravel}$ = surface area (ft^2) of bioretention bottom, soil and gravel layers, and surface ponding $T_{drawdown}$ = drawdown time for stored runoff (hrs), default is 48 hours T_{fill} = duration of storm when infiltration is occurring as basin is filling (hrs), default is 3 hours $d_{ponded,gravel}$ = depth (ft) of ponding and gravel layers n_{gravel} = porosity of gravel layer	Riverside County LID BMP Manual[2] Orange County TGD for Project WQMPs Appendix XIV[1]

BMP	DMA-B	
	DA-1	
P_{design}	0.50	in/hr
SA_{inf}	4,200	sf
SA_{ponded}	4,200	sf
SA_{soil}	4,200	sf
SA_{gravel}	4,200	sf
$T_{drawdown}$	48	hours
T_{fill}	3	hours
d_{ponded}	1.0	ft
d_{gravel}	1.0	ft
d_{soil}	2.0	ft
n_{gravel}	0.40	
n_{soil}	0.40	
V_{ret}	**9,765**	cf
DCV	9,682	cf

BMP	DMA-C	
	DA-1	
P_{design}	0.50	in/hr
SA_{inf}	4,000	sf
SA_{ponded}	4,000	sf
SA_{soil}	4,000	sf
SA_{gravel}	4,000	sf
$T_{drawdown}$	48	hours
T_{fill}	3	hours
d_{ponded}	1.0	ft
d_{gravel}	1.0	ft
d_{soil}	2.0	ft
n_{gravel}	0.40	
n_{soil}	0.40	
V_{ret}	**9,300**	cf
DCV	8,386	cf

Phase 2/Ultimate Condition

BMP	DMA-A2	
DA-2		
P_{design}	0.50	in/hr
SA_{inf}	6,035	sf
SA_{ponded}	6,035	sf
SA_{soil}	6,035	sf
SA_{gravel}	6,035	sf
$T_{drawdown}$	48	hours
T_{fill}	3	hours
d_{ponded}	1.0	ft
d_{gravel}	1.0	ft
d_{soil}	2.0	ft
n_{gravel}	0.40	
n_{soil}	0.40	
V_{ret}	**14,031**	cf
DCV	11,662	cf

Runoff Volume Calculations (2-year, 24-hour)

Phase 2/Ultimate Condition

Refer to San Bernardino Hydrology Manual for Curve Numbers (Figure C-3)
Project Site Hydrologic Soil Type A
EX developed portion of the site assumed 85% impervious and 15% commercial landscape; remaining portion assumed open brush
PR entire site developed at 85% impevious and 15% commercial landscape

Total DA-1			
Total Area	A	1,432,894	sf
Total Area	A	32.89	ac
2-YR, 24-HR Rainfall Depth	$P_{2yr,24hr}$	2.07	in
Rootop Curve Number	CN	98	AMC-II
Pavement Curve Number	CN	98	AMC-II
Urban Cover Comm. Landscape	CN	32	AMC-II
Open Brush w/Good Cover	CN	41	AMC-II
Existing Area @ CN 98	A	292,825	sf
Existing Area @ CN 32	A	51,675	sf
Existing Area @ CN 41	A	1,249,605	sf
EX. Area-Weighted CN	CN_{EX}	57	
Storage Capacity	S	7.56	
Initial Abstraction	Ia	1.51	
EX. Runoff Volume	**VOL_{EX}**	**4,567**	cf
Proposed Area @ CN 98	A	1,217,960	sf
Proposed Area @ CN 32	A	214,934	sf
Proposed Area @ CN 41	A	0	sf
PR. Area-Weighted CN	CN_{PR}	88	
Storage Capacity	S	1.35	
Initial Abstraction	Ia	0.27	
PR. Runoff Volume	**VOL_{PR}**	**122,776**	**cf**

Required Volume Reduction	**VOL_{HCOC}**	**112,070**	**cf**

Total Site DCV =	DCV	109,935	cf

Provided Volume Retention	**VOLprov**	**113,628**	**cf**

Phase 2/Ultimate Condition

Total DA-2			
Total Area	A	152,000	sf
Total Area	A	3.49	ac
2-YR, 24-HR Rainfall Depth	$P_{2yr,24hr}$	2.07	in
Rootop Curve Number	CN	98	AMC-II
Pavement Curve Number	CN	98	AMC-II
Urban Cover Comm. Landscape	CN	32	AMC-II
Open Brush w/Good Cover	CN	41	AMC-II
Existing Area @ CN 98	A	0	sf
Existing Area @ CN 32	A	0	sf
Existing Area @ CN 41	A	152,000	sf
EX. Area-Weighted CN	CN_{EX}	41	
Storage Capacity	S	14.39	
Initial Abstraction	Ia	2.88	
EX. Runoff Volume	**VOL_{EX}**	**609**	cf
Proposed Area @ CN 98	A	129,200	sf
Proposed Area @ CN 32	A	22,800	sf
Proposed Area @ CN 41	A	0	sf
PR. Area-Weighted CN	CN_{PR}	88	
Storage Capacity	S	1.35	
Initial Abstraction	Ia	0.27	
PR. Runoff Volume	**VOL_{PR}**	**13,024**	**cf**

Required Volume Reduction	**VOL_{HCOC}**	**11,764**	**cf**

Total Site DCV =	DCV	11,662	cf

Provided Volume Retention	**VOLprov**	**14,031**	**cf**

NOAA Atlas 14, Volume 6, Version 2
Location name: Redlands, California, USA*
Latitude: 34.0718°, Longitude: -117.2296°
Elevation: 1150.22 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.099 (0.082-0.120)	0.128 (0.107-0.156)	0.168 (0.139-0.205)	0.200 (0.165-0.246)	0.246 (0.195-0.312)	0.281 (0.218-0.365)	0.317 (0.240-0.422)	0.355 (0.262-0.487)	0.407 (0.288-0.583)	0.449 (0.306-0.665)
10-min	0.141 (0.118-0.171)	0.184 (0.153-0.223)	0.241 (0.199-0.293)	0.287 (0.236-0.353)	0.352 (0.280-0.448)	0.402 (0.313-0.523)	0.454 (0.345-0.606)	0.509 (0.375-0.698)	0.584 (0.412-0.836)	0.643 (0.438-0.954)
15-min	0.171 (0.142-0.207)	0.222 (0.185-0.270)	0.291 (0.241-0.355)	0.348 (0.286-0.427)	0.426 (0.338-0.541)	0.487 (0.378-0.632)	0.550 (0.417-0.732)	0.615 (0.453-0.844)	0.706 (0.498-1.01)	0.778 (0.530-1.15)
30-min	0.253 (0.211-0.307)	0.329 (0.274-0.400)	0.431 (0.357-0.525)	0.515 (0.423-0.632)	0.630 (0.501-0.802)	0.721 (0.560-0.937)	0.814 (0.617-1.08)	0.911 (0.671-1.25)	1.05 (0.738-1.50)	1.15 (0.785-1.71)
60-min	0.370 (0.308-0.450)	0.482 (0.401-0.586)	0.631 (0.523-0.769)	0.754 (0.620-0.926)	0.923 (0.733-1.17)	1.06 (0.821-1.37)	1.19 (0.904-1.59)	1.34 (0.983-1.83)	1.53 (1.08-2.19)	1.69 (1.15-2.50)
2-hr	0.531 (0.442-0.645)	0.682 (0.567-0.828)	0.881 (0.730-1.07)	1.04 (0.858-1.28)	1.27 (1.01-1.61)	1.44 (1.12-1.87)	1.62 (1.23-2.16)	1.81 (1.33-2.48)	2.06 (1.45-2.95)	2.26 (1.54-3.35)
3-hr	0.653 (0.544-0.793)	0.834 (0.693-1.01)	1.07 (0.889-1.31)	1.27 (1.04-1.56)	1.53 (1.22-1.95)	1.74 (1.35-2.26)	1.95 (1.48-2.60)	2.17 (1.60-2.98)	2.47 (1.74-3.54)	2.70 (1.84-4.01)
6-hr	0.911 (0.758-1.11)	1.16 (0.963-1.41)	1.49 (1.23-1.81)	1.75 (1.44-2.15)	2.11 (1.68-2.69)	2.39 (1.86-3.11)	2.68 (2.03-3.57)	2.97 (2.19-4.08)	3.37 (2.38-4.82)	3.68 (2.51-5.46)
12-hr	1.20 (1.00-1.46)	1.54 (1.28-1.87)	1.98 (1.64-2.41)	2.33 (1.92-2.87)	2.82 (2.24-3.58)	3.19 (2.48-4.14)	3.56 (2.70-4.75)	3.95 (2.91-5.42)	4.47 (3.16-6.40)	4.88 (3.33-7.23)
24-hr	1.61 (1.42-1.85)	2.07 (1.83-2.39)	2.69 (2.37-3.11)	3.18 (2.78-3.71)	3.85 (3.26-4.64)	4.37 (3.63-5.37)	4.89 (3.96-6.16)	5.43 (4.28-7.03)	6.15 (4.65-8.29)	6.71 (4.91-9.36)
2-day	1.96 (1.74-2.26)	2.57 (2.28-2.97)	3.38 (2.98-3.91)	4.04 (3.53-4.71)	4.93 (4.18-5.94)	5.62 (4.66-6.91)	6.32 (5.12-7.97)	7.05 (5.56-9.13)	8.04 (6.08-10.8)	8.80 (6.44-12.3)
3-day	2.11 (1.87-2.43)	2.81 (2.48-3.24)	3.73 (3.29-4.31)	4.49 (3.93-5.23)	5.53 (4.68-6.66)	6.34 (5.26-7.80)	7.17 (5.81-9.04)	8.04 (6.34-10.4)	9.23 (6.98-12.4)	10.2 (7.43-14.2)
4-day	2.25 (1.99-2.59)	3.02 (2.67-3.49)	4.05 (3.57-4.68)	4.90 (4.28-5.71)	6.07 (5.14-7.31)	6.98 (5.80-8.59)	7.93 (6.42-9.99)	8.91 (7.03-11.5)	10.3 (7.77-13.9)	11.3 (8.30-15.8)
7-day	2.59 (2.30-2.99)	3.53 (3.13-4.08)	4.79 (4.22-5.54)	5.83 (5.10-6.80)	7.28 (6.16-8.77)	8.41 (6.98-10.3)	9.58 (7.76-12.1)	10.8 (8.52-14.0)	12.5 (9.46-16.9)	13.8 (10.1-19.3)
10-day	2.82 (2.49-3.25)	3.87 (3.42-4.47)	5.28 (4.66-6.11)	6.46 (5.65-7.53)	8.09 (6.85-9.75)	9.38 (7.78-11.5)	10.7 (8.67-13.5)	12.1 (9.54-15.7)	14.0 (10.6-18.9)	15.6 (11.4-21.7)
20-day	3.46 (3.07-3.99)	4.82 (4.26-5.56)	6.64 (5.86-7.68)	8.16 (7.14-9.52)	10.3 (8.72-12.4)	12.0 (9.94-14.7)	13.7 (11.1-17.3)	15.6 (12.3-20.2)	18.2 (13.7-24.5)	20.2 (14.8-28.2)
30-day	4.09 (3.62-4.71)	5.69 (5.03-6.56)	7.85 (6.92-9.08)	9.66 (8.46-11.3)	12.2 (10.3-14.7)	14.2 (11.8-17.5)	16.4 (13.3-20.6)	18.6 (14.7-24.1)	21.7 (16.4-29.3)	24.2 (17.7-33.8)
45-day	4.92 (4.36-5.67)	6.79 (6.01-7.83)	9.33 (8.23-10.8)	11.5 (10.0-13.4)	14.5 (12.3-17.5)	16.9 (14.0-20.8)	19.5 (15.8-24.5)	22.1 (17.5-28.7)	25.9 (19.6-34.9)	28.9 (21.2-40.4)
60-day	5.78 (5.12-6.66)	7.89 (6.98-9.10)	10.8 (9.50-12.5)	13.2 (11.6-15.4)	16.6 (14.1-20.1)	19.4 (16.1-23.9)	22.3 (18.1-28.1)	25.4 (20.0-32.9)	29.7 (22.5-40.1)	33.2 (24.3-46.3)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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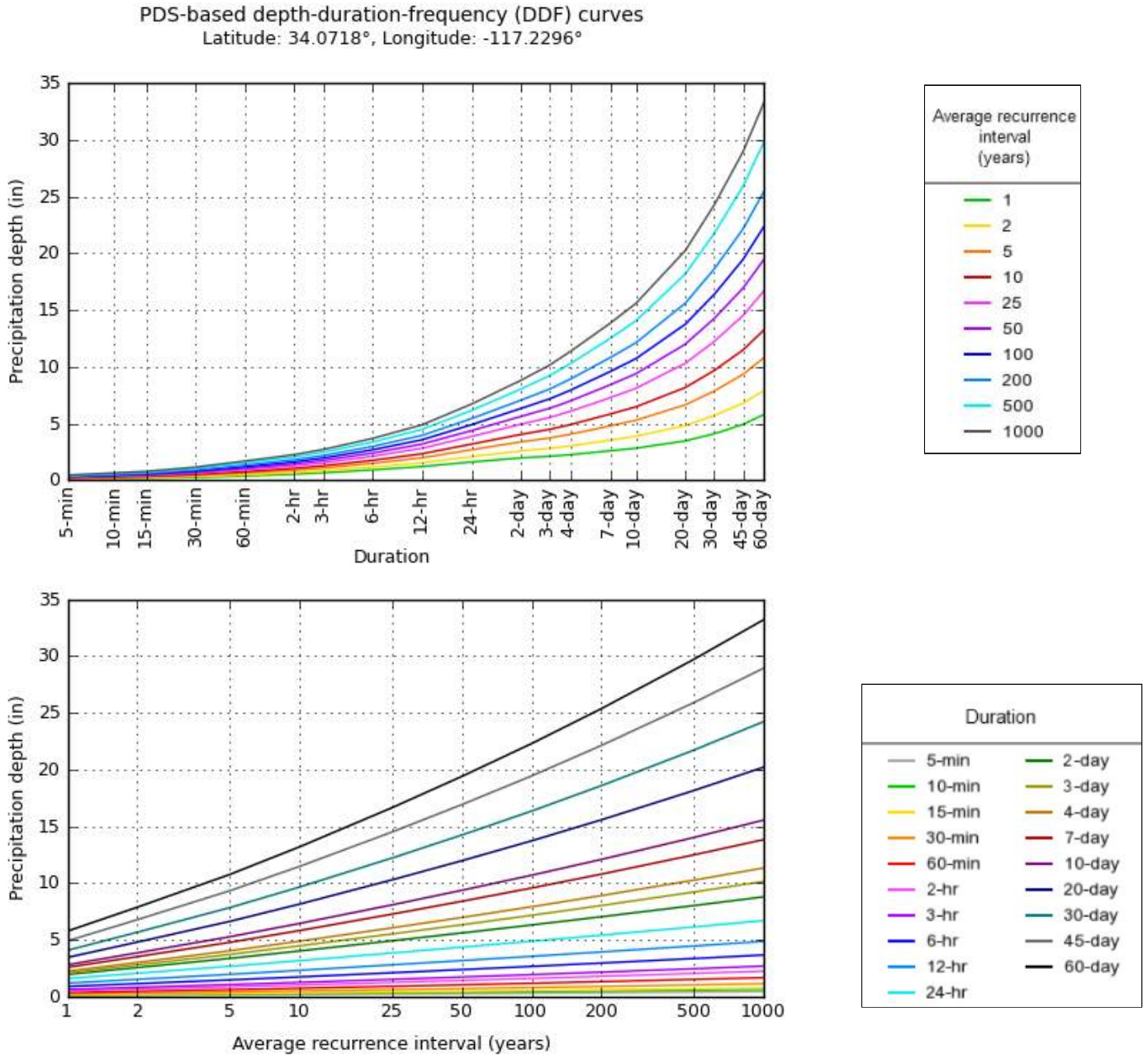
PF graphical



NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Mon Aug 15 17:21:06 2022

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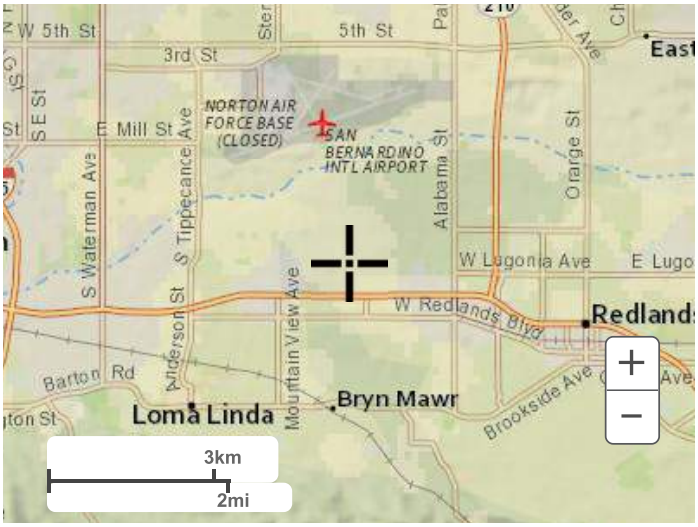
Maps & aerials

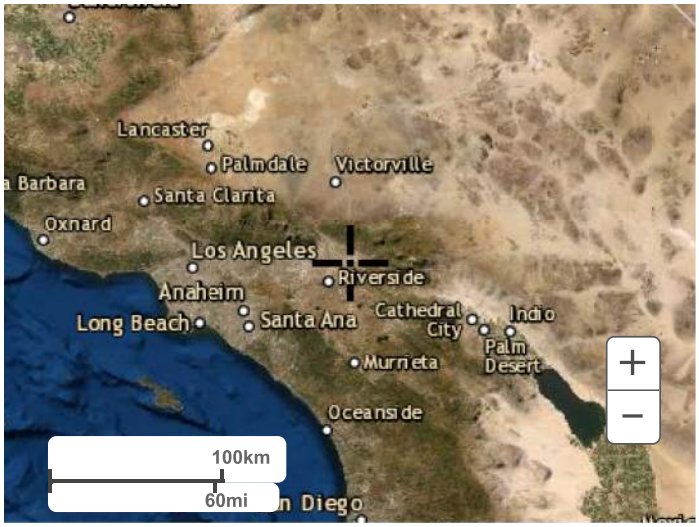
Small scale terrain



Large scale terrain

Large scale map

Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Appendix E

Soils Information

A project-specific Geotechnical Investigation is forthcoming and is expected to, in part, confirm the feasibility of infiltration at the site. A design infiltration rate of 0.5 in/hr has been used for BMP design and will be confirmed.

Hydrologic Soil Group—San Bernardino County Southwestern Part, California

A project-specific Geotechnical Investigation is forthcoming and is expected to, in part, confirm the feasibility of infiltration at the site. A design infiltration rate of 0.5 in/hr has been used for BMP design and will be confirmed.

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Bernardino County Southwestern Part, California
Survey Area Data: Version 13, Sep 13, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Nov 11, 2020—Nov 15, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

A project-specific Geotechnical Investigation is forthcoming and is expected to, in part, confirm the feasibility of infiltration at the site. A design infiltration rate of 0.5 in/hr has been used for BMP design and will be confirmed.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
HbA	Hanford sandy loam, 0 to 2 percent slopes	A	44.5	100.0%
Totals for Area of Interest			**44.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix F

CASQA Information

Spill Prevention, Control & Cleanup SC-11

Photo Credit: Geoff Brosseau

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Description

Many activities that occur at an industrial or commercial site have the potential to cause accidental or illegal spills. Preparation for accidental or illegal spills, with proper training and reporting systems implemented, can minimize the discharge of pollutants to the environment.

Spills and leaks are one of the largest contributors of stormwater pollutants. Spill prevention and control plans are applicable to any site at which hazardous materials are stored or used. An effective plan should have spill prevention and response procedures that identify potential spill areas, specify material handling procedures, describe spill response procedures, and provide spill clean-up equipment. The plan should take steps to identify and characterize potential spills, eliminate and reduce spill potential, respond to spills when they occur in an effort to prevent pollutants from entering the stormwater drainage system, and train personnel to prevent and control future spills.

Targeted Constituents

Sediment	
Nutrients	
Trash	
Metals	✓
Bacteria	
Oil and Grease	✓
Organics	✓

Approach

Pollution Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.

- Develop a Spill Prevention Control and Countermeasure (SPCC) Plan. The plan should include:

CASQA California Stormwater Quality Association

- Description of the facility, owner and address, activities and chemicals present
- Facility map
- Notification and evacuation procedures
- Cleanup instructions
- Identification of responsible departments
- Identify key spill response personnel

- Recycle, reclaim, or reuse materials whenever possible. This will reduce the amount of process materials that are brought into the facility.

Suggested Protocols (including equipment needs)

Spill Prevention

- Develop procedures to prevent/mitigate spills to storm drain systems. Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures.
- If consistent illegal dumping is observed at the facility:
  - Post "No Dumping" signs with a phone number for reporting illegal dumping and disposal. Signs should also indicate fines and penalties applicable for illegal dumping.
  - Landscaping and beautification efforts may also discourage illegal dumping.
  - Bright lighting and/or entrance barriers may also be needed to discourage illegal dumping.
- Store and contain liquid materials in such a manner that if the tank is ruptured, the contents will not discharge, flow, or be washed into the storm drainage system, surface waters, or groundwater.
- If the liquid is oil, gas, or other material that separates from and floats on water, install a spill control device (such as a tee section) in the catch basins that collects runoff from the storage tank area.
- Routine maintenance:
  - Place drip pans or absorbent materials beneath all mounted taps, and at all potential drip and spill locations during filling and unloading of tanks. Any collected liquids or soiled absorbent materials must be reused/recycled or properly disposed.
  - Store and maintain appropriate spill cleanup materials in a location known to all near the tank storage area; and ensure that employees are familiar with the site's spill control plan and/or proper spill cleanup procedures.
  - Sweep and clean the storage area monthly if it is paved, *do not hose down the area to a storm drain.*

  - Check tanks (and any containment sumps) daily for leaks and spills. Replace tanks that are leaking, corroded, or otherwise deteriorating with tanks in good condition. Collect all spilled liquids and properly dispose of them.

- Label all containers according to their contents (e.g., solvent, gasoline).
- Label hazardous substances regarding the potential hazard (corrosive, radioactive, flammable, explosive, poisonous).
- Prominently display required labels on transported hazardous and toxic materials (per US DOT regulations).
- Identify key spill response personnel.

Spill Control and Cleanup Activities

- Follow the Spill Prevention Control and Countermeasure Plan.
- Clean up leaks and spills immediately.
- Place a stockpile of spill cleanup materials where it will be readily accessible (e.g., near storage and maintenance areas).
- On paved surfaces, clean up spills with as little water as possible. Use a rag for small spills, a damp mop for general cleanup, and absorbent material for larger spills. If the spilled material is hazardous, then the used cleanup materials are also hazardous and must be sent to a certified laundry (rags) or disposed of as hazardous waste. Physical methods for the cleanup of dry chemicals include the use of brooms, shovels, sweepers, or plows.
- Never hose down or bury dry material spills. Sweep up the material and dispose of properly.
- Chemical cleanups of material can be achieved with the use of adsorbents, gels, and foams. Use adsorbent materials on small spills rather than hosing down the spill. Remove the adsorbent materials promptly and dispose of properly.
- For larger spills, a private spill cleanup company or Hazmat team may be necessary.

Reporting

- Report spills that pose an immediate threat to human health or the environment to the Regional Water Quality Control Board.
- Federal regulations require that any oil spill into a water body or onto an adjoining shoreline be reported to the National Response Center (NRC) at 800-424-8802 (24 hour).
- Report spills to local agencies, such as the fire department; they can assist in cleanup.
- Establish a system for tracking incidents. The system should be designed to identify the following:

  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)

- Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
- Responsible parties

Training

- Educate employees about spill prevention and cleanup.
- Well-trained employees can reduce human errors that lead to accidental releases or spills:
  - The employee should have the tools and knowledge to immediately begin cleaning up a spill should one occur.
  - Employees should be familiar with the Spill Prevention Control and Countermeasure Plan.
- Employees should be educated about aboveground storage tank requirements. Employees responsible for aboveground storage tanks and liquid transfers should be thoroughly familiar with the Spill Prevention Control and Countermeasure Plan and the plan should be readily available.
- Train employees to recognize and report illegal dumping incidents.

Other Considerations (Limitations and Regulations)

- State regulations exist for facilities with a storage capacity of 10,000 gallons or more of petroleum to prepare a Spill Prevention Control and Countermeasure (SPCC) Plan (Health & Safety Code Chapter 6.67).
- State regulations also exist for storage of hazardous materials (Health & Safety Code Chapter 6.95), including the preparation of area and business plans for emergency response to the releases or threatened releases.
- Consider requiring smaller secondary containment areas (less than 200 sq. ft.) to be connected to the sanitary sewer, prohibiting any hard connections to the storm drain.

Requirements

Costs (including capital and operation & maintenance)

- Will vary depending on the size of the facility and the necessary controls.
- Prevention of leaks and spills is inexpensive. Treatment and/or disposal of contaminated soil or water can be quite expensive.

Maintenance (including administrative and staffing)

- This BMP has no major administrative or staffing requirements. However, extra time is needed to properly handle and dispose of spills, which results in increased labor costs.

Supplemental Information

Further Detail of the BMP

Reporting

Record keeping and internal reporting represent good operating practices because they can increase the efficiency of the facility and the effectiveness of BMPs. A good record keeping system helps the facility minimize incident recurrence, correctly respond with appropriate cleanup activities, and comply with legal requirements. A record keeping and reporting system should be set up for documenting spills, leaks, and other discharges, including discharges of hazardous substances in reportable quantities. Incident records describe the quality and quantity of non-stormwater discharges to the storm sewer. These records should contain the following information:

- Date and time of the incident
- Weather conditions
- Duration of the spill/leak/discharge
- Cause of the spill/leak/discharge
- Response procedures implemented
- Persons notified
- Environmental problems associated with the spill/leak/discharge

Separate record keeping systems should be established to document housekeeping and preventive maintenance inspections, and training activities. All housekeeping and preventive maintenance inspections should be documented. Inspection documentation should contain the following information:

- The date and time the inspection was performed
- Name of the inspector
- Items inspected
- Problems noted
- Corrective action required
- Date corrective action was taken

Other means to document and record inspection results are field notes, timed and dated photographs, videotapes, and drawings and maps.

Aboveground Tank Leak and Spill Control

Accidental releases of materials from aboveground liquid storage tanks present the potential for contaminating stormwater with many different pollutants. Materials spilled, leaked, or lost from

tanks may accumulate in soils or on impervious surfaces and be carried away by stormwater runoff.

The most common causes of unintentional releases are:

- Installation problems
- Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves)
- External corrosion and structural failure
- Spills and overfills due to operator error
- Leaks during pumping of liquids or gases from truck or rail car to a storage tank or vice versa

Storage of reactive, ignitable, or flammable liquids should comply with the Uniform Fire Code and the National Electric Code. Practices listed below should be employed to enhance the code requirements:

- Tanks should be placed in a designated area.
- Tanks located in areas where firearms are discharged should be encapsulated in concrete or the equivalent.
- Designated areas should be impervious and paved with Portland cement concrete, free of cracks and gaps, in order to contain leaks and spills.
- Liquid materials should be stored in UL approved double walled tanks or surrounded by a curb or dike to provide the volume to contain 10 percent of the volume of all of the containers or 110 percent of the volume of the largest container, whichever is greater. The area inside the curb should slope to a drain.
- For used oil or dangerous waste, a dead-end sump should be installed in the drain.
- All other liquids should be drained to the sanitary sewer if available. The drain must have a positive control such as a lock, valve, or plug to prevent release of contaminated liquids.
- Accumulated stormwater in petroleum storage areas should be passed through an oil/water separator.

Maintenance is critical to preventing leaks and spills. Conduct routine inspections and:

- Check for external corrosion and structural failure.
- Check for spills and overfills due to operator error.
- Check for failure of piping system (pipes, pumps, flanger, coupling, hoses, and valves).
- Check for leaks or spills during pumping of liquids or gases from truck or rail car to a storage facility or vice versa.

- Visually inspect new tank or container installation for loose fittings, poor welding, and improper or poorly fitted gaskets.
- Inspect tank foundations, connections, coatings, and tank walls and piping system. Look for corrosion, leaks, cracks, scratches, and other physical damage that may weaken the tank or container system.
- Frequently relocate accumulated stormwater during the wet season.
- Periodically conduct integrity testing by a qualified professional.

Vehicle Leak and Spill Control

Major spills on roadways and other public areas are generally handled by highly trained Hazmat teams from local fire departments or environmental health departments. The measures listed below pertain to leaks and smaller spills at vehicle maintenance shops.

In addition to implementing the spill prevention, control, and clean up practices above, use the following measures related to specific activities:

Vehicle and Equipment Maintenance

- Perform all vehicle fluid removal or changing inside or under cover to prevent the run-on of stormwater and the runoff of spills.
- Regularly inspect vehicles and equipment for leaks, and repair immediately.
- Check incoming vehicles and equipment (including delivery trucks, and employee and subcontractor vehicles) for leaking oil and fluids. Do not allow leaking vehicles or equipment onsite.
- Always use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.
- Immediately drain all fluids from wrecked vehicles.
- Store wrecked vehicles or damaged equipment under cover.
- Place drip pans or absorbent materials under heavy equipment when not in use.
- Use adsorbent materials on small spills rather than hosing down the spill.
- Remove the adsorbent materials promptly and dispose of properly.
- Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- Oil filters disposed of in trashcans or dumpsters can leak oil and contaminate stormwater. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

- Store cracked batteries in a non-leaking secondary container. Do this with all cracked batteries, even if you think all the acid has drained out. If you drop a battery, treat it as if it is cracked. Put it into the containment area until you are sure it is not leaking.

Vehicle and Equipment Fueling

- Design the fueling area to prevent the run-on of stormwater and the runoff of spills:
  - Cover fueling area if possible.
  - Use a perimeter drain or slope pavement inward with drainage to a sump.
  - Pave fueling area with concrete rather than asphalt.
- If dead-end sump is not used to collect spills, install an oil/water separator.
- Install vapor recovery nozzles to help control drips as well as air pollution.
- Discourage "topping-off" of fuel tanks.
- Use secondary containment when transferring fuel from the tank truck to the fuel tank.
- Use adsorbent materials on small spills and general cleaning rather than hosing down the area. Remove the adsorbent materials promptly.
- Carry out all Federal and State requirements regarding underground storage tanks, or install above ground tanks.
- Do not use mobile fueling of mobile industrial equipment around the facility; rather, transport the equipment to designated fueling areas.
- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Train employees in proper fueling and cleanup procedures.

Industrial Spill Prevention Response

For the purposes of developing a spill prevention and response program to meet the stormwater regulations, facility managers should use information provided in this fact sheet and the spill prevention/response portions of the fact sheets in this handbook, for specific activities. The program should:

- Integrate with existing emergency response/hazardous materials programs (e.g., Fire Department)
- Develop procedures to prevent/mitigate spills to storm drain systems
- Identify responsible departments
- Develop and standardize reporting procedures, containment, storage, and disposal activities, documentation, and follow-up procedures
- Address spills at municipal facilities, as well as public areas

- Provide training concerning spill prevention, response and cleanup to all appropriate personnel

References and Resources

California's Nonpoint Source Program Plan http://www.swrcb.ca.gov/nps/index.html

Clark County Storm Water Pollution Control Manual
http://www.co.clark.wa.us/pubworks/bmpman.pdf

King County Storm Water Pollution Control Manual http://dnr.metrokc.gov/wlr/dss/spcm.htm

Santa Clara Valley Urban Runoff Pollution Prevention Program http://www.scvurppp.org

The Stormwater Managers Resource Center http://www.stormwatercenter.net/

Trash Storage Areas SD-32

Description

Trash storage areas are areas where a trash receptacle (s) are located for use as a repository for solid wastes. Stormwater runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. Waste handling operations that may be sources of stormwater pollution include dumpsters, litter control, and waste piles.

Approach

This fact sheet contains details on the specific measures required to prevent or reduce pollutants in stormwater runoff associated with trash storage and handling. Preventative measures including enclosures, containment structures, and impervious pavements to mitigate spills, should be used to reduce the likelihood of contamination.

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Design requirements for waste handling areas are governed by Building and Fire Codes, and by current local agency ordinances and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code and ordinance requirements. Hazardous waste should be handled in accordance with legal requirements established in Title 22, California Code of Regulation.

Wastes from commercial and industrial sites are typically hauled by either public or commercial carriers that may have design or access requirements for waste storage areas. The design criteria in this fact sheet are recommendations and are not intended to be in conflict with requirements established by the waste hauler. The waste hauler should be contacted prior to the design of your site trash collection areas. Conflicts or issues should be discussed with the local agency.

Designing New Installations

Trash storage areas should be designed to consider the following structural or treatment control BMPs:

- Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This might include berming or grading the waste handling area to prevent run-on of stormwater.
- Make sure trash container areas are screened or walled to prevent off-site transport of trash.

- Use lined bins or dumpsters to reduce leaking of liquid waste.
- Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
- Pave trash storage areas with an impervious surface to mitigate spills.
- Do not locate storm drains in immediate vicinity of the trash storage area.
- Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Maintenance Considerations

The integrity of structural elements that are subject to damage (i.e., screens, covers, and signs) must be maintained by the owner/operator. Maintenance agreements between the local agency and the owner/operator may be required. Some agencies will require maintenance deed restrictions to be recorded of the property title. If required by the local agency, maintenance agreements or deed restrictions must be executed by the owner/operator before improvement plans are approved.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Maintenance Bays & Docks SD-31

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- ☑ Contain Pollutants
- Collect and Convey

Description

Several measures can be taken to prevent operations at maintenance bays and loading docks from contributing a variety of toxic compounds, oil and grease, heavy metals, nutrients, suspended solids, and other pollutants to the stormwater conveyance system.

Approach

In designs for maintenance bays and loading docks, containment is encouraged. Preventative measures include overflow containment structures and dead-end sumps. However, in the case of loading docks from grocery stores and warehouse/distribution centers, engineered infiltration systems may be considered.

Suitable Applications

Appropriate applications include commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for vehicle maintenance and repair are governed by Building and Fire Codes, and by current local agency ordinances, and zoning requirements. The design criteria described in this fact sheet are meant to enhance and be consistent with these code requirements.

Designing New Installations

Designs of maintenance bays should consider the following:

- Repair/maintenance bays and vehicle parts with fluids should be indoors; or designed to preclude urban run-on and runoff.
- Repair/maintenance floor areas should be paved with Portland cement concrete (or equivalent smooth impervious surface).

- Repair/maintenance bays should be designed to capture all wash water leaks and spills. Provide impermeable berms, drop inlets, trench catch basins, or overflow containment structures around repair bays to prevent spilled materials and wash-down waters form entering the storm drain system. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.
- Other features may be comparable and equally effective.

The following designs of loading/unloading dock areas should be considered:

- Loading dock areas should be covered, or drainage should be designed to preclude urban run-on and runoff.
- Direct connections into storm drains from depressed loading docks (truck wells) are prohibited.
- Below-grade loading docks from grocery stores and warehouse/distribution centers of fresh food items should drain through water quality inlets, or to an engineered infiltration system, or an equally effective alternative. Pre-treatment may also be required.
- Other features may be comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permit.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Storm Drain Signage SD-13

Design Objectives

- Maximize Infiltration
- Provide Retention
- Slow Runoff
- Minimize Impervious Land Coverage
- ☑ Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Waste materials dumped into storm drain inlets can have severe impacts on receiving and ground waters. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Storm drain signs and stencils are highly visible source controls that are typically placed directly adjacent to storm drain inlets.

Approach

The stencil or affixed sign contains a brief statement that prohibits dumping of improper materials into the urban runoff conveyance system. Storm drain messages have become a popular method of alerting the public about the effects of and the prohibitions against waste disposal.

Suitable Applications

Stencils and signs alert the public to the destination of pollutants discharged to the storm drain. Signs are appropriate in residential, commercial, and industrial areas, as well as any other area where contributions or dumping to storm drains is likely.

Design Considerations

Storm drain message markers or placards are recommended at all storm drain inlets within the boundary of a development project. The marker should be placed in clear sight facing toward anyone approaching the inlet from either side. All storm drain inlet locations should be identified on the development site map.

Designing New Installations

The following methods should be considered for inclusion in the project design and show on project plans:

- Provide stenciling or labeling of all storm drain inlets and catch basins, constructed or modified, within the project area with prohibitive language. Examples include "NO DUMPING

– DRAINS TO OCEAN" and/or other graphical icons to discourage illegal dumping.

- Post signs with prohibitive language and/or graphical icons, which prohibit illegal dumping at public access points along channels and creeks within the project area.

Note - Some local agencies have approved specific signage and/or storm drain message placards for use. Consult local agency stormwater staff to determine specific requirements for placard types and methods of application.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. If the project meets the definition of "redevelopment", then the requirements stated under " designing new installations" above should be included in all project design plans.

Additional Information

Maintenance Considerations

- Legibility of markers and signs should be maintained. If required by the agency with jurisdiction over the project, the owner/operator or homeowner's association should enter into a maintenance agreement with the agency or record a deed restriction upon the property title to maintain the legibility of placards or signs.

Placement

- Signage on top of curbs tends to weather and fade.

- Signage on face of curbs tends to be worn by contact with vehicle tires and sweeper brooms.

Supplemental Information

Examples

- Most MS4 programs have storm drain signage programs. Some MS4 programs will provide stencils, or arrange for volunteers to stencil storm drains as part of their outreach program.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Efficient Irrigation SD-12

Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Irrigation water provided to landscaped areas may result in excess irrigation water being conveyed into stormwater drainage systems.

Approach

Project plan designs for development and redevelopment should include application methods of irrigation water that minimize runoff of excess irrigation water into the stormwater conveyance system.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment. (Detached residential single-family homes are typically excluded from this requirement.)

Design Considerations

Designing New Installations

The following methods to reduce excessive irrigation runoff should be considered, and incorporated and implemented where determined applicable and feasible by the Permittee:

- Employ rain-triggered shutoff devices to prevent irrigation after precipitation.
- Design irrigation systems to each landscape area's specific water requirements.
- Include design featuring flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
- Implement landscape plans consistent with County or City water conservation resolutions, which may include provision of water sensors, programmable irrigation times (for short cycles), etc.

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- Design timing and application methods of irrigation water to minimize the runoff of excess irrigation water into the storm water drainage system.
- Group plants with similar water requirements in order to reduce excess irrigation runoff and promote surface filtration. Choose plants with low irrigation requirements (for example, native or drought tolerant species). Consider design features such as:
  - Using mulches (such as wood chips or bar) in planter areas without ground cover to minimize sediment in runoff
  - Installing appropriate plant materials for the location, in accordance with amount of sunlight and climate, and use native plant materials where possible and/or as recommended by the landscape architect
  - Leaving a vegetative barrier along the property boundary and interior watercourses, to act as a pollutant filter, where appropriate and feasible
  - Choosing plants that minimize or eliminate the use of fertilizer or pesticides to sustain growth
- Employ other comparable, equally effective methods to reduce irrigation water runoff.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Other Resources

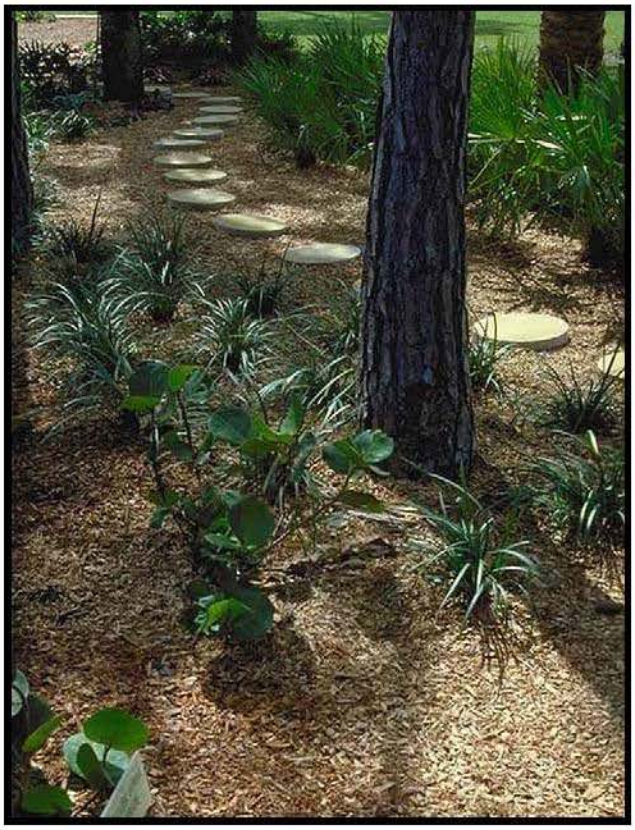
A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Site Design & Landscape Planning SD-10



Design Objectives

- ☑ Maximize Infiltration
- ☑ Provide Retention
- ☑ Slow Runoff
- ☑ Minimize Impervious Land Coverage
- Prohibit Dumping of Improper Materials
- Contain Pollutants
- Collect and Convey

Description

Each project site possesses unique topographic, hydrologic, and vegetative features, some of which are more suitable for development than others. Integrating and incorporating appropriate landscape planning methodologies into the project design is the most effective action that can be done to minimize surface and groundwater contamination from stormwater.

Approach

Landscape planning should couple consideration of land suitability for urban uses with consideration of community goals and projected growth. Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Suitable Applications

Appropriate applications include residential, commercial and industrial areas planned for development or redevelopment.

Design Considerations

Design requirements for site design and landscapes planning should conform to applicable standards and specifications of agencies with jurisdiction and be consistent with applicable General Plan and Local Area Plan policies.

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Designing New Installations

Begin the development of a plan for the landscape unit with attention to the following general principles:

- Formulate the plan on the basis of clearly articulated community goals. Carefully identify conflicts and choices between retaining and protecting desired resources and community growth.

- Map and assess land suitability for urban uses. Include the following landscape features in the assessment: wooded land, open unwooded land, steep slopes, erosion-prone soils, foundation suitability, soil suitability for waste disposal, aquifers, aquifer recharge areas, wetlands, floodplains, surface waters, agricultural lands, and various categories of urban land use. When appropriate, the assessment can highlight outstanding local or regional resources that the community determines should be protected (e.g., a scenic area, recreational area, threatened species habitat, farmland, fish run). Mapping and assessment should recognize not only these resources but also additional areas needed for their sustenance.

Project plan designs should conserve natural areas to the extent possible, maximize natural water storage and infiltration opportunities, and protect slopes and channels.

Conserve Natural Areas during Landscape Planning

If applicable, the following items are required and must be implemented in the site layout during the subdivision design and approval process, consistent with applicable General Plan and Local Area Plan policies:

- Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.

- Limit clearing and grading of native vegetation at a site to the minimum amount needed to build lots, allow access, and provide fire protection.

- Maximize trees and other vegetation at each site by planting additional vegetation, clustering tree areas, and promoting the use of native and/or drought tolerant plants.

- Promote natural vegetation by using parking lot islands and other landscaped areas.

- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

- Promote the conservation of forest cover. Building on land that is already deforested affects basin hydrology to a lesser extent than converting forested land. Loss of forest cover reduces interception storage, detention in the organic forest floor layer, and water losses by evapotranspiration, resulting in large peak runoff increases and either their negative effects or the expense of countering them with structural solutions.

- Maintain natural storage reservoirs and drainage corridors, including depressions, areas of permeable soils, swales, and intermittent streams. Develop and implement policies and

regulations to discourage the clearing, filling, and channelization of these features. Utilize them in drainage networks in preference to pipes, culverts, and engineered ditches.

- Evaluating infiltration opportunities by referring to the stormwater management manual for the jurisdiction and pay particular attention to the selection criteria for avoiding groundwater contamination, poor soils, and hydrogeological conditions that cause these facilities to fail. If necessary, locate developments with large amounts of impervious surfaces or a potential to produce relatively contaminated runoff away from groundwater recharge areas.

Protection of Slopes and Channels during Landscape Design

- Convey runoff safely from the tops of slopes.
- Avoid disturbing steep or unstable slopes.
- Avoid disturbing natural channels.
- Stabilize disturbed slopes as quickly as possible.
- Vegetate slopes with native or drought tolerant vegetation.
- Control and treat flows in landscaping and/or other controls prior to reaching existing natural drainage systems.
- Stabilize temporary and permanent channel crossings as quickly as possible, and ensure that increases in run-off velocity and frequency caused by the project do not erode the channel.
- Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.
- Line on-site conveyance channels where appropriate, to reduce erosion caused by increased flow velocity due to increases in tributary impervious area. The first choice for linings should be grass or some other vegetative surface, since these materials not only reduce runoff velocities, but also provide water quality benefits from filtration and infiltration. If velocities in the channel are high enough to erode grass or other vegetative linings, riprap, concrete, soil cement, or geo-grid stabilization are other alternatives.
- Consider other design principles that are comparable and equally effective.

Redeveloping Existing Installations

Various jurisdictional stormwater management and mitigation plans (SUSMP, WQMP, etc.) define "redevelopment" in terms of amounts of additional impervious area, increases in gross floor area and/or exterior construction, and land disturbing activities with structural or impervious surfaces. The definition of " redevelopment" must be consulted to determine whether or not the requirements for new development apply to areas intended for redevelopment. If the definition applies, the steps outlined under "designing new installations" above should be followed.

Redevelopment may present significant opportunity to add features which had not previously been implemented. Examples include incorporation of depressions, areas of permeable soils, and swales in newly redeveloped areas. While some site constraints may exist due to the status of already existing infrastructure, opportunities should not be missed to maximize infiltration, slow runoff, reduce impervious areas, disconnect directly connected impervious areas.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Stormwater Management Manual for Western Washington, Washington State Department of Ecology, August 2001.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Landscape Maintenance SC-73

Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

Sediment	☑
Nutrients	☑
Trash	☑
Metals	
Bacteria	
Oil and Grease	
Organics	
Oxygen Demanding	☑

Description

Landscape maintenance activities include vegetation removal; herbicide and insecticide application; fertilizer application; watering; and other gardening and lawn care practices. Vegetation control typically involves a combination of chemical (herbicide) application and mechanical methods. All of these maintenance practices have the potential to contribute pollutants to the storm drain system. The major objectives of this BMP are to minimize the discharge of pesticides, herbicides and fertilizers to the storm drain system and receiving waters; prevent the disposal of landscape waste into the storm drain system by collecting and properly disposing of clippings and cuttings, and educating employees and the public.

Approach

Pollution Prevention

- Implement an integrated pest management (IPM) program. IPM is a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools.
- Choose low water using flowers, trees, shrubs, and groundcover.
- Consider alternative landscaping techniques such as naturescaping and xeriscaping.
- Conduct appropriate maintenance (i.e. properly timed fertilizing, weeding, pest control, and pruning) to help preserve the landscapes water efficiency.

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- Consider grass cycling (grass cycling is the natural recycling of grass by leaving the clippings on the lawn when mowing. Grass clippings decompose quickly and release valuable nutrients back into the lawn).

Suggested Protocols

Mowing, Trimming, and Weeding

- Whenever possible use mechanical methods of vegetation removal (e.g mowing with tractor-type or push mowers, hand cutting with gas or electric powered weed trimmers) rather than applying herbicides. Use hand weeding where practical.
- Avoid loosening the soil when conducting mechanical or manual weed control, this could lead to erosion. Use mulch or other erosion control measures when soils are exposed.
- Performing mowing at optimal times. Mowing should not be performed if significant rain events are predicted.
- Mulching mowers may be recommended for certain flat areas. Other techniques may be employed to minimize mowing such as selective vegetative planting using low maintenance grasses and shrubs.
- Collect lawn and garden clippings, pruning waste, tree trimmings, and weeds. Chip if necessary, and compost or dispose of at a landfill (see waste management section of this fact sheet).
- Place temporarily stockpiled material away from watercourses, and berm or cover stockpiles to prevent material releases to storm drains.

Planting

- Determine existing native vegetation features (location, species, size, function, importance) and consider the feasibility of protecting them. Consider elements such as their effect on drainage and erosion, hardiness, maintenance requirements, and possible conflicts between preserving vegetation and the resulting maintenance needs.
- Retain and/or plant selected native vegetation whose features are determined to be beneficial, where feasible. Native vegetation usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Consider using low water use groundcovers when planting or replanting.

Waste Management

- Compost leaves, sticks, or other collected vegetation or dispose of at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Place temporarily stockpiled material away from watercourses and storm drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Reduce the use of high nitrogen fertilizers that produce excess growth requiring more frequent mowing or trimming.

- Avoid landscape wastes in and around storm drain inlets by either using bagging equipment or by manually picking up the material.

Irrigation

- Where practical, use automatic timers to minimize runoff.
- Use popup sprinkler heads in areas with a lot of activity or where there is a chance the pipes may be broken. Consider the use of mechanisms that reduce water flow to sprinkler heads if broken.
- Ensure that there is no runoff from the landscaped area(s) if re-claimed water is used for irrigation.
- If bailing of muddy water is required (e.g. when repairing a water line leak), do not put it in the storm drain; pour over landscaped areas.
- Irrigate slowly or pulse irrigate to prevent runoff and then only irrigate as much as is needed.
- Apply water at rates that do not exceed the infiltration rate of the soil.

Fertilizer and Pesticide Management

- Utilize a comprehensive management system that incorporates integrated pest management (IPM) techniques. There are many methods and types of IPM, including the following:
  - Mulching can be used to prevent weeds where turf is absent, fencing installed to keep rodents out, and netting used to keep birds and insects away from leaves and fruit.
  - Visible insects can be removed by hand (with gloves or tweezers) and placed in soapy water or vegetable oil. Alternatively, insects can be sprayed off the plant with water or in some cases vacuumed off of larger plants.
  - Store-bought traps, such as species-specific, pheromone-based traps or colored sticky cards, can be used.
  - Slugs can be trapped in small cups filled with beer that are set in the ground so the slugs can get in easily.
  - In cases where microscopic parasites, such as bacteria and fungi, are causing damage to plants, the affected plant material can be removed and disposed of (pruning equipment should be disinfected with bleach to prevent spreading the disease organism).
  - Small mammals and birds can be excluded using fences, netting, tree trunk guards.
  - Beneficial organisms, such as bats, birds, green lacewings, ladybugs, praying mantis, ground beetles, parasitic nematodes, trichogramma wasps, seed head weevils, and spiders that prey on detrimental pest species can be promoted.
- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.

- Use pesticides only if there is an actual pest problem (not on a regular preventative schedule).
- Do not use pesticides if rain is expected. Apply pesticides only when wind speeds are low (less than 5 mph).
- Do not mix or prepare pesticides for application near storm drains.
- Prepare the minimum amount of pesticide needed for the job and use the lowest rate that will effectively control the pest.
- Employ techniques to minimize off-target application (e.g. spray drift) of pesticides, including consideration of alternative application techniques.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Calibrate fertilizer and pesticide application equipment to avoid excessive application.
- Periodically test soils for determining proper fertilizer use.
- Sweep pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Purchase only the amount of pesticide that you can reasonably use in a given time period (month or year depending on the product).
- Triple rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Dispose of empty pesticide containers according to the instructions on the container label.

Inspection

- Inspect irrigation system periodically to ensure that the right amount of water is being applied and that excessive runoff is not occurring. Minimize excess watering, and repair leaks in the irrigation system as soon as they are observed.
- Inspect pesticide/fertilizer equipment and transportation vehicles daily.

Training

- Educate and train employees on use of pesticides and in pesticide application techniques to prevent pollution. Pesticide application must be under the supervision of a California qualified pesticide applicator.
- Train/encourage municipal maintenance crews to use IPM techniques for managing public green areas.
- Annually train employees within departments responsible for pesticide application on the appropriate portions of the agency's IPM Policy, SOPs, and BMPs, and the latest IPM techniques.

- Employees who are not authorized and trained to apply pesticides should be periodically (at least annually) informed that they cannot use over-the-counter pesticides in or around the workplace.
- Use a training log or similar method to document training.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Have spill cleanup materials readily available and in a know in location
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- The Federal Pesticide, Fungicide, and Rodenticide Act and California Title 3, Division 6, Pesticides and Pest Control Operations place strict controls over pesticide application and handling and specify training, annual refresher, and testing requirements. The regulations generally cover: a list of approved pesticides and selected uses, updated regularly; general application information; equipment use and maintenance procedures; and record keeping. The California Department of Pesticide Regulations and the County Agricultural Commission coordinate and maintain the licensing and certification programs. All public agency employees who apply pesticides and herbicides in "agricultural use" areas such as parks, golf courses, rights-of-way and recreation areas should be properly certified in accordance with state regulations. Contracts for landscape maintenance should include similar requirements.
- All employees who handle pesticides should be familiar with the most recent material safety data sheet (MSDS) files.
- Municipalities do not have the authority to regulate the use of pesticides by school districts, however the California Healthy Schools Act of 2000 (AB 2260) has imposed requirements on California school districts regarding pesticide use in schools. Posting of notification prior to the application of pesticides is now required, and IPM is stated as the preferred approach to pest management in schools.

Requirements

Costs

Additional training of municipal employees will be required to address IPM techniques and BMPs. IPM methods will likely increase labor cost for pest control which may be offset by lower chemical costs.

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

Composting is one of the better disposal alternatives if locally available. Most municipalities either have or are planning yard waste composting facilities as a means of reducing the amount of waste going to the landfill. Lawn clippings from municipal maintenance programs as well as private sources would probably be compatible with most composting facilities

Contractors and Other Pesticide Users

Municipal agencies should develop and implement a process to ensure that any contractor employed to conduct pest control and pesticide application on municipal property engages in pest control methods consistent with the IPM Policy adopted by the agency. Specifically, municipalities should require contractors to follow the agency's IPM policy, SOPs, and BMPs; provide evidence to the agency of having received training on current IPM techniques when feasible; provide documentation of pesticide use on agency property to the agency in a timely manner.

References and Resources

King County Stormwater Pollution Control Manual. Best Management Practices for Businesses. 1995. King County Surface Water Management. July. On-line: http://dnr.metrokc.gov/wlr/dss/spcm.htm

Los Angeles County Stormwater Quality Model Programs. Public Agency Activities http://ladpw.org/wmd/npdes/model_links.cfm

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality Control Board. July. 1998.

Orange County Stormwater Program http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Santa Clara Valley Urban Runoff Pollution Prevention Program. 1997 Urban Runoff Management Plan. September 1997, updated October 2000.

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Landscaping and Lawn Care. Office of Water. Office of Wastewater Management. On-line: http://www.epa.gov/npdes/menuofbmps/poll_8.htm

Drainage System Maintenance SC-44

Objectives

- Cover
- Contain
- Educate
- Reduce/Minimize

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff and stormwater that may contain certain pollutants. The protocols in this fact sheet are intended to reduce pollutants reaching receiving waters through proper conveyance system operation and maintenance.

Targeted Constituents

Sediment	✓
Nutrients	
Trash	✓
Metals	
Bacteria	✓
Oil and Grease	
Organics	

Approach

Pollution Prevention

Maintain catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis to remove pollutants, reduce high pollutant concentrations during the first flush of storms, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Suggested Protocols

Catch Basins/Inlet Structures

- Staff should regularly inspect facilities to ensure compliance with the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC34 Waste Handling and Disposal).

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- Clean catch basins, storm drain inlets, and other conveyance structures before the wet season to remove sediments and debris accumulated during the summer.
- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes if necessary with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed. Do not dewater near a storm drain or stream.

Storm Drain Conveyance System

- Locate reaches of storm drain with deposit problems and develop a flushing schedule that keeps the pipe clear of excessive buildup.
- Collect and pump flushed effluent to the sanitary sewer for treatment whenever possible.

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge to reach the storm drain system when cleaning a storm drain pump station or other facility.
- Conduct routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.

Open Channel

- Modify storm channel characteristics to improve channel hydraulics, increase pollutant removals, and enhance channel/creek aesthetic and habitat value.
- Conduct channel modification/improvement in accordance with existing laws. Any person, government agency, or public utility proposing an activity that will change the natural (emphasis added) state of any river, stream, or lake in California, must enter into a Steam or Lake Alteration Agreement with the Department of Fish and Game. The developer-applicant should also contact local governments (city, county, special districts), other state agencies (SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS.

Illicit Connections and Discharges

- Look for evidence of illegal discharges or illicit connections during routine maintenance of conveyance system and drainage structures:
  - Is there evidence of spills such as paints, discoloring, etc?