GENERAL EARTHWORK AND GRADING SPECIFICATIONS

1.0 GENERAL INTENT

These specifications present general procedures and requirements for grading and earthwork as shown on the approved grading plans, including preparation of areas to be filled, placement of fill, installations of subdrains, and excavations. The recommendations contained in the geotechnical report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict. Evaluations performed by the consultant during the course of grading may result in new recommendations which could supersede these specifications or the recommendations of the geotechnical report.

2.0 EARTHWORK OBSERVATIONS AND TESTING

Prior to the commencement of grading, a qualified geotechnical consultant (soils engineer and engineering geologist, and their representatives) shall be employed for the purpose of observing earthwork procedures and testing the fills for conformance with the recommendations of the geotechnical report and these specifications. It will be necessary that the consultant provide adequate testing and observations so that he may determine that the work was accomplished as specified. It shall be the responsibility of the contractor to assist the consultant and keep him apprised of work schedules and changes so that he may schedule his personnel accordingly.

It shall be the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and approved grading plans. If, in the opinion of the consultant, unsatisfactory conditions, such as questionable soil, poor moisture conditions, inadequate compaction, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the consultant will be empowered to reject the work and recommend that construction be stopped until the unsatisfactory conditions are rectified.

Maximum dry density tests used to determine the degree of compaction will be performed in accordance with the American Society of Testing and Materials, test method ASTM D1557-09.

3.0 PREPARATION OF AREAS TO BE FILLED

3.1 Clearing and Grubbing

All brush, vegetation, and debris shall be removed or piled and otherwise disposed of.

3.2 Processing

The existing ground which is determined to be satisfactory for support of fill shall be scarified to a minimum depth of 6 inches. Existing ground which is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until the soils are broken down and free of large clay lumps or clods and until the working surface is reasonably uniform and free of uneven features which would inhibit uniform compaction.

3.3 Overexcavation

Soft, dry, spongy, highly fractured or otherwise unsuitable ground, extending to such depth that surface processing cannot adequately improve the condition, shall be overexcavated down to firm ground, approved by the consultant.

3.4 Moisture Conditioning

Overexcavated and processed soils shall be watered, dried-back, blended, and/or mixed, as required to attain a uniform moisture content near optimum.

3.5 Recompaction

Overexcavation and processed soils which have been properly mixed and moisture-conditioned shall be recompacted to a minimum relative compaction of 90 percent.

3.6 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal : vertical), the ground shall be stepped or benched. The lowest bench shall be a minimum of 15 feet wide, shall be at least 2 feet deep, shall expose firm materials, and shall be approved by the consultant. Other benches shall be excavated in firm materials for a minimum width of 4 feet. Ground sloping flatter than 5:1 (horizontal : vertical) shall be benched or otherwise overexcavated when considered necessary by the consultant.

3.7 Approval

All areas to receive fill, including processed areas, removal areas and toe-of-fill benches shall be approved by the consultant prior to fill placement.

4.0 FILL MATERIAL

4.1 General

Material to be placed as fill shall be free of organic matter and other deleterious substances, and shall be approved by the consultant. Soils of poor gradation, expansion, or strength characteristics shall be placed in areas designated by consultant or shall be mixed with other soils to serve as satisfactory fill material.

4.2 Oversize

Oversize materials defined as rock, or other irreducible material with maximum dimension greater than 12 inches, shall not be buried or placed in fills, unless the location, materials, and disposal methods are specifically approved by the consultant. Oversize disposal operations shall be such that nesting of oversize material does not occur, and such that the oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 feet vertically of finish grade or within the range of future utilities or underground construction, unless specifically approved by the consultant.

4.3 Import

If importing of fill material is required for grading, the import material shall meet the requirements of Section 4.1.

5.0 FILL PLACEMENT and COMPACTION

5.1 Fill Lifts

Approved fill material shall be placed in areas prepared to receive fill in near-horizontal layers not exceeding 6 inches in compacted thickness. The consultant may approve thicker lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to attain uniformity of material and moisture in each layer.

5.2 Fill Moisture

Fill layers at a moisture content less than optimum shall be watered and mixed, and wet fill layers shall be aerated by scarification or shall be blended with drier material. Moisture conditioning and mixing of fill layers shall continue until the fill material is at a uniform moisture content at or near optimum.

5.3 Compaction of Fill

After each layer has been evenly spread, moisture-conditioned, and mixed, it shall be uniformly compacted to not less than 90 percent of maximum dry density. Compaction equipment shall be adequately sized and shall be either specifically designed for soil compaction or of proven reliability, to efficiently achieve the specified degree of compaction.

5.4 *Fill Slopes*

Compacting of slopes shall be accomplished, in addition to normal compacting procedures, by backrolling of slopes with sheepsfoot rollers at frequent increments of 2 to 3 feet in fill elevation gain, or by other methods producing satisfactory results. At the completion of grading, the relative compaction of the slope out to the slope face shall be at least 90 percent.

5.5 *Compaction Testing*

Field-tests to check the fill moisture and degree of compaction will be performed by the consultant. The location and frequency of tests shall be at the consultant's discretion. In general, the tests will be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of embankment.

6.0 SUBDRAIN INSTALLATION

Subdrain systems, if required, shall be installed in approved ground to conform to the approximate alignment and details shown on the plans or herein. The subdrain location or materials shall not be changed or modified without the approval of the consultant. The consultant, however, may recommend and upon approval, direct changes in subdrain line, grade or material. All subdrains should be surveyed for line and grade after installation and sufficient time shall be allowed for the surveys, prior to commencement of filling over the subdrain.

7.0 EXCAVATION

Excavations and cut slopes will be examined during grading. If directed by the consultant, further excavation or overexcavation and refilling of cut areas shall be performed, and/or remedial grading of cut slopes shall be performed. Where fill-over-cut slopes are to be graded, unless otherwise approved, the cut portion of the slope shall be made and approved by the consultant prior to placement of materials for construction of the fill portion of the slope.

8.0 TRENCH BACKFILLS

Trench excavations for utility pipes shall be backfilled under engineering supervision.

After the utility pipe has been laid, the space under and around the pipe shall be backfilled with clean sand or approved granular soil to a depth of at least one foot over the top of the pipe. The sand backfill shall be uniformly jetted into place before the controlled backfill is placed over the sand.

The onsite materials, or other soils approved by the soil engineer, shall be watered and mixed as necessary prior to placement in lifts over the sand backfill.

The controlled backfill shall be compacted to at least 90 percent of the maximum dry density as determined by the ASTM D1557-09 test method.

Field density tests and inspection of the backfill procedures shall be made by the soil engineer during backfilling to see that proper moisture content and uniform compaction is being maintained. The contractor shall provide test holes and exploratory pits as required by the soil engineer to enable sampling and testing.

SOIL
EXPLORATION
COMPANY, INC.

Soil Engineering, Environmental Engineering, Materials Testing, Geology

December 16, 2019

Project No. 13167-01

TO: West Coast Hotels Group LLC
19215 Wild Mustang Ct.
Apple Valley, CA 92307

ATTENTION: Hitesh Patel

SUBJECT: California Building Code (CBC) 2016 Seismic Update, Proposed 8.8±Acre, 14 Lot Residential Subdivision, SEC Victoria Avenue and La Sierra Avenue, City of Riverside, California

REFERENCES: Soil Exploration Co., Inc., "Preliminary Geotechnical Investigation/Liquefaction Evaluation/Infiltration Tests Report, Proposed 8.8± Acre, 14 Lot Residential Subdivision, SEC of Victoria Avenue and La Sierra Avenue (APN 136-220-016), City of Riverside, California", Dated January 24, 2014 (Project No. 13167-01).

Introduction

As requested, we have prepared the following updated seismic parameters for the subject site.

CBC 2016 Seismic Parameters

The CBC (2016) seismic parameters for the site are tabulated below:

2016 CBC – SEISMIC PARAMETERS		
Site Coordinates	**Latitude**	**Longitude**
	33.8875	**-117.4619**
Mapped Spectral Response Acceleration	**S_s = 1.500**	**S_1 = 0.600**
Site Coefficients (Class "D")	**F_a = 1.00**	**F_v = 1.50**
Maximum Considered Earthquake (MCE) Spectral Response Acceleration	**S_{MS} = 1.500**	**S_{M1} = 0.900**
Design Spectral Response Acceleration Parameters	**S_{DS} = 1.000**	**S_{D1} = 0.600**
Seismic Design Category	D	
Peak Ground Acceleration (PGA)	**0.514g**	

References:

- Earthquake.usgs.gov/research/hazmaps/design
- 2016 California Building Code, California Code of Regulations, Title 24, Part 2, Volume 2 of 2, Section 1613, Earthquake Loads

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soilexploration@yahoo.com • www.soilexp.com

Foundation Plan Review/Additional Observations and Testing

Soil Exploration Co., Inc. should review the foundation plans and observe and/or test at the following stages of construction:

- During any additional grading or fill placement.
- Following footings excavation and prior to placement of footing materials.
- During all utility trench backfills and street subgrade/base compaction.
- Following wetting of slab subgrade (1.2X optimum to a depth of at least 6") and prior to placement of slab materials.
- When any unusual conditions are encountered.

Limitation

Soil Exploration Co., Inc. has striven to perform our services within the limits prescribed by our client, and in a manner consistent with the usual thoroughness and competence of reputable soils engineers practicing under similar circumstances. No other representation, express or implied, and no warranty or guarantee is included or intended by virtue of the services performed or reports, opinion, documents, or otherwise supplied.

Closure

If you should have any questions regarding this report, please do not hesitate to contact our office. We appreciate this opportunity to be of service.

Very truly yours,
Soil Exploration Co., Inc.

REGISTERED PROFESSIONAL ENGINEER
GENE KINH-TOAN LUU
C 53417
EXP. 6/30/21
CIVIL
STATE OF CALIFORNIA

Gene K. Luu, PE 53417
Project Engineer

Distribution: [1] Addressee (hitesh@westcoasthotelsgroup.com)

Attachments: Figure 1 Site Location Map

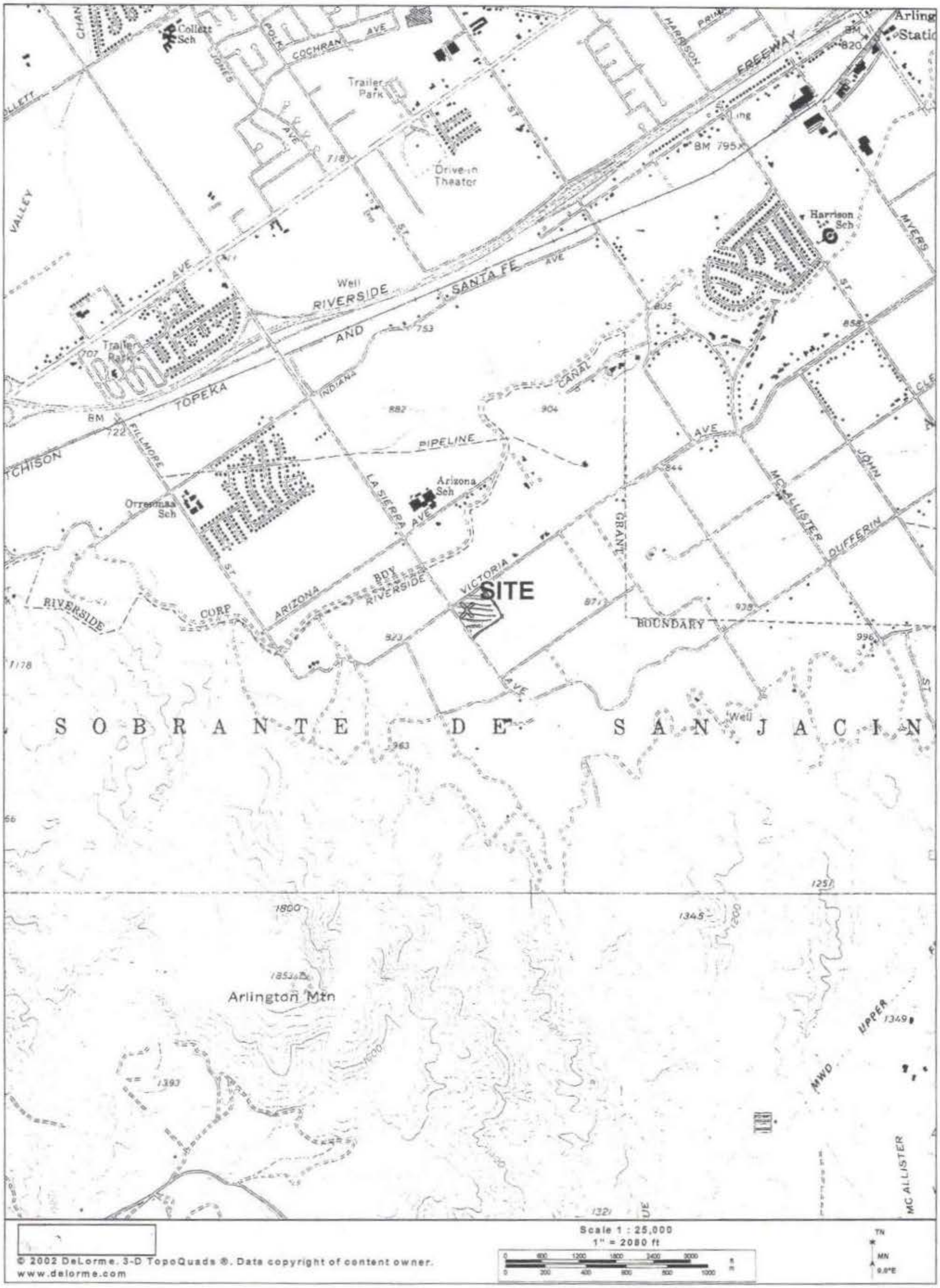
SITE
Arlington Station
FREEWAY
HARRISON
COCHRAN AVE
POLK AVE
JONES
Collett Sch
Trailer Park
Drive-in Theater
BM 795
BM 820
Harrison Sch
MYERS
VALLEY
RIVERSIDE AVE
SANTA FE
AND
TOPEKA
TCHISON
Well
INDIANA
FILLMORE
BM 722
PIPELINE
CANAL
Arizona Sch
Orrenmaa Sch
LA SIERRA AVE
ARIZONA
VICTORIA
GRANT
RIVERSIDE CORP BDY
BOUNDARY
MC ALLISTER
DUFFERIN
JOHN
ST
AVE
S O B R A N T E D E S A N J A C I N
Arlington Mtn
UPPER
MWD
MC ALLISTER
© 2002 DeLorme. 3-D TopoQuads ®. Data copyright of content owner.
www.delorme.com
Scale 1 : 25,000
1" = 2080 ft
TN
MN

Figure 1

Appendix 4: Historical Site Conditions

Phase I Environmental Site Assessment or Other Information on Past Site Use

Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

Santa Ana Watershed - BMP Design Volume, V_{BMP}

(Rev. 10-2011)

Legend: Required Entries / Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Adkan Engineers — Date: 1/31/2022

Designed by: Israel Duque — Case No:

Company Project Number/Name: Warmington- Tract 36713

BMP Identification

BMP NAME / ID: Inflitration basin

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth,
from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.56 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
C1	*132538*	*Roofs*	*1.00*	*0.89*	*118223.9*			
C2	*65141*	*Concrete or Asphalt*	*1.00*	*0.89*	*58105.8*			
C3	*111239*	*Ornamental Landscaping*	*0.1*	*0.11*	*12287.2*			
B1	*3674*	*Natural (A Soil)*	*0.03*	*0.06*	*229.8*			
	312592	***Total***			**188846.7**	**0.56**	***8812.8***	***9177.5***

Notes:

Infiltration Basin - Design Procedure (Rev. 03-2012)	BMP ID	Legend:	Required Entries / Calculated Cells

Company Name:	Adkan Engineers	Date:	
Designed by:	ISRAEL DUQUE	County/City Case No.:	

Design Volume

a) Tributary area (BMP subarea)	$A_T =$	7.4	acres
b) Enter V_{BMP} determined from Section 2.1 of this Handbook	$V_{BMP} =$	8,832	ft^3

Maximum Depth

a) Infiltration rate	I =	2.85	in/hr
b) Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" from this BMP Handbook)	FS =	3	
c) Calculate D_1 $\quad D_1 = \dfrac{I\ (in/hr) \times 72\ hrs}{12\ (in/ft) \times FS}$	$D_1 =$	5.7	ft
d) Enter the depth of freeboard (at least 1 ft)		1	ft
e) Enter depth to historic high ground water (measured from **top** of basin)		15	ft
f) Enter depth to top of bedrock or impermeable layer (measured from **top** of basin)		15	ft
g) D_2 is the smaller of: Depth to groundwater - (10 ft + freeboard) and Depth to impermeable layer - (5 ft + freeboard)	$D_2 =$	4.0	ft
h) D_{MAX} is the smaller value of D_1 and D_2 but shall not exceed 5 feet	$D_{MAX} =$	4.0	ft

Basin Geometry

a) Basin side slopes (no steeper than 4:1) — Slope no steeper than 4:1	z =	2	:1
b) Proposed basin depth (excluding freeboard)	$d_B =$	2.5	ft
c) Minimum bottom surface area of basin ($A_S = V_{BMP}/d_B$)	$A_S =$	3533	ft^2
d) Proposed Design Surface Area	$A_D =$	3,671	ft^2

Forebay

a) Forebay volume (minimum 0.5% V_{BMP})	Volume =	44	ft^3
b) Forebay depth (height of berm/splashwall. 1 foot min.)	Depth =	1	ft
c) Forebay surface area (minimum)	Area =	44	ft^2
d) Full height notch-type weir	Width (W) =	36.0	in

Notes:

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

Basin Storage Volume Calculations	
Infiltration Basin Bottom Area (sf)	3674
Basin Top Area (sf)	4899
Depth of Basin (ft)	2.5
Open Basin Volume Provided (cf)	10716
Rock Storage depth (ft)	4.6
Rock Storage Volume (40% void) (cf)	6755
Total Flood Volume Stored	**17472**
Ex. 2-yr 24-hr Storm Volume (cf)	8233
Prop. 2-yr 24-hr Storm Volume (cf)	26528
Allowable 2-yr 24-hr Storm Volume (mitigated to 110% of existing) (cf)	**9056**
Prop. 2-yr 24-hr Storm Volume (cf)	26528
Total Flood Volume Stored	17472
Remaining Storm Volume	**9056**

```
      U n i t   H y d r o g r a p h   A n a l y s i s

      Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2008, Version 8.1
             Study date  02/22/24 File: EX2YR242.out

++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
------------------------------------------------------------------------

Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 5006

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
--------------------------------------------------------------------
Drainage Area =       7.00(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.00(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =     596.00(Ft.)
Length along longest watercourse measured to centroid =     300.00(Ft.)
Length along longest watercourse =      0.113 Mi.
Length along longest watercourse measured to centroid =      0.057 Mi.
Difference in elevation =      26.00(Ft.)
Slope along watercourse =    230.3356 Ft./Mi.
Average Manning's 'N' = 0.030
Lag time =    0.038 Hr.
Lag time =     2.26 Min.
25% of lag time =     0.56 Min.
40% of lag time =     0.90 Min.
Unit time =     5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.00           1.80                 12.60

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.00           6.00                 42.00

STORM EVENT (YEAR) =    2.00
Area Averaged 2-Year Rainfall =    1.800(In)
Area Averaged 100-Year Rainfall =    6.000(In)

Point rain (area averaged) =    1.800(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.800(In)

Sub-Area Data:
Area(Ac.)          Runoff Index   Impervious %
     7.000            72.00         0.100
 Total Area Entered =      7.00(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)     (In/Hr)      (Dec.)    (In/Hr)
72.0  53.4      0.537     0.100        0.489       1.000      0.489
                                                  Sum (F) =   0.489
Area averaged mean soil loss (F) (In/Hr) =  0.489
Minimum soil loss rate ((In/Hr)) =  0.244
(for 24 hour storm duration)
Soil low loss rate (decimal) =   0.820
---------------------------------------------------------------------

               U n i t   H y d r o g r a p h
                      VALLEY S-Curve
--------------------------------------------------------------------
               Unit Hydrograph Data
---------------------------------------------------------------------
Unit time period   Time % of lag   Distribution   Unit Hydrograph
    (hrs)                            Graph %           (CFS)
```

1	0.083	221.634	46.905	3.309
2	0.167	443.269	41.886	2.955
3	0.250	664.903	7.981	0.563
4	0.333	886.537	3.228	0.228
			Sum = 100.000	Sum= 7.055

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Loss rate(In./Hr) Low	Effective (In/Hr)
1	0.08	0.07	0.014	(0.867)	0.012	0.003
2	0.17	0.07	0.014	(0.863)	0.012	0.003
3	0.25	0.07	0.014	(0.860)	0.012	0.003
4	0.33	0.10	0.022	(0.857)	0.018	0.004
5	0.42	0.10	0.022	(0.853)	0.018	0.004
6	0.50	0.10	0.022	(0.850)	0.018	0.004
7	0.58	0.10	0.022	(0.847)	0.018	0.004
8	0.67	0.10	0.022	(0.843)	0.018	0.004
9	0.75	0.10	0.022	(0.840)	0.018	0.004
10	0.83	0.13	0.029	(0.837)	0.024	0.005
11	0.92	0.13	0.029	(0.834)	0.024	0.005
12	1.00	0.13	0.029	(0.830)	0.024	0.005
13	1.08	0.10	0.022	(0.827)	0.018	0.004
14	1.17	0.10	0.022	(0.824)	0.018	0.004
15	1.25	0.10	0.022	(0.820)	0.018	0.004
16	1.33	0.10	0.022	(0.817)	0.018	0.004
17	1.42	0.10	0.022	(0.814)	0.018	0.004
18	1.50	0.10	0.022	(0.811)	0.018	0.004
19	1.58	0.10	0.022	(0.807)	0.018	0.004
20	1.67	0.10	0.022	(0.804)	0.018	0.004
21	1.75	0.10	0.022	(0.801)	0.018	0.004
22	1.83	0.13	0.029	(0.798)	0.024	0.005
23	1.92	0.13	0.029	(0.795)	0.024	0.005
24	2.00	0.13	0.029	(0.791)	0.024	0.005
25	2.08	0.13	0.029	(0.788)	0.024	0.005
26	2.17	0.13	0.029	(0.785)	0.024	0.005
27	2.25	0.13	0.029	(0.782)	0.024	0.005
28	2.33	0.13	0.029	(0.779)	0.024	0.005
29	2.42	0.13	0.029	(0.775)	0.024	0.005
30	2.50	0.13	0.029	(0.772)	0.024	0.005
31	2.58	0.17	0.036	(0.769)	0.030	0.006
32	2.67	0.17	0.036	(0.766)	0.030	0.006
33	2.75	0.17	0.036	(0.763)	0.030	0.006
34	2.83	0.17	0.036	(0.760)	0.030	0.006
35	2.92	0.17	0.036	(0.756)	0.030	0.006
36	3.00	0.17	0.036	(0.753)	0.030	0.006
37	3.08	0.17	0.036	(0.750)	0.030	0.006
38	3.17	0.17	0.036	(0.747)	0.030	0.006
39	3.25	0.17	0.036	(0.744)	0.030	0.006
40	3.33	0.17	0.036	(0.741)	0.030	0.006
41	3.42	0.17	0.036	(0.738)	0.030	0.006
42	3.50	0.17	0.036	(0.735)	0.030	0.006
43	3.58	0.17	0.036	(0.732)	0.030	0.006
44	3.67	0.17	0.036	(0.729)	0.030	0.006
45	3.75	0.17	0.036	(0.726)	0.030	0.006
46	3.83	0.20	0.043	(0.722)	0.035	0.008
47	3.92	0.20	0.043	(0.719)	0.035	0.008
48	4.00	0.20	0.043	(0.716)	0.035	0.008
49	4.08	0.20	0.043	(0.713)	0.035	0.008
50	4.17	0.20	0.043	(0.710)	0.035	0.008
51	4.25	0.20	0.043	(0.707)	0.035	0.008
52	4.33	0.23	0.050	(0.704)	0.041	0.009
53	4.42	0.23	0.050	(0.701)	0.041	0.009
54	4.50	0.23	0.050	(0.698)	0.041	0.009
55	4.58	0.23	0.050	(0.695)	0.041	0.009
56	4.67	0.23	0.050	(0.692)	0.041	0.009
57	4.75	0.23	0.050	(0.689)	0.041	0.009
58	4.83	0.27	0.058	(0.686)	0.047	0.010
59	4.92	0.27	0.058	(0.683)	0.047	0.010
60	5.00	0.27	0.058	(0.680)	0.047	0.010
61	5.08	0.20	0.043	(0.677)	0.035	0.008
62	5.17	0.20	0.043	(0.674)	0.035	0.008
63	5.25	0.20	0.043	(0.672)	0.035	0.008
64	5.33	0.23	0.050	(0.669)	0.041	0.009
65	5.42	0.23	0.050	(0.666)	0.041	0.009
66	5.50	0.23	0.050	(0.663)	0.041	0.009
67	5.58	0.27	0.058	(0.660)	0.047	0.010
68	5.67	0.27	0.058	(0.657)	0.047	0.010
69	5.75	0.27	0.058	(0.654)	0.047	0.010
70	5.83	0.27	0.058	(0.651)	0.047	0.010
71	5.92	0.27	0.058	(0.648)	0.047	0.010
72	6.00	0.27	0.058	(0.645)	0.047	0.010

73	6.08	0.30	0.065	(0.643)	0.053	0.012
74	6.17	0.30	0.065	(0.640)	0.053	0.012
75	6.25	0.30	0.065	(0.637)	0.053	0.012
76	6.33	0.30	0.065	(0.634)	0.053	0.012
77	6.42	0.30	0.065	(0.631)	0.053	0.012
78	6.50	0.30	0.065	(0.628)	0.053	0.012
79	6.58	0.33	0.072	(0.626)	0.059	0.013
80	6.67	0.33	0.072	(0.623)	0.059	0.013
81	6.75	0.33	0.072	(0.620)	0.059	0.013
82	6.83	0.33	0.072	(0.617)	0.059	0.013
83	6.92	0.33	0.072	(0.614)	0.059	0.013
84	7.00	0.33	0.072	(0.612)	0.059	0.013
85	7.08	0.33	0.072	(0.609)	0.059	0.013
86	7.17	0.33	0.072	(0.606)	0.059	0.013
87	7.25	0.33	0.072	(0.603)	0.059	0.013
88	7.33	0.37	0.079	(0.600)	0.065	0.014
89	7.42	0.37	0.079	(0.598)	0.065	0.014
90	7.50	0.37	0.079	(0.595)	0.065	0.014
91	7.58	0.40	0.086	(0.592)	0.071	0.016
92	7.67	0.40	0.086	(0.589)	0.071	0.016
93	7.75	0.40	0.086	(0.587)	0.071	0.016
94	7.83	0.43	0.094	(0.584)	0.077	0.017
95	7.92	0.43	0.094	(0.581)	0.077	0.017
96	8.00	0.43	0.094	(0.579)	0.077	0.017
97	8.08	0.50	0.108	(0.576)	0.089	0.019
98	8.17	0.50	0.108	(0.573)	0.089	0.019
99	8.25	0.50	0.108	(0.571)	0.089	0.019
100	8.33	0.50	0.108	(0.568)	0.089	0.019
101	8.42	0.50	0.108	(0.565)	0.089	0.019
102	8.50	0.50	0.108	(0.563)	0.089	0.019
103	8.58	0.53	0.115	(0.560)	0.094	0.021
104	8.67	0.53	0.115	(0.557)	0.094	0.021
105	8.75	0.53	0.115	(0.555)	0.094	0.021
106	8.83	0.57	0.122	(0.552)	0.100	0.022
107	8.92	0.57	0.122	(0.550)	0.100	0.022
108	9.00	0.57	0.122	(0.547)	0.100	0.022
109	9.08	0.63	0.137	(0.544)	0.112	0.025
110	9.17	0.63	0.137	(0.542)	0.112	0.025
111	9.25	0.63	0.137	(0.539)	0.112	0.025
112	9.33	0.67	0.144	(0.537)	0.118	0.026
113	9.42	0.67	0.144	(0.534)	0.118	0.026
114	9.50	0.67	0.144	(0.531)	0.118	0.026
115	9.58	0.70	0.151	(0.529)	0.124	0.027
116	9.67	0.70	0.151	(0.526)	0.124	0.027
117	9.75	0.70	0.151	(0.524)	0.124	0.027
118	9.83	0.73	0.158	(0.521)	0.130	0.029
119	9.92	0.73	0.158	(0.519)	0.130	0.029
120	10.00	0.73	0.158	(0.516)	0.130	0.029
121	10.08	0.50	0.108	(0.514)	0.089	0.019
122	10.17	0.50	0.108	(0.511)	0.089	0.019
123	10.25	0.50	0.108	(0.509)	0.089	0.019
124	10.33	0.50	0.108	(0.506)	0.089	0.019
125	10.42	0.50	0.108	(0.504)	0.089	0.019
126	10.50	0.50	0.108	(0.501)	0.089	0.019
127	10.58	0.67	0.144	(0.499)	0.118	0.026
128	10.67	0.67	0.144	(0.497)	0.118	0.026
129	10.75	0.67	0.144	(0.494)	0.118	0.026
130	10.83	0.67	0.144	(0.492)	0.118	0.026
131	10.92	0.67	0.144	(0.489)	0.118	0.026
132	11.00	0.67	0.144	(0.487)	0.118	0.026
133	11.08	0.63	0.137	(0.485)	0.112	0.025
134	11.17	0.63	0.137	(0.482)	0.112	0.025
135	11.25	0.63	0.137	(0.480)	0.112	0.025
136	11.33	0.63	0.137	(0.477)	0.112	0.025
137	11.42	0.63	0.137	(0.475)	0.112	0.025
138	11.50	0.63	0.137	(0.473)	0.112	0.025
139	11.58	0.57	0.122	(0.470)	0.100	0.022
140	11.67	0.57	0.122	(0.468)	0.100	0.022
141	11.75	0.57	0.122	(0.466)	0.100	0.022
142	11.83	0.60	0.130	(0.463)	0.106	0.023
143	11.92	0.60	0.130	(0.461)	0.106	0.023
144	12.00	0.60	0.130	(0.459)	0.106	0.023
145	12.08	0.83	0.180	(0.456)	0.148	0.032
146	12.17	0.83	0.180	(0.454)	0.148	0.032
147	12.25	0.83	0.180	(0.452)	0.148	0.032
148	12.33	0.87	0.187	(0.450)	0.154	0.034
149	12.42	0.87	0.187	(0.447)	0.154	0.034
150	12.50	0.87	0.187	(0.445)	0.154	0.034
151	12.58	0.93	0.202	(0.443)	0.165	0.036
152	12.67	0.93	0.202	(0.441)	0.165	0.036
153	12.75	0.93	0.202	(0.438)	0.165	0.036
154	12.83	0.97	0.209	(0.436)	0.171	0.038
155	12.92	0.97	0.209	(0.434)	0.171	0.038
156	13.00	0.97	0.209	(0.432)	0.171	0.038
157	13.08	1.13	0.245	(0.430)	0.201	0.044
158	13.17	1.13	0.245	(0.427)	0.201	0.044

159	13.25	1.13	0.245	(0.425)	0.201	0.044
160	13.33	1.13	0.245	(0.423)	0.201	0.044
161	13.42	1.13	0.245	(0.421)	0.201	0.044
162	13.50	1.13	0.245	(0.419)	0.201	0.044
163	13.58	0.77	0.166	(0.417)	0.136	0.030
164	13.67	0.77	0.166	(0.415)	0.136	0.030
165	13.75	0.77	0.166	(0.412)	0.136	0.030
166	13.83	0.77	0.166	(0.410)	0.136	0.030
167	13.92	0.77	0.166	(0.408)	0.136	0.030
168	14.00	0.77	0.166	(0.406)	0.136	0.030
169	14.08	0.90	0.194	(0.404)	0.159	0.035
170	14.17	0.90	0.194	(0.402)	0.159	0.035
171	14.25	0.90	0.194	(0.400)	0.159	0.035
172	14.33	0.87	0.187	(0.398)	0.154	0.034
173	14.42	0.87	0.187	(0.396)	0.154	0.034
174	14.50	0.87	0.187	(0.394)	0.154	0.034
175	14.58	0.87	0.187	(0.392)	0.154	0.034
176	14.67	0.87	0.187	(0.390)	0.154	0.034
177	14.75	0.87	0.187	(0.388)	0.154	0.034
178	14.83	0.83	0.180	(0.386)	0.148	0.032
179	14.92	0.83	0.180	(0.384)	0.148	0.032
180	15.00	0.83	0.180	(0.382)	0.148	0.032
181	15.08	0.80	0.173	(0.380)	0.142	0.031
182	15.17	0.80	0.173	(0.378)	0.142	0.031
183	15.25	0.80	0.173	(0.376)	0.142	0.031
184	15.33	0.77	0.166	(0.374)	0.136	0.030
185	15.42	0.77	0.166	(0.372)	0.136	0.030
186	15.50	0.77	0.166	(0.370)	0.136	0.030
187	15.58	0.63	0.137	(0.368)	0.112	0.025
188	15.67	0.63	0.137	(0.367)	0.112	0.025
189	15.75	0.63	0.137	(0.365)	0.112	0.025
190	15.83	0.63	0.137	(0.363)	0.112	0.025
191	15.92	0.63	0.137	(0.361)	0.112	0.025
192	16.00	0.63	0.137	(0.359)	0.112	0.025
193	16.08	0.13	0.029	(0.357)	0.024	0.005
194	16.17	0.13	0.029	(0.355)	0.024	0.005
195	16.25	0.13	0.029	(0.354)	0.024	0.005
196	16.33	0.13	0.029	(0.352)	0.024	0.005
197	16.42	0.13	0.029	(0.350)	0.024	0.005
198	16.50	0.13	0.029	(0.348)	0.024	0.005
199	16.58	0.10	0.022	(0.346)	0.018	0.004
200	16.67	0.10	0.022	(0.345)	0.018	0.004
201	16.75	0.10	0.022	(0.343)	0.018	0.004
202	16.83	0.10	0.022	(0.341)	0.018	0.004
203	16.92	0.10	0.022	(0.339)	0.018	0.004
204	17.00	0.10	0.022	(0.338)	0.018	0.004
205	17.08	0.17	0.036	(0.336)	0.030	0.006
206	17.17	0.17	0.036	(0.334)	0.030	0.006
207	17.25	0.17	0.036	(0.333)	0.030	0.006
208	17.33	0.17	0.036	(0.331)	0.030	0.006
209	17.42	0.17	0.036	(0.329)	0.030	0.006
210	17.50	0.17	0.036	(0.328)	0.030	0.006
211	17.58	0.17	0.036	(0.326)	0.030	0.006
212	17.67	0.17	0.036	(0.324)	0.030	0.006
213	17.75	0.17	0.036	(0.323)	0.030	0.006
214	17.83	0.13	0.029	(0.321)	0.024	0.005
215	17.92	0.13	0.029	(0.320)	0.024	0.005
216	18.00	0.13	0.029	(0.318)	0.024	0.005
217	18.08	0.13	0.029	(0.316)	0.024	0.005
218	18.17	0.13	0.029	(0.315)	0.024	0.005
219	18.25	0.13	0.029	(0.313)	0.024	0.005
220	18.33	0.13	0.029	(0.312)	0.024	0.005
221	18.42	0.13	0.029	(0.310)	0.024	0.005
222	18.50	0.13	0.029	(0.309)	0.024	0.005
223	18.58	0.10	0.022	(0.307)	0.018	0.004
224	18.67	0.10	0.022	(0.306)	0.018	0.004
225	18.75	0.10	0.022	(0.304)	0.018	0.004
226	18.83	0.07	0.014	(0.303)	0.012	0.003
227	18.92	0.07	0.014	(0.301)	0.012	0.003
228	19.00	0.07	0.014	(0.300)	0.012	0.003
229	19.08	0.10	0.022	(0.299)	0.018	0.004
230	19.17	0.10	0.022	(0.297)	0.018	0.004
231	19.25	0.10	0.022	(0.296)	0.018	0.004
232	19.33	0.13	0.029	(0.294)	0.024	0.005
233	19.42	0.13	0.029	(0.293)	0.024	0.005
234	19.50	0.13	0.029	(0.292)	0.024	0.005
235	19.58	0.10	0.022	(0.290)	0.018	0.004
236	19.67	0.10	0.022	(0.289)	0.018	0.004
237	19.75	0.10	0.022	(0.288)	0.018	0.004
238	19.83	0.07	0.014	(0.286)	0.012	0.003
239	19.92	0.07	0.014	(0.285)	0.012	0.003
240	20.00	0.07	0.014	(0.284)	0.012	0.003
241	20.08	0.10	0.022	(0.283)	0.018	0.004
242	20.17	0.10	0.022	(0.281)	0.018	0.004
243	20.25	0.10	0.022	(0.280)	0.018	0.004
244	20.33	0.10	0.022	(0.279)	0.018	0.004

245	20.42	0.10	0.022	(0.278)	0.018	0.004
246	20.50	0.10	0.022	(0.277)	0.018	0.004
247	20.58	0.10	0.022	(0.275)	0.018	0.004
248	20.67	0.10	0.022	(0.274)	0.018	0.004
249	20.75	0.10	0.022	(0.273)	0.018	0.004
250	20.83	0.07	0.014	(0.272)	0.012	0.003
251	20.92	0.07	0.014	(0.271)	0.012	0.003
252	21.00	0.07	0.014	(0.270)	0.012	0.003
253	21.08	0.10	0.022	(0.269)	0.018	0.004
254	21.17	0.10	0.022	(0.268)	0.018	0.004
255	21.25	0.10	0.022	(0.267)	0.018	0.004
256	21.33	0.07	0.014	(0.266)	0.012	0.003
257	21.42	0.07	0.014	(0.265)	0.012	0.003
258	21.50	0.07	0.014	(0.264)	0.012	0.003
259	21.58	0.10	0.022	(0.263)	0.018	0.004
260	21.67	0.10	0.022	(0.262)	0.018	0.004
261	21.75	0.10	0.022	(0.261)	0.018	0.004
262	21.83	0.07	0.014	(0.260)	0.012	0.003
263	21.92	0.07	0.014	(0.259)	0.012	0.003
264	22.00	0.07	0.014	(0.258)	0.012	0.003
265	22.08	0.10	0.022	(0.257)	0.018	0.004
266	22.17	0.10	0.022	(0.256)	0.018	0.004
267	22.25	0.10	0.022	(0.256)	0.018	0.004
268	22.33	0.07	0.014	(0.255)	0.012	0.003
269	22.42	0.07	0.014	(0.254)	0.012	0.003
270	22.50	0.07	0.014	(0.253)	0.012	0.003
271	22.58	0.07	0.014	(0.253)	0.012	0.003
272	22.67	0.07	0.014	(0.252)	0.012	0.003
273	22.75	0.07	0.014	(0.251)	0.012	0.003
274	22.83	0.07	0.014	(0.251)	0.012	0.003
275	22.92	0.07	0.014	(0.250)	0.012	0.003
276	23.00	0.07	0.014	(0.249)	0.012	0.003
277	23.08	0.07	0.014	(0.249)	0.012	0.003
278	23.17	0.07	0.014	(0.248)	0.012	0.003
279	23.25	0.07	0.014	(0.248)	0.012	0.003
280	23.33	0.07	0.014	(0.247)	0.012	0.003
281	23.42	0.07	0.014	(0.247)	0.012	0.003
282	23.50	0.07	0.014	(0.246)	0.012	0.003
283	23.58	0.07	0.014	(0.246)	0.012	0.003
284	23.67	0.07	0.014	(0.245)	0.012	0.003
285	23.75	0.07	0.014	(0.245)	0.012	0.003
286	23.83	0.07	0.014	(0.245)	0.012	0.003
287	23.92	0.07	0.014	(0.245)	0.012	0.003
288	24.00	0.07	0.014	(0.245)	0.012	0.003
			(Loss Rate Not Used)			
Sum =		100.0			Sum =	3.9

```
   Flood volume = Effective rainfall      0.32(In)
    times area       7.0(Ac.)/[(In)/(Ft.)] =       0.2(Ac.Ft)
   Total soil loss =      1.48(In)
   Total soil loss =     0.861(Ac.Ft)
   Total rainfall =      1.80(In)
   Flood volume =        8232.7 Cubic Feet
   Total soil loss =       37504.6 Cubic Feet
   --------------------------------------------------------------------
    Peak flow rate of this hydrograph =      0.311(CFS)
   --------------------------------------------------------------------
   ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                       24 - H O U R   S T O R M
                  R u n o f f     H y d r o g r a p h
   --------------------------------------------------------------------
               Hydrograph in   5   Minute intervals ((CFS))

   --------------------------------------------------------------------
 Time(h+m) Volume Ac.Ft   Q(CFS)  0         2.5       5.0       7.5      10.0
 -----------------------------------------------------------------------
   0+ 5      0.0001      0.01  Q         |         |         |         |
   0+10      0.0002      0.02  Q         |         |         |         |
   0+15      0.0003      0.02  Q         |         |         |         |
   0+20      0.0004      0.02  Q         |         |         |         |
   0+25      0.0006      0.03  Q         |         |         |         |
   0+30      0.0008      0.03  Q         |         |         |         |
   0+35      0.0010      0.03  Q         |         |         |         |
   0+40      0.0012      0.03  Q         |         |         |         |
   0+45      0.0014      0.03  Q         |         |         |         |
   0+50      0.0016      0.03  Q         |         |         |         |
   0+55      0.0018      0.04  Q         |         |         |         |
   1+ 0      0.0021      0.04  Q         |         |         |         |
   1+ 5      0.0023      0.03  Q         |         |         |         |
   1+10      0.0025      0.03  Q         |         |         |         |
   1+15      0.0027      0.03  Q         |         |         |         |
   1+20      0.0029      0.03  Q         |         |         |         |
   1+25      0.0031      0.03  Q         |         |         |         |
   1+30      0.0033      0.03  Q         |         |         |         |
   1+35      0.0035      0.03  Q         |         |         |         |
   1+40      0.0037      0.03  Q         |         |         |         |
   1+45      0.0038      0.03  Q         |         |         |         |
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1+50       0.0041      0.03  Q         |         |         |         |
1+55       0.0043      0.04  Q         |         |         |         |
2+ 0       0.0046      0.04  Q         |         |         |         |
2+ 5       0.0048      0.04  QV        |         |         |         |
2+10       0.0051      0.04  QV        |         |         |         |
2+15       0.0053      0.04  QV        |         |         |         |
2+20       0.0056      0.04  QV        |         |         |         |
2+25       0.0058      0.04  QV        |         |         |         |
2+30       0.0061      0.04  QV        |         |         |         |
2+35       0.0063      0.04  QV        |         |         |         |
2+40       0.0067      0.04  QV        |         |         |         |
2+45       0.0070      0.05  QV        |         |         |         |
2+50       0.0073      0.05  QV        |         |         |         |
2+55       0.0076      0.05  QV        |         |         |         |
3+ 0       0.0079      0.05  QV        |         |         |         |
3+ 5       0.0082      0.05  QV        |         |         |         |
3+10       0.0085      0.05  QV        |         |         |         |
3+15       0.0089      0.05  QV        |         |         |         |
3+20       0.0092      0.05  QV        |         |         |         |
3+25       0.0095      0.05  Q V       |         |         |         |
3+30       0.0098      0.05  Q V       |         |         |         |
3+35       0.0101      0.05  Q V       |         |         |         |
3+40       0.0104      0.05  Q V       |         |         |         |
3+45       0.0107      0.05  Q V       |         |         |         |
3+50       0.0111      0.05  Q V       |         |         |         |
3+55       0.0115      0.05  Q V       |         |         |         |
4+ 0       0.0118      0.05  Q V       |         |         |         |
4+ 5       0.0122      0.05  Q V       |         |         |         |
4+10       0.0126      0.05  Q V       |         |         |         |
4+15       0.0130      0.05  Q V       |         |         |         |
4+20       0.0134      0.06  Q V       |         |         |         |
4+25       0.0138      0.06  Q V       |         |         |         |
4+30       0.0143      0.06  Q  V      |         |         |         |
4+35       0.0147      0.06  Q  V      |         |         |         |
4+40       0.0151      0.06  Q  V      |         |         |         |
4+45       0.0156      0.06  Q  V      |         |         |         |
4+50       0.0160      0.07  Q  V      |         |         |         |
4+55       0.0165      0.07  Q  V      |         |         |         |
5+ 0       0.0170      0.07  Q  V      |         |         |         |
5+ 5       0.0175      0.06  Q  V      |         |         |         |
5+10       0.0179      0.06  Q  V      |         |         |         |
5+15       0.0183      0.06  Q  V      |         |         |         |
5+20       0.0187      0.06  Q  V      |         |         |         |
5+25       0.0191      0.06  Q   V     |         |         |         |
5+30       0.0195      0.06  Q   V     |         |         |         |
5+35       0.0200      0.07  Q   V     |         |         |         |
5+40       0.0205      0.07  Q   V     |         |         |         |
5+45       0.0210      0.07  Q   V     |         |         |         |
5+50       0.0215      0.07  Q   V     |         |         |         |
5+55       0.0220      0.07  Q   V     |         |         |         |
6+ 0       0.0225      0.07  Q   V     |         |         |         |
6+ 5       0.0231      0.08  Q   V     |         |         |         |
6+10       0.0236      0.08  Q   V     |         |         |         |
6+15       0.0242      0.08  Q    V    |         |         |         |
6+20       0.0248      0.08  Q    V    |         |         |         |
6+25       0.0253      0.08  Q    V    |         |         |         |
6+30       0.0259      0.08  Q    V    |         |         |         |
6+35       0.0265      0.09  Q    V    |         |         |         |
6+40       0.0271      0.09  Q    V    |         |         |         |
6+45       0.0277      0.09  Q    V    |         |         |         |
6+50       0.0284      0.09  Q     V   |         |         |         |
6+55       0.0290      0.09  Q     V   |         |         |         |
7+ 0       0.0296      0.09  Q     V   |         |         |         |
7+ 5       0.0303      0.09  Q     V   |         |         |         |
7+10       0.0309      0.09  Q     V   |         |         |         |
7+15       0.0315      0.09  Q     V   |         |         |         |
7+20       0.0322      0.10  Q     V   |         |         |         |
7+25       0.0329      0.10  Q     V   |         |         |         |
7+30       0.0336      0.10  Q      V  |         |         |         |
7+35       0.0343      0.10  Q      V  |         |         |         |
7+40       0.0350      0.11  Q      V  |         |         |         |
7+45       0.0358      0.11  Q      V  |         |         |         |
7+50       0.0366      0.11  Q      V  |         |         |         |
7+55       0.0374      0.12  Q      V  |         |         |         |
8+ 0       0.0382      0.12  Q       V |         |         |         |
8+ 5       0.0391      0.13  Q       V |         |         |         |
8+10       0.0400      0.14  Q       V |         |         |         |
8+15       0.0409      0.14  Q       V |         |         |         |
8+20       0.0419      0.14  Q       V |         |         |         |
8+25       0.0428      0.14  Q        V|         |         |         |
8+30       0.0438      0.14  Q        V|         |         |         |
8+35       0.0448      0.14  Q        V|         |         |         |
8+40       0.0458      0.15  Q        V|         |         |         |
8+45       0.0468      0.15  Q        V|         |         |         |
8+50       0.0478      0.15  Q         V         |         |         |
8+55       0.0489      0.15  Q         V         |         |         |
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 9+ 0       0.0499      0.16  Q         V         |         |         |
 9+ 5       0.0511      0.16  Q         V         |         |         |
 9+10       0.0522      0.17  Q         |V        |         |         |
 9+15       0.0534      0.17  Q         |V        |         |         |
 9+20       0.0547      0.18  Q         |V        |         |         |
 9+25       0.0559      0.18  Q         |V        |         |         |
 9+30       0.0572      0.18  Q         | V       |         |         |
 9+35       0.0585      0.19  Q         | V       |         |         |
 9+40       0.0598      0.19  Q         | V       |         |         |
 9+45       0.0611      0.19  Q         | V       |         |         |
 9+50       0.0625      0.20  Q         |  V      |         |         |
 9+55       0.0638      0.20  Q         |  V      |         |         |
10+ 0       0.0652      0.20  Q         |  V      |         |         |
10+ 5       0.0664      0.17  Q         |   V     |         |         |
10+10       0.0674      0.14  Q         |   V     |         |         |
10+15       0.0683      0.14  Q         |   V     |         |         |
10+20       0.0693      0.14  Q         |   V     |         |         |
10+25       0.0702      0.14  Q         |   V     |         |         |
10+30       0.0712      0.14  Q         |    V    |         |         |
10+35       0.0723      0.16  Q         |    V    |         |         |
10+40       0.0735      0.18  Q         |    V    |         |         |
10+45       0.0747      0.18  Q         |    V    |         |         |
10+50       0.0760      0.18  Q         |     V   |         |         |
10+55       0.0773      0.18  Q         |     V   |         |         |
11+ 0       0.0785      0.18  Q         |     V   |         |         |
11+ 5       0.0798      0.18  Q         |     V   |         |         |
11+10       0.0810      0.17  Q         |      V  |         |         |
11+15       0.0822      0.17  Q         |      V  |         |         |
11+20       0.0834      0.17  Q         |      V  |         |         |
11+25       0.0846      0.17  Q         |      V  |         |         |
11+30       0.0858      0.17  Q         |       V |         |         |
11+35       0.0869      0.17  Q         |       V |         |         |
11+40       0.0880      0.16  Q         |       V |         |         |
11+45       0.0891      0.16  Q         |       V |         |         |
11+50       0.0902      0.16  Q         |        V|         |         |
11+55       0.0913      0.16  Q         |        V|         |         |
12+ 0       0.0924      0.16  Q         |        V|         |         |
12+ 5       0.0938      0.19  Q         |        V|         |         |
12+10       0.0953      0.22  Q         |         V         |         |
12+15       0.0968      0.23  Q         |         V         |         |
12+20       0.0984      0.23  Q         |         V         |         |
12+25       0.1001      0.24  Q         |         |V        |         |
12+30       0.1017      0.24  Q         |         |V        |         |
12+35       0.1034      0.25  Q         |         |V        |         |
12+40       0.1052      0.25  |Q        |         | V       |         |
12+45       0.1069      0.26  |Q        |         | V       |         |
12+50       0.1087      0.26  |Q        |         |  V      |         |
12+55       0.1105      0.26  |Q        |         |  V      |         |
13+ 0       0.1124      0.26  |Q        |         |  V      |         |
13+ 5       0.1143      0.29  |Q        |         |   V     |         |
13+10       0.1164      0.31  |Q        |         |   V     |         |
13+15       0.1186      0.31  |Q        |         |    V    |         |
13+20       0.1207      0.31  |Q        |         |    V    |         |
13+25       0.1229      0.31  |Q        |         |     V   |         |
13+30       0.1250      0.31  |Q        |         |     V   |         |
13+35       0.1268      0.26  |Q        |         |     V   |         |
13+40       0.1283      0.22  Q         |         |      V  |         |
13+45       0.1298      0.21  Q         |         |      V  |         |
13+50       0.1313      0.21  Q         |         |      V  |         |
13+55       0.1327      0.21  Q         |         |       V |         |
14+ 0       0.1342      0.21  Q         |         |       V |         |
14+ 5       0.1357      0.23  Q         |         |       V |         |
14+10       0.1374      0.24  Q         |         |        V|         |
14+15       0.1391      0.25  Q         |         |        V|         |
14+20       0.1408      0.24  Q         |         |        V|         |
14+25       0.1424      0.24  Q         |         |         V         |
14+30       0.1440      0.24  Q         |         |         V         |
14+35       0.1457      0.24  Q         |         |         V         |
14+40       0.1473      0.24  Q         |         |         |V        |
14+45       0.1490      0.24  Q         |         |         |V        |
14+50       0.1506      0.23  Q         |         |         |V        |
14+55       0.1521      0.23  Q         |         |         | V       |
15+ 0       0.1537      0.23  Q         |         |         | V       |
15+ 5       0.1553      0.22  Q         |         |         | V       |
15+10       0.1568      0.22  Q         |         |         |  V      |
15+15       0.1583      0.22  Q         |         |         |  V      |
15+20       0.1598      0.22  Q         |         |         |  V      |
15+25       0.1612      0.21  Q         |         |         |   V     |
15+30       0.1627      0.21  Q         |         |         |   V     |
15+35       0.1640      0.19  Q         |         |         |   V     |
15+40       0.1652      0.18  Q         |         |         |   V     |
15+45       0.1665      0.17  Q         |         |         |    V    |
15+50       0.1677      0.17  Q         |         |         |    V    |
15+55       0.1688      0.17  Q         |         |         |    V    |
16+ 0       0.1700      0.17  Q         |         |         |    V    |
16+ 5       0.1708      0.11  Q         |         |         |     V   |
```

16+10	0.1712	0.05	Q			V
16+15	0.1714	0.04	Q			V
16+20	0.1717	0.04	Q			V
16+25	0.1719	0.04	Q			V
16+30	0.1722	0.04	Q			V
16+35	0.1724	0.03	Q			V
16+40	0.1726	0.03	Q			V
16+45	0.1728	0.03	Q			V
16+50	0.1730	0.03	Q			V
16+55	0.1732	0.03	Q			V
17+ 0	0.1734	0.03	Q			V
17+ 5	0.1736	0.04	Q			V
17+10	0.1739	0.04	Q			V
17+15	0.1742	0.05	Q			V
17+20	0.1745	0.05	Q			V
17+25	0.1749	0.05	Q			V
17+30	0.1752	0.05	Q			V
17+35	0.1755	0.05	Q			V
17+40	0.1758	0.05	Q			V
17+45	0.1761	0.05	Q			V
17+50	0.1764	0.04	Q			V
17+55	0.1767	0.04	Q			V
18+ 0	0.1769	0.04	Q			V
18+ 5	0.1772	0.04	Q			V
18+10	0.1774	0.04	Q			V
18+15	0.1777	0.04	Q			V
18+20	0.1779	0.04	Q			V
18+25	0.1782	0.04	Q			V
18+30	0.1784	0.04	Q			V
18+35	0.1787	0.03	Q			V
18+40	0.1789	0.03	Q			V
18+45	0.1790	0.03	Q			V
18+50	0.1792	0.02	Q			V
18+55	0.1793	0.02	Q			V
19+ 0	0.1795	0.02	Q			V
19+ 5	0.1796	0.02	Q			V
19+10	0.1798	0.03	Q			V
19+15	0.1800	0.03	Q			V
19+20	0.1802	0.03	Q			V
19+25	0.1805	0.04	Q			V
19+30	0.1807	0.04	Q			V
19+35	0.1809	0.03	Q			V
19+40	0.1811	0.03	Q			V
19+45	0.1813	0.03	Q			V
19+50	0.1815	0.02	Q			V
19+55	0.1816	0.02	Q			V
20+ 0	0.1817	0.02	Q			V
20+ 5	0.1819	0.02	Q			V
20+10	0.1821	0.03	Q			V
20+15	0.1823	0.03	Q			V
20+20	0.1824	0.03	Q			V
20+25	0.1826	0.03	Q			V
20+30	0.1828	0.03	Q			V
20+35	0.1830	0.03	Q			V
20+40	0.1832	0.03	Q			V
20+45	0.1834	0.03	Q			V
20+50	0.1835	0.02	Q			V
20+55	0.1837	0.02	Q			V
21+ 0	0.1838	0.02	Q			V
21+ 5	0.1840	0.02	Q			V
21+10	0.1841	0.03	Q			V
21+15	0.1843	0.03	Q			V
21+20	0.1845	0.02	Q			V
21+25	0.1846	0.02	Q			V
21+30	0.1848	0.02	Q			V
21+35	0.1849	0.02	Q			V
21+40	0.1851	0.03	Q			V
21+45	0.1853	0.03	Q			V
21+50	0.1854	0.02	Q			V
21+55	0.1856	0.02	Q			V
22+ 0	0.1857	0.02	Q			V
22+ 5	0.1859	0.02	Q			V
22+10	0.1860	0.03	Q			V
22+15	0.1862	0.03	Q			V
22+20	0.1864	0.02	Q			V
22+25	0.1865	0.02	Q			V
22+30	0.1866	0.02	Q			V
22+35	0.1868	0.02	Q			V
22+40	0.1869	0.02	Q			V
22+45	0.1870	0.02	Q			V
22+50	0.1871	0.02	Q			V
22+55	0.1873	0.02	Q			V
23+ 0	0.1874	0.02	Q			V
23+ 5	0.1875	0.02	Q			V
23+10	0.1877	0.02	Q			V
23+15	0.1878	0.02	Q			V

```
   23+20        0.1879       0.02  Q          |          |          |        V|
   23+25        0.1880       0.02  Q          |          |          |        V|
   23+30        0.1882       0.02  Q          |          |          |        V|
   23+35        0.1883       0.02  Q          |          |          |        V|
   23+40        0.1884       0.02  Q          |          |          |        V|
   23+45        0.1885       0.02  Q          |          |          |        V|
   23+50        0.1887       0.02  Q          |          |          |        V|
   23+55        0.1888       0.02  Q          |          |          |        V|
   24+ 0        0.1889       0.02  Q          |          |          |        V|
   24+ 5        0.1890       0.01  Q          |          |          |        V|
   24+10        0.1890       0.00  Q          |          |          |        V|
   24+15        0.1890       0.00  Q          |          |          |        V|
----------------------------------------------------------------------
```

```
       U n i t   H y d r o g r a p h   A n a l y s i s

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               Study date  02/22/24 File: 2YR242.out

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Riverside County Synthetic Unit Hydrology Method
RCFC & WCD Manual date - April 1978


Program License Serial Number 5006

---------------------------------------------------------------------
 English (in-lb) Input Units Used
 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



---------------------------------------------------------------------
--------------------------------------------------------------------
Drainage Area =       7.00(Ac.)  =      0.011 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =       7.00(Ac.)  =      0.011 Sq. Mi.
Length along longest watercourse =     861.00(Ft.)
Length along longest watercourse measured to centroid =     430.00(Ft.)
Length along longest watercourse =      0.163 Mi.
Length along longest watercourse measured to centroid =      0.081 Mi.
Difference in elevation =      16.90(Ft.)
Slope along watercourse =    103.6376 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.029 Hr.
Lag time =     1.73 Min.
25% of lag time =     0.43 Min.
40% of lag time =     0.69 Min.
Unit time =     5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.00           1.80                 12.60

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
        7.00           6.00                 42.00

STORM EVENT (YEAR) =    2.00
Area Averaged 2-Year Rainfall =    1.800(In)
Area Averaged 100-Year Rainfall =    6.000(In)

Point rain (area averaged) =    1.800(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    1.800(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
     7.000          69.00         0.600
 Total Area Entered =      7.00(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-1     (In/Hr)    (Dec.%)     (In/Hr)      (Dec.)    (In/Hr)
69.0  49.8      0.574     0.600        0.264       1.000      0.264
                                                  Sum (F) =   0.264
Area averaged mean soil loss (F) (In/Hr) =  0.264
Minimum soil loss rate ((In/Hr)) =  0.132
(for 24 hour storm duration)
Soil low loss rate (decimal) =   0.420
---------------------------------------------------------------------

               U n i t  H y d r o g r a p h
                      VALLEY S-Curve
--------------------------------------------------------------------
               Unit Hydrograph Data
---------------------------------------------------------------------
Unit time period   Time % of lag   Distribution   Unit Hydrograph
    (hrs)                           Graph %           (CFS)
```

1	0.083	288.833	55.504	3.916
2	0.167	577.666	37.752	2.663
3	0.250	866.500	6.744	0.476
			Sum = 100.000	Sum= 7.055

The following loss rate calculations reflect use of the minimum calculated loss rate subtracted from the Storm Rain to produce the maximum Effective Rain value

Unit	Time (Hr.)	Pattern Percent	Storm Rain (In/Hr)	Loss rate(In./Hr) Max	Low	Effective (In/Hr)
1	0.08	0.07	0.014	(0.468)	0.006	0.008
2	0.17	0.07	0.014	(0.466)	0.006	0.008
3	0.25	0.07	0.014	(0.464)	0.006	0.008
4	0.33	0.10	0.022	(0.463)	0.009	0.013
5	0.42	0.10	0.022	(0.461)	0.009	0.013
6	0.50	0.10	0.022	(0.459)	0.009	0.013
7	0.58	0.10	0.022	(0.457)	0.009	0.013
8	0.67	0.10	0.022	(0.455)	0.009	0.013
9	0.75	0.10	0.022	(0.454)	0.009	0.013
10	0.83	0.13	0.029	(0.452)	0.012	0.017
11	0.92	0.13	0.029	(0.450)	0.012	0.017
12	1.00	0.13	0.029	(0.448)	0.012	0.017
13	1.08	0.10	0.022	(0.447)	0.009	0.013
14	1.17	0.10	0.022	(0.445)	0.009	0.013
15	1.25	0.10	0.022	(0.443)	0.009	0.013
16	1.33	0.10	0.022	(0.441)	0.009	0.013
17	1.42	0.10	0.022	(0.439)	0.009	0.013
18	1.50	0.10	0.022	(0.438)	0.009	0.013
19	1.58	0.10	0.022	(0.436)	0.009	0.013
20	1.67	0.10	0.022	(0.434)	0.009	0.013
21	1.75	0.10	0.022	(0.433)	0.009	0.013
22	1.83	0.13	0.029	(0.431)	0.012	0.017
23	1.92	0.13	0.029	(0.429)	0.012	0.017
24	2.00	0.13	0.029	(0.427)	0.012	0.017
25	2.08	0.13	0.029	(0.426)	0.012	0.017
26	2.17	0.13	0.029	(0.424)	0.012	0.017
27	2.25	0.13	0.029	(0.422)	0.012	0.017
28	2.33	0.13	0.029	(0.420)	0.012	0.017
29	2.42	0.13	0.029	(0.419)	0.012	0.017
30	2.50	0.13	0.029	(0.417)	0.012	0.017
31	2.58	0.17	0.036	(0.415)	0.015	0.021
32	2.67	0.17	0.036	(0.414)	0.015	0.021
33	2.75	0.17	0.036	(0.412)	0.015	0.021
34	2.83	0.17	0.036	(0.410)	0.015	0.021
35	2.92	0.17	0.036	(0.408)	0.015	0.021
36	3.00	0.17	0.036	(0.407)	0.015	0.021
37	3.08	0.17	0.036	(0.405)	0.015	0.021
38	3.17	0.17	0.036	(0.403)	0.015	0.021
39	3.25	0.17	0.036	(0.402)	0.015	0.021
40	3.33	0.17	0.036	(0.400)	0.015	0.021
41	3.42	0.17	0.036	(0.398)	0.015	0.021
42	3.50	0.17	0.036	(0.397)	0.015	0.021
43	3.58	0.17	0.036	(0.395)	0.015	0.021
44	3.67	0.17	0.036	(0.393)	0.015	0.021
45	3.75	0.17	0.036	(0.392)	0.015	0.021
46	3.83	0.20	0.043	(0.390)	0.018	0.025
47	3.92	0.20	0.043	(0.388)	0.018	0.025
48	4.00	0.20	0.043	(0.387)	0.018	0.025
49	4.08	0.20	0.043	(0.385)	0.018	0.025
50	4.17	0.20	0.043	(0.384)	0.018	0.025
51	4.25	0.20	0.043	(0.382)	0.018	0.025
52	4.33	0.23	0.050	(0.380)	0.021	0.029
53	4.42	0.23	0.050	(0.379)	0.021	0.029
54	4.50	0.23	0.050	(0.377)	0.021	0.029
55	4.58	0.23	0.050	(0.375)	0.021	0.029
56	4.67	0.23	0.050	(0.374)	0.021	0.029
57	4.75	0.23	0.050	(0.372)	0.021	0.029
58	4.83	0.27	0.058	(0.371)	0.024	0.033
59	4.92	0.27	0.058	(0.369)	0.024	0.033
60	5.00	0.27	0.058	(0.367)	0.024	0.033
61	5.08	0.20	0.043	(0.366)	0.018	0.025
62	5.17	0.20	0.043	(0.364)	0.018	0.025
63	5.25	0.20	0.043	(0.363)	0.018	0.025
64	5.33	0.23	0.050	(0.361)	0.021	0.029
65	5.42	0.23	0.050	(0.359)	0.021	0.029
66	5.50	0.23	0.050	(0.358)	0.021	0.029
67	5.58	0.27	0.058	(0.356)	0.024	0.033
68	5.67	0.27	0.058	(0.355)	0.024	0.033
69	5.75	0.27	0.058	(0.353)	0.024	0.033
70	5.83	0.27	0.058	(0.352)	0.024	0.033
71	5.92	0.27	0.058	(0.350)	0.024	0.033
72	6.00	0.27	0.058	(0.349)	0.024	0.033
73	6.08	0.30	0.065	(0.347)	0.027	0.038

74	6.17	0.30	0.065	(0.345)	0.027	0.038
75	6.25	0.30	0.065	(0.344)	0.027	0.038
76	6.33	0.30	0.065	(0.342)	0.027	0.038
77	6.42	0.30	0.065	(0.341)	0.027	0.038
78	6.50	0.30	0.065	(0.339)	0.027	0.038
79	6.58	0.33	0.072	(0.338)	0.030	0.042
80	6.67	0.33	0.072	(0.336)	0.030	0.042
81	6.75	0.33	0.072	(0.335)	0.030	0.042
82	6.83	0.33	0.072	(0.333)	0.030	0.042
83	6.92	0.33	0.072	(0.332)	0.030	0.042
84	7.00	0.33	0.072	(0.330)	0.030	0.042
85	7.08	0.33	0.072	(0.329)	0.030	0.042
86	7.17	0.33	0.072	(0.327)	0.030	0.042
87	7.25	0.33	0.072	(0.326)	0.030	0.042
88	7.33	0.37	0.079	(0.324)	0.033	0.046
89	7.42	0.37	0.079	(0.323)	0.033	0.046
90	7.50	0.37	0.079	(0.321)	0.033	0.046
91	7.58	0.40	0.086	(0.320)	0.036	0.050
92	7.67	0.40	0.086	(0.318)	0.036	0.050
93	7.75	0.40	0.086	(0.317)	0.036	0.050
94	7.83	0.43	0.094	(0.315)	0.039	0.054
95	7.92	0.43	0.094	(0.314)	0.039	0.054
96	8.00	0.43	0.094	(0.312)	0.039	0.054
97	8.08	0.50	0.108	(0.311)	0.045	0.063
98	8.17	0.50	0.108	(0.310)	0.045	0.063
99	8.25	0.50	0.108	(0.308)	0.045	0.063
100	8.33	0.50	0.108	(0.307)	0.045	0.063
101	8.42	0.50	0.108	(0.305)	0.045	0.063
102	8.50	0.50	0.108	(0.304)	0.045	0.063
103	8.58	0.53	0.115	(0.302)	0.048	0.067
104	8.67	0.53	0.115	(0.301)	0.048	0.067
105	8.75	0.53	0.115	(0.300)	0.048	0.067
106	8.83	0.57	0.122	(0.298)	0.051	0.071
107	8.92	0.57	0.122	(0.297)	0.051	0.071
108	9.00	0.57	0.122	(0.295)	0.051	0.071
109	9.08	0.63	0.137	(0.294)	0.057	0.079
110	9.17	0.63	0.137	(0.293)	0.057	0.079
111	9.25	0.63	0.137	(0.291)	0.057	0.079
112	9.33	0.67	0.144	(0.290)	0.060	0.084
113	9.42	0.67	0.144	(0.288)	0.060	0.084
114	9.50	0.67	0.144	(0.287)	0.060	0.084
115	9.58	0.70	0.151	(0.286)	0.064	0.088
116	9.67	0.70	0.151	(0.284)	0.064	0.088
117	9.75	0.70	0.151	(0.283)	0.064	0.088
118	9.83	0.73	0.158	(0.282)	0.067	0.092
119	9.92	0.73	0.158	(0.280)	0.067	0.092
120	10.00	0.73	0.158	(0.279)	0.067	0.092
121	10.08	0.50	0.108	(0.277)	0.045	0.063
122	10.17	0.50	0.108	(0.276)	0.045	0.063
123	10.25	0.50	0.108	(0.275)	0.045	0.063
124	10.33	0.50	0.108	(0.273)	0.045	0.063
125	10.42	0.50	0.108	(0.272)	0.045	0.063
126	10.50	0.50	0.108	(0.271)	0.045	0.063
127	10.58	0.67	0.144	(0.269)	0.060	0.084
128	10.67	0.67	0.144	(0.268)	0.060	0.084
129	10.75	0.67	0.144	(0.267)	0.060	0.084
130	10.83	0.67	0.144	(0.266)	0.060	0.084
131	10.92	0.67	0.144	(0.264)	0.060	0.084
132	11.00	0.67	0.144	(0.263)	0.060	0.084
133	11.08	0.63	0.137	(0.262)	0.057	0.079
134	11.17	0.63	0.137	(0.260)	0.057	0.079
135	11.25	0.63	0.137	(0.259)	0.057	0.079
136	11.33	0.63	0.137	(0.258)	0.057	0.079
137	11.42	0.63	0.137	(0.256)	0.057	0.079
138	11.50	0.63	0.137	(0.255)	0.057	0.079
139	11.58	0.57	0.122	(0.254)	0.051	0.071
140	11.67	0.57	0.122	(0.253)	0.051	0.071
141	11.75	0.57	0.122	(0.251)	0.051	0.071
142	11.83	0.60	0.130	(0.250)	0.054	0.075
143	11.92	0.60	0.130	(0.249)	0.054	0.075
144	12.00	0.60	0.130	(0.248)	0.054	0.075
145	12.08	0.83	0.180	(0.246)	0.076	0.104
146	12.17	0.83	0.180	(0.245)	0.076	0.104
147	12.25	0.83	0.180	(0.244)	0.076	0.104
148	12.33	0.87	0.187	(0.243)	0.079	0.109
149	12.42	0.87	0.187	(0.242)	0.079	0.109
150	12.50	0.87	0.187	(0.240)	0.079	0.109
151	12.58	0.93	0.202	(0.239)	0.085	0.117
152	12.67	0.93	0.202	(0.238)	0.085	0.117
153	12.75	0.93	0.202	(0.237)	0.085	0.117
154	12.83	0.97	0.209	(0.236)	0.088	0.121
155	12.92	0.97	0.209	(0.234)	0.088	0.121
156	13.00	0.97	0.209	(0.233)	0.088	0.121
157	13.08	1.13	0.245	(0.232)	0.103	0.142
158	13.17	1.13	0.245	(0.231)	0.103	0.142
159	13.25	1.13	0.245	(0.230)	0.103	0.142

160	13.33	1.13	0.245	(0.228)	0.103	0.142
161	13.42	1.13	0.245	(0.227)	0.103	0.142
162	13.50	1.13	0.245	(0.226)	0.103	0.142
163	13.58	0.77	0.166	(0.225)	0.070	0.096
164	13.67	0.77	0.166	(0.224)	0.070	0.096
165	13.75	0.77	0.166	(0.223)	0.070	0.096
166	13.83	0.77	0.166	(0.222)	0.070	0.096
167	13.92	0.77	0.166	(0.220)	0.070	0.096
168	14.00	0.77	0.166	(0.219)	0.070	0.096
169	14.08	0.90	0.194	(0.218)	0.082	0.113
170	14.17	0.90	0.194	(0.217)	0.082	0.113
171	14.25	0.90	0.194	(0.216)	0.082	0.113
172	14.33	0.87	0.187	(0.215)	0.079	0.109
173	14.42	0.87	0.187	(0.214)	0.079	0.109
174	14.50	0.87	0.187	(0.213)	0.079	0.109
175	14.58	0.87	0.187	(0.212)	0.079	0.109
176	14.67	0.87	0.187	(0.210)	0.079	0.109
177	14.75	0.87	0.187	(0.209)	0.079	0.109
178	14.83	0.83	0.180	(0.208)	0.076	0.104
179	14.92	0.83	0.180	(0.207)	0.076	0.104
180	15.00	0.83	0.180	(0.206)	0.076	0.104
181	15.08	0.80	0.173	(0.205)	0.073	0.100
182	15.17	0.80	0.173	(0.204)	0.073	0.100
183	15.25	0.80	0.173	(0.203)	0.073	0.100
184	15.33	0.77	0.166	(0.202)	0.070	0.096
185	15.42	0.77	0.166	(0.201)	0.070	0.096
186	15.50	0.77	0.166	(0.200)	0.070	0.096
187	15.58	0.63	0.137	(0.199)	0.057	0.079
188	15.67	0.63	0.137	(0.198)	0.057	0.079
189	15.75	0.63	0.137	(0.197)	0.057	0.079
190	15.83	0.63	0.137	(0.196)	0.057	0.079
191	15.92	0.63	0.137	(0.195)	0.057	0.079
192	16.00	0.63	0.137	(0.194)	0.057	0.079
193	16.08	0.13	0.029	(0.193)	0.012	0.017
194	16.17	0.13	0.029	(0.192)	0.012	0.017
195	16.25	0.13	0.029	(0.191)	0.012	0.017
196	16.33	0.13	0.029	(0.190)	0.012	0.017
197	16.42	0.13	0.029	(0.189)	0.012	0.017
198	16.50	0.13	0.029	(0.188)	0.012	0.017
199	16.58	0.10	0.022	(0.187)	0.009	0.013
200	16.67	0.10	0.022	(0.186)	0.009	0.013
201	16.75	0.10	0.022	(0.185)	0.009	0.013
202	16.83	0.10	0.022	(0.184)	0.009	0.013
203	16.92	0.10	0.022	(0.183)	0.009	0.013
204	17.00	0.10	0.022	(0.182)	0.009	0.013
205	17.08	0.17	0.036	(0.181)	0.015	0.021
206	17.17	0.17	0.036	(0.181)	0.015	0.021
207	17.25	0.17	0.036	(0.180)	0.015	0.021
208	17.33	0.17	0.036	(0.179)	0.015	0.021
209	17.42	0.17	0.036	(0.178)	0.015	0.021
210	17.50	0.17	0.036	(0.177)	0.015	0.021
211	17.58	0.17	0.036	(0.176)	0.015	0.021
212	17.67	0.17	0.036	(0.175)	0.015	0.021
213	17.75	0.17	0.036	(0.174)	0.015	0.021
214	17.83	0.13	0.029	(0.173)	0.012	0.017
215	17.92	0.13	0.029	(0.173)	0.012	0.017
216	18.00	0.13	0.029	(0.172)	0.012	0.017
217	18.08	0.13	0.029	(0.171)	0.012	0.017
218	18.17	0.13	0.029	(0.170)	0.012	0.017
219	18.25	0.13	0.029	(0.169)	0.012	0.017
220	18.33	0.13	0.029	(0.168)	0.012	0.017
221	18.42	0.13	0.029	(0.168)	0.012	0.017
222	18.50	0.13	0.029	(0.167)	0.012	0.017
223	18.58	0.10	0.022	(0.166)	0.009	0.013
224	18.67	0.10	0.022	(0.165)	0.009	0.013
225	18.75	0.10	0.022	(0.164)	0.009	0.013
226	18.83	0.07	0.014	(0.164)	0.006	0.008
227	18.92	0.07	0.014	(0.163)	0.006	0.008
228	19.00	0.07	0.014	(0.162)	0.006	0.008
229	19.08	0.10	0.022	(0.161)	0.009	0.013
230	19.17	0.10	0.022	(0.160)	0.009	0.013
231	19.25	0.10	0.022	(0.160)	0.009	0.013
232	19.33	0.13	0.029	(0.159)	0.012	0.017
233	19.42	0.13	0.029	(0.158)	0.012	0.017
234	19.50	0.13	0.029	(0.158)	0.012	0.017
235	19.58	0.10	0.022	(0.157)	0.009	0.013
236	19.67	0.10	0.022	(0.156)	0.009	0.013
237	19.75	0.10	0.022	(0.155)	0.009	0.013
238	19.83	0.07	0.014	(0.155)	0.006	0.008
239	19.92	0.07	0.014	(0.154)	0.006	0.008
240	20.00	0.07	0.014	(0.153)	0.006	0.008
241	20.08	0.10	0.022	(0.153)	0.009	0.013
242	20.17	0.10	0.022	(0.152)	0.009	0.013
243	20.25	0.10	0.022	(0.151)	0.009	0.013
244	20.33	0.10	0.022	(0.151)	0.009	0.013
245	20.42	0.10	0.022	(0.150)	0.009	0.013

246	20.50	0.10	0.022	(0.149)	0.009	0.013
247	20.58	0.10	0.022	(0.149)	0.009	0.013
248	20.67	0.10	0.022	(0.148)	0.009	0.013
249	20.75	0.10	0.022	(0.148)	0.009	0.013
250	20.83	0.07	0.014	(0.147)	0.006	0.008
251	20.92	0.07	0.014	(0.146)	0.006	0.008
252	21.00	0.07	0.014	(0.146)	0.006	0.008
253	21.08	0.10	0.022	(0.145)	0.009	0.013
254	21.17	0.10	0.022	(0.145)	0.009	0.013
255	21.25	0.10	0.022	(0.144)	0.009	0.013
256	21.33	0.07	0.014	(0.143)	0.006	0.008
257	21.42	0.07	0.014	(0.143)	0.006	0.008
258	21.50	0.07	0.014	(0.142)	0.006	0.008
259	21.58	0.10	0.022	(0.142)	0.009	0.013
260	21.67	0.10	0.022	(0.141)	0.009	0.013
261	21.75	0.10	0.022	(0.141)	0.009	0.013
262	21.83	0.07	0.014	(0.140)	0.006	0.008
263	21.92	0.07	0.014	(0.140)	0.006	0.008
264	22.00	0.07	0.014	(0.139)	0.006	0.008
265	22.08	0.10	0.022	(0.139)	0.009	0.013
266	22.17	0.10	0.022	(0.138)	0.009	0.013
267	22.25	0.10	0.022	(0.138)	0.009	0.013
268	22.33	0.07	0.014	(0.138)	0.006	0.008
269	22.42	0.07	0.014	(0.137)	0.006	0.008
270	22.50	0.07	0.014	(0.137)	0.006	0.008
271	22.58	0.07	0.014	(0.136)	0.006	0.008
272	22.67	0.07	0.014	(0.136)	0.006	0.008
273	22.75	0.07	0.014	(0.136)	0.006	0.008
274	22.83	0.07	0.014	(0.135)	0.006	0.008
275	22.92	0.07	0.014	(0.135)	0.006	0.008
276	23.00	0.07	0.014	(0.135)	0.006	0.008
277	23.08	0.07	0.014	(0.134)	0.006	0.008
278	23.17	0.07	0.014	(0.134)	0.006	0.008
279	23.25	0.07	0.014	(0.134)	0.006	0.008
280	23.33	0.07	0.014	(0.133)	0.006	0.008
281	23.42	0.07	0.014	(0.133)	0.006	0.008
282	23.50	0.07	0.014	(0.133)	0.006	0.008
283	23.58	0.07	0.014	(0.133)	0.006	0.008
284	23.67	0.07	0.014	(0.133)	0.006	0.008
285	23.75	0.07	0.014	(0.132)	0.006	0.008
286	23.83	0.07	0.014	(0.132)	0.006	0.008
287	23.92	0.07	0.014	(0.132)	0.006	0.008
288	24.00	0.07	0.014	(0.132)	0.006	0.008

(Loss Rate Not Used)

Sum = 100.0 Sum = 12.5

Flood volume = Effective rainfall 1.04(In)
times area 7.0(Ac.)/[(In)/(Ft.)] = 0.6(Ac.Ft)
Total soil loss = 0.76(In)
Total soil loss = 0.441(Ac.Ft)
Total rainfall = 1.80(In)
Flood volume = 26527.7 Cubic Feet
Total soil loss = 19209.7 Cubic Feet

Peak flow rate of this hydrograph = 1.002(CFS)

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24 - H O U R S T O R M
R u n o f f H y d r o g r a p h

Hydrograph in 5 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+ 5	0.0002	0.03	Q	|	|	|	|
0+10	0.0006	0.05	Q	|	|	|	|
0+15	0.0010	0.06	Q	|	|	|	|
0+20	0.0015	0.08	Q	|	|	|	|
0+25	0.0021	0.09	Q	|	|	|	|
0+30	0.0027	0.09	Q	|	|	|	|
0+35	0.0033	0.09	Q	|	|	|	|
0+40	0.0040	0.09	Q	|	|	|	|
0+45	0.0046	0.09	Q	|	|	|	|
0+50	0.0053	0.10	Q	|	|	|	|
0+55	0.0061	0.12	Q	|	|	|	|
1+ 0	0.0069	0.12	Q	|	|	|	|
1+ 5	0.0076	0.10	Q	|	|	|	|
1+10	0.0082	0.09	Q	|	|	|	|
1+15	0.0088	0.09	Q	|	|	|	|
1+20	0.0094	0.09	Q	|	|	|	|
1+25	0.0100	0.09	Q	|	|	|	|
1+30	0.0106	0.09	Q	|	|	|	|
1+35	0.0113	0.09	Q	|	|	|	|
1+40	0.0119	0.09	Q	|	|	|	|
1+45	0.0125	0.09	Q	|	|	|	|
1+50	0.0132	0.10	Q	|	|	|	|

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1+55       0.0140      0.12  Q         |         |         |         |
2+ 0       0.0148      0.12  Q         |         |         |         |
2+ 5       0.0156      0.12  QV        |         |         |         |
2+10       0.0164      0.12  QV        |         |         |         |
2+15       0.0172      0.12  QV        |         |         |         |
2+20       0.0181      0.12  QV        |         |         |         |
2+25       0.0189      0.12  QV        |         |         |         |
2+30       0.0197      0.12  QV        |         |         |         |
2+35       0.0206      0.13  QV        |         |         |         |
2+40       0.0216      0.15  QV        |         |         |         |
2+45       0.0226      0.15  QV        |         |         |         |
2+50       0.0236      0.15  QV        |         |         |         |
2+55       0.0247      0.15  QV        |         |         |         |
3+ 0       0.0257      0.15  QV        |         |         |         |
3+ 5       0.0267      0.15  QV        |         |         |         |
3+10       0.0277      0.15  QV        |         |         |         |
3+15       0.0287      0.15  QV        |         |         |         |
3+20       0.0297      0.15  QV        |         |         |         |
3+25       0.0307      0.15  Q V       |         |         |         |
3+30       0.0318      0.15  Q V       |         |         |         |
3+35       0.0328      0.15  Q V       |         |         |         |
3+40       0.0338      0.15  Q V       |         |         |         |
3+45       0.0348      0.15  Q V       |         |         |         |
3+50       0.0359      0.16  Q V       |         |         |         |
3+55       0.0371      0.17  Q V       |         |         |         |
4+ 0       0.0384      0.18  Q V       |         |         |         |
4+ 5       0.0396      0.18  Q V       |         |         |         |
4+10       0.0408      0.18  Q V       |         |         |         |
4+15       0.0420      0.18  Q V       |         |         |         |
4+20       0.0433      0.19  Q V       |         |         |         |
4+25       0.0447      0.20  Q V       |         |         |         |
4+30       0.0462      0.21  Q  V      |         |         |         |
4+35       0.0476      0.21  Q  V      |         |         |         |
4+40       0.0490      0.21  Q  V      |         |         |         |
4+45       0.0504      0.21  Q  V      |         |         |         |
4+50       0.0520      0.22  Q  V      |         |         |         |
4+55       0.0536      0.23  Q  V      |         |         |         |
5+ 0       0.0552      0.24  Q  V      |         |         |         |
5+ 5       0.0566      0.20  Q  V      |         |         |         |
5+10       0.0578      0.18  Q  V      |         |         |         |
5+15       0.0591      0.18  Q  V      |         |         |         |
5+20       0.0604      0.19  Q  V      |         |         |         |
5+25       0.0618      0.20  Q   V     |         |         |         |
5+30       0.0632      0.21  Q   V     |         |         |         |
5+35       0.0647      0.22  Q   V     |         |         |         |
5+40       0.0664      0.23  Q   V     |         |         |         |
5+45       0.0680      0.24  Q   V     |         |         |         |
5+50       0.0696      0.24  Q   V     |         |         |         |
5+55       0.0712      0.24  Q   V     |         |         |         |
6+ 0       0.0729      0.24  Q   V     |         |         |         |
6+ 5       0.0746      0.25  |Q  V     |         |         |         |
6+10       0.0764      0.26  |Q   V    |         |         |         |
6+15       0.0782      0.27  |Q   V    |         |         |         |
6+20       0.0801      0.27  |Q   V    |         |         |         |
6+25       0.0819      0.27  |Q   V    |         |         |         |
6+30       0.0837      0.27  |Q   V    |         |         |         |
6+35       0.0857      0.28  |Q   V    |         |         |         |
6+40       0.0877      0.29  |Q   V    |         |         |         |
6+45       0.0897      0.29  |Q   V    |         |         |         |
6+50       0.0917      0.29  |Q    V   |         |         |         |
6+55       0.0938      0.29  |Q    V   |         |         |         |
7+ 0       0.0958      0.29  |Q    V   |         |         |         |
7+ 5       0.0978      0.29  |Q    V   |         |         |         |
7+10       0.0998      0.29  |Q    V   |         |         |         |
7+15       0.1019      0.29  |Q    V   |         |         |         |
7+20       0.1040      0.31  |Q    V   |         |         |         |
7+25       0.1062      0.32  |Q    V   |         |         |         |
7+30       0.1085      0.32  |Q     V  |         |         |         |
7+35       0.1108      0.34  |Q     V  |         |         |         |
7+40       0.1132      0.35  |Q     V  |         |         |         |
7+45       0.1157      0.35  |Q     V  |         |         |         |
7+50       0.1182      0.37  |Q     V  |         |         |         |
7+55       0.1209      0.38  |Q     V  |         |         |         |
8+ 0       0.1235      0.38  |Q      V |         |         |         |
8+ 5       0.1264      0.42  |Q      V |         |         |         |
8+10       0.1294      0.44  |Q      V |         |         |         |
8+15       0.1324      0.44  |Q      V |         |         |         |
8+20       0.1355      0.44  |Q      V |         |         |         |
8+25       0.1385      0.44  |Q       V|         |         |         |
8+30       0.1416      0.44  |Q       V|         |         |         |
8+35       0.1447      0.46  |Q       V|         |         |         |
8+40       0.1479      0.47  |Q       V|         |         |         |
8+45       0.1512      0.47  |Q       V|         |         |         |
8+50       0.1546      0.49  |Q        V         |         |         |
8+55       0.1580      0.50  |Q        V         |         |         |
9+ 0       0.1614      0.50  | Q       V         |         |         |
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  9+ 5      0.1651      0.53  | Q       V         |         |         |
  9+10      0.1689      0.56  | Q       |V        |         |         |
  9+15      0.1728      0.56  | Q       |V        |         |         |
  9+20      0.1768      0.58  | Q       |V        |         |         |
  9+25      0.1808      0.59  | Q       |V        |         |         |
  9+30      0.1849      0.59  | Q       | V       |         |         |
  9+35      0.1891      0.61  | Q       | V       |         |         |
  9+40      0.1933      0.62  | Q       | V       |         |         |
  9+45      0.1976      0.62  | Q       | V       |         |         |
  9+50      0.2019      0.64  | Q       |  V      |         |         |
  9+55      0.2064      0.65  | Q       |  V      |         |         |
 10+ 0      0.2109      0.65  | Q       |  V      |         |         |
 10+ 5      0.2145      0.53  | Q       |   V     |         |         |
 10+10      0.2177      0.46  |Q        |   V     |         |         |
 10+15      0.2207      0.44  |Q        |   V     |         |         |
 10+20      0.2238      0.44  |Q        |   V     |         |         |
 10+25      0.2268      0.44  |Q        |   V     |         |         |
 10+30      0.2299      0.44  |Q        |    V    |         |         |
 10+35      0.2335      0.52  | Q       |    V    |         |         |
 10+40      0.2375      0.58  | Q       |    V    |         |         |
 10+45      0.2415      0.59  | Q       |    V    |         |         |
 10+50      0.2456      0.59  | Q       |     V   |         |         |
 10+55      0.2496      0.59  | Q       |     V   |         |         |
 11+ 0      0.2537      0.59  | Q       |     V   |         |         |
 11+ 5      0.2576      0.57  | Q       |     V   |         |         |
 11+10      0.2615      0.56  | Q       |      V  |         |         |
 11+15      0.2654      0.56  | Q       |      V  |         |         |
 11+20      0.2692      0.56  | Q       |      V  |         |         |
 11+25      0.2731      0.56  | Q       |      V  |         |         |
 11+30      0.2769      0.56  | Q       |       V |         |         |
 11+35      0.2806      0.53  | Q       |       V |         |         |
 11+40      0.2841      0.51  | Q       |       V |         |         |
 11+45      0.2875      0.50  | Q       |       V |         |         |
 11+50      0.2911      0.52  | Q       |        V|         |         |
 11+55      0.2947      0.53  | Q       |        V|         |         |
 12+ 0      0.2984      0.53  | Q       |        V|         |         |
 12+ 5      0.3028      0.65  | Q       |        V|         |         |
 12+10      0.3078      0.72  | Q       |         V         |         |
 12+15      0.3129      0.74  | Q       |         V         |         |
 12+20      0.3180      0.75  |  Q      |         V         |         |
 12+25      0.3233      0.76  |  Q      |         |V        |         |
 12+30      0.3286      0.77  |  Q      |         |V        |         |
 12+35      0.3341      0.80  |  Q      |         |V        |         |
 12+40      0.3397      0.82  |  Q      |         | V       |         |
 12+45      0.3454      0.83  |  Q      |         | V       |         |
 12+50      0.3512      0.84  |  Q      |         |  V      |         |
 12+55      0.3571      0.85  |  Q      |         |  V      |         |
 13+ 0      0.3630      0.85  |  Q      |         |  V      |         |
 13+ 5      0.3694      0.94  |  Q      |         |   V     |         |
 13+10      0.3763      0.99  |  Q      |         |   V     |         |
 13+15      0.3832      1.00  |   Q     |         |    V    |         |
 13+20      0.3901      1.00  |   Q     |         |    V    |         |
 13+25      0.3970      1.00  |   Q     |         |     V   |         |
 13+30      0.4039      1.00  |   Q     |         |     V   |         |
 13+35      0.4095      0.82  |  Q      |         |     V   |         |
 13+40      0.4144      0.70  | Q       |         |      V  |         |
 13+45      0.4190      0.68  | Q       |         |      V  |         |
 13+50      0.4237      0.68  | Q       |         |      V  |         |
 13+55      0.4284      0.68  | Q       |         |       V |         |
 14+ 0      0.4330      0.68  | Q       |         |       V |         |
 14+ 5      0.4382      0.74  | Q       |         |       V |         |
 14+10      0.4436      0.79  |  Q      |         |        V|         |
 14+15      0.4491      0.80  |  Q      |         |        V|         |
 14+20      0.4544      0.78  |  Q      |         |        V|         |
 14+25      0.4597      0.77  |  Q      |         |         V         |
 14+30      0.4650      0.77  |  Q      |         |         V         |
 14+35      0.4703      0.77  |  Q      |         |         V         |
 14+40      0.4756      0.77  |  Q      |         |         |V        |
 14+45      0.4808      0.77  |  Q      |         |         |V        |
 14+50      0.4860      0.75  | Q       |         |         |V        |
 14+55      0.4911      0.74  | Q       |         |         | V       |
 15+ 0      0.4962      0.74  | Q       |         |         | V       |
 15+ 5      0.5011      0.72  | Q       |         |         | V       |
 15+10      0.5060      0.71  | Q       |         |         |  V      |
 15+15      0.5109      0.71  | Q       |         |         |  V      |
 15+20      0.5156      0.69  | Q       |         |         |  V      |
 15+25      0.5203      0.68  | Q       |         |         |   V     |
 15+30      0.5250      0.68  | Q       |         |         |   V     |
 15+35      0.5292      0.61  | Q       |         |         |   V     |
 15+40      0.5331      0.57  | Q       |         |         |    V    |
 15+45      0.5370      0.56  | Q       |         |         |    V    |
 15+50      0.5408      0.56  | Q       |         |         |    V    |
 15+55      0.5447      0.56  | Q       |         |         |    V    |
 16+ 0      0.5486      0.56  | Q       |         |         |     V   |
 16+ 5      0.5507      0.31  |Q        |         |         |     V   |
 16+10      0.5517      0.15  Q         |         |         |     V   |
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16+15	0.5525	0.12	Q	|	|	|	V |
16+20	0.5534	0.12	Q	|	|	|	V |
16+25	0.5542	0.12	Q	|	|	|	V |
16+30	0.5550	0.12	Q	|	|	|	V |
16+35	0.5557	0.10	Q	|	|	|	V |
16+40	0.5563	0.09	Q	|	|	|	V |
16+45	0.5569	0.09	Q	|	|	|	V |
16+50	0.5575	0.09	Q	|	|	|	V |
16+55	0.5581	0.09	Q	|	|	|	V |
17+ 0	0.5587	0.09	Q	|	|	|	V |
17+ 5	0.5596	0.12	Q	|	|	|	V |
17+10	0.5606	0.14	Q	|	|	|	V |
17+15	0.5616	0.15	Q	|	|	|	V |
17+20	0.5626	0.15	Q	|	|	|	V |
17+25	0.5636	0.15	Q	|	|	|	V |
17+30	0.5646	0.15	Q	|	|	|	V |
17+35	0.5656	0.15	Q	|	|	|	V |
17+40	0.5667	0.15	Q	|	|	|	V |
17+45	0.5677	0.15	Q	|	|	|	V |
17+50	0.5686	0.13	Q	|	|	|	V |
17+55	0.5694	0.12	Q	|	|	|	V |
18+ 0	0.5702	0.12	Q	|	|	|	V |
18+ 5	0.5710	0.12	Q	|	|	|	V |
18+10	0.5718	0.12	Q	|	|	|	V |
18+15	0.5726	0.12	Q	|	|	|	V |
18+20	0.5735	0.12	Q	|	|	|	V |
18+25	0.5743	0.12	Q	|	|	|	V |
18+30	0.5751	0.12	Q	|	|	|	V |
18+35	0.5758	0.10	Q	|	|	|	V |
18+40	0.5764	0.09	Q	|	|	|	V |
18+45	0.5770	0.09	Q	|	|	|	V |
18+50	0.5775	0.07	Q	|	|	|	V |
18+55	0.5779	0.06	Q	|	|	|	V |
19+ 0	0.5783	0.06	Q	|	|	|	V |
19+ 5	0.5789	0.08	Q	|	|	|	V |
19+10	0.5794	0.09	Q	|	|	|	V |
19+15	0.5801	0.09	Q	|	|	|	V |
19+20	0.5808	0.10	Q	|	|	|	V |
19+25	0.5816	0.12	Q	|	|	|	V |
19+30	0.5824	0.12	Q	|	|	|	V |
19+35	0.5831	0.10	Q	|	|	|	V |
19+40	0.5837	0.09	Q	|	|	|	V |
19+45	0.5843	0.09	Q	|	|	|	V |
19+50	0.5848	0.07	Q	|	|	|	V |
19+55	0.5852	0.06	Q	|	|	|	V |
20+ 0	0.5856	0.06	Q	|	|	|	V |
20+ 5	0.5862	0.08	Q	|	|	|	V |
20+10	0.5868	0.09	Q	|	|	|	V |
20+15	0.5874	0.09	Q	|	|	|	V |
20+20	0.5880	0.09	Q	|	|	|	V |
20+25	0.5886	0.09	Q	|	|	|	V |
20+30	0.5892	0.09	Q	|	|	|	V |
20+35	0.5898	0.09	Q	|	|	|	V |
20+40	0.5904	0.09	Q	|	|	|	V |
20+45	0.5910	0.09	Q	|	|	|	V |
20+50	0.5915	0.07	Q	|	|	|	V |
20+55	0.5919	0.06	Q	|	|	|	V |
21+ 0	0.5923	0.06	Q	|	|	|	V |
21+ 5	0.5929	0.08	Q	|	|	|	V |
21+10	0.5935	0.09	Q	|	|	|	V |
21+15	0.5941	0.09	Q	|	|	|	V|
21+20	0.5946	0.07	Q	|	|	|	V|
21+25	0.5950	0.06	Q	|	|	|	V|
21+30	0.5954	0.06	Q	|	|	|	V|
21+35	0.5959	0.08	Q	|	|	|	V|
21+40	0.5965	0.09	Q	|	|	|	V|
21+45	0.5971	0.09	Q	|	|	|	V|
21+50	0.5976	0.07	Q	|	|	|	V|
21+55	0.5980	0.06	Q	|	|	|	V|
22+ 0	0.5984	0.06	Q	|	|	|	V|
22+ 5	0.5989	0.08	Q	|	|	|	V|
22+10	0.5995	0.09	Q	|	|	|	V|
22+15	0.6002	0.09	Q	|	|	|	V|
22+20	0.6007	0.07	Q	|	|	|	V|
22+25	0.6011	0.06	Q	|	|	|	V|
22+30	0.6015	0.06	Q	|	|	|	V|
22+35	0.6019	0.06	Q	|	|	|	V|
22+40	0.6023	0.06	Q	|	|	|	V|
22+45	0.6027	0.06	Q	|	|	|	V|
22+50	0.6031	0.06	Q	|	|	|	V|
22+55	0.6035	0.06	Q	|	|	|	V|
23+ 0	0.6039	0.06	Q	|	|	|	V|
23+ 5	0.6043	0.06	Q	|	|	|	V|
23+10	0.6047	0.06	Q	|	|	|	V|
23+15	0.6051	0.06	Q	|	|	|	V|
23+20	0.6055	0.06	Q	|	|	|	V|

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   23+25        0.6059      0.06  Q         |         |         |        V|
   23+30        0.6063      0.06  Q         |         |         |        V|
   23+35        0.6068      0.06  Q         |         |         |        V|
   23+40        0.6072      0.06  Q         |         |         |        V|
   23+45        0.6076      0.06  Q         |         |         |        V|
   23+50        0.6080      0.06  Q         |         |         |        V|
   23+55        0.6084      0.06  Q         |         |         |        V|
   24+ 0        0.6088      0.06  Q         |         |         |        V|
   24+ 5        0.6090      0.03  Q         |         |         |        V|
   24+10        0.6090      0.00  Q         |         |         |        V|
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Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions in Section G of the WQMP Template):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your WQMP Exhibit.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in your WQMP. Use the format shown in Table G.1on page 23 of this WQMP Template. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ A. **On-site storm drain inlets**	☒ **Locations of inlets.**	☒ **Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.**	☒ **Maintain and periodically repaint or replace inlet markings.** ☒ **Provide stormwater pollution prevention information to new site owners, lessees, or operators.** ☒ **See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** ☒ **Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."**
❑ B. **Interior floor drains and elevator shaft sump pumps**		❑ **State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.**	❑ **Inspect and maintain drains to prevent blockages and overflow.**
❑ C. **Interior parking garages**		❑ **State that parking garage floor drains will be plumbed to the sanitary sewer.**	❑ **Inspect and maintain drains to prevent blockages and overflow.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ D1. **Need for future indoor & structural pest control**		☐ **Note building design features that discourage entry of pests.**	☐ **Provide Integrated Pest Management information to owners, lessees, and operators.**
☒ D2. **Landscape/ Outdoor Pesticide Use**	☐ **Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained.** ☒ **Show self-retaining landscape areas, if any.** ☒ **Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.)**	**State that final landscape plans will accomplish all of the following.** ☐ **Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.** ☒ **Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.** ☒ **Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions.** ☒ **Consider using pest-resistant plants, especially adjacent to hardscape.** ☒ **To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.**	☒ **Maintain landscaping using minimum or no pesticides.** ☒ **See applicable operational BMPs in "What you should know for…..Landscape and Gardening"** at http://rcflood.org/stormwater/**Error! Hyperlink reference not valid.** ☒ **Provide IPM information to new owners, lessees and operators.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ E. **Pools, spas, ponds, decorative fountains, and other water features.**	❑ **Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)**	**If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.**	❑ **See applicable operational BMPs in** "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at http://rcflood.org/stormwater/
❑ F. **Food service**	❑ **For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment.** ❑ **On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.**	❑ **Describe the location and features of the designated cleaning area.** ❑ **Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.**	❑ **See the brochure, "**The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at http://rcflood.org/stormwater/ **Provide this brochure to new site owners, lessees, and operators.**
❑ G. **Refuse areas**	❑ **Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas.** ❑ **If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area.** ❑ **Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.**	❑ **State how site refuse will be handled and provide supporting detail to what is shown on plans.** ❑ **State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.**	❑ **State how the following will be implemented:** **Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ H. **Industrial processes.**	❑ **Show process area.**	❑ **If industrial processes are to be located on site, state: “All process activities to be performed indoors. No processes to drain to exterior or to storm drain system.”**	❑ **See Fact Sheet SC-10, “Non-Stormwater Discharges” in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** See the brochure “Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities” at http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ I. **Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)**	❑ **Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area.** ❑ **Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults.** ❑ **Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.**	**Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.** **Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:** ▪ **Hazardous Waste Generation** ▪ **Hazardous Materials Release Response and Inventory** ▪ **California Accidental Release (CalARP)** ▪ **Aboveground Storage Tank** ▪ **Uniform Fire Code Article 80 Section 103(b) & (c) 1991** ▪ **Underground Storage Tank** **www.cchealth.org/groups/hazmat/**	❑ **See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ J. **Vehicle and Equipment Cleaning**	❑ **Show on drawings as appropriate:** **(1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.** **(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use).** **(3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.** **(4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.**	❑ **If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced.**	**Describe operational measures to implement the following (if applicable):** ❑ **Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system.** Refer to “Outdoor Cleaning Activities and Professional Mobile Service Providers” for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/ ❑**Car dealerships and similar may rinse cars with water only.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ K. **Vehicle/Equipment Repair and Maintenance**	❑ **Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.** ❑ **Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.** ❑ **Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.**	❑ **State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.** ❑ **State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.** ❑ **State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.**	**In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:** ❑ **No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.** ❑ **No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.** ❑ **No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.** Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations". Brochure can be found at http://rcflood.org/stormwater/ Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ L. **Fuel Dispensing Areas**	❑ **Fueling areas[6] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable.** ❑ **Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.**		❑ **The property owner shall dry sweep the fueling area routinely.** ❑ **See the Fact Sheet SD-30 , "Fueling Areas" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

[6] **The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ M. **Loading Docks**	❑ **Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer.** ❑ **Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.** ❑ **Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.**		❑ **Move loaded and unloaded items indoors as soon as possible.** ❑ **See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☐ N. **Fire Sprinkler Test Water**		☐ **Provide a means to drain fire sprinkler test water to the sanitary sewer.**	☐ **See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**
O. **Miscellaneous Drain or Wash Water or Other Sources** ☐ **Boiler drain lines** ☒ **Condensate drain lines** ☐ **Rooftop equipment** ☐ **Drainage sumps** ☒ **Roofing, gutters, and trim.** ☐ **Other sources**		☐ **Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.** ☒ **Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system.** ☒ **Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment.** ☐ **Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water.** ☒ **Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.** ☐ **Include controls for other sources as specified by local reviewer.**	

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ P. **Plazas, sidewalks, and parking lots.**			☒ **Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.**

Appendix 9: O&M

Operation and Maintenance Plan and Documentation of Finance, Maintenance and Recording Mechanisms

Operations & Maintenance Responsibility for Treatment Control BMP's

BMP Required Maintenance	Frequency	Maintenance Requirements	Responsibility
Trash	Weekly	Empty Dumpsters	Property Owner
Roof Drains/ Gutters	Before wet season, or significant rain event, or when needed	Roof Gutters shall be visually inspected for defects and possible leakage. Damage or defects found shall be corrected as soon as possible. Owners should avoid use of gutters, roofing, and trim made of copper so as to prevent the metal from leaching into runoff.	Property Owner
INFILTRATION BASIN	Bi-Weekly Semi-Annual Annually As Needed	Mow, weed, trim and remove accumulation of trash debris and/or sediment. Routine inspections for areas of standing water within the BMP and corrective measures to restore proper infiltration rates are necessary. Trim Vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation. Replant eroded or barren spots to prevent erosion and accumulation of sediment. Per Condition of Approval 90.FLOODRI all BMPs are to be inspected, and if required, cleaned no later than October 15 each year Stabilize eroded banks, repair undercut and eroded areas at inflow and outflow areas, maintain access to the basin for regular maintenance, mow as appropriate for vegetative cover species, monitor health of vegetation and replace as necessary, control mosquitos as necessary, remove liter and debris. Mulch replacement may be necessary on an occasional basis to fill in voids, mulching should be done prior to the wet season. Unclog underdrain, and regulate soil pH. **For additional maintenance information please see Appendix 10 of the WQMP** **Grading Plans and BMP Map provided in WQMP document provide additional information on location of Bio-retention facility and tributary areas.**	Home Owners Association
Self-Retaining/ Landscape Areas	Bi-Weekly	Mow, weed, trim and remove accumulation of trash debris and/or sediment. Retaining areas should be mowed at 4-6 inches in height if grass is proposed. **Maintain landscaping using minimal pesticides**	Home Owners Association

BMP's should start and be inspected prior to forecast rain, daily during extended rain events, after rain events, weekly during the rainy season, and at two-week intervals during the non-rainy season.

Property Owner
Beazer Homes, 310 Commerce Street Irvine, CA 92602 – (949) 333-9592

Funding

Funding for Ongoing Maintenance will be provided by the Home Owner's Association.

Basin Site Maintenance Summary Form

Date:	Inspector Name:	Basin:
Maintenance Performed:		
Date:	Inspector Name:	Basin:
Maintenance Performed:		
Date:	Inspector Name:	Basin:
Maintenance Performed:		
Date:	Inspector Name:	Basin:
Maintenance Performed:		
Date:	Inspector Name:	Basin:
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Date:	Inspector Name:	Basin:
Maintenance Performed:		

WHEN RECORDED MAIL TO:

City Clerk
City of Riverside
City Hall, 3900 Main Street
Riverside, CA 92522

Planning Case: P__-____

For Recorder's Office Use Only

COVENANT AND AGREEMENT
ESTABLISHING NOTIFICATION PROCESS AND RESPONSIBILITY FOR
WATER QUALITY MANAGEMENT PLAN IMPLEMENTATION AND MAINTENANCE

THIS COVENANT AND AGREEMENT FOR WATER QUALITY MANAGEMENT PLAN IMPLEMENTATION AND MAINTENANCE is made and entered into this ______ day of ___________________, 20__, by LA SIERRA VICTORIA DEVELOPMENT LLC ______________________________("Declarant"), with reference to the following facts:

A. Declarant is the fee owner of the real property (the "Property") situated in the City of Riverside, County of Riverside, State of California, and legally described in Exhibit "A", which is attached hereto and incorporated within by reference.

B. Declarant has applied to the City of Riverside ("City") for ____________ TRACT 38921 DP-2023-01293 ____.

C. As a condition of approval and prior to the map recordation and/or issuance of any permits, the City is requiring Declarant to execute and record an agreement stating that the future property owners shall be informed of the requirements to implement and maintain the Best Management Practices ("BMPs") as described in the approved project specific Water Quality Management Plan.

D. Declarant intends by this document to comply with the conditions imposed by the City and to impose upon the Property mutually beneficial restrictions, conditions, covenants and agreements for the benefit of Property.

NOW, THEREFORE, for the purposes of complying with the conditions imposed by the City of Riverside for the approval of Planning Case P__-____, Declarant hereby declares that the Property is and hereafter shall be held, conveyed, transferred, mortgaged, encumbered, leased, rented, used, occupied, sold and improved subject to the following declarations, limitations, covenants, conditions, restrictions and easements, all of which are imposed as equitable servitudes pursuant to a general plan for the development of the Property for the purpose of enhancing and protecting the value and attractiveness of the Property, and each Parcel thereof, in accordance with the plan for the improvement of the Property, and to comply with certain conditions imposed by the City for the approval of P__-____, and shall be binding and inure to the benefit of each successor and assignee in interest of each such party. Any conveyance, transfer, sale, assignment, lease or sublease made by Declarant of a Parcel of the Property shall be and hereby is deemed to incorporate by reference all the provisions of the Covenant and Agreement including, but not limited to, all the covenants, conditions, restrictions, limitations, grants of easement, rights, rights-of-way, and equitable servitude contained herein.

1. This Covenant and Agreement hereby establishes a notification process for future individual property owners to ensure they are subject to and adhere to the Water Quality Management Plan implementation measures and that it shall be the responsibility of the Declarant, its heirs, successors and assigns to implement and maintain all Best Management Practices (BMPs) in good working order.

2. Declarant shall use its best efforts to diligently implement and maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by Declarant, its heirs, successors and assigns, in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the City, Declarant, its heirs, successors and assigns shall provide the City with documentation identifying the material(s) removed, the quantity, and disposal destination.

3. In the event Declarant, or its heirs, successors or assigns, fails to undertake the maintenance contemplated by this Covenant and Agreement within twenty-one (21) days of being given written notice by the City, or fails to complete any maintenance contemplated by this Covenant and Agreement with reasonable diligence, the City is hereby authorized to cause any maintenance necessary to be completed and charge the entire cost and expense to the Declarant or Declarant's successors or assigns, including administrative costs, reasonable attorneys fees and interest thereon at the maximum rate authorized by the Civil Code from the date of the notice of expense until paid in full. As an additional remedy, the Public Works Director may withdraw any previous urban runoff-related approval with respect to the Property on which BMPs have been installed and/or implemented until such time as Declarant, its heirs, successors or assigns, repays to City its reasonable costs incurred in accordance with this paragraph.

4. Any person who now or hereafter owns or acquires any right, title or interest in or to any parcel of the Property shall be deemed to have consented and agreed to every covenant, condition, restriction and easement contained herein.

5. In addition, each of the provisions hereof shall operate as covenants running with the land for the benefit of the Property and each Parcel thereof and shall inure to the benefit of all owners of the Parcels thereof, their successors and assigns in interest, and shall apply to and bind each successive owner of each Parcel, their successors and assigns in interest.

6. The terms of this Covenant and Agreement may be enforced by the City, its successors or assigns, and by any owner, lessee or tenant of the Parcels of the Property. Should the City or any owner, lessee or tenant bring an action to enforce any of the terms of this Covenant and Agreement, the prevailing party shall be entitled to costs of suit including reasonable attorneys' fees.

7. Subject to the prior written approval of the City by its Public Works Director, any provision contained herein may be terminated, modified or amended as to all of the Property or any portion thereof. No such termination, modification or amendment shall be effective until there shall have been executed, acknowledged and recorded in the Office of the Recorder of Riverside County, California, an appropriate instrument evidencing the same including the consent thereto by the City.

IN WITNESS WHEREOF, Declarant has caused this Covenant and Agreement to be executed as of the day and year first written above.

LA SIERRA VICTORIA DEVELOPMENT LLC

____
Name:
Title:

____
Name:
Title:

APPROVED AS TO FORM:

____
Name:
Deputy City Attorney

APPROVED AS TO CONTENT

____
Name:
Public Works Department:

STATE OF)
)
COUNTY OF)

On ______________________________, before me, _____________________________, Notary Public, personally appeared ____, who proved to me on the basis of satisfactory evidence, to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of ______________ that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

__________________________________ (SEAL)
Notary Public Signature

STATE OF)
)
COUNTY OF)

On ______________________________, before me, _____________________________, Notary Public, personally appeared ____, who proved to me on the basis of satisfactory evidence, to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of ______________ that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

__________________________________ (SEAL)
Notary Public Signature

EXHIBIT A
(Legal Description)

EXHIBIT B
(Map/Illustration)

Appendix 10: Educational Materials

BMP Fact Sheets, Maintenance Guidelines and Other End-User BMP Information

Infiltration Basin TC-11

Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

Targeted Constituent	Removal
Sediment	High
Nutrients	High
Trash	High
Metals	High
Bacteria	High
Oil and Grease	High
Organics	High
Flow Control	High

CALIFORNIA STORMWATER QUALITY ASSOCIATION®

Description

An infiltration basin is a relatively large impoundment that is designed to infiltrate stormwater. Infiltration basins use the natural filtering ability of the soil to remove pollutants in stormwater runoff. Infiltration facilities store runoff until it gradually exfiltrates through the soil and eventually into the water table. This practice removes surface flow and associated pollutants through infiltration and can also help recharge groundwater, thus helping to maintain low flows in stream systems. Infiltration basins can be challenging to apply on many sites, however, because of soils requirements. In addition, some studies have shown relatively high failure rates compared with other management practices.

California Experience

Infiltration basins have a long history of use in California, especially in the Central Valley. Basins located in Fresno were among those initially evaluated in the National Urban Runoff Program and were found to be effective at reducing the volume of runoff, while posing little long-term threat to groundwater quality (EPA, 1983; Schroeder, 1995). Proper siting of these devices is crucial as underscored by the experience of Caltrans in siting two basins in Southern California. The basin with marginal separation from groundwater and soil permeability failed immediately and could never be rehabilitated. The Water Augmentatoin Study (LASGRWC 2010) perfomred in the Los Angeles region showed no negative impact to ground water from infiltrating stormwater through infiltration practices treating stormwater from sites ranging from 0.5 acres to 7.4 acres.

Infiltration basins have been shown to be effective at reducing many of the pollutants regulated by the State and Regional Water Boards. Additionally, the Water Boards have determined that infiltration basins can qualify as a "Full Capture System (FCS)[1]" for trash. Accordingly, in addition to providing general specifications, this fact sheet includes trash-specific information to assist with upgrading either an existing BMP or the design of a planned BMP to meet the FCS definition. See the "**Full Trash Capture Compliance**" section and "***Trash FCS***" subsections in this fact sheet for more information.

Advantages

- Provides stormwater treatment and can be designed to meet hydromodification management requirements and the full capture system definition for trash control.
- 100% reduction in the load discharged to surface waters.
- Can achieve pre-development hydrology by infiltrating a significant portion of the average annual rainfall runoff.

Limitations

- Have a high failure rate if soil and subsurface conditions are not suitable.
- May not be appropriate for industrial sites or locations where spills may occur.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C or D.

Performance

As water migrates through porous soil and rock, pollutant attenuation mechanisms include precipitation, sorption, physical filtration, and bacterial degradation (Table 1). Vegetation establishment may improve water quality performance and decrease residence time (i.e., increase water losses). If functioning properly, this approach is presumed to have high removal efficiencies for particulate pollutants and moderate removal of soluble pollutants. Actual pollutant removal in the subsurface would be expected to vary depending upon site-specific soil types. This technology eliminates discharge to surface waters except for the very largest storms; consequently, complete removal of all stormwater constituents can be assumed.

Table 1. Typical pollutant removal for constituents and removal processes

Pollutant	Typical Removal	Median Effluent Concentration[1]	Removal Processes	Treatment Depth	References
Sediment	High (90%)	9.9 mg/l	Settling, filtration and sedimentation in top 2 to 8 inches of media.	1.5 feet	Geosyntec Consultants and Wright Water Engineering 2012; Hatt et al. 2008; Hunt et al. 2012; Li and Davis 2008; Stander and Borst 2010; Maniquiz, 2010; Scholes, 2007

[1] Full Capture System (FCS): A treatment control, or series of treatment controls, including but not limited to, a multi-benefit projector a low impact development control that traps all particles that are 5 mm or greater, and has a design treatment capacity that is either: a) of not less than the peak flow rate, Q, resulting from a one-year, one-hour, storm in the subdrainage area, or b) appropriately sized to, and designed to carry at least the same flows as, the corresponding storm drain.

Pollutant	Typical Removal	Median Effluent Concentration[1]	Removal Processes	Treatment Depth	References
Metals	High	TCd: 0.07 µg/L, TCr: 0.35 µg/L, TCu: 5.33 µg/L, *TFe: 1027 µg/L,* TPb: 0.19 µg/L, *TNi: 4.53 µg/L,* TZn: 12.0 µg/L	Settling with sediment and sorption to organic matter and clay in media.	2 feet	Geosyntec Consultants and Wright Water Engineering 2012; Hsieh and Davis 2005; Hunt et al. 2012; Maniquiz, 2010
Hydro-carbons	High (90-97%)	N/A	Volatilization, sorption, and degradation in mulch layer.	1 foot	Hong et al. 2006; Hunt et al. 2012; Barraud et al 1999; Dierkes and Geiger, 1999; Mikkelsen et al. 1997; Hong et al. 2006. Hsieh and Davis 2005; Pitt et al. 1999
Total phosphorus	High (-240% to 99%)	*0.240 mg/l*	Settling with sediment, sorption to organic matter and clay in media, and plant uptake. Poor removal efficiency can result from media containing high organic matter or with high background concentrations of phosphorus.	2 feet	Clark and Pitt 2009; Davis 2007; Geosyntec Consultants and Wright Water Engineering 2012; Hsieh and Davis 2005; Hunt et al. 2006; Hunt and Lord 2006; Li et al. 2010; Maniquiz 2010
Total nitrogen	High (TKN: -5% to 64%, Nitrate: 1% to 80%)	TN: 0.92 mg/l, TKN: 1.34 mg/l, $NO_{2,3}$-N: 0.37 mg/l	Sorption and settling (TKN), denitrification in IWS (nitrate), and plant uptake. Poor removal efficiency can result from media containing high organic matter.	3 feet	Barrett et al. 2013; Clark and Pitt 2009; Geosyntec Consultants and Wright Water Engineering 2012; Hunt et al. 2006; Hunt et al. 2012; Kim et al. 2003; Li et al. 2010; Passeport et al. 2009; Maniquiz, 2010; Winiarski et al. 2006

Pollutant	Typical Removal	Median Effluent Concentration[1]	Removal Processes	Treatment Depth	References
Bacteria	High	*Enterococcus*: 235 MPN/ 100 mL, *E.coli*: 101 MPN/100 mL	Sedimentation, filtration, sorption, desiccation, predation, and photolysis in mulch layer and media.	2 feet	Geosyntec Consultants and Wright Water Engineering 2012; Hathaway et al. 2009; Hathaway et al. 2011; Hunt and Lord 2006; Hunt et al. 2008; Hunt et al. 2012; Jones and Hunt 2010
Trash	High	*N/A*	Filtration	1.5 feet of media	Barrett et al. 2013

[1] Concentrations are based on bioretention performance data. Underlined effluent concentrations were (statistically) significantly lower than influent concentrations, as determined by statistical hypothesis testing on the available sampled data. Effluent concentrations displayed in *italics* were (statistically) significantly higher than influent concentrations.

Groundwater contamination concerns exists for infiltration basins (Lind and Karro, 1995; Datry et al., 2004; Pitt, 1999) but pollutant concentrations in the soil column have been shown to decrease rapidly with depth (within the first 6 to 18 inches) (Dechesne, M. et al., 2004; Dierkes and Geiger, 1999; Mikkelsen et al., 1997; Datry et al., 2004). However, pollutant concentrations can be of concern as deep as 10 feet, preferential flow pathways are suspected as the means of transport in some geologic settings (Winiarski et al. 2006). These observations warrant a 10 foot minimum between infiltration basin bottom and seasonal high water table.

Trash FCS

The Trash Amendments adopted by the State Water Board in April 2015 provide a performance standard for treatment of stormwater for trash in the form of the definition of FCS, which infiltration basin meets (see Section 5.6.1 for FCS details).

Suitability and Design

The use of infiltration basins may be limited by a number of factors, including type of native soils, climate, and location of groundwater table. Site characteristics, such as excessive slope of the drainage area, fine-grained soil types, and proximate location of the water table and bedrock, can also preclude the use of infiltration basins. The constraints of each site dictate the appropriate siting and footprint. Fundamental infiltration basin design components are as follows:

- Infiltration rate assessed on-site by a licensed geotechnical engineer or soil scientist.
- Unsuitable if known soil contamination is present, or if upstream drainage area uses or store chemicals or hazardous materials that could drain to the basin.
- 10 feet of separation between bottom of the basin and seasonal high water table.

- Drainage area that has been fully stabilized, plus use of a pretreatment BMP (e.g. grassed swales, gravity separator) at the entry point to ensure longevity.
- 10-ft setback from foundations, 100-ft from septic fields and water supply wells, and 50-ft from steep slopes.

Basin design is highly dependent on the constraints of the considered site. Costs will vary in accordance with the design. Table 2 details a number of core construction components and corresponding design considerations.

Table 2. Cost of design components and associated considerations

Component	Cost	Design Consideration
Excavation		Requires infiltration rate > 0.5 in/hr. When excavating ensure that subgrade compaction is minimized. Design for 6 to 18 inches average ponding depth. Basin should contain entire upstream WQV. After final grading, till the infiltration surface deeply
Without underdrains	$2.75–$5.00/ft^2	
With underdrains	$3.90–$6.15/ft^2	
Soil Media		1.5–4 feet (deeper for better pollutant removal, hydrologic benefits, and rooting depths) at minimum 5 in/hr infiltration. Total phosphorus < 15 ppm, pH 6–8, CEC > 5 meq/100 g soil. Organic Matter Content < 5% by weight. 65% sand, 20% sandy loam, and 15% compost (from vegetation-based feedstock) by volume.
Recommended mix	$2.90–$4.30/ft^2	
With engineered media	$3.60–$5.40/ft^2	
Soil Media Barrier		When incorporating an underdrain, separate media from native soil with a geotextile layer, 2 to 4 inches of washed sand (ASTM C-33), followed by 2 inches of choking stone (ASTM No. 8) over a 1.5 ft envelope of ASTM No. 57 stone.
Geotextile	$0.45/ft^2	
Washed sand (2-inch layer)	$0.20/ft^2	
No. 8 aggregate (min 2 inches thick)	$0.28/ft^2	
No. 57 stone (1.5 + feet)	$2.49/ft^2	
Hydraulic Restriction Layer		May use hydraulic restriction layer on vertical surfaces to restrict lateral flows to adjacent subgrades, foundations, or utilities.
Filter fabric	$0.45/ft^2	
Clay	$0.65/ft^2	
30-mil liner	$0.35/ft^2	
Concrete barrier	$12.00/ft^2	

Subsurface Option (Figure 1)		Constructing a subsurface facility includes excavating to depth, installing concrete unit, overdig, and backfill. Concrete unit height assumed here: 11' 4". *Requires* pretreatment BMP to capture trash and debris.
Excavation, Installation, and Backfill	$9.20/ft^2	
Concrete Unit	$59.93/ft^2	
Landscape	$0.20–$3.50/ft^2	Armor surface with cobble or vegetation. If planted (optional), install native, deep rooting, and drought tolerant plants.

Ensure that adequate head is available to operate flow splitter structures (to allow the basin to be offline) without ponding in the splitter structure or creating backwater upstream of the splitter.

Basin invert area should be determined by the equation. Where:

$$A = \frac{WQV}{kt}$$

A	=	Basin invert area (m^2)
WQV	=	water quality volume (m^3)
k	=	0.5 times the lowest field-measured hydraulic Conductivity (m/hr)
t	=	drawdown time (48 hr)

Design Variations

When traditional surface basins are infeasible because of land constraints, subsurface extended detention basin are ideal (Figure 1). Open space parks (e.g., baseball fields, etc.) are an example of where a subsurface infiltration basin is ideal because the park's purpose as a recreational area is not compromised. Additionally, recreational areas typical lack large structures, therefore the issue of overhead weight over the subsurface unit is not a concern.

[redacted]

Full Trash Capture Compliance

This section provides trash-specific information to assist with upgrading either an existing BMP or the design of a planned BMP to meet the FCS definition. In addition to developing and adopting the Trash Amendments, the State Water Board provides implementation information on its Trash Implementation web page: https://www.waterboards.ca.gov/water_issues/programs/stormwater/trash_implementation.html.

The web page includes information on best management practices or Full Capture Systems, including lists of State-certified Multi-Benefit Trash Treatment Systems. So, when selecting BMPs for trash control, fact sheet users should refer to both this BMP fact sheet and the State Water Board's Trash Implementation web page.

Design Modifications to Prevent Trash Migration, Sustain Capacity, and Prevent Reduced Functionality

The infiltration basin must be configured to allow trash to enter the system and for trash to remain in the basin until it can be collected and removed. To meet the requirement, inlets must be designed to pass the peak flow produced by the one-year, one-hour design storm or the same flows as the capacity of the inlet storm drain and solids that would be retained by a 5 mm screen or mesh, must remain in the system.

Inlets

There are a multitude of inlet configurations that will allow trash to enter and be captured in an infiltration basin. An open inlet with a forebay is recommended.

Pretreatment

Pretreatment is beneficial to increase and consolidate trash capture while managing maintenance requirements. A forebay with mortared cobble is one example of incorporating pretreatment in the inlet (Figure 2). This configuration can slow flow and allow trash and gross solids to settle out while consolidating at the edge of the infiltration basin to make it easier for maintenance crews to collect and remove.

[redacted]

Trash Containment

Once trash has been captured in an infiltration basin it must be contained so trash does not escape the infiltration basin. Containment may be provided by one or more of these features:

[redacted]

- an external design feature or up-gradient structure designed to bypass flows exceeding the region-specific one-year, one-hour storm event; or
- the BMP having sufficient capacity to trap particles from flows exceeding those generated by the one-year, one-hour storm event; or
- the BMP having sufficient capacity to treat either the design flows or volumes through media filtration or infiltration into native or amended soils; or
- use of a maximum 5 mm mesh screen on all outlets.

Maintenance

A considerable cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time. To mitigate failure, ensure particulate loading of the stormwater is minimal, or is reduced with an adjacent pretreatment (i.e. vegetated buffer strip). Reducing the particulate loading enables the soils infiltrative capacity to stay high and functional.

Clogged infiltration basins reduced water quality performance but can also enable standing water to become a nuisance due to mosquito breeding. If the basin takes more than 48 hours to drain, then the rock fill should be removed and all dimensions of the basin should be increased by 2 inches to provide a fresh surface for infiltration. To mitigate failure, ensure particulate loading of the stormwater is minimal, or is reduced with an adjacent pretreatment (Figure 2). Reducing particulate loading enables the soil's infiltrative capacity to remain high and functional. Table 3 provides maintenance activity details, frequency, and costs.

Table 3. Typical maintenance activities and associated costs and frequency

Frequency	Cost	Activity
Routine Maintenance (required monthly to every 2 years)		Remove excess sediment, trash, and debris across the surface, inlet, and outlet. Check for and stabilize erosion. Pruning and mowing overgrown
Routine (small)	$7.62/ft^2	

Frequency	Cost	Activity
Routine (medium) Routine (large)	$1.91/ft^2 $1.91/ft^2	vegetation that interferes with access, or safety (if applicable).
End of Life Replacement (service life of 20 years)		Excavate to the depth of soil media. Test soil for excessive soil contamination of common stormwater pollutants (e.g. metals, nutrients). Continue to remove underlying soil if pollutants exceed standard for contaminated soil. Replace with clean soil.
Replacement (small) Replacement (medium) Replacement (large)	$10.52/ft^2 $10.17/ft^2 $10.11/ft^2	
Note: Small System = 500 ft^2; Medium System = 2000 ft^2; Large System = 4000 ft^2 Underlined statement indicates that the activity may be required more frequently than shown in the table to meet the State Water Board maintenance criteria for Multi-Benefit Treatment Systems to be qualified as Full Capture Systems.		

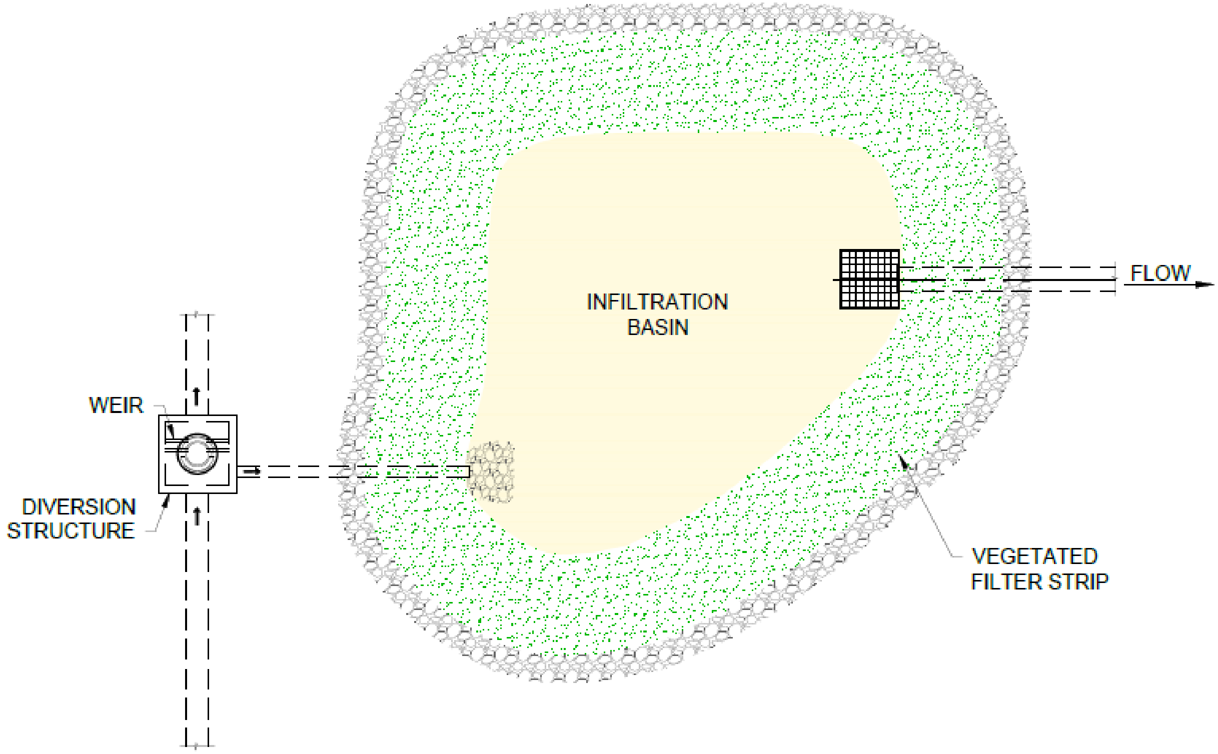
Trash FCS

Maintenance to Prevent Trash Migration, Sustain Capacity, and Prevent Reduced Functionality

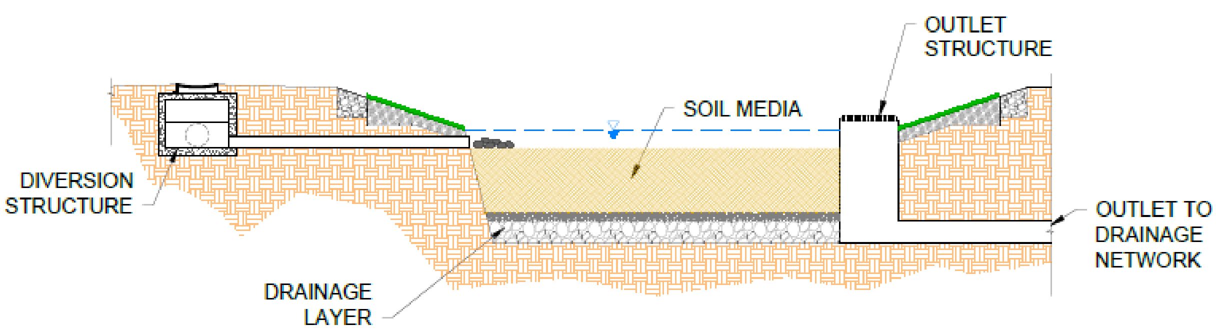
For Multi-Benefit Treatment Systems to be qualified as Full Capture Systems, the State Water Board requires regular maintenance to maintain adequate trash capture capacity and to ensure that trapped trash does not migrate offsite. Additionally, the State Water Board requires the BMP owner to establish a maintenance schedule based on site-specific factors, including the design trash capacity of the Infiltration Basin Multi-Benefit Trash Treatment System, storm frequency, and estimated or measured trash loading from the drainage area. To meet those criteria, it is likely that the frequency of trash and debris removal will have to be increased above the recommended monthly interval during the wet season to prevent trash from being blown from the BMP or being washed out of the infiltration basin in the subsequent rain events (see Table 3). Depending on the frequency and size of storms, and upstream pollutant characteristics, trash and debris removal can be as frequent as before and after every wet weather event. The optimum maintenance frequency is best determined by site observation over an average water year.

Trash maintenance not only plays a role in the functionality of the infiltration basin but also in the aesthetics and public perception of the infiltration basin (and of all BMPs). Part of maintaining positive perception among the public is the visibility of a well-maintained BMP. This positive perception can self-perpetuate further support for integrated stormwater management practices and therefore further investment in regular maintenance.

Schematic



A INFILTRATION BASIN - PLAN VIEW
- NOT TO SCALE



A INFILTRATION BASIN - SECTION
- NOT TO SCALE

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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.

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.

Rain Garden

Design Objectives

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

Description

Various roof runoff controls are available to address stormwater that drains off rooftops. The objective is to reduce the total volume and rate of runoff from individual lots, and retain the pollutants on site that may be picked up from roofing materials and atmospheric deposition. Roof runoff controls consist of directing the roof runoff away from paved areas and mitigating flow to the storm drain system through one of several general approaches: cisterns or rain barrels; dry wells or infiltration trenches; pop-up emitters, and foundation planting. The first three approaches require the roof runoff to be contained in a gutter and downspout system. Foundation planting provides a vegetated strip under the drip line of the roof.

Approach

Design of individual lots for single-family homes as well as lots for higher density residential and commercial structures should consider site design provisions for containing and infiltrating roof runoff or directing roof runoff to vegetative swales or buffer areas. Retained water can be reused for watering gardens, lawns, and trees. Benefits to the environment include reduced demand for potable water used for irrigation, improved stormwater quality, increased groundwater recharge, decreased runoff volume and peak flows, and decreased flooding potential.

Suitable Applications

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

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain

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barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

If the cistern has an operable valve, the valve can be closed to store stormwater for irrigation or infiltration between storms. This system requires continual monitoring by the resident or grounds crews, but provides greater flexibility in water storage and metering. If a cistern is provided with an operable valve and water is stored inside for long periods, the cistern must be covered to prevent mosquitoes from breeding.

A cistern system with a permanently open outlet can also provide for metering stormwater runoff. If the cistern outlet is significantly smaller than the size of the downspout inlet (say ¼ to ½ inch diameter), runoff will build up inside the cistern during storms, and will empty out slowly after peak intensities subside. This is a feasible way to mitigate the peak flow increases caused by rooftop impervious land coverage, especially for the frequent, small storms.

Dry wells and Infiltration Trenches

Roof downspouts can be directed to dry wells or infiltration trenches. A dry well is constructed by excavating a hole in the ground and filling it with an open graded aggregate, and allowing the water to fill the dry well and infiltrate after the storm event. An underground connection from the downspout conveys water into the dry well, allowing it to be stored in the voids. To minimize sedimentation from lateral soil movement, the sides and top of the stone storage matrix can be wrapped in a permeable filter fabric, though the bottom may remain open. A perforated observation pipe can be inserted vertically into the dry well to allow for inspection and maintenance.

In practice, dry wells receiving runoff from single roof downspouts have been successful over long periods because they contain very little sediment. They must be sized according to the amount of rooftop runoff received, but are typically 4 to 5 feet square, and 2 to 3 feet deep, with a minimum of 1-foot soil cover over the top (maximum depth of 10 feet).

To protect the foundation, dry wells must be set away from the building at least 10 feet. They must be installed in solids that accommodate infiltration. In poorly drained soils, dry wells have very limited feasibility.

Infiltration trenches function in a similar manner and would be particularly effective for larger roof areas. An infiltration trench is a long, narrow, rock-filled trench with no outlet that receives stormwater runoff. These are described under Treatment Controls.

Pop-up Drainage Emitter

Roof downspouts can be directed to an underground pipe that daylights some distance from the building foundation, releasing the roof runoff through a pop-up emitter. Similar to a pop-up irrigation head, the emitter only opens when there is flow from the roof. The emitter remains flush to the ground during dry periods, for ease of lawn or landscape maintenance.

Foundation Planting

Landscape planting can be provided around the base to allow increased opportunities for stormwater infiltration and protect the soil from erosion caused by concentrated sheet flow coming off the roof. Foundation plantings can reduce the physical impact of water on the soil and provide a subsurface matrix of roots that encourage infiltration. These plantings must be sturdy enough to tolerate the heavy runoff sheet flows, and periodic soil saturation.

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.

Supplemental Information

Examples

- City of Ottawa’s Water Links Surface –Water Quality Protection Program
- City of Toronto Downspout Disconnection Program
- City of Boston, MA, Rain Barrel Demonstration Program

Other Resources

Hager, Marty Catherine, Stormwater, “Low-Impact Development”, January/February 2003. www.stormh2o.com

Low Impact Urban Design Tools, Low Impact Development Design Center, Beltsville, MD. www.lid-stormwater.net

Start at the Source, Bay Area Stormwater Management Agencies Association, 1999 Edition

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.