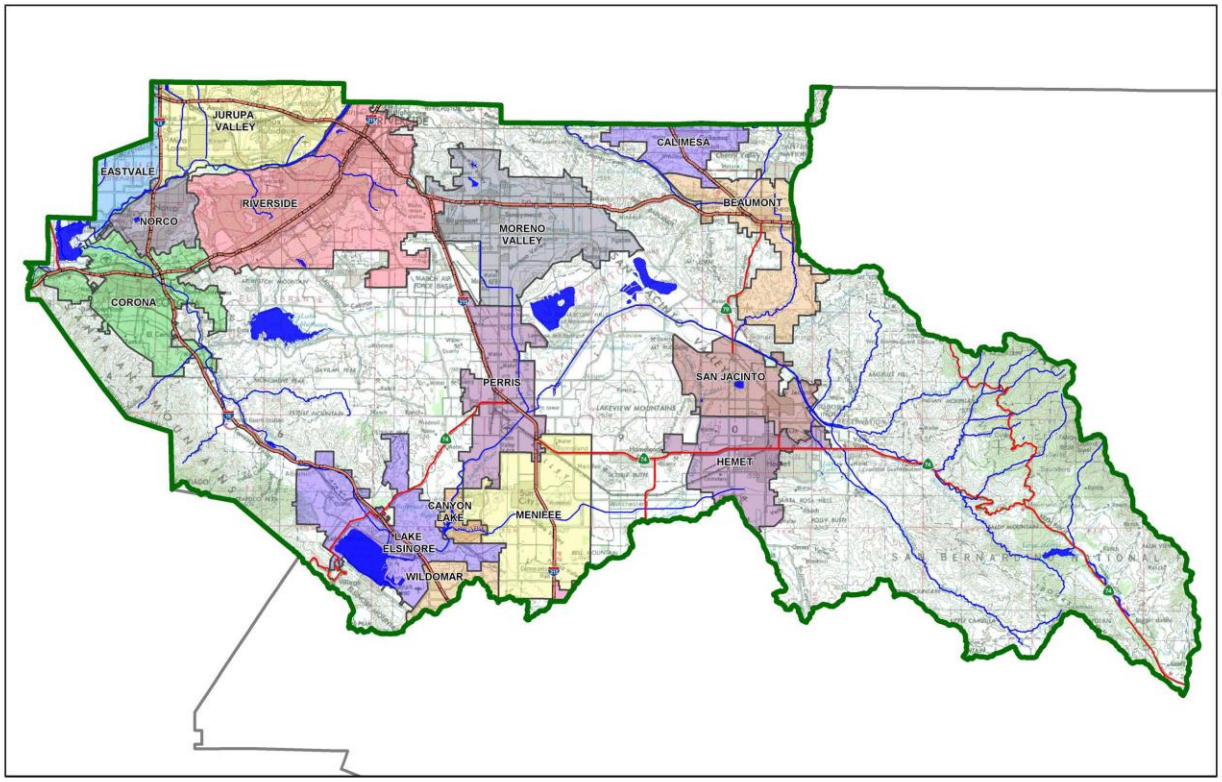
Project Specific Water Quality Management Plan

Santa Ana Watershed *Region of Riverside County*

Project Title: Lakeshore Manor Condominiums

Development No: Tentative Tract Map 37280

Design Review/Case No: Preliminary WQMP



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☒ **Preliminary**
☐ **Final**

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Prepared for Compliance with
Regional Board Order No. **R8-2010-0033**

OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for HONG GUAN, LLC by KOLIBRIEN CORP. for the Lakeshore Manor Condominiums project.

This WQMP is intended to comply with the requirements of City of Lake Elsinore for Water Quality Ordinance which includes the requirement for the preparation and implementation of a Project-Specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation and funding of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. In addition, the property owner accepts responsibility for interim operation and maintenance of Stormwater BMPs until such time as this responsibility is formally transferred to a subsequent owner. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity. The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under City of Lake Elsinore Water Quality Ordinance (Municipal Code Section14.08).

"I, the undersigned, certify under penalty of law that the provisions of this WQMP have been reviewed and accepted and that the WQMP will be transferred to future successors in interest."

Owner's Signature	04/10/2017 Date
Chyiiluu Chi Owner's Printed Name	Owner Owner's Title/Position

PREPARER'S CERTIFICATION

"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan meet the requirements of Regional Water Quality Control Board Order No. **R8-2010-0033** and any subsequent amendments thereto."

Preparer's Signature	04/10/2017 Date
John Johnson, P.E. Preparer's Printed Name	Principal Engineer Preparer's Title/Position

Preparer's Licensure: Civil 83934

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Section A: Project and Site Information

PROJECT INFORMATION	
Type of Project:	Residential, Condominiums
Planning Area:	Lakeshore Village Specific Plan, Attached Residential 18DU/AC
Community Name:	Lake Elsinore, Lakeshore Village
Development Name:	Lakeshore Manor
Narrative:	The project site comprises approximately 7.28 net acres and is located on Lakeshore Dr., in the City of Lake Elsinore, California. The project proposes 11 2 story condominium buildings with 144 proposed units, a club house, a pool, tennis court and a playground. The project site is located approximately 4 miles westerly of the 15 freeway, along Lakeshore Dr. The project site drains into an existing sediment basin and then into the existing 60 inch storm drain within Lakeshore Dr, and is then conveyed directly to Lake Elsinore. The project site is partially developed along lakeshore with existing rough grading improvements from the previous adjacent Lakeshore Village tract. The current site is a previously rough graded pad that now has natural plant and weed vegetation growing on it. The street fronting the property are also developed AC pavement with some improvements. The project site was previously developed as a part of the prior subdivision development and is currently vacant land. The project site is the site has gentle slopes of about 1%-2% with existing street slopes roughly 1.5%. The site drains northerly and easterly. The elevation of the project site ranges from 1313 to 1304 feet above mean sea level (msl). Stormwater in the proposed condition shall be conveyed into two proposed underground infiltration basins with a metered outlet to mitigate increased flowrates back into the ms-4 system. The basins are designed for both water quality and stormwater flowrate/ volume mitigation and total in storage capacity of 36,794 cubic feet.

PROJECT LOCATION
Latitude & Longitude (DMS): LAT 33d 41' 14" N / LONG -117d 22' 18" W
Project Watershed and Sub-Watershed: Santa Ana River, San Jacinto Valley, Lake Elsinore
APN(s): 379-230-001-9
Map Book and Page No.: MB 8/377

PROJECT CHARACTERISTICS	
Proposed or Potential Land Use(s)	Residential
Proposed or Potential SIC Code(s)	NA
Area of Impervious Project Footprint (SF)	224,586
Total Area of proposed Impervious Surfaces within the Project Limits (SF)/or Replacement	224,586
Does the project consist of offsite road improvements?	☒ Y ☐ N
Does the project propose to construct unpaved roads?	☐ Y ☒ N
Is the project part of a larger common plan of development (phased project)?	☐ Y ☒ N

EXISTING SITE CHARACTERISTICS	
Total area of existing Impervious Surfaces within the project limits (SF)	0
Is the project located within any MSHCP Criteria Cell?	☐ Y ☒ N
If so, identify the Cell number:	
Are there any natural hydrologic features on the project site?	☐ Y ☒ N
Is a Geotechnical Report attached?	☐ Y ☒ N
If no Geotech. Report, list the NRCS soils type(s) present on the site (A, B, C and/or D)	B
What is the Water Quality Design Storm Depth for the project?	0.78

A.1 Maps and Site Plans

WQMP Site Plan Exhibit with vicinity map and existing topography

Conceptual Stormtech underground infiltration basin plans

Receiving waters maps, soil map & precipitation maps

A.2 Identify Receiving Waters

Table A.1 Identification of Receiving Waters

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use
City of Lake Elsinore MS-4 Storm Drain System	None	None	None
Lake Elsinore HU# 802.31	Nutrients, Organic enrichment, Low dissolved oxygen, Sedimentation, Siltation, Unknown toxicity, PCB's	REC1, REC2, WARM, WILD	Not designated as RARE

A.3 Additional Permits/Approvals required for the Project:

Table A.2 Other Applicable Permits

Agency	Permit Required	
State Department of Fish and Game, 1602 Streambed Alteration Agreement	☐ Y	☒ N
State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Cert.	☐ Y	☒ N
US Army Corps of Engineers, CWA Section 404 Permit	☐ Y	☒ N
US Fish and Wildlife, Endangered Species Act Section 7 Biological Opinion	☐ Y	☒ N
Statewide Construction General Permit Coverage	☒ Y	☐ N
Statewide Industrial General Permit Coverage	☐ Y	☒ N
Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP)	☐ Y	☒ N
Other *(please list in the space below as required)* Grading permit, Building Permit	☒ Y	☐ N

Section B: Optimize Site Utilization (LID Principles)

Site Optimization

Did you identify and preserve existing drainage patterns? If so, how? If not, why?

The proposed project mitigates increased runoff flowrates and volumes for all modeled storms for 10 and 100 year conditions. Drainage patterns are similar in direction and slope to the original and future erosion to the existing site will be eliminated.

Did you identify and protect existing vegetation? If so, how? If not, why?

The site is currently vacant with a couple small trees as well as natural vegetation such as weeds and bushes. There is nothing notable to protect and new vegetation will be planted onsite that will be much more abundant and aesthetically pleasing than the existing vegetation..

Did you identify and preserve natural infiltration capacity? If so, how? If not, why?

Yes, the proposed site is roughly 70% impervious which leaves 30% of vegetated landscaped areas for natural vegetation as well as two underground infiltration basins with nearly 12,000 square feet of infiltration area underneath two of the proposed parking alley areas.

Did you identify and minimize impervious area? If so, how? If not, why?

A condominium complex, the amount of pervious area was maximized with open space and landscape areas.

Did you identify and disperse runoff to adjacent pervious areas? If so, how? If not, why?

The proposed building roof tops shall drain back to landscape areas where possible for natural filtration. The catch basins will have filtration inserts to filter runoff prior to entering the proposed underground infiltration basins.

Section C: Delineate Drainage Management Areas (DMAs)

Table C.1 DMA Classifications

DMA Name or ID	Surface Type(s)[1]	Area (Sq. Ft.)	DMA Type
R/1	*Roofs*	*33459.51*	*TYPE D, DRAINS TO L/1*
R/2	*Roofs*	*10433.9*	*TYPE D, DRAINS TO L/1*
R/3	*Roofs*	*6801.96*	*TYPE D, DRAINS TO L/1*
R/4	*Roofs*	*3943.91*	*TYPE D, DRAINS TO L/1*
P/1	*Concrete or Asphalt*	*5338.38*	*TYPE D, DRAINS TO H/1*
P/2	*Concrete or Asphalt*	*3523.33*	*TYPE D, DRAINS TO H/1*
T/1	*Concrete or Asphalt*	*7200*	*TYPE D, DRAINS TO H/1*
H/1	*Concrete or Asphalt*	*153885*	*TYPE D, DRAINS TO BMP*
L/1	*Natural*	*92543.77*	*TYPE A, DRAINS TO H/1*

[1]Reference Table 2-1 in the WQMP Guidance Document to populate this column

Table C.2 Type 'A', Self-Treating Areas

DMA Name or ID	Area (Sq. Ft.)	Stabilization Type	Irrigation Type (if any)
L/1	*92543.77*	*Drought tolerant plants, bushes, trees and grass*	Drip irrigation

Table C.3 Type 'B', Self-Retaining Areas

Self-Retaining Area				**Type 'C' DMAs that are draining to the Self-Retaining Area**		
DMA Name/ ID	Post-project surface type	Area (square feet) [A]	Storm Depth (inches) [B]	DMA Name / ID	[C] from Table C.4 = [C]	Required Retention Depth (inches) [D]
NA				NA		

$$[D] = [B] + \frac{[B] \cdot [C]}{[A]}$$

Table C.4 Type 'C', Areas that Drain to Self-Retaining Areas

DMA					Receiving Self-Retaining DMA		
DMA Name/ ID	Area (square feet)	Post-project surface type	Runoff factor	Product		Area (square feet)	Ratio
	[A]		[B]	[C] = [A] x [B]	DMA name /ID	[D]	[C]/[D]
NA							

Table C.5 Type 'D', Areas Draining to BMPs

DMA Name or ID	BMP Name or ID
R/1	DRAINS TO I1, THEN TO INFILTRATIN BASINS
R/2	DRAINS TO I1, THEN TO INFILTRATIN BASINS
R/2	DRAINS TO I1, THEN TO INFILTRATIN BASINS
R/4	DRAINS TO I1, THEN TO INFILTRATIN BASINS
P/1	DRAINS TO INFILTRATIN BASINS
P/2	DRAINS TO INFILTRATIN BASINS
T/1	DRAINS TO INFILTRATIN BASINS
H/1	DRAINS TO INFILTRATIN BASINS
L/1	SELF TREATING, THEN TO INFILTRATION BASINS

Note: More than one drainage management area can drain to a single LID BMP, however, one drainage management area may not drain to more than one BMP.

Section D: Implement LID BMPs

D.1 Infiltration Applicability

Is there an approved downstream 'Highest and Best Use' for stormwater runoff (see discussion in Chapter 2.4.4 of the WQMP Guidance Document for further details)? ☐ Y ☒ N

Geotechnical Report

Included

Is this project classified as a small project consistent with the requirements of Chapter 2 of the WQMP Guidance Document? ☐ Y ☒ N

Infiltration Feasibility

Table D.1 Infiltration Feasibility

Does the project site…	YES	NO
…have any DMAs with a seasonal high groundwater mark shallower than 10 feet?		X
If Yes, list affected DMAs:		
…have any DMAs located within 100 feet of a water supply well?		X
If Yes, list affected DMAs:		
…have any areas identified by the geotechnical report as posing a public safety risk where infiltration of stormwater could have a negative impact?		X
If Yes, list affected DMAs:		
…have measured in-situ infiltration rates of less than 1.6 inches / hour? Infiltration testing will be done at a later date. Assumed infiltration rates of 1.25 were conservatively chosen for this PWQMP. Phase I indicated that moderate to good infiltration rates are likely.		X
If Yes, list affected DMAs:		
…have significant cut and/or fill conditions that would preclude in-situ testing of infiltration rates at the final infiltration surface?		X
If Yes, list affected DMAs:		
…geotechnical report identify other site-specific factors that would preclude effective and safe infiltration?		X
Describe here:		

Geotechnical report to be prepared with infiltration testing prior to final WQMP submittal during the permit phase.

D.2 Harvest and Use Assessment

Please check what applies*:*

☐ Reclaimed water will be used for the non-potable water demands for the project.

☐Downstream water rights may be impacted by Harvest and Use as approved by the Regional Board (verify with the Copermittee).

X The Design Capture Volume will be addressed using Infiltration Only BMPs. In such a case, Harvest and Use BMPs are still encouraged, but it would not be required if the Design Capture Volume will be infiltrated or evapotranspired.

If any of the above boxes have been checked, Harvest and Use BMPs need not be assessed for the site.

Irrigation Use Feasibility

Not proposed

Complete the following steps to determine the feasibility of harvesting stormwater runoff for Irrigation Use BMPs on your site:

Step 1: Identify the total area of irrigated landscape on the site, and the type of landscaping used.

Total Area of Irrigated Landscape:

Type of Landscaping (Conservation Design or Active Turf): Conservation Design

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for irrigation use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces:

Step 3: Cross reference the Design Storm depth for the project site (see Exhibit A of the WQMP Guidance Document) with the left column of Table 2-3 in Chapter 2 to determine the minimum area of Effective Irrigated Area per Tributary Impervious Area (EIATIA).

Enter your EIATIA factor:

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum irrigated area that would be required.

Minimum required irrigated area:

Step 5: Determine if harvesting stormwater runoff for irrigation use is feasible for the project by comparing the total area of irrigated landscape (Step 1) to the minimum required irrigated area (Step 4).

Minimum required irrigated area (Step 4)	Available Irrigated Landscape (Step 1)

Toilet Use Feasibility

Not proposed

Complete the following steps to determine the feasibility of harvesting stormwater runoff for toilet flushing uses on your site:

Step 1: Identify the projected total number of daily toilet users during the wet season, and account for any periodic shut downs or other lapses in occupancy:

Projected Number of Daily Toilet Users:

Project Type: Residential

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for toilet use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces:

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-1 in Chapter 2 to determine the minimum number or toilet users per tributary impervious acre (TUTIA).

Enter your TUTIA factor:

Step 4: Multiply the unit value obtained from Step 3 by the total of impervious areas from Step 2 to develop the minimum number of toilet users that would be required.

Minimum number of toilet users:

Step 5: Determine if harvesting stormwater runoff for toilet flushing use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

Minimum required Toilet Users (Step 4)	Projected number of toilet users (Step 1)

Other Non-Potable Use Feasibility

Not proposed

Are there other non-potable uses for stormwater runoff on the site (e.g. industrial use)? See Chapter 2 of the Guidance for further information. If yes, describe below. If no, write N/A.

NA

Step 1: Identify the projected average daily non-potable demand, in gallons per day, during the wet season and accounting for any periodic shut downs or other lapses in occupancy or operation.

Average Daily Demand: Projected average daily use (gpd)

Step 2: Identify the planned total of all impervious areas on the proposed project from which runoff might be feasibly captured and stored for the identified non-potable use. Depending on the configuration of buildings and other impervious areas on the site, you may consider the site as

a whole, or parts of the site, to evaluate reasonable scenarios for capturing and storing runoff and directing the stored runoff to the potential use(s) identified in Step 1 above.

Total Area of Impervious Surfaces:

Step 3: Enter the Design Storm depth for the project site (see Exhibit A) into the left column of Table 2-3 in Chapter 2 to determine the minimum demand for non-potable uses per tributary impervious acre.

Enter the factor from Table 2-3:

Step 4: Multiply the unit value obtained from Step 4 by the total of impervious areas from Step 3 to develop the minimum number of gallons per day of non-potable use that would be required.

Minimum required use:

Step 5: Determine if harvesting stormwater runoff for other non-potable use is feasible for the project by comparing the Number of Daily Toilet Users (Step 1) to the minimum required number of toilet users (Step 4).

Minimum required non-potable use (Step 4)	**Projected average daily use (Step 1)**

If Irrigation, Toilet and Other Use feasibility anticipated demands are less than the applicable minimum values, Harvest and Use BMPs are not required and you should proceed to utilize LID Bioretention and Biotreatment, unless a site-specific analysis has been completed that demonstrates technical infeasibility as noted in D.3 below.

D.3 Bioretention and Biotreatment Assessment

Other LID Bioretention and Biotreatment BMPs as described in Chapter 2.4.7 of the WQMP Guidance Document are feasible on nearly all development sites with sufficient advance planning.

Select one of the following:

X LID Bioretention/Biotreatment BMPs will be used for some or all DMAs of the project as noted below in Section D.4 (note the requirements of Section 3.4.2 in the WQMP Guidance Document).

☐ A site-specific analysis demonstrating the technical infeasibility of all LID BMPs has been performed and is included in Appendix 5. If you plan to submit an analysis demonstrating the technical infeasibility of LID BMPs, request a pre-submittal meeting with the Copermittee to discuss this option. Proceed to Section E to document your alternative compliance measures.

D.4 Feasibility Assessment Summaries

Table D.2 LID Prioritization Summary Matrix

DMA Name/ID	LID BMP Hierarchy				No LID (Alternative Compliance)
	1. Infiltration	2. Harvest and use	3. Bioretention	4. Biotreatment	
R/1	☐	☐	☐	☐	Roof to L1
R/2	☐	☐	☐	☐	Roof to L1
R/2	☐	☐	☐	☐	Roof to L1
R/4	☐	☐	☐	☐	Roof to L1
P/1	☒	☐	☐	☐	Pool to Basin
P/2	☒	☐	☐	☐	Plaground to Basin
T/1	☒	☐	☐	☐	Tennis court to Basin
H/1	☒	☐	☐	☐	Streets and hardscape to Basin
L/1	☒	☐	☐	☒	Self treating areas to basin

For those DMAs where LID BMPs are not feasible, provide a brief narrative below summarizing why they are not feasible, include your technical infeasibility criteria in Appendix 5, and proceed to Section E below to document Alternative Compliance measures for those DMAs. Recall that each proposed DMA must pass through the LID BMP hierarchy before alternative compliance measures may be considered.

Bioretention is not proposed as the highest and best use. The infiltration basins are proposed as the highest and best use and designed to store excess stormwater runoff generated from 70% of new impervious area proposed, mitigate peak flowrates to be less than or equal to existing flowrates, and to store and infiltrate the VBMP as well as the differential maximum volume generated by increased stormwater runopff for the 100 year 24 hour storm event.

D.5 LID BMP Sizing

Table D.3 DCV Calculations for LID BMPs

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Impervious Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Enter BMP Name / Identifier Here*		
	[A]		[B]	[C]	[A] x [C]			
R/1	*33459.51*	*Roofs*	*1*	*0.89*	29845.9			
R/2	*10433.9*	*Roofs*	*1*	*0.89*	9307			
R/2	*6801.96*	*Roofs*	*1*	*0.89*	6067.3			
R/4	*3943.91*	*Roofs*	*1*	*0.89*	3518			
P/1	*5338.38*	*Concrete or Asphalt*	*1*	*0.89*	4761.8			
P/2	*3523.33*	*Concrete or Asphalt*	*1*	*0.89*	3142.8			
T/1	*7200*	*Concrete or Asphalt*	*1*	*0.89*	6422.4			
H/1	*153885*	*Concrete or Asphalt*	*1*	*0.89*	137265.4	*Design Storm Depth (in)*	*Design Capture Volume,* V_{BMP} *(cubic feet)*	*Proposed Volume on Plans (cubic feet)*
L/1	*92543.77*	*Landscape*	*0.03*	*0.06*	5787.8			
	$A_T = \Sigma[A]$ 317,129				$\Sigma=$ [D] 206,118	[E] 0.78	$[F] = \frac{[D]x[E]}{12}$ 13,397 36,437 by hydromodification unit hydrgraph differential volumes 48,149-11,712 cubic feet	[G] 24,000

[B], [C] is obtained as described in Section 2.3.1 of the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is obtained from a design procedure sheet, such as in LID BMP Design Handbook and placed in Appendix 6

Section E: Alternative Compliance (LID Waiver Program)

LID BMPs are expected to be feasible on virtually all projects. Where LID BMPs have been demonstrated to be infeasible as documented in Section D, other Treatment Control BMPs must be used (subject to LID waiver approval by the Copermittee). Check one of the following Boxes:

X LID Principles and LID BMPs have been incorporated into the site design to fully address all Drainage Management Areas. No alternative compliance measures are required for this project and thus this Section is not required to be completed.

- *Or* -

☐ The following Drainage Management Areas are unable to be addressed using LID BMPs. A site-specific analysis demonstrating technical infeasibility of LID BMPs has been approved by the Co-Permittee and included in Appendix 5. Additionally, no downstream regional and/or sub-regional LID BMPs exist or are available for use by the project. The following alternative compliance measures on the following pages are being implemented to ensure that any pollutant loads expected to be discharged by not incorporating LID BMPs, are fully mitigated.

E.1 Identify Pollutants of Concern

Table E.1 Potential Pollutants by Land Use Type

Priority Development Project Categories and/or Project Features (check those that apply)	General Pollutant Categories							
	Bacterial Indicators	Metals	Nutrients	Pesticides	Toxic Organic Compounds	Sediments	Trash & Debris	Oil & Grease
☐ Detached Residential Development	P	N	P	P	N	P	P	P
☒ Attached Residential Development	P	N	P	P	N	P	P	P(2)
☐ Commercial/Industrial Development	P(3)	P	P(1)	P(1)	P(5)	P(1)	P	P
☐ Automotive Repair Shops	N	P	N	N	P(4, 5)	N	P	P
☐ Restaurants (>5,000 ft^2)	P	N	N	N	N	N	P	P
☐ Hillside Development (>5,000 ft^2)	P	N	P	P	N	P	P	P
☐ Parking Lots (>5,000 ft^2)	P(6)	P	P(1)	P(1)	P(4)	P(1)	P	P
☐ Retail Gasoline Outlets	N	P	N	N	P	N	P	P
Project Priority Pollutant(s) of Concern	☒	☒	☒	☒	☒	☒	☒	☒

P = Potential

N = Not Potential

(1) A potential Pollutant if non-native landscaping exists or is proposed onsite; otherwise not expected

(2) A potential Pollutant if the project includes uncovered parking areas; otherwise not expected

(3) A potential Pollutant is land use involving animal waste

(4) Specifically petroleum hydrocarbons

(5) Specifically solvents

(6) Bacterial indicators are routinely detected in pavement runoff

E.2 Stormwater Credits

Projects that cannot implement LID BMPs but nevertheless implement smart growth principles are potentially eligible for Stormwater Credits. Utilize Table 3-8 within the WQMP Guidance Document to identify your Project Category and its associated Water Quality Credit. If not applicable, write N/A.

Table E.2 Water Quality Credits

Qualifying Project Categories	Credit Percentage[2]
N/A	
Total Credit Percentage[1]	

[1]Cannot Exceed 50%
[2]Obtain corresponding data from Table 3-8 in the WQMP Guidance Document

E.3 Sizing Criteria

Table E.3 Treatment Control BMP Sizing

DMA Type/ID	**DMA Area (square feet)**	**Post-Project Surface Type**	**Effective Impervious Fraction, I_f**	**DMA Runoff Factor**	**DMA Area x Runoff Factor**		***Enter BMP Name / Identifier Here***		
	[A]		[B]	[C]	[A] x [C]				
						Design Storm Depth (in)	*Minimum Design Capture Volume or Design Flow Rate (cubic feet or cfs)*	*Total Storm Water Credit % Reduction*	*Proposed Volume or Flow on Plans (cubic feet or cfs)*
	A_T=Σ[A]				Σ= [D]	[E]	$[F] = \frac{[D]x[E]}{[G]}$	[F] X (1-[H])	[I]

[B], [C] is obtained as described in Section 2.3.1 from the WQMP Guidance Document
[E] is obtained from Exhibit A in the WQMP Guidance Document
[G] is for Flow-Based Treatment Control BMPs [G] = 43,560, for Volume-Based Control Treatment BMPs, [G] = 12
[H] is from the Total Credit Percentage as Calculated from Table E.2 above
[I] as obtained from a design procedure sheet from the BMP manufacturer and should be included in Appendix 6

E.4 Treatment Control BMP Selection

Table E.4 Treatment Control BMP Selection

Selected Treatment Control BMP Name or ID[1]	Priority Pollutant(s) of Concern to Mitigate[2]	Removal Efficiency Percentage[3]
INFILTRATION BASIN Per RCFC&WCD and referencing CASQA TC-11	Sediment, nutrients, trash, metals, bacteria, oil and grease, organics	high
LANDSCAPE BUFFER AREAS Per RCFC&WCD and referencing CASQA TC-31	Sediment, metals, oil and grease Organics Nutrients, bacteria	High Medium Low
STORM DRAIN INSERTS per CASQA MP-32	Sediment, nutrients, trash, metals, bacteria, oil and grease, organics	Low

[1] Treatment Control BMPs must not be constructed within Receiving Waters. In addition, a proposed Treatment Control BMP may be listed more than once if they possess more than one qualifying pollutant removal efficiency.
[2] Cross Reference Table E.1 above to populate this column.
[3] As documented in a Co-Permittee Approved Study and provided in Appendix 6.

Section F: Hydromodification

F.1 Hydrologic Conditions of Concern (HCOC) Analysis

HCOC EXEMPTION 1: The Priority Development Project disturbs less than one acre. The Copermittee has the discretion to require a Project-Specific WQMP to address HCOCs on projects less than one acre on a case by case basis. The disturbed area calculation should include all disturbances associated with larger common plans of development.

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, HCOC criteria do not apply.

HCOC EXEMPTION 2: The volume and time of concentration[1] of storm water runoff for the post-development condition is not significantly different from the pre-development condition for a 2-year return frequency storm (a difference of 5% or less is considered insignificant) using one of the following methods to calculate:

- Riverside County Hydrology Manual
- Technical Release 55 (TR-55): Urban Hydrology for Small Watersheds (NRCS 1986), or derivatives thereof, such as the Santa Barbara Urban Hydrograph Method
- Other methods acceptable to the Co-Permittee

Does the project qualify for this HCOC Exemption? ☐ Y ☒ N

If Yes, report results in Table F.1 below and provide your substantiated hydrologic analysis in Appendix 7.

Table F.1 Hydrologic Conditions of Concern Summary

	2 year – 24 hour		
	Pre-condition	**Post-condition**	**% Difference**
Time of Concentration			
Volume (Cubic Feet)			

[1] Time of concentration is defined as the time after the beginning of the rainfall when all portions of the drainage basin are contributing to flow at the outlet.

HCOC EXEMPTION 3: All downstream conveyance channels to an adequate sump (for example, Prado Dam, Lake Elsinore, Canyon Lake, Santa Ana River, or other lake, reservoir or naturally erosion resistant feature) that will receive runoff from the project are engineered and regularly maintained to ensure design flow capacity; no sensitive stream habitat areas will be adversely affected; or are not identified on the Co-Permittees Hydromodification Sensitivity Maps.

Does the project qualify for this HCOC Exemption? ☒ Y ☐ N

If Yes, HCOC criteria do not apply and note below which adequate sump applies to this HCOC qualifier:

Lake Elsinore are ultimate sumps

F.2 HCOC Mitigation

If none of the above HCOC Exemption Criteria are applicable, HCOC criteria is considered mitigated if they meet one of the following conditions:

a. Additional LID BMPS are implemented onsite or offsite to mitigate potential erosion or habitat impacts as a result of HCOCs. This can be conducted by an evaluation of site-specific conditions utilizing accepted professional methodologies published by entities such as the California Stormwater Quality Association (CASQA), the Southern California Coastal Water Research Project (SCCRWP), or other Co-Permittee approved methodologies for site-specific HCOC analysis.

b. The project is developed consistent with an approved Watershed Action Plan that addresses HCOC in Receiving Waters.

c. Mimicking the pre-development hydrograph with the post-development hydrograph, for a 2-year return frequency storm. Generally, the hydrologic conditions of concern are not significant, if the post-development hydrograph is no more than 10% greater than pre-development hydrograph. In cases where excess volume cannot be infiltrated or captured and reused, discharge from the site must be limited to a flow rate no greater than 110% of the pre-development 2-year peak flow.

NOTE: Hydromodification mitigation shall be addressed by storing the excess flood volume in the proposed underground infiltration basin, infiltrating the required differential volume between the most severe storm modeling situation as well as designing an overflow outlet structure that meters the post construction excess flow rates to match existing conditions or improve existing conditions within 10% for the 2 year, 24 hour storm, as well as the 10 and 100 year storms for the 1, 3, 6 and 24 hour models. Volume mitigation will be based on the differential volume of the 100 year 24 hour storm event unless otherwise directed by the City.

Section G: Source Control BMPs

Table G.1 Permanent and Operational Source Control Measures

Potential Sources of Runoff pollutants	Permanent Structural Source Control BMPs	Operational Source Control BMPs
Streets, sidewalks, and parking areas	Per SD-10 Site design and landscape planning	Routine Maintenance and inspections as required by SD-10. 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.
Roof runoff	Per SD-11 Roof runoff control	Access to BMPs
Onsite landscape areas	Per SD-12 Efficient irrigation final landscape plans will accomplish all of the following: 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, plants shall be tolerant of saturated soil conditions. pest-resistant plants, especially adjacent to hardscape, shall be planted where possible. Landscape architect has selected 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 where possible. See applicable operational BMPs in "What you should know for…..Landscape and Gardening" at http://rcflood.org/stormwater/ Provide IPM information to new owners, lessees and operators.
Pool and spa	Per SC-72 The primary pollutant of concern in swimming pool water is chlorine or chloramine used as a	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

	disinfectant. This water, if discharged to the storm drain system, can be toxic to aquatic life. Overflow and pool drain to be tied to Sewer system with backflow prevention to prevent damage to Lake Elsinore Ecosystem.	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/
Onsite storm drain inlets	Per SD-13 Storm drain signage and RCFC&WCD and City of Elsinore standards. 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."
onsite refuse location	Per SD-32 Trash enclosures and City of Hemet standards R101,102&103 Signs shall be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.	double enclosure refuse locations are shown on plans. Owner's maintenance staff and tenants shall Inspect receptacles regularly; repair or replace leaky receptacles. Receptacles shall remain 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. Owner's maintenance staff shall 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
Storm drain inserts	Per MP-32 Drain inserts with manufactured filters or fabric placed	See applicable operational BMPs in Fact Sheet SC-44, "Drainage System

	in a drop inlet to remove sediment and debris	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." Inspect for sediment buildup and proper functioning At the beginning of the wet season and after significant storms. Verify that stormwater enters the unit and does not leak around the perimeter after construction. Remove sediment At the beginning of the wet season and as necessary.

Section H: Construction Plan Checklist

Table H.1 Construction Plan Cross-reference

BMP No. or ID	BMP Identifier and Description	Corresponding Plan Sheet(s)
1	SD-10 drought tolerant landscaping and use of existing landscape features	Sheet 1
2	SD-11 roof runoff controls direct roof runoff into buffer strip and into storm drain system	Sheet 1
3	SD-12 efficient irrigation for proposed landscape areas	Sheet 1
4	SD-13 storm drain signage at each onsite storm drain catch basin inlets	Sheet 1
5	SD-32 Trash enclosures per city of Hemet standards	Sheet 1
6	TC-11 north and south bio-infiltration/retention basins used as the primary treatment method	Sheet 1
7	TC-31 vegetated buffer areas used to filter roof runoff	Sheet 1
8	MP-32 Water quality catch basin filter inserts at each onsite storm drain catch basin inlets, Tristar or equivalent to filter trash and debris as well as minimally treat first flush street runoff.	Sheet 1
9	SC-72 Pool and Spa Overflow and pool drain to be tied to Sewer system with backflow prevention to prevent damage to Lake Elsinore Ecosystem.	Sheet 1

Section I: Operation, Maintenance and Funding

Maintenance Mechanism: Maintained by owner and property management company.

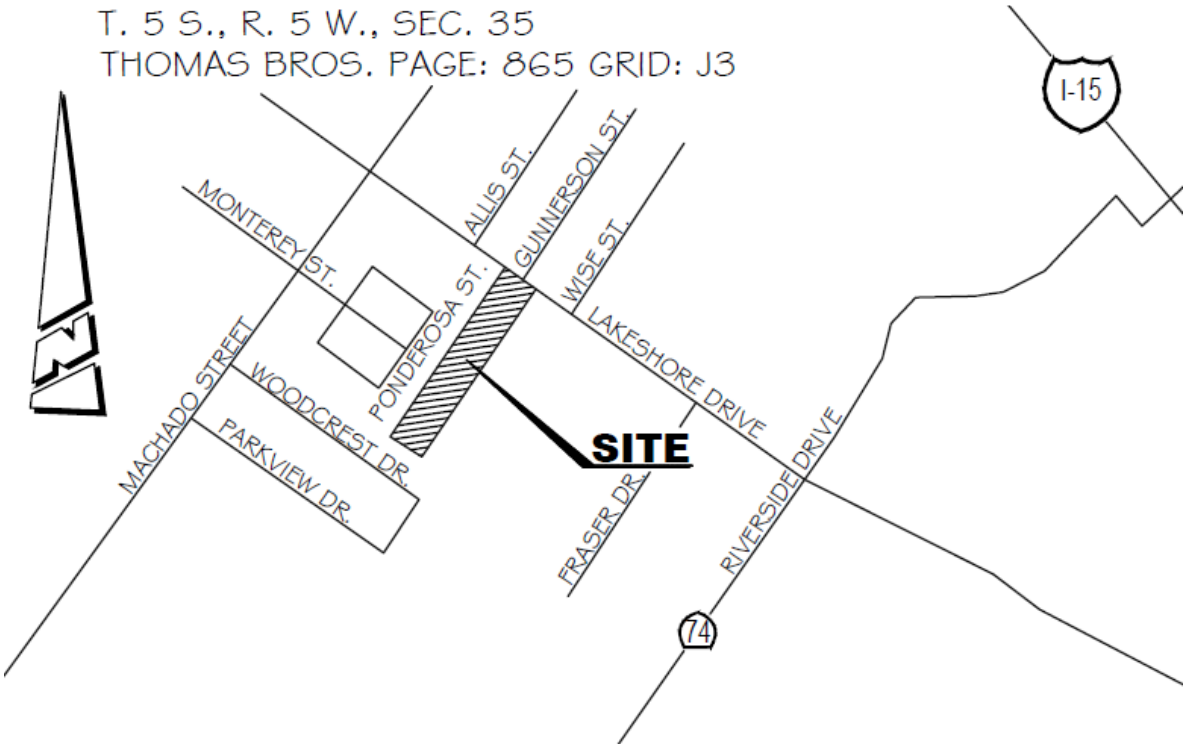
Will the proposed BMPs be maintained by a Home Owners' Association (HOA) or Property Owners Association (POA)?

☐ Y ☒ N

Appendix 1: Maps and Site Plans

Location Map, WQMP Site Plan and Receiving Waters Map

Project Information:



VICINITY MAP

NOT TO SCALE

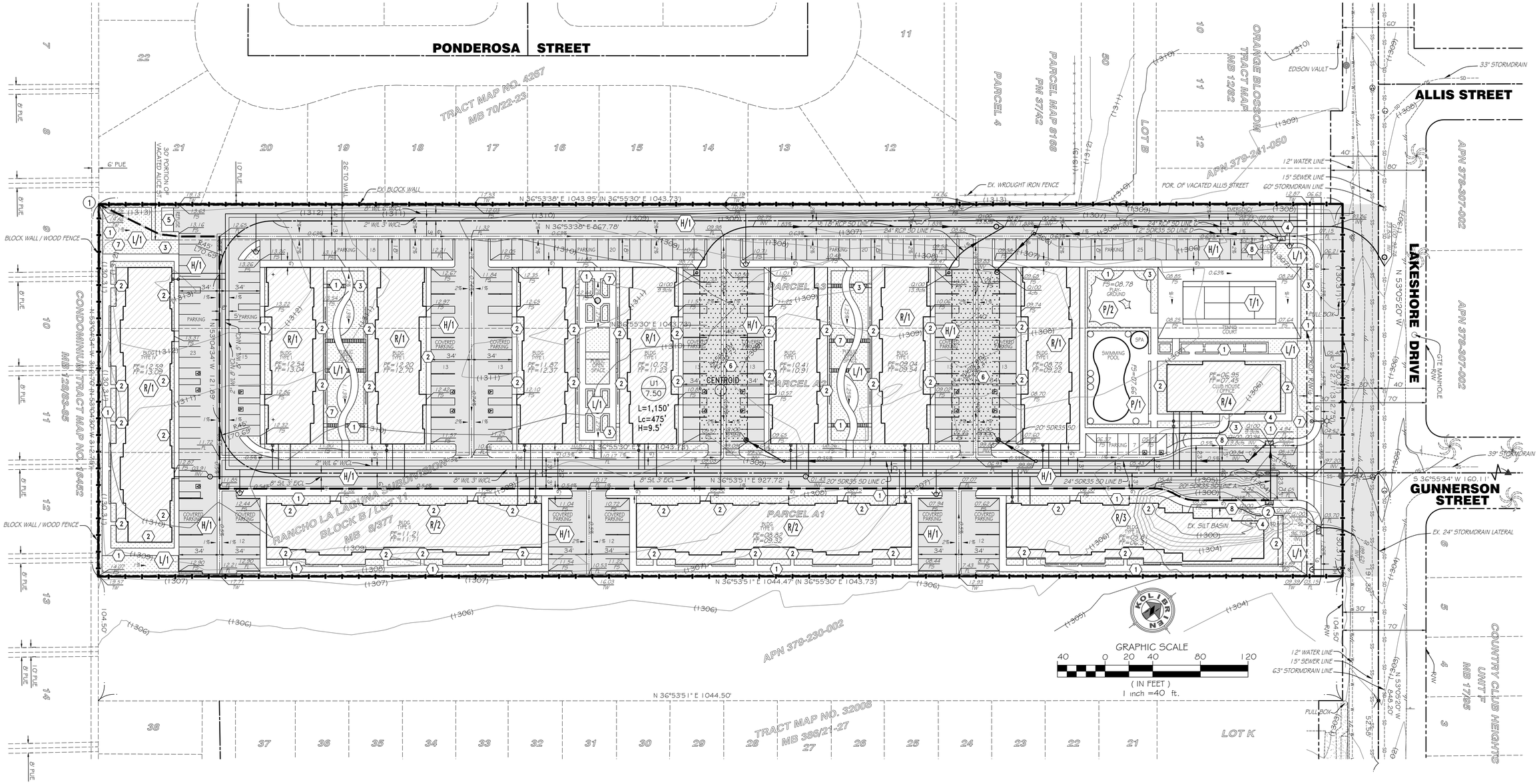
SITE ADDRESS:

LAKESHORE DR., LAKE ELSINORE, CA 92530

ASSESSOR'S PARCEL NO.:

379-230-001

PRELIMINARY WATER QUALITY MANAGEMENT PLAN



DRAINAGE MANAGEMENT AREAS

DMA Name or ID	Surface Type(s)	Area (Sq. Ft.)	DMA Type
R/1	Roofs	33459.51	TYPE D, DRAINS TO L/1
R/2	Roofs	10433.9	TYPE D, DRAINS TO L/1
R/3	Roofs	6801.86	TYPE D, DRAINS TO L/1
R/4	Roofs	3943.91	TYPE D, DRAINS TO L/1
P/1	Concrete or Asphalt	5338.38	TYPE D, DRAINS TO H/1
P/2	Concrete or Asphalt	3523.33	TYPE D, DRAINS TO H/1
T/1	Concrete or Asphalt	7200	TYPE D, DRAINS TO H/1
H/1	Concrete or Asphalt	153885	TYPE D, DRAINS TO BMP
L/1	Natural	92543.77	TYPE A, DRAINS TO H/1

DESIGN STORM DEPTH = 0.78"

DESIGN CAPTURE VOLUME = 13,397 CUBIC FEET

PROPOSED BMP VOLUME ON PLANS = 37,000 CUBIC FEET

PROPOSED LEGEND

- STREET LIGHT
- SEWER MANHOLE
- STORMDRAIN CLEANOUT
- STORMDRAIN MANHOLE
- FIRE HYDRANT
- 7' WIDE CATCH BASIN
- STORMDRAIN BASIN OUTLET STRUCTURE
- STORMDRAIN BASIN INLET STRUCTURE
- 6" SEWER LATERAL
- 2" WATER LATERAL & BFP
- 4" FIRE LATERAL, DCDA, PIV & FCA
- 8" SANITARY SEWER LINE
- 2" IRRIGATION WATER LINE
- 8" WATER LINE
- STORM DRAIN LINE (SIZE/TYPE PER PLAN)
- BLOCK WALL
- 6" CURB
- 6" CURB & GUTTER
- 4' WIDE VALLEY GUTTER
- PROPERTY LINE
- RIGHT-OF-WAY LINE
- STREET CENTERLINE
- BUILDING
- ASPHALT PAVEMENT
- LANDSCAPING
- UNDERGROUND DETENTION BASIN

ABBREVIATIONS

CENTER LINE	CL
PARCEL MAP	PM
MAP BOOK	MB
FLOW LINE	FL
POWER POLE	PP
STORM DRAIN	SD
TOP OF CURB	TC
TOP OF BERM	TB
SEWER LINE	SL
WATER LINE	WL
BOTTOM	BTM
PARCEL	PAR
FINISHED SURFACE	FS
FINISH GRADE	FG
CUBIC FEET PER SECOND	CFS
PAD ELEVATION	PE
FINISHED FLOOR	FF
EDGE OF PAVEMENT	EP
PROPERTY LINE	P/L
RIGHT-OF-WAY	R/W
INVERT ELEVATION	INV
PUBLIC UTILITY EASEMENT	PUE
TOP OF WALL	TW
ASSESSORS PARCEL NO.	APN
OFFSET DIRECTION FROM C/L	(N,S,E,W)C/L

BMP LEGEND:

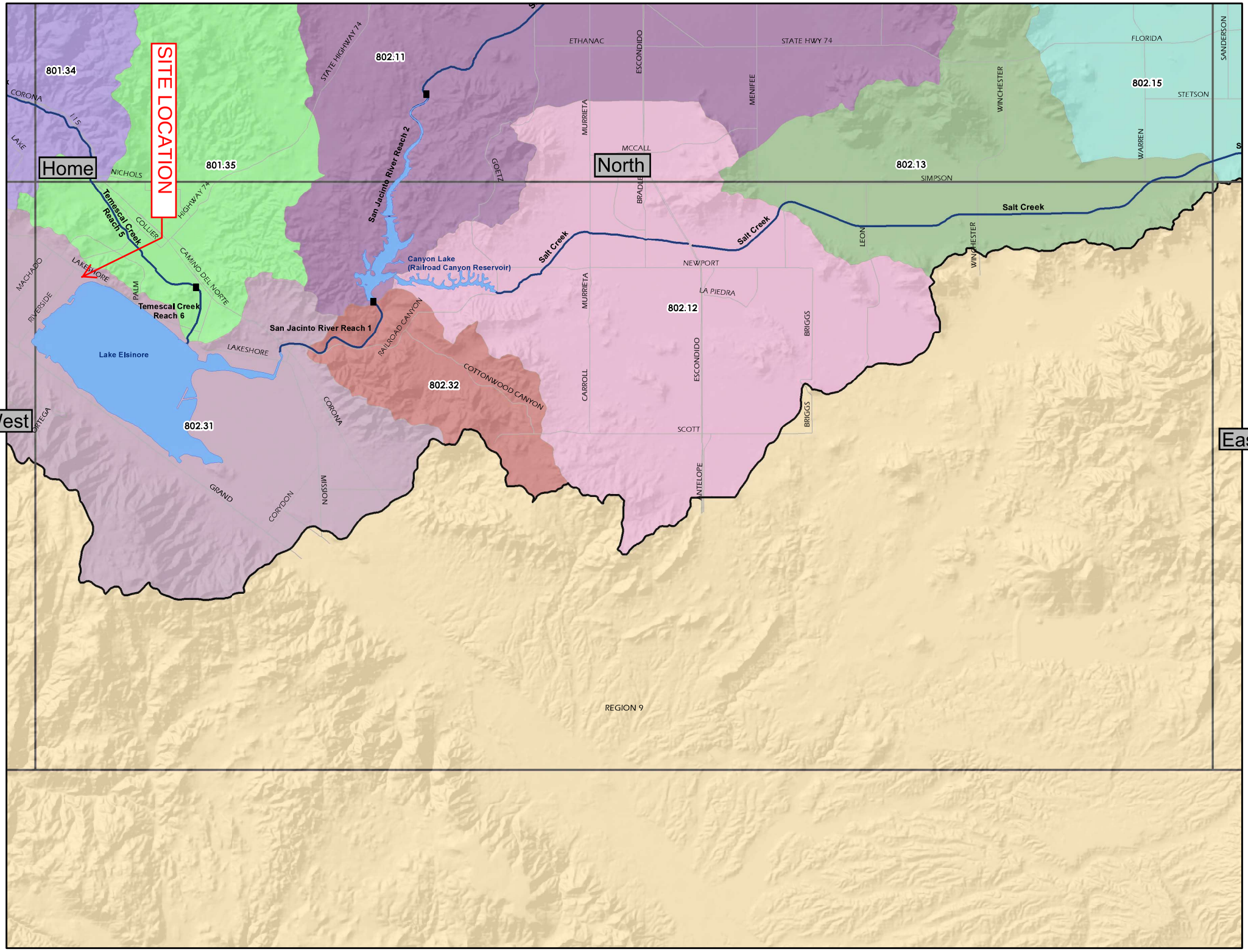
- L=XXX' — INDICATES LONGEST FLOW PATH LENGTH
- Lc=XXX' — LONGEST LENGTH UPSTREAM TO CENTROID
- H=XXX' — CHANGE IN HEIGHT BETWEEN NODES
- U1 / 7.50 — INDICATES TOTAL SITE TRIBUTARY AREA DESIGNATION; INDICATES AREA IN ACRES
- X — INDICATES DRAINAGE NODE
- X/# — DRAINAGE MANAGEMENT AREA DESIGNATION
- INDICATES SITE TRIBUTARY AREA BOUNDARY
- INDICATES LONGEST FLOWLINE PATH

BMP NOTES

1. PER SD-10 DROUGHT TOLERANT LANDSCAPING AREA PER LANDSCAPE PLANS
2. PER SD-11 ROOF RUNNOFF CONTROLS, ROOF RUNNOFF DIRECTED TO DOWNSPOUTS THEN ROUTED TO BUFFER AREAS
3. PER SD-12 EFFICIENT IRRIGATION PER LANDSCAPE ARCHITECTURE PLANS
4. PER SD-13 STORM DRAIN SIGNAGE AND CITY OF ELSINORE SPECIFICATIONS
5. PER SD-32 TRASH ENCLOSURES, AND CITY OF ELSINORE STANDARDS
6. PER TC-11 UNDERGROUND INFILTRATION/RETENTION BASINS
7. PER TC-31 VEGETATED LANDSCAPE BUFFER, GRASS OR MULCH WITH DROUGHT PLANTS PER LANDSCAPE PLANS, USED TO TREAT RUNNOFF WHERE POSSIBLE.
8. PER MP-32 CATCH BASIN FILTER INSERTS, ADS OR EQUAL.

KOLIBRIEN
CIVIL / STRUCTURAL / SURVEYING
41593 Winchester Rd., Ste 200, Temecula, CA 92590
Phone: (951) 252-1034 Web: WWW.KOLIBRIEN.BIZ

File: C02001


SITE LOCATION
Home
North
West
East
801.34
801.35
802.11
802.12
802.13
802.15
802.31
802.32
CORONA
LAKE
I 15
NICHOLS
STATE HIGHWAY 74
HIGHWAY 74
COLLIER
CAMINO DEL NORTE
Temescal Creek Reach 5
Temescal Creek Reach 6
LAKESHORE
PALM
MACHADO
RIVERSIDE
Lake Elsinore
San Jacinto River Reach 1
San Jacinto River Reach 2
Canyon Lake
(Railroad Canyon Reservoir)
RAILROAD CANYON
COTTONWOOD CANYON
Salt Creek
ETHANAC
ESCONDIDO
STATE HWY 74
MENIFEE
WINCHESTER
FLORIDA
STETSON
SANDERSON
WARREN
MURRIETA
MCCALL
GOETZ
BRADLEY
SIMPSON
LEON
NEWPORT
LA PIEDRA
BRIGGS
CARROLL
SCOTT
ANTELOPE
ORTEGA
CORONA
GRAND
CORYDON
MISSION
REGION 9

Appendix 2: Construction Plans

Grading and Drainage Plans, landscape plans, utility plans

TO BE PROVIDED WITH FINAL WQMP

Appendix 3: Soils Information

Geotechnical Study and Other Infiltration Testing Data

TO BE PROVIDED WITH FINAL WQMP

Appendix 4: Historical Site Conditions

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

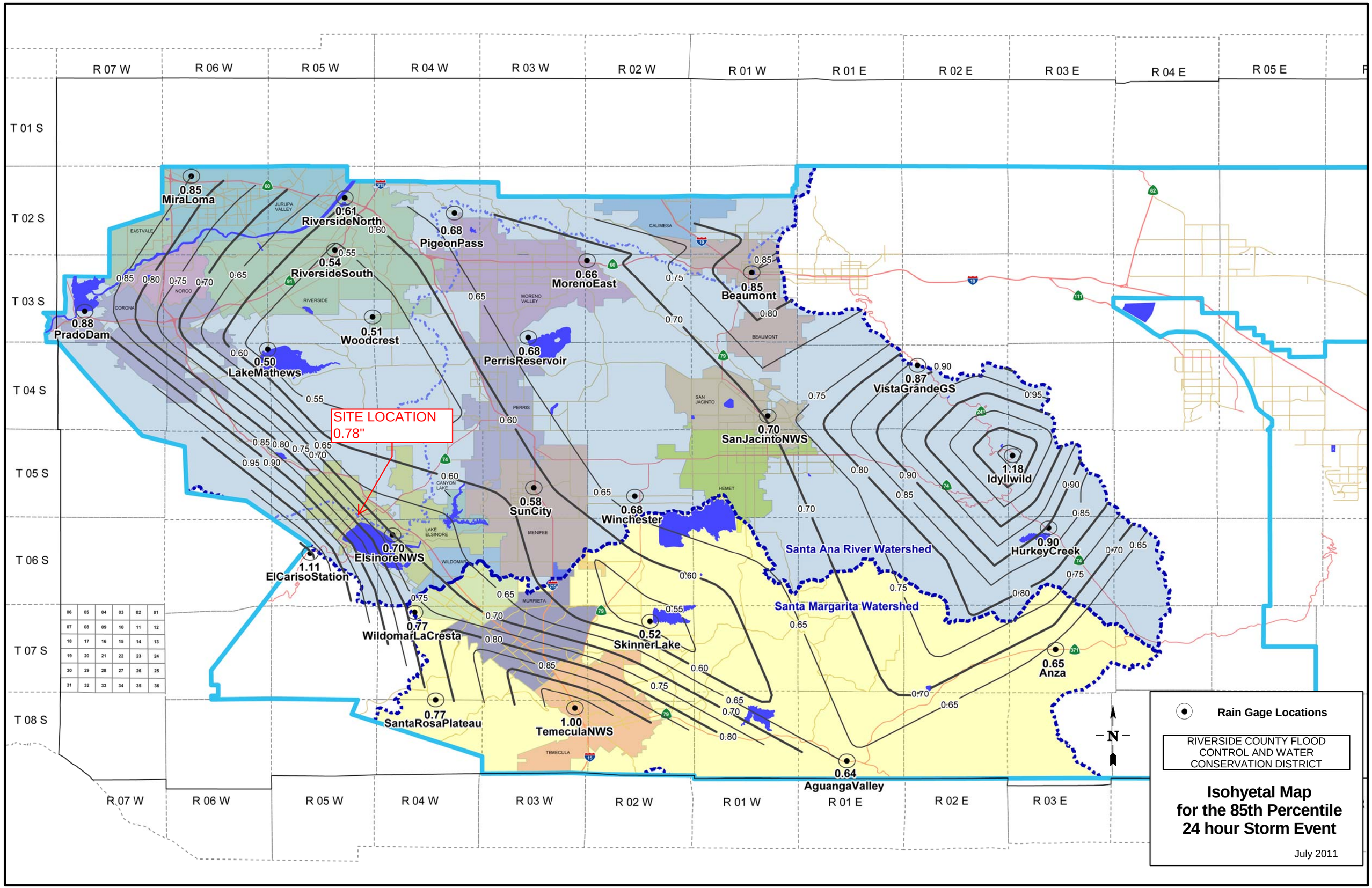
Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

NOT APPLICABLE

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation


R 07 W
R 06 W
R 05 W
R 04 W
R 03 W
R 02 W
R 01 W
R 01 E
R 02 E
R 03 E
R 04 E
R 05 E
T 01 S
T 02 S
T 03 S
T 04 S
T 05 S
T 06 S
T 07 S
T 08 S
0.85 MiraLoma
0.61 RiversideNorth
0.68 PigeonPass
0.54 RiversideSouth
0.66 MorenoEast
0.85 Beaumont
0.88 PradoDam
0.51 Woodcrest
0.50 LakeMathews
0.68 PerrisReservoir
0.87 VistaGrandeGS
0.70 SanJacintoNWS
1.18 Idyllwild
0.58 SunCity
0.68 Winchester
0.90 HurkeyCreek
0.70 ElsinoreNWS
1.11 ElCarisoStation
0.77 WildomarLaCresta
0.52 SkinnerLake
0.65 Anza
0.77 SantaRosaPlateau
1.00 TemeculaNWS
0.64 AguangaValley
SITE LOCATION
0.78"
Santa Ana River Watershed
Santa Margarita Watershed
EASTVALE
JURUPA VALLEY
CORONA
NORCO
RIVERSIDE
MORENO VALLEY
CALIMESA
BEAUMONT
SAN JACINTO
PERRIS
HEMET
CANYON LAKE
LAKE ELSINORE
WILDOMAR
MENIFEE
MURRIETA
TEMECULA
N
Rain Gage Locations
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
Isohyetal Map for the 85th Percentile 24 hour Storm Event
July 2011

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	KOLIBRIEN CORP.	Date	12/15/2016
Designed by	JJ	Case No	1
Company Project Number/Name	LAKESHORE MANOR CONDOMINIUMS		

BMP Identification

BMP NAME / ID: STORMTECH UNDERGROUND INFILTRATION 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}= 0.78 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)*
R/1	*33459.51*	*Roofs*	*1*	*0.89*	*29845.9*			
R/2	*10433.9*	*Roofs*	*1*	*0.89*	*9307*			
R/2	*6801.96*	*Roofs*	*1*	*0.89*	*6067.3*			
R/4	*3943.91*	*Roofs*	*1*	*0.89*	*3518*			
P/1	*5338.38*	*Concrete or Asphalt*	*1*	*0.89*	*4761.8*			
P/2	*3523.33*	*Concrete or Asphalt*	*1*	*0.89*	*3142.8*			
T/1	*7200*	*Concrete or Asphalt*	*1*	*0.89*	*6422.4*			
H/1	*153885*	*Concrete or Asphalt*	*1*	*0.89*	*137265.4*			
L/1	*92543.77*	*Natural*	*0.03*	*0.06*	*5787.8*			
	317129.76	***Total***			**206118.4**	**0.78**	***13397.7***	***36794***

Notes:

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

Company Name:	KOLIBRIEN CORP.	Date:	12/15/2016
Designed by:	JHJ	County/City Case No.:	

Design Volume

a) Tributary area (BMP subarea)	A_T =	7.28	acres
b) Enter V_{BMP} determined from Section 2.1 of this Handbook	V_{BMP}=	13,398	ft^3

Maximum Depth

a) Infiltration rate	I =	1.25	in/hr
b) Factor of Safety (See Table 1, Appendix A: "Infiltration Testing" from this BMP Handbook)	FS =	3	
c) Calculate D_1 $D_1 = \frac{I\ (in/hr) \times 72\ hrs}{12\ (in/ft) \times FS}$	D_1 =	2.5	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)		100	ft
f) Enter depth to top of bedrock or impermeable layer (measured from **top** of basin)		500	ft
g) D_2 is the smaller of: Depth to groundwater - (10 ft + freeboard) and Depth to impermeable layer - (5 ft + freeboard)	D_2 =	89.0	ft
h) D_{MAX} is the smaller value of D_1 and D_2 but shall not exceed 5 feet	D_{MAX} =	2.5	ft

Basin Geometry

a) Basin side slopes (no steeper than 4:1)	z =	4	: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 =	5359	ft^2
d) Proposed Design Surface Area	A_D =	11526	ft^2

Forebay

a) Forebay volume (minimum 0.5% V_{BMP})	Volume =	67	ft^3
b) Forebay depth (height of berm/splashwall. 1 foot min.)	Depth =	1	ft
c) Forebay surface area (minimum)	Area =	67	ft^2
d) Full height notch-type weir	Width (W) =	24.0	in

Notes: phase I suggests moderate to high infiltrtion rates, 1.25 in/hr assumed. Infiltration testing shall be performed as part of the final WQMP.

2 each identical basins per these specifications.

StormTech
Detention • Retention • Water Quality
A division of ADS

User Inputs

Chamber Model	MC-3500
Outlet Control Structure	Yes (Outlet)
Project Name	Lakeshore Condos
Project Location	Lakeshore Dr., Lake Elsinore
Project Date	04/10/2017
Engineer	Kolibrien Corp.
Measurement Type	Imperial
Required Storage Volume	18250 cubic ft.
Stone Porosity	40%
Stone Above Chambers	12 in.
Stone Foundation Depth	9 in.
Average Cover Over Chambers	24 in.
Design Constraint	Width
Design Constraint Dimension	50 ft.

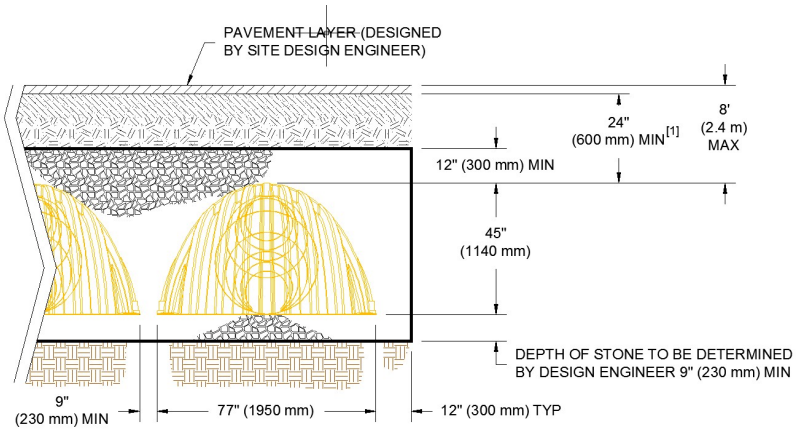
Results

System Volume and Bed Size

Installed Storage Volume	18397 cubic ft.
Storage Volume Per Chamber	178.9 cubic ft.
Storage Volume Per End Cap	46.9 cubic ft.
Number Of Chambers Required	94 each
Number Of End Caps Required	12 each
Rows/Chambers	4 row(s) of 16 chamber(s)
Leftover Rows/Chambers	2 row(s) of 15 chamber(s)
Maximum Length	124.25 ft.
Maximum Width	44.85 ft.
Approx. Bed Size Required	5495 square ft.

System Components

Amount Of Stone Required	730 cubic yards
Volume Of Excavation (Not Including Fill)	1119 cubic yards
Non-woven Filter Fabric Required	1430 square yards
Length Of Isolator Row	118.37 ft.
Woven Isolator Row Fabric	232 square yards



[1] - TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 30" (750 mm).

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ADVANCED DRAINAGE SYSTEMS, INC.

Lakeshore Condos

Lakeshore Dr., Lake Elsinore

STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500 OR APPROVED EQUAL.
2. CHAMBERS SHALL BE MADE FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORT PANELS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
4. THE STRUCTURAL DESIGN OF THE CHAMBERS, THE STRUCTURAL BACKFILL, AND THE INSTALLATION REQUIREMENTS SHALL ENSURE THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET FOR: 1) LONG-DURATION DEAD LOADS AND 2) SHORT-DURATION LIVE LOADS, BASED ON THE AASHTO DESIGN TRUCK WITH CONSIDERATION FOR IMPACT AND MULTIPLE VEHICLE PRESENCES.
5. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
6. CHAMBERS SHALL BE DESIGNED AND ALLOWABLE LOADS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
7. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. THE CHAMBER MANUFACTURER SHALL SUBMIT THE FOLLOWING UPON REQUEST TO THE SITE DESIGN ENGINEER FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE:
   a. A STRUCTURAL EVALUATION SEALED BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES THAT THE SAFETY FACTORS ARE GREATER THAN OR EQUAL TO 1.95 FOR DEAD LOAD AND 1.75 FOR LIVE LOAD, THE MINIMUM REQUIRED BY ASTM F2787 AND BY AASHTO FOR THERMOPLASTIC PIPE.
   b. A STRUCTURAL EVALUATION SEALED BY A REGISTERED PROFESSIONAL ENGINEER THAT DEMONSTRATES THAT THE LOAD FACTORS SPECIFIED IN THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, SECTION 12.12, ARE MET. THE 50 YEAR CREEP MODULUS DATA SPECIFIED IN ASTM F2418 MUST BE USED AS PART OF THE AASHTO STRUCTURAL EVALUATION TO VERIFY LONG-TERM PERFORMANCE.
   c. STRUCTURAL CROSS SECTION DETAIL ON WHICH THE STRUCTURAL EVALUATION IS BASED.
8. CHAMBERS AND END CAPS SHALL BE PRODUCED AT AN ISO 9001 CERTIFIED MANUFACTURING FACILITY.

IMPORTANT - NOTES FOR THE BIDDING AND INSTALLATION OF MC-3500 CHAMBER SYSTEM

1. STORMTECH MC-3500 CHAMBERS SHALL NOT BE INSTALLED UNTIL THE MANUFACTURER'S REPRESENTATIVE HAS COMPLETED A PRE-CONSTRUCTION MEETING WITH THE INSTALLERS.
2. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. CHAMBERS ARE NOT TO BE BACKFILLED WITH A DOZER OR AN EXCAVATOR SITUATED OVER THE CHAMBERS.

   STORMTECH RECOMMENDS 3 BACKFILL METHODS:
   - STONESHOOTER LOCATED OFF THE CHAMBER BED.
   - BACKFILL AS ROWS ARE BUILT USING AN EXCAVATOR ON THE FOUNDATION STONE OR SUBGRADE.
   - BACKFILL FROM OUTSIDE THE EXCAVATION USING A LONG BOOM HOE OR EXCAVATOR.
4. THE FOUNDATION STONE SHALL BE LEVELED AND COMPACTED PRIOR TO PLACING CHAMBERS.
5. JOINTS BETWEEN CHAMBERS SHALL BE PROPERLY SEATED PRIOR TO PLACING STONE.
6. MAINTAIN MINIMUM - 9" (230 mm) SPACING BETWEEN THE CHAMBER ROWS.
7. INLET AND OUTLET MANIFOLDS MUST BE INSERTED A MINIMUM OF 12" (300 mm) INTO CHAMBER END CAPS.
8. EMBEDMENT STONE SURROUNDING CHAMBERS MUST BE A CLEAN, CRUSHED, ANGULAR STONE 3/4-2" (20-50 mm) MEETING THE AASHTO M43 DESIGNATION OF #3 OR #4.
9. STONE MUST BE PLACED ON THE TOP CENTER OF THE CHAMBER TO ANCHOR THE CHAMBERS IN PLACE AND PRESERVE ROW SPACING..
10. ADS RECOMMENDS THE USE OF "FLEXSTORM CATCH IT" INSERTS DURING CONSTRUCTION FOR ALL INLETS TO PROTECT THE SUBSURFACE STORMWATER MANAGEMENT SYSTEM FROM CONSTRUCTION SITE RUNOFF.

NOTES FOR CONSTRUCTION EQUIPMENT

1. STORMTECH MC-3500 CHAMBERS SHALL BE INSTALLED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
2. THE USE OF EQUIPMENT OVER MC-3500 CHAMBERS IS LIMITED:
   - NO EQUIPMENT IS ALLOWED ON BARE CHAMBERS.
   - NO RUBBER TIRED LOADER, DUMP TRUCK, OR EXCAVATORS ARE ALLOWED UNTIL PROPER FILL DEPTHS ARE REACHED IN ACCORDANCE WITH THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
   - WEIGHT LIMITS FOR CONSRUCTION EQUIPMENT CAN BE FOUND IN THE "STORMTECH MC-3500/MC-4500 CONSTRUCTION GUIDE".
3. FULL 36" (900 mm) OF STABILIZED COVER MATERIALS OVER THE CHAMBERS IS REQUIRED FOR DUMP TRUCK TRAVEL OR DUMPING.

USE OF A DOZER TO PUSH EMBEDMENT STONE BETWEEN THE ROWS OF CHAMBERS MAY CAUSE DAMAGE TO CHAMBERS AND IS NOT AN ACCEPTABLE BACKFILL METHOD. ANY CHAMBERS DAMAGED BY USING THE "DUMP AND PUSH" METHOD ARE NOT COVERED UNDER THE STORMTECH STANDARD WARRANTY.

CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

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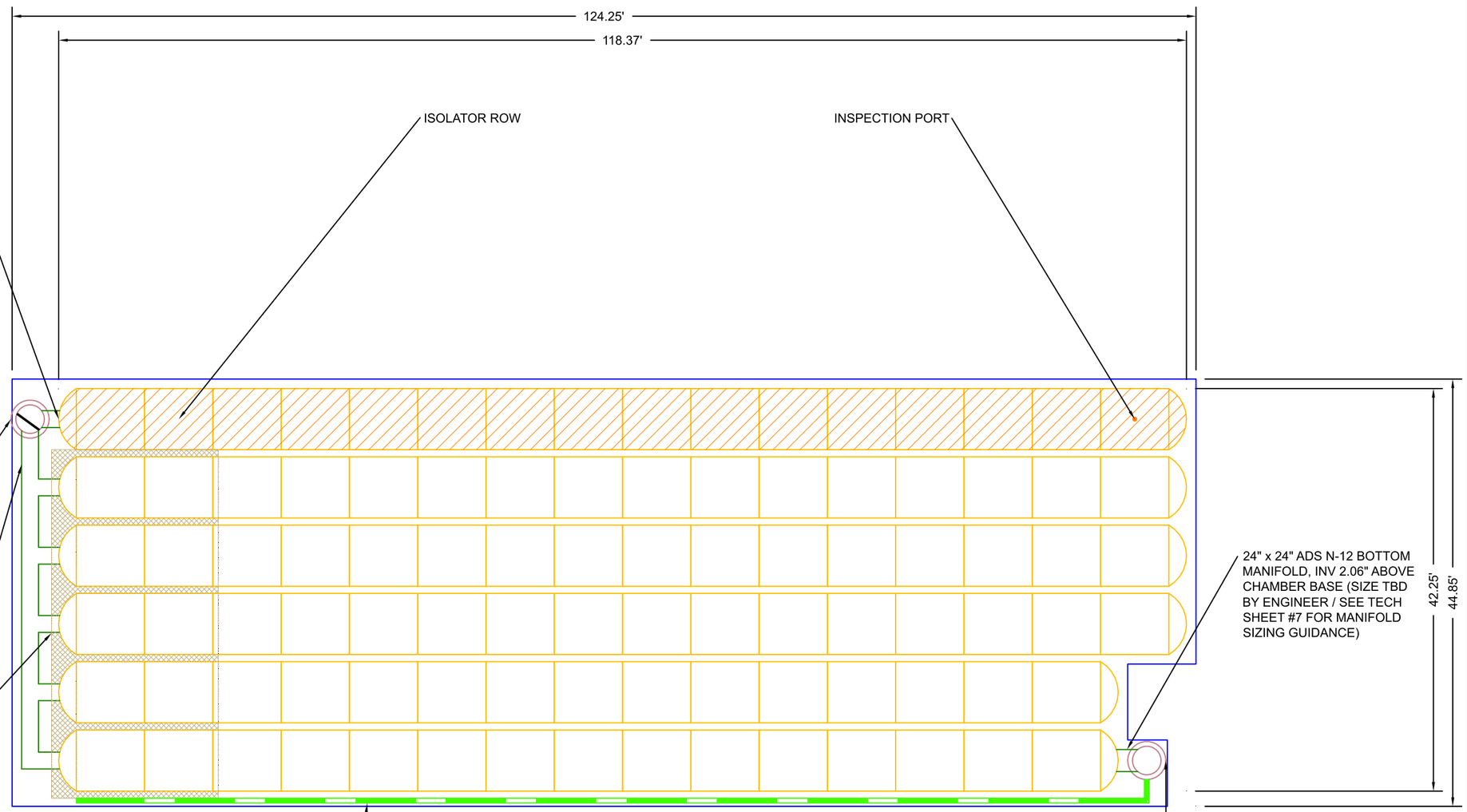
CONCEPTUAL LAYOUT

(94) STORMTECH MC-3500 CHAMBERS
(12) STORMTECH MC-3500 END CAPS
INSTALLED WITH 12 " COVER STONE, 9 " BASE STONE, 40% STONE VOID
INSTALLED SYSTEM VOLUME: 18397 CF
AREA OF SYSTEM: 5495 **FT²**
PERIMETER OF SYSTEM: 347 **FT**

2 each, identical basins = 36,794 cubic feet of storage.

COMPUTER GENERATED CONCEPTUAL LAYOUT - NOT FOR CONSTRUCTION



Lakeshore Condos
Lakeshore Dr., Lake Elsinore

DATE: 04/10/2017 | DRAWN: jj
PROJECT #: Tool | CHECKED: ---

REV	DRW	CHK	DESCRIPTION

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NOT TO SCALE

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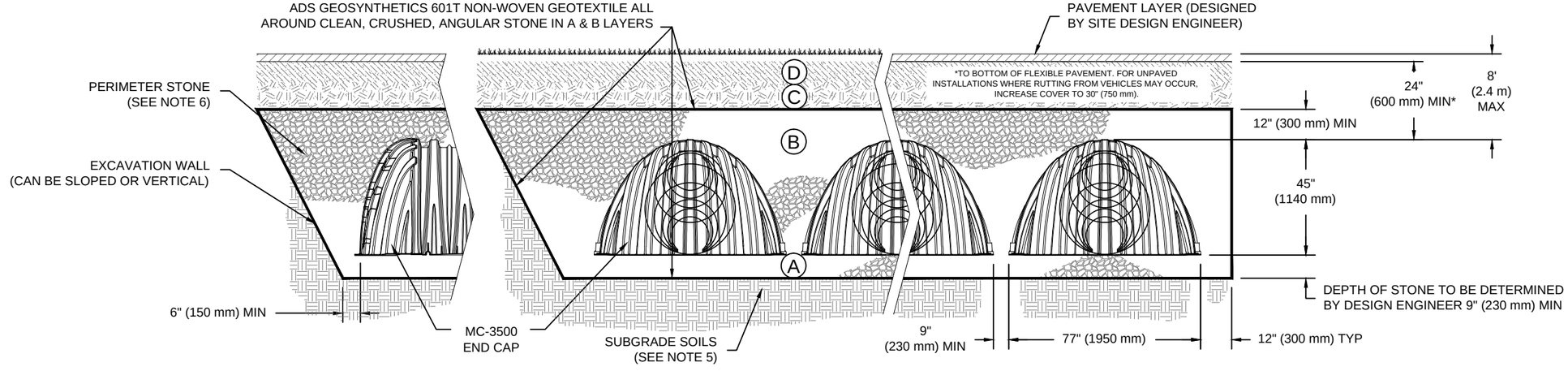
ACCEPTABLE FILL MATERIALS: STORMTECH MC-3500 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 24" (600 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 24" (600 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 12" (300 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS.
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE, NOMINAL SIZE DISTRIBUTION BETWEEN 3/4-2 INCH (20-50 mm)	AASHTO M43[1] 3, 4	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE, NOMINAL SIZE DISTRIBUTION BETWEEN 3/4-2 INCH (20-50 mm)	AASHTO M43[1] 3, 4	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE. [2] [3]

PLEASE NOTE:

1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 9" (230 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.



NOTES:

1. MC-3500 CHAMBERS SHALL CONFORM TO THE REQUIREMENTS OF ASTM F2418 "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
2. MC-3500 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. "ACCEPTABLE FILL MATERIALS" TABLE ABOVE PROVIDES MATERIAL LOCATIONS, DESCRIPTIONS, GRADATIONS, AND COMPACTION REQUIREMENTS FOR FOUNDATION, EMBEDMENT, AND FILL MATERIALS.
4. THE "SITE DESIGN ENGINEER" REFERS TO THE ENGINEER RESPONSIBLE FOR THE DESIGN AND LAYOUT OF THE STORMTECH CHAMBERS FOR THIS PROJECT.
5. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
6. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
7. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.

Lakeshore Condos
Lakeshore Dr., Lake Elsinore

DATE: 04/10/2017 DRAWN: jj
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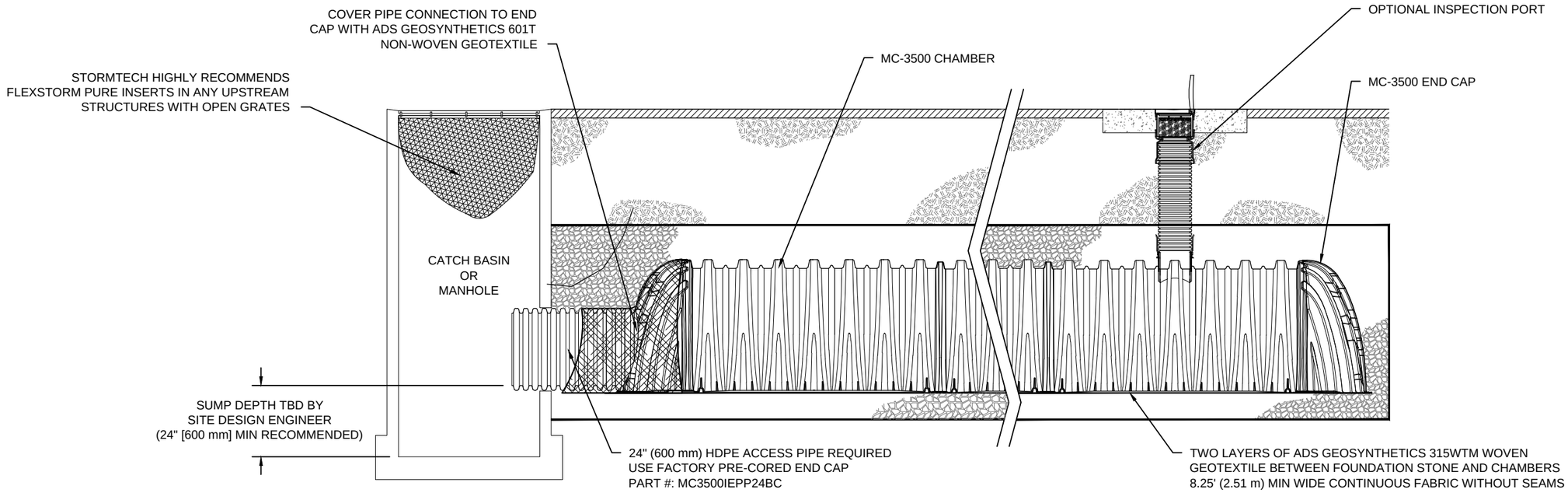


MC-3500 ISOLATOR ROW DETAIL

NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW FOR SEDIMENT
- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

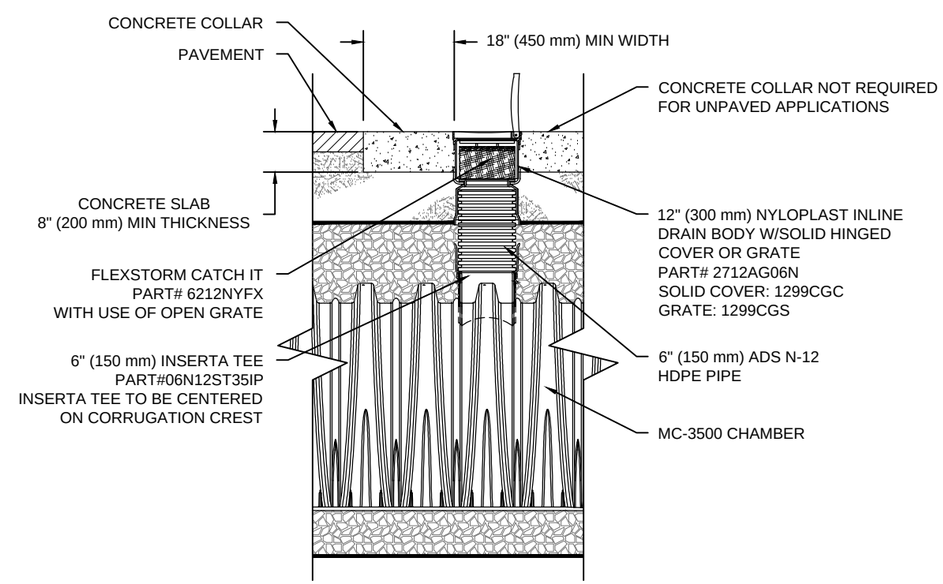
STEP 2) CLEAN OUT ISOLATOR ROW USING THE JETVAC PROCESS
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



MC-3500 6" INSPECTION PORT DETAIL

NTS

Lakeshore Condos
Lakeshore Dr., Lake Elsinore

DATE: 04/10/2017 DRAWN: jj
PROJECT #: Tool CHECKED: ---

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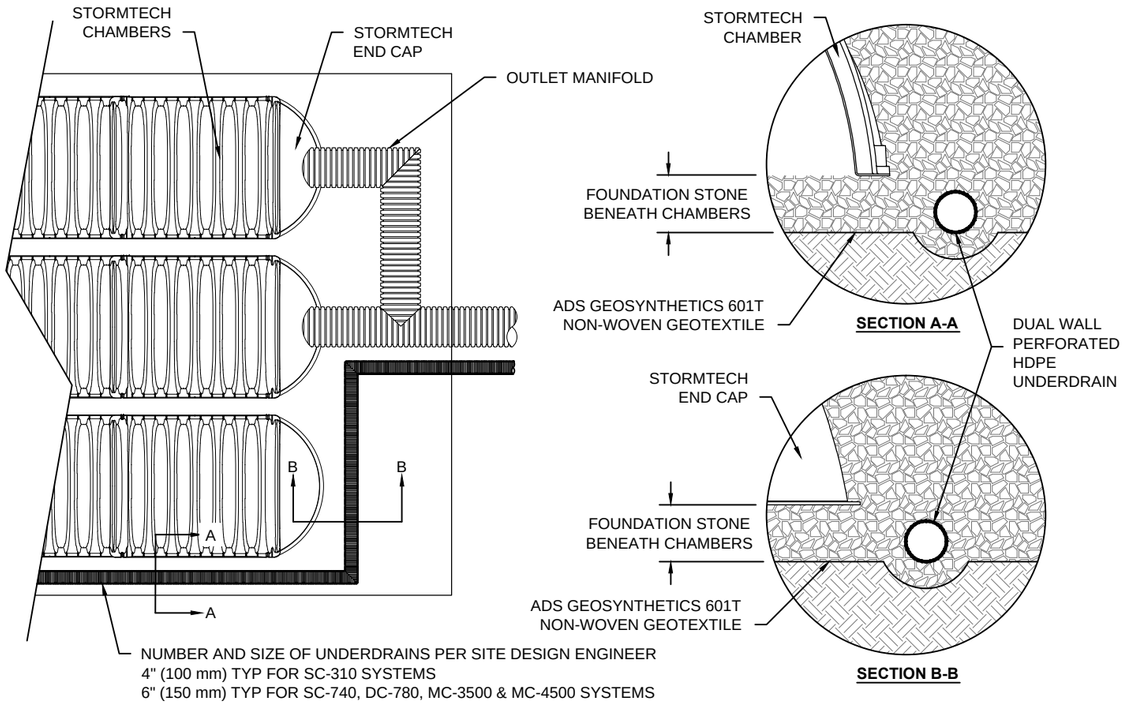
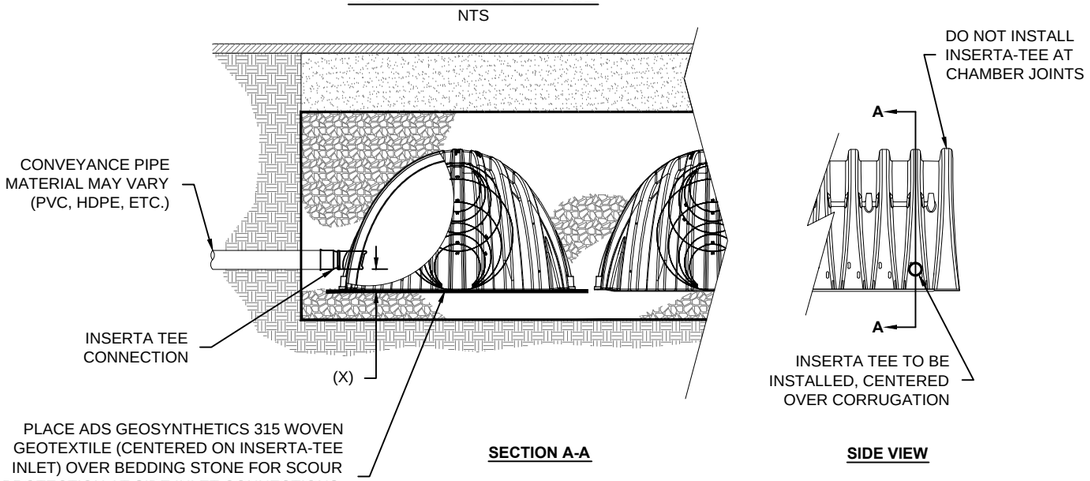
UNDERDRAIN DETAIL

NTS



INSERTA TEE DETAIL

NTS

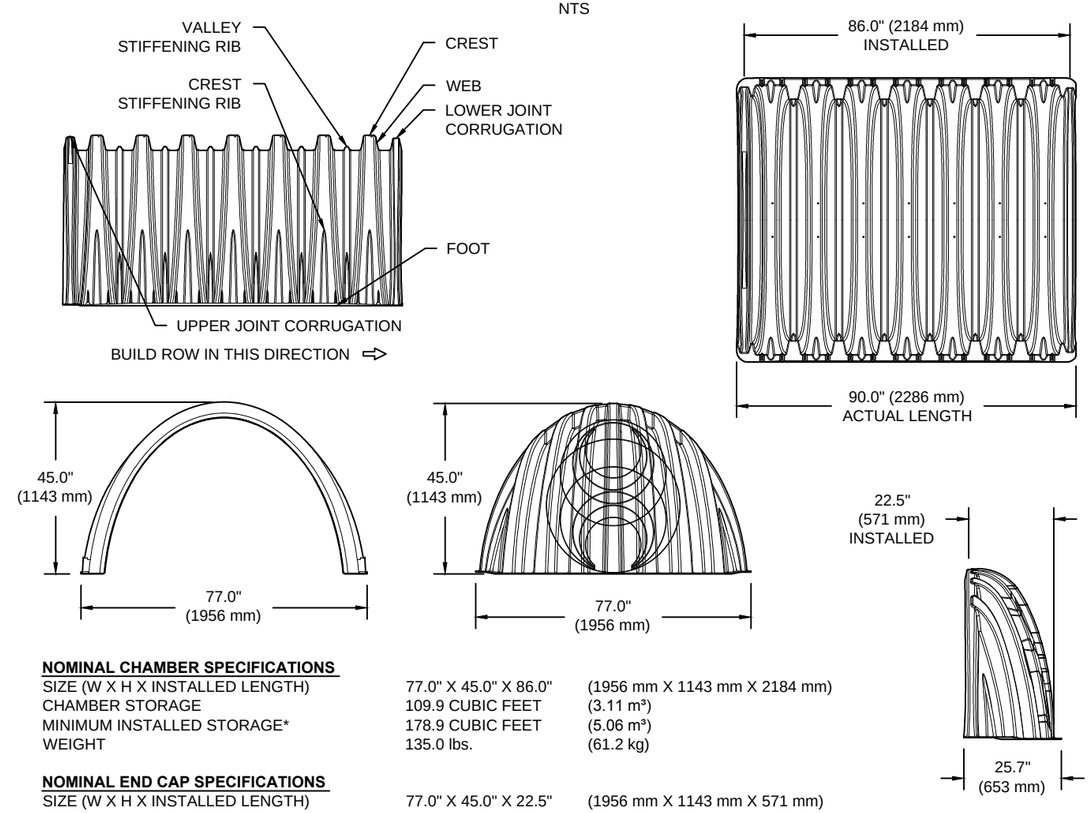


NOTE:
PART NUMBERS WILL VARY BASED ON INLET PIPE MATERIALS.
CONTACT STORMTECH FOR MORE INFORMATION.

CHAMBER	MAX DIAMETER OF INSERTA TEE	HEIGHT FROM BASE OF CHAMBER (X)
SC-310	6" (150 mm)	4" (100 mm)
SC-740	10" (250 mm)	4" (100 mm)
DC-780	10" (250 mm)	4" (100 mm)
MC-3500	12" (300 mm)	6" (150 mm)
MC-4500	12" (300 mm)	8" (200 mm)
INSERTA TEE FITTINGS AVAILABLE FOR SDR 26, SDR 35, SCH 40 IPS GASKETED & SOLVENT WELD, N-12, HP STORM, C-900 OR DUCTILE IRON		

MC-3500 TECHNICAL SPECIFICATION

NTS



NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 86.0"	(1956 mm X 1143 mm X 2184 mm)
CHAMBER STORAGE	109.9 CUBIC FEET	(3.11 m³)
MINIMUM INSTALLED STORAGE*	178.9 CUBIC FEET	(5.06 m³)
WEIGHT	135.0 lbs.	(61.2 kg)

NOMINAL END CAP SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	77.0" X 45.0" X 22.5"	(1956 mm X 1143 mm X 571 mm)
END CAP STORAGE	14.9 CUBIC FEET	(0.42 m³)
MINIMUM INSTALLED STORAGE*	46.0 CUBIC FEET	(1.30 m³)
WEIGHT	50.0 lbs.	(22.7 kg)

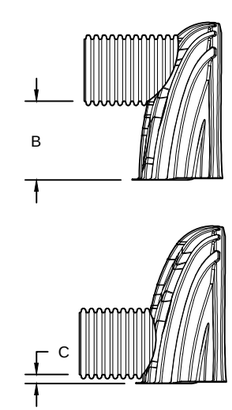
*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION AND BETWEEN CHAMBERS, 12" (305 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY

STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"

PART #	STUB	B	C
MC3500IEPP06T	6" (150 mm)	33.21" (844 mm)	---
MC3500IEPP06B		---	0.66" (17 mm)
MC3500IEPP08T	8" (200 mm)	31.16" (791 mm)	---
MC3500IEPP08B		---	0.81" (21 mm)
MC3500IEPP10T	10" (250 mm)	29.04" (738 mm)	---
MC3500IEPP10B		---	0.93" (24 mm)
MC3500IEPP12T	12" (300 mm)	26.36" (670 mm)	---
MC3500IEPP12B		---	1.35" (34 mm)
MC3500IEPP15T	15" (375 mm)	23.39" (594 mm)	---
MC3500IEPP15B		---	1.50" (38 mm)
MC3500IEPP18TC	18" (450 mm)	20.03" (509 mm)	---
MC3500IEPP18BC		---	1.77" (45 mm)
MC3500IEPP24TC	24" (600 mm)	14.48" (368 mm)	---
MC3500IEPP24BC		---	2.06" (52 mm)
MC3500IEPP30BC	30" (750 mm)	---	

NOTE: ALL DIMENSIONS ARE NOMINAL

CUSTOM PRECORED INVERTS ARE AVAILABLE UPON REQUEST. INVENTORIED MANIFOLDS INCLUDE 12-24" (300-600 mm) SIZE ON SIZE AND 15-48" (375-1200 mm) ECCENTRIC MANIFOLDS.
CUSTOM INVERT LOCATIONS ON THE MC-3500 END CAP CUT IN THE FIELD ARE NOT RECOMMENDED FOR PIPE SIZES GREATER THAN 10" (250 mm)
THE INVERT LOCATION IN COLUMN 'B' ARE THE HIGHTEST POSSIBLE FOR THE PIPE SIZE.



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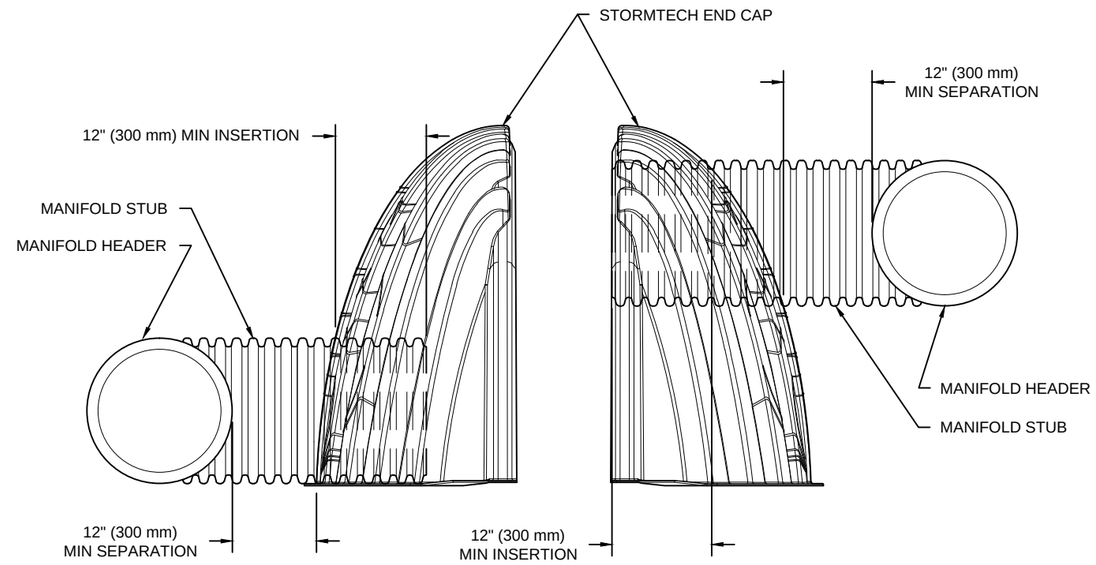
MC-SERIES END CAP INSERTION DETAIL

NTS



NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

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Tech Sheet

StormTech®
Detention • Retention • Water Quality
A division of ADS

Porosity of Structural Backfill

Tech Sheet # 1
November 2012

General:
StormTech advises that a porosity of 40% is appropriate to use for the storage capacity of structural aggregate used in the bedding and embedment zones around StormTech chambers. This memo provides technical support for the use of a porosity of 40%. The major points of the memo are:

- 40% porosity is appropriate for the clean, open graded, angular aggregate material StormTech recommends for foundation and embedment.
- Most of the porosity data available is based on a compacted condition. StormTech requires compaction of the foundation (bedding) and allows dumped aggregate embedment around the chambers.
- Test data indicates that the average porosity of all gradations of the *compacted* foundation is approximately 40%. The porosity of the *dumped* backfill in the embedment zone is typically greater than 40% and the calculated weighted average porosity therefore exceeds 40% for typical StormTech systems.
- Porosity is protected from soils migration by a non-woven geotextile that surrounds the entire system. For some exfiltration systems, a drainage net is substituted for the geotextile on the bottom of the bed.

Terms:
Porosity (n) is defined as the volume voids over the total volume expressed as a percent: $n = (V_v / V_t) \times 100\%$. Other terms commonly used to describe porosity include; "voids" and "void space". A related term that should not be confused with porosity is *void ratio* (e) which is the volume of voids over the volume of solids expressed as a decimal: $e = V_v / V_s$.

Compilation of Known Test Data:

Sample	Data Source	Porosity	Bulk Density	Test / Description
AASHTO # 4	StormTech lab	39.9%	94.3 lbs/ft^3	dumped, corrected[1]
AASHTO # 57	StormTech lab	45.4%	87.2 lbs/ft^3	dumped, corrected[1]
AASHTO # 4	StormTech lab	37.4%	103.0 lbs/ft^3	jigged & tamped, corrected[1]
AASHTO # 57	StormTech lab	38.7%	97.7 lbs/ft^3	jigged & tamped, corrected[1]
AASHTO # 57	NTH lab	50 - 51%		tapped & agitated, dried[2]
AASHTO # 57	NTH lab	50 - 52 %		tapped & agitated, dried[2]
AASHTO # 3	NTH lab	53 - 54%		tapped & agitated, dried[2]
-1 ½"	Anderson Eng. Cons.	41.9%	96.8 lbs/ft^3	dry rodded, C29[3]
-1 ½"	Anderson Eng. Cons.	35.3%	101.7 lbs/ft^3	dry rodded, C29[3]
-1 ½"	Anderson Eng. Cons.	37.8%	98.6 lbs/ft^3	dry rodded, C29[3]
-1 ½"	Anderson Eng. Cons.	41.3%	93.6 lbs/ft^3	dry rodded, C29[3]
-1 ½"	Anderson Eng. Cons.	38.2%	98.7 lbs/ft^3	dry rodded, C29[3]
-3/4"	Anderson Eng. Cons.	38.5%	100.3 lbs/ft^3	dry rodded, C29[3]
-3/4"	Anderson Eng. Cons.	38.9%	97.9 bs/ft^3	dry rodded, C29[3]

Compilation of Known Test Data:

Sample	Data Source	Porosity	Bulk Density	Test / Description
AASHTO # 4	Universal Eng. Serv.	44.3%	78.6 lbs/ft^3	rodded C29[4]
AASHTO # 57	Universal Eng. Serv.	43.2%	79.8 lbs/ft^3	rodded C29[4]
AASHTO # 4	Universal Eng. Serv.	46.1%	70.8 lbs/ft^3	rodded C29[5]
AASHTO # 57	Universal Eng. Serv.	42.8%	74.8 lbs/ft^3	rodded C29[5]
-1 ½" Crushed Rock	CTL Thompson TX	46%	90.5 lbs/ft^3	rodded C29[6]
-1" Crushed Rock	CTL Thompson TX	45%	91.6 lbs/ft^3	rodded C29[6]
-1 ½" Crushed Conc	CTL Thompson TX	48%	77.1 lbs/ft^3	rodded C29[6]

[1]Testing was conducted by StormTech in October, 2003 using aggregate from Connecticut. Water was used to fill voids and a correction factor that reduced porosities by 3 to 16% was calculated and applied to correct for wall effects of the test container.

[2]Testing was conducted by NTH Consultants,Ltd. Exton, PA in December, 2002 for ADS. This was dry testing in accordance with the "Civil Engineering Reference Manual, Sixth Edition" by Michael R. Lindburg, PE.

[3]Testing was conducted by Anderson Engineering Consultants, Inc., Little Rock, AR in February, 2000 for 7 different aggregate samples from four suppliers in Arkansas.

[4]The material tested was lime rock from central Florida. Testing was conducted by Universal Engineering Sciences in Orlando, FL in November, 2005.

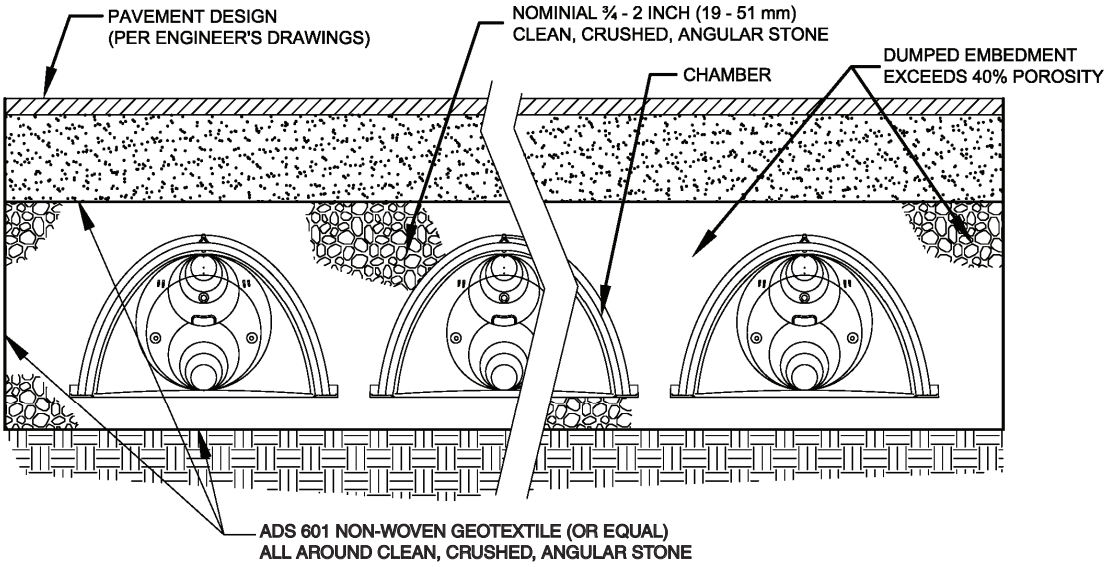
[5]The material tested was recycled, crushed concrete from central Florida. Testing was conducted by Universal Engineering Sciences in Orlando, FL in November, 2005.

[6]Testing was conducted by CTL | Thompson Texas, LLC in August, 2006.

ASTM C29 is the "Standard Test Method for Bulk Density (Unit Weight) and Voids in Aggregate".

Porosity References:

- "Urban Runoff Quality Management" WEF MOP 23 / ASCE MOP 87. Table 5.12 lists uniform sized gravel at 40%.
- "Controlling Urban Runoff:" by Thomas R. Schueler, July 1987 describes storage volume of the void space in the trench at 40% of the excavated trench volume.
- "On-site Stormwater Management: Applications for Landscape and Engineering" Second Edition by Bruce Ferguson and Thomas Debo states that open graded crushed stone has 40% void space.



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Tech Sheet

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Thermoplastic Liners for Detention Systems

Tech Sheet # 2
December, 2012

General:
StormTech chambers offer the distinct advantage and versatility that allow them to be designed as an open bottom *detention or retention* system. In fact the vast majority of StormTech installations and designs are *open bottom detention* systems. Using an open bottom system enables treatment of the storm water through the underlying soils and provides a volume safety factor based on the infiltrative capacity of the underlying soils.

In some applications, however, open bottom detention systems may not be allowed. This memo provides guidance for the design and installation of thermoplastic liners for detention systems using StormTech chambers. The major points of the memo are:

- Infiltration of stormwater is generally a desirable stormwater management practice, often required by regulations. Lined systems should only be specified where unique site conditions preclude significant infiltration.
- Thermoplastic liners provide cost effective and viable means to contain stormwater in StormTech subsurface systems where infiltration is undesirable.
- PVC and LLDPE are the most cost effective, installed membrane materials.
- Enhanced puncture resistance from angular aggregate on the water side and from protrusions on the soil side can be achieved by placing a non-woven geotextile on each side of the geomembrane. A sand underlayment in lieu of the geotextile on the soil side may be considered when cost effective.
- StormTech does not design, fabricate, sell or install thermoplastic liners. StormTech recommends consulting with liner professionals for final design and installation advice.

Membrane Materials:
Polyvinyl chloride (PVC) is an effective liner material for StormTech systems. PVC offers good chemical resistance to contaminant concentrations typical of highway runoff and to chlorides from road salting applications. Non-reinforced 30 mil PVC liners are recommended for StormTech systems. PVC is flexible. It can be folded without damage and is typically prefabricated and shipped to the jobsite. Panels as large as 20,000 sq. ft. can be prefabricated into a 4000 lb panel (30 mil is 0.195 lbs/sq. ft., SG = 1.2). PVC has the versatility to be field solvent welded, taped or field heat welded. A very significant advantage of PVC is that an excavation contractor can install a PVC liner without specialty crews. Solvent welding of seams, patches and pipe boots can all be done by the excavation contractor making PVC the lowest cost liner alternative.

The PVC compound includes fillers and plasticizers to reduce cost and UV inhibitors to extend the service life under exposure to sunlight. Under prolonged sunlight exposures such as in a permanent surface pool, these additives can leach into the pool and reach concentrations

harmful to aquatic life. PVC compounds referred to as "fish safe" are sometimes used for surface pond liners and may be considered for StormTech liners. However, since StormTech systems are subsurface, there is no opportunity for UV attack by sunlight. Also since stormwater is detained for short durations, typically 48 hours or less, there is little opportunity for accumulation of leachates. Therefore PVC is an excellent membrane material for thermoplastic liner detention systems.

Recommended Configuration: 30 mil PVC with 8 ounce non-woven geotextile underlayment and overlayment, open top with high flow bypass.
Recommended Restriction: Do not use for fuel spill containment.

Linear low density polyethylene (LLDPE) is a very inert material that offers excellent chemical resistance and is "fish safe". LLDPE is an effective liner system for StormTech systems, particularly for small projects where the entire liner can be prefabricated in one piece or when using taped seams. LLDPE is flexible up to 30 mil but thicknesses greater than 30 mil should not be folded without potential damage. 30 mil LLDPE is recommended. Extra care should be taken to protect against puncture. A minimum 8-ounce non-woven fabric underlayment and 12-ounce overlayment should be specified. The underlayment should be increased to 12-ounce where water tightness is essential and increased puncture risk exists. Panels as large as 27,000 sq. ft. can be prefabricated into a 4000 lb roll (30 mil is 0.15 lbs/sq. ft.). LLDPE has a specific gravity less than 1.0. LLDPE seams can be taped or field heat welded. Installation costs may increase if field seaming by a specialty contractor is required.

Recommended Configuration: 30 mil LLDPE with 8 ounce non-woven geotextile underlayment and 12-ounce overlayment, open top with high flow bypass.
Recommended Restriction: Do not use for fuel spill containment.

Reinforced Polypropylene (RPP), EPDM *and* ***XR-5*** are excellent materials for lining systems due to their flexibility, durability and excellent chemical and UV resistance. Although excellent lining materials, they generally exceed the engineering requirements for typical applications and are higher in cost than PVC or LLDPE. For fuel and oil concentrations normally found in storm water from parking and roadways, PVC, LLDPE and PP are suitable. However, if containment of aggressive contaminants, fuels or fuel spills are anticipated, a liner professional should be consulted. XR-5 in thicknesses of 30 mil or more, with welded seams may be suitable.

Polyethylene (PE) materials are generally inert, offer excellent chemical resistance and are "fish safe". Although ***medium density polyethylene (MDPE)*** liners are widely used for sanitary landfills and fish ponds, they are generally much higher in total cost and are not likely to be cost effective lining materials. ***High density polyethylene (HDPE)*** is not flexible enough to resist puncture and conform to the excavation. Cost aside, MDPE is an acceptable liner material for StormTech systems but should be limited to subgrades that are well prepared, without protrusions and must be field seamed.

Geotextile Materials:

6-ounce	AASHTO M288 Class 2 non-woven separation geotextile over the top of stone (ADS 601 or equal)
8-ounce	AASHTO M288 Class 2 non-woven geotextile for use as protection layer for PVC, RPP and LLDPE (ADS 801 or equal)
12-ounce	AREMA Chapter 1 Part 10 Category "Regular" non-woven geotextile for use as protection layer for LLDPE and other PE membranes (ADS 1201 or equal)

Seaming Options*:*

1. ***Prefabricated vs. Field*** Prefabricated seams are preferable to field seams for all liner materials whenever possible.
2. ***Solvent Welded*** PVC only, low cost
3. ***Heat Welded*** Costly, require trained seamer, for all liner materials
4. ***Taped*** Cost effective, M50-RC Gray distributed by Titus Industrial Group recommended, single sided, 4" width, for all liner materials. No water tightness data is available.
5. ***Overlapped*** Not water tight, no leakage rates available, suggest 4 ft overlap for all materials.

Pipe "boots" are used to seal pipe penetrations through the liner. Boots can either be prefabricated by the liner fabricator or field fabricated by the contractor. The boot is then solvent cemented, heat welded or taped to the liner. A pipe clamp is normally used to seal the boot around the pipe. Seaming and sealing pipe boots at low temperatures (32° F minimum) requires preheating of the material.

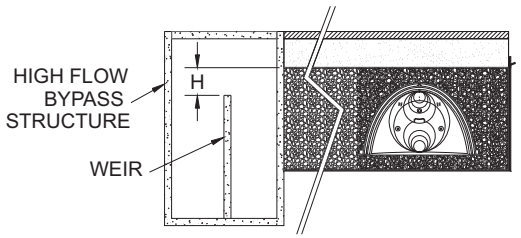
Design:

General The design of a lined system must be performed by the consulting engineer and, at minimum, requires knowledge of design storage, peak flow rates and maximum seasonal high groundwater elevation. This information is used to design the peak flow control structure, maximum liner height and groundwater control (if necessary).

High Flow Bypass A high flow control is an important component for any lined system. The high flow control is designed to pass the peak flow while ensuring that the liner is not overtopped. The control structure can be an upstream high flow bypass or a downstream overflow structure. In both cases, a high flow weir, very similar to the high flow control in a pond outlet control structure, is normally used. The high flow weir should be sized such that the water surface elevation based on the maximum head on the weir is less than the top of the liner. Additional freeboard should be provided.

In a typical upstream bypass design, the calculated depth of flow over the weir (H) is subtracted from the maximum water surface elevation in the chamber system to establish the weir crest elevation. The storage in the chamber system associated with the weir crest elevation may be a design constraint. The designer may choose to increase the weir length and therefore decrease the flow depth to establish a higher weir crest.

The equation for a rectangular weir is:



$H = (Q / (C_d \times L))^{2/3}$

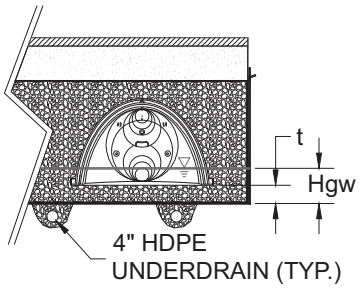
Where:
- Q = flow over the weir (cfs)
- C_d = discharge coefficient = 3.3
- H = Depth of flow over crest (ft)
- L = length of weir (ft)

In a typical downstream overflow design, the designer may incorporate one or more low flow orifices into the high flow weir wall. The weir crest is established as described above but hydraulic losses from the inlet to chamber to the outlet structure may need to be considered. Losses may be factored in by lowering the weir crest or increasing the liner freeboard.

Buoyancy StormTech recommends against installing lined chamber systems below groundwater. Although the total weight of a chamber system generally exceeds the buoyant force, a limiting stability condition may result when the buoyant pressure exceeds the resistance pressure directly under the chamber. This could result in a heave of the bedding under the chamber leading to instability. To prevent adverse impacts from ground water, where gravity discharge is possible, StormTech recommends the installation of an underdrain system under the liner. Where there is a potential buoyant force, StormTech recommends a sufficient stone bedding thickness, such that the weight of stone exceeds the maximum buoyant force.

The bedding thickness calculation is simplified by ignoring any structural contribution from the liner and reinforcing material and considering only the weight of the stone in the thinnest area of the bedding, which is located under the chamber.

The relationship between bedding thickness and maximum allowable groundwater elevation is:



$H_{gw} \times (62.4\ lb/ft^3) = (\gamma_{stone} \times t) / SF$

Where:
- H_{gw} = height of groundwater above liner bottom (inches)
- γ_{stone} = bulk density of bedding stone (lb/ft^3)
- t = thickness of stone bedding (inches)
- SF = safety factor (1.5 typical minimum)*

The bulk density of the open graded stone bedding materials varies from about 75 lbs/ft^3 to over 100 lbs/ft^3. Without specific bulk density information for the stone actually used, StormTech recommends using not more than 75 $lbs/ft^{3.}$

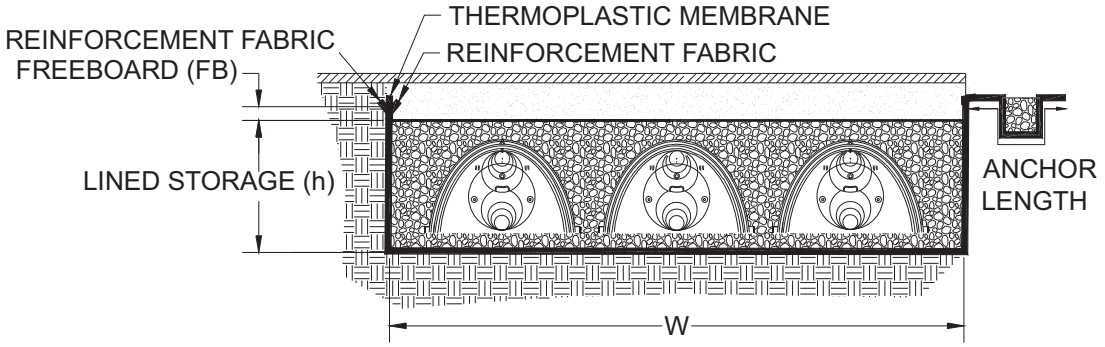
* The consulting engineer may apply a lower or higher safety factor.

Installation:
Installation should be in accordance with the liner manufacturer's instructions. Associations representing membrane materials have developed installation standards and other support documents for the respective lining materials. Visit their web sites for additional information.

- PVC Geomembrane Institute, University of Illinois, web: http://Pgi-tp.cee.uiuc.edu/forweb
- "HDPE Geomembrane Installation Specification" by the International Association of Geosynthetic Installers. Revised February 2000: http://www.iagi.org/specifications.htm

PVC and LLDPE liners should not be installed at temperatures less than 32° F or on windy days. Wind can catch the liner and be extremely dangerous to laborers. Stones and other protrusions should always be removed from the excavation. Rolling or compacting is recommended to knock down any remaining protrusions. The non-woven underlayment fabric is then placed in the excavation, the membrane placed, and a fabric reinforcement placed over the membrane. Liners are flapped by laborers to get air under the liner to enable easy drag across bed. Corners are generally formed by folding or "pleating" excess liner material.

An "anchor trench" about 12" deep by 12" wide may be dug around the top of the excavation to anchor the top of the reinforcement fabric and thermoplastic liner at the top of the excavation. Stone should be placed carefully to avoid puncture from long free falls. Similarly, additional care must be taken when spreading and compacting bedding stone to prevent stones from puncturing the liner during construction.



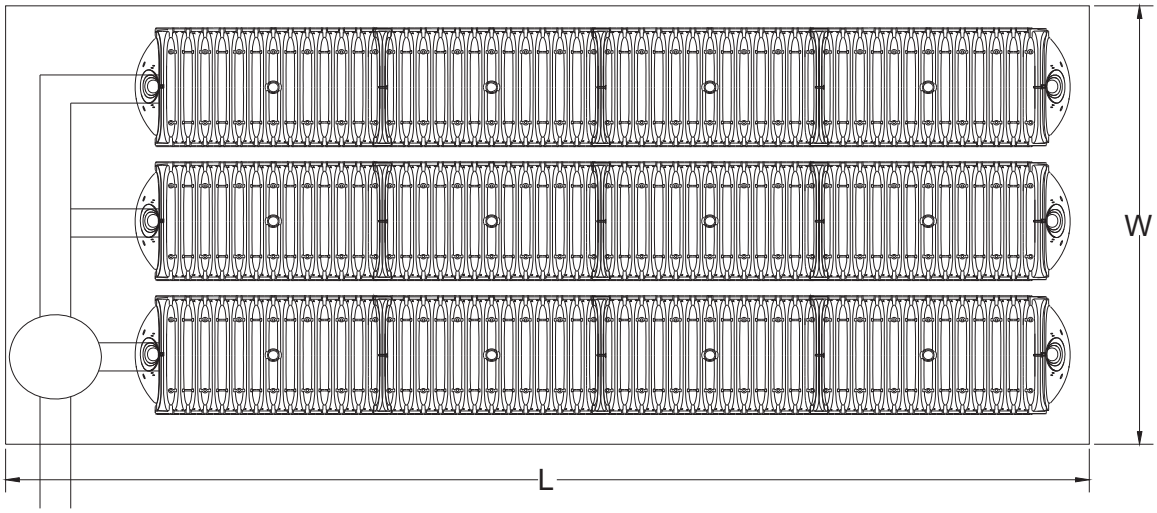
Estimating Liner Material:
Liner fabricators require dimensional details to design panels and provide firm material quotations. The liner and reinforcing fabric quantities should include sidewalls and extra material for anchoring during installation. The excavation contractor should use care not to over excavate since a larger excavation would require additional liner materials.

The fabricated sheet size for estimating purposes is calculated as follows:

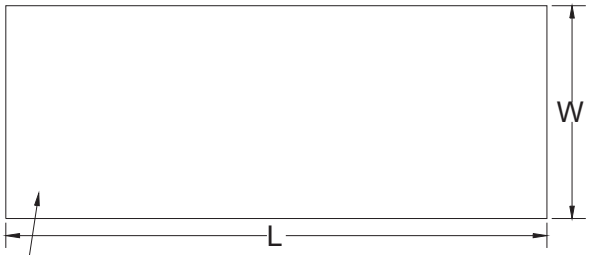
Panel Size = [W + 2(h + FB + AL)] x [L + 2(h + FB + AL)]
Where:

W	= system width from StormTech layout drawing
L	= system length from StormTech layout drawing
FB	= freeboard based on engineer's advice (0.5' typical)
AL	= anchor length of membrane and reinforcement to tie back sidewall material during installation and backfill of chambers (4' typical)

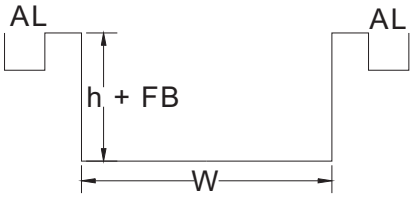
The location and size of pipe penetrations should also be summarized for the fabricator.



Estimating Worksheet:



24" HDPE PIPE PENETRATION (EG.)



Panel Size = [W + 2(h + FB + AL)] x [L + 2(h + FB + AL)]

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Tech Sheet

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ASTM & AASHTO Standards for Buried Thermoplastic Structures

Tech Sheet # 6
November 2012

Design Requirements for Thermoplastic Structures:

1. **The structural design must evaluate short term live loads, intermediate term loads and long term soil loads.**
2. **The materials used in production must provide necessary short, intermediate and long term properties.**
3. **The structural design must be completed by experts in the field of soil-structure interaction.**
4. **The product must be designed and manufactured to meet meaningful standards.**
5. **The structural design of the subsurface stormwater system must be up to the standards that a professional engineer expects.**

General:
This summarizes key components of structural design and national standards for subsurface thermoplastic structures. Although the focus of this guidance is on chamber systems, the principles apply to the wider category of buried products of various structural shapes and material properties.

Structural Design of a Subsurface Thermoplastic System:
The objective of *structural* design is to ensure a proper safety factor over the intended ***service life*** of the buried system. Typically the intended service life of a subsurface storm drainage system ranges from 20 to 100 years. Since the polypropylene and polyethylene, thermoplastic materials now used for subsurface structures are very stable in the stormwater environment; the limiting criterion for service life is generally long-term structural stability.

The primary benefit of subsurface systems is to facilitate additional paved surfaces for the purpose of parking or traffic flow. For such applications, where public safety is of paramount importance, "structural survival", i.e. lack of failure, is not sufficient. For a design to be safe, structural ***safety factors*** must be demonstrated for the entire service life of the project to account for uncertainties in loading, installation, and material performance. AASHTO design procedures mandate load factors of 1.75 for live loads to account for impact effects and the presence of multiple or overweight loads and 1.95 for earth loads on buried culverts.

There are two components to ensuring long term performance of any structural product: 1) the product must be designed, tested and manufactured to meet meaningful ***product standards*** and 2) the system must be designed to meet meaningful ***design standards***. ASTM and AASHTO, the most respected, dependable standards available, have developed standards for buried structures.

Short Term Properties, Intermediate Term Properties, Long Term Properties, Strain and Deflection:
Buried thermoplastic products must be designed for three conditions: 1) short duration live loads under shallow cover, 2) minimum 1-week sustained loads and 3) permanent earth loads. ***Load duration*** is a key criterion for the design of thermoplastic structures since the "apparent strength" and stiffness decrease with increasing load duration. For live load design, the thermoplastic product must be able to withstand the dynamic load from moving vehicles. *Live load design is based on short duration loads and short term material properties.* Intermediate load design requires the thermoplastic product to withstand 1-week sustained loads from parked oversized loads. *Intermediate load design is based on 1-week duration loads and 1-week material properties.*

1 AASHTO is the American Association of State Highway and Transportation Officials
2 ASTM / ASTM International is the American Society of Testing Materials

Earth (dead) loads are permanent in duration and magnitude. For dead load design, the thermoplastic product must be able to withstand the continuous dead load and remain stable after 75 years or more under sustained load. For thermoplastic systems using structural aggregate (stone) support, the performance of the structure is a function of the ability of the thermoplastic structure to a shed significant portion of the load to the surrounding stone (arching). *Earth load design is based on permanent loads and long term material properties.* The material properties that govern long-term design are tensile creep rupture and creep modulus.

Strain limits are the maximum strains that can occur before the structure fails. Long, slender shapes are inherently unstable and fail at lower loads by buckling. Wide, flat shapes may also buckle under continuous load. Design for long-term service life must be based on long duration loads, long term creep modulus and strain limits. ***Without proper soil support, thermoplastic structures may reach a strain limit and fail.***

Deflection is generally not a failure limit or a service limit for soil supported chamber systems. When deflection is not limited by soil support, excessive deflection of thermoplastic structures has been found to cause pavement distress. ***Without proper soil support, deflection is a service limit for thermoplastic structures.***

Specifying industry standards, not just products, establishes objective, meaningful performance criteria and a defensible basis of design.

AASHTO Standards:
The AASHTO LRFD Bridge Design Specification is the primary source of design standards for soil-structure interaction under traffic loads. Section 3 of this specification provides for calculation of loads and Section 12.12 provides for structural design of buried thermoplastic structures.
The AASHTO standard:

- **Assures design safety factors for live loads and long-term loads**
- **Provides the design method for soil-structure interaction**
- **Assures a long-term service life by designing for creep and strain limits**
- **Provides consulting engineers with a defensible basis of design**

ASTM Standards:
ASTM is an internationally recognized source for a variety of standards including; testing methods, standard practices and product specifications. ASTM has developed two product standards for Stormwater chambers, designations ASTM F2418 (polypropylene chambers) and ASTM F2922 (polyethylene chambers).
The ASTM F 2418 and F2922 Standards:

- **Assure consistent product quality in a non-proprietary specification**
- **Establish physical and mechanical requirements for the finished product**
- **Establish long and short-term material properties for design**
- **Require AASHTO safety factors and full scale validation testing**

ASTM has developed a design standard for Stormwater chambers, designation: ASTM F 2787, entitled "Standard Practice for Structural Design of Thermoplastic Corrugated Wall Stormwater Collection Chambers".
The ASTM F 2787 Standard:

- **Applies the AASHTO Section 12.12 thermoplastic pipe design criteria and applies it directly to chambers**
- **Includes an additional design load for a minimum 1-week sustained vehicle load to account for parked vehicles**
- **Provides design criteria that can be applied to different thermoplastic resins.**

Product Design:

Stone support is a key component of the soil-structure interaction system. Stone columns between thermoplastic components provide the load paths from the load above to the foundation below. For stone-structure designs, the stone reduces the load that the thermoplastic components must carry and limits the deflection and strain of the thermoplastic components. Designs of subsurface thermoplastic structures that purport to require no structural stone or are not designed in accordance with AASHTO requirements may result in excessive deflections or complete failure.

StormTech chambers are designed and rigorously tested in accordance with national standards to provide the most reliable subsurface system available.

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Tech Sheet

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Manifold Sizing Guidance for StormTech Chamber Systems

Tech Sheet # 7
August, 2012

General:
The design of subsurface chambers systems, as part of a site design, involves many site-specific and regulatory constraints that necessarily leave overall design responsibility with the consulting engineer. However StormTech offers assistance to the design engineer for the layout of chamber systems and the manifolds that connect the chambers to the drainage system. This summarizes methods StormTech uses for calculating the size and configuration of manifolds for the StormTech chamber system.

StormTech manifolds are comprised of smooth interior HDPE pipes, fittings and prefabricated manifold sections that align with proper spacing of the chamber rows. The use of common pipe components enables the engineer to apply simple equations of hydraulics to size the manifold system. Available prefabricated manifolds are shown in Table 1.

	Trunk in. (mm)		SC-310 & RC-310 Manifolds								
Stub in. (mm)	48 (1200)	42 (1050)	36 (900)	30 (750)	24 (600)	18 (450)	15 (375)	12 (300)	10 (250)	8 (200)	6 (150)
12 (300)	NA	NA	NA	NA	Avail	Avail	Avail	Avail	NA	NA	NA
10 (250)	NA	NA	NA	NA	Avail	Avail	Avail	Avail	Avail	NA	NA
8 (200)	NA	NA	NA	NA	Avail	Avail	Avail	Avail	Avail	Avail	NA
6 (150)	NA	NA	NA	NA	Avail	Avail	Avail	Avail	Avail	Avail	Avail

	Trunk in. (mm)		SC-740, DC-780 & RC-750 Manifolds								
Stub in. (mm)	48 (1200)	42 (1050)	36 (900)	30 (750)	24 (600)	18 (450)	15 (375)	12 (300)	10 (250)	8 (200)	6 (150)
24 (600)	Avail	Avail	Avail	Avail	Avail	NA	NA	NA	NA	NA	NA
18 (450)	Avail	Avail	Avail	Avail	Avail	Avail	NA	NA	NA	NA	NA
15 (375)	Avail	Avail	Avail	Avail	Avail	Avail	Avail	NA	NA	NA	NA
12 (300)	Avail	Avail	Avail	Avail	Avail	Avail	Avail	Avail	NA	NA	NA
10 (250)	NA	NA	NA	NA	Avail	Avail	Avail	Avail	Avail	NA	NA
8 (200)	NA	NA	NA	NA	Avail	Avail	Avail	Avail	Avail	Avail	NA
6 (150)	NA	NA	NA	Avail	Avail	Avail	Avail	Avail	Avail	Avail	Avail

	Trunk in. (mm)		MC-3500 & MC-4500 Manifolds								
Stub in. (mm)	48 (1200)	42 (1050)	36 (900)	30 (750)	24 (600)	18 (450)	15 (375)	12 (300)	10 (250)	8 (200)	6 (150)
24 (600)	Avail	Avail	Avail	Avail	Avail	NA	NA	NA	NA	NA	NA
18 (450)	Avail	Avail	Avail	Avail	Avail	Avail	NA	NA	NA	NA	NA
15 (375)	Avail	Avail	Avail	Avail	Avail	Avail	Avail	NA	NA	NA	NA
12 (300)	Avail	Avail	Avail	Avail	Avail	Avail	Avail	Avail	NA	NA	NA

Table 1 Standard Manifolds Manufactured by ADS (special sizes available)

The primary manifold design objectives are; 1) to convey the peak flows to and from the chamber system without causing an unacceptable backwater and 2) to preclude scour of structural stone under the chamber system. StormTech assumes the maximum allowable water surface elevation is at full storage (top of open graded stone). The design engineer may choose to design for a higher maximum water surface elevation. Since the relationship between the inflow hydrographs, outlet control, time to peak and accumulated storage are site specific and complex, StormTech assumes that the peak inlet flow occurs when there is no water in the chambers. This is the worst case condition for scour. StormTech assumes that the chambers are full when the peak outlet flow occurs.

Inlet Manifolds:
Inlet manifold sizing is broken down into two parts: 1) sizing the main trunk and 2) determining the size and number of stubs required. The following guidance includes how to determine main trunk size and a sufficient number of properly sized stub connections.

Inlet Trunk Sizing:
StormTech manifold systems are generally laid level. The analysis of the trunk can be performed by looking at the trunk as an orifice of a short tube and submerged at peak flow. The premise is that the length between the manhole and first stub is relatively short. Thus the orifice

of a short tube can be looked at as the length of main trunk to the first inlet stub. The short tube is the constriction.

Flow in the main trunk is reduced after each stub and headlosses in the balance of the trunk do not control.

The equation for an orifice of a short tube[1] is:

$$Q = Ca\sqrt{2gh}$$

With the variables defined as follows:
Q = maximum flow rate cresting the weir (cfs)
C = 0.75
a = area of manifold trunk (ft^2) (to be determined)
g = 32.2 (ft/s^2)
h = head over center of orifice (ft) (figure 1)

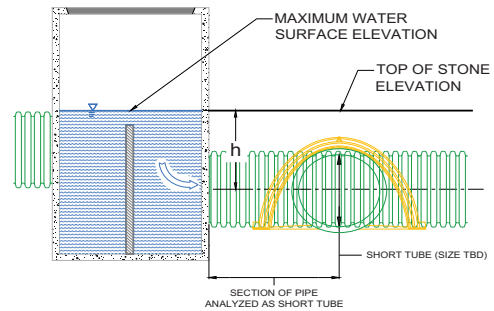

Figure 1 Orifice of a Short Tube

This analysis is used to determine the area of the orifice required to pass the flow rate. A pipe is selected with at least this area.
The design engineer may apply a greater value for "h" if it is not limited by the maximum water surface elevation at the top of stone.

Inlet Stub Sizing:
The number and size of the stubs can be determined by analyzing each inlet stub as a broad crested weir. Weir analysis is dependant upon whether a tailwater condition exists inside the chambers. Unless otherwise determined by the inlet hydrograph, no tail water is used for the analysis (worst case scenario).
The equation for a broad crested weir [1] is:

$$Q = CLH^{3/2}$$

With the variables defined as follows:
Q = flow rate in the stub (cfs)
C = discharge coefficient
L= width of weir (ft)
H = height of water over weir (ft)
b = Length of weir (ft) *(used to determine C)*

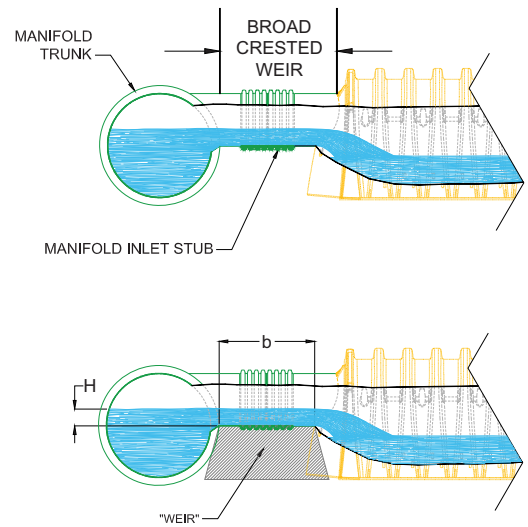

Figure 2 Broad Crested Weir

These parameters are defined in figure 2. When performing the analysis on the weir, the first step is to determine the maximum allowable flow rate through the stubs into the chambers. Table 2 shows the maximum velocities based on scour analysis and pipe size. Specifying scour protection fabric allows higher velocities to be tolerated. **Note: the velocity from Table 2 cannot be multiplied by the area of the pipe to determine the allowable flow rate through the pipe stubs.**

Inlet Pipe Diameter in. (mm)	Maximum Inlet Pipe Velocities ft/s (m/s)
4 (100)	2.43 (0.74)
6 (150)	2.61 (0.80)
8 (200)	2.73 (0.83)
10 (250)	2.44 (0.74)
12 (300)	2.19 (0.67)
15 (375)	2.00 (0.61)
18 (450)	1.88 (0.57)
24 (600)	1.74 (0.53)

Table 2: Maximum inlet velocities for various pipes

When sizing the stubs for a "size on size" manifold, there is no weir formed by the stub. A conservative approach to determine the number of stubs required is to assume an eccentric manifold with the desired stub size and an oversized trunk. Thus if a 24" x 24" manifold is desired then size a 30" x 24" manifold to determine the number of 24" stubs required and use this number of stubs for the 24" x 24" manifold.

Outlet Manifolds:
The purpose of the outlet manifold "hard-pipe connection(s)" is to ensure that there are free-flooding conditions between the StormTech chambers and the outlet control structure. The outlet manifold must be able to pass the design peak outlet flow rate from the chamber system to the outlet control structure and the outlet control structure must in-fact control the flow.

The premise for the StormTech sizing approach is that the outlet control structure has caused the chambers to be full when the peak outlet flow occurs. Essentially, the outlet control structure has impeded flow and caused a backwater in the StormTech chambers. This premise is appropriate for most flow attenuation systems and also simplifies the design. Since the chambers are assumed to be full, the allowable flow through the chamber row is the full chamber flow area multiplied by the acceptable scour velocity. However, when the design intent is to maximize storage in the chambers, the outlet structure would cause a high tailwater and driving head would be small. Under the low driving head scenario, pipe flow is more constricting than chamber row flow.

The outlet manifold sizing then becomes full pipe flow which is dependent upon driving head, headlosses at the pipe entrance, friction losses in the pipes, fitting losses (if a manifold) and exit losses. This is solved by a simple application of the energy equation and the Darcy Weisbach equation for piping connecting two reservoirs; the upstream reservoir elevation being the maximum water surface elevation in the chamber system and the downstream reservoir elevation being the water surface elevation caused by the outlet control (see figure 3).

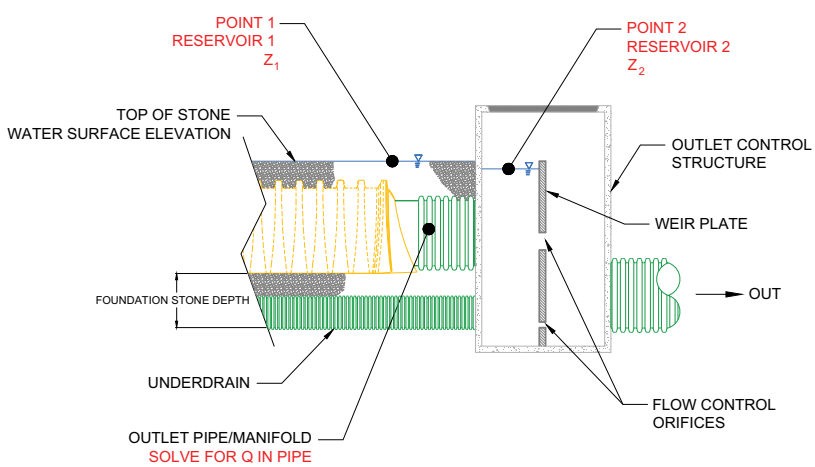

Figure 3, Outlet connections (reservoir-to-reservoir connection)

The formulas to be used are:
Energy Equation [2]:

$$\frac{p_1}{\gamma} + \alpha_1 \frac{v_1^2}{2g} + z_1 = \frac{p_2}{\gamma} + \alpha_2 \frac{v_2^2}{2g} + z_2 + h_L$$

Where:

p/γ = pressure head

$\alpha v^2/2g$ = velocity head

α = kinetic energy correction factor (typically set to 1)

z = elevation

h_L = head loss between sections 1 and 2

Darcy-Weisbach formula[2]:

$$h_f = f \frac{L}{D} \frac{V^2}{2g}$$

Where:

h_f = headloss in pipe

$V^2/2g$ = velocity head

L = length of pipe

D = pipe diameter

f = resistance coefficient

Colebrook formula[3]:

$$\frac{1}{\sqrt{f}} = 2.0 \log\left(\frac{\varepsilon/D}{3.7} + \frac{2.51}{Re\sqrt{f}}\right)$$

Where:

f = headloss in pipe

ε/D = equivalent relative roughness

D = pipe diameter

ε = equivalent absolute roughness

Re = Reynolds number

Note: Most hydraulics textbooks contain a copy of the Moody Chart that can be used to calculate f instead of the Colebrook formula.

Headloss in transitions and fitting can be calculated using the formula [2]:

$$h_L = K \frac{V^2}{2g}$$

Where: K_e = 0.5 for a square edged inlet pipe [2]
K_E = 1.0 for a re-entrant (pipe into outlet control structure) [2]
K_L = 2.0 for a branched tee (manifold tee) [4]

StormTech has solved the energy equation and the Darcy Weisbach equation based on a driving head of 0.25 ft, losses that include: 1 square edge inlet, 1 tee, 1 outlet and ≤ 50 ft of pipe and suggests maximum flow rates for stub and manifold sizes as shown in table 3. When the pipe required is larger than the maximum sized pipe that can be inlet into the chamber the pipe size calculated is specified as the main manifold trunk (see table 3). The number of stubs required for the manifold is obtained by dividing the outlet flow rate by the maximum flow rate

from table 3 for the desired stub size. For example, with an outlet flow rate of 6 cfs a 24 in manifold trunk is required for the SC-310 chamber (maximum pipe size is 12 in). To size a 24" x 12" outlet manifold the 6 cfs is divided by 2.0 cfs (maximum outlet flow rate for 12 inch pipe) for a total of three 12 inch stubs required.

Manifold Configuration:
As well as conveying the design flow rates and preventing scour of the foundation stone, the manifold must also disperse the water across the chamber bed and ensure that peak flows readily reach to the outlet control structure. For wide beds with many rows, the manifold stubs should be spread out so that large areas of the bed are not dependent upon flow through stone to fill.

Figure 4 shows an example of a "limiting row" that requires nearly half the chamber bed to be filled via the stone permeability. The flow to the remainder of the bed and to the outlet control structure is limited by the flow through the stone of only one chamber row. Based on the inlet hydrograph and the permeability of the stone this limiting row may cause a backwater condition. In figure 4 there are 9 chambers that will laterally feed the remainder of the bed consisting of 54 chambers.

Outlet Pipe Diameter in. (mm)	Maximum Outlet Pipe Flow Rates cfs (l/s)
6 (150)	0.4 (11.3)
8 (200)	0.7 (19.8)
10 (250)	1.0 (28.3)
12 (300)	2.0 (56.6)
15 (375)	2.7 (76.5)
18 (450)	4.0 (113.3)
24 (600)	7.0 (198.2)
30 (750)	11.0 (311.5)
36 (400)	16.0 (453.1)
42 (1050)	22.0 (623.0)
48 (1200)	28.0 (792.9)

Max. SC-310 pipe connection

Max. SC-740 pipe connection

Table 3: Maximum outlet flow rate for various pipes

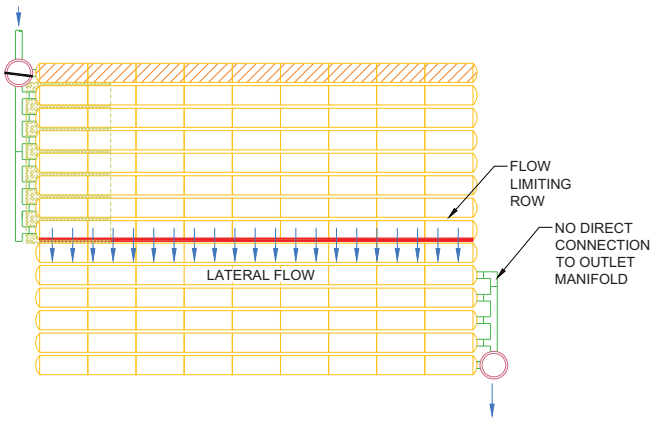

Figure 4: Limiting row of chamber potentially causing backwater

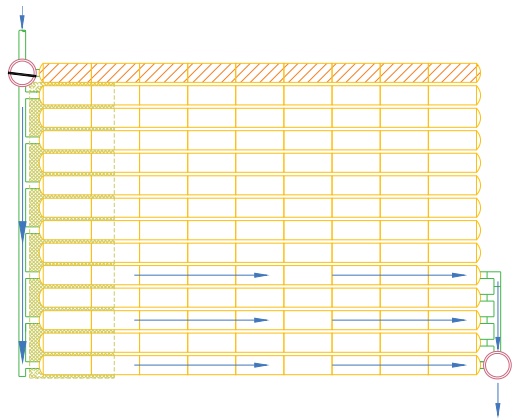

Figure 5: Typical inlet/outlet manifold system

In figure 5 the manifold is spread out to inlet every other row. With this configuration there are now 63 chambers connected to the inlet manifold, laterally feeding 54 chambers that do not have inlet stubs. Also there are three chamber rows connected on both the inlet and outlet ends (creating three direct flow paths from the inlet to the outlet).

The aggregate used for StormTech's chambers have permeability's (Darcy *k* values) that range from 0.1 ft/s (0.03 m/s) to 1.6 ft/s (0.5 m/s) (No. 57 and No. 3 respectively) [5]. StormTech has estimated of flow through the stone beneath the chambers (one direction) as:

Stone Gradation	Darcy "k" ft/s (m/s)	SC-310		SC-740	
		Velocity ft/s (m/s)	Q* cfs (L/s)	Velocity ft/s (m/s)	Q* cfs (L/s)
#3	1.6 (0.5)	0.91 (0.28)	3.04 (86.1)	1.2 (0.37)	4.2 (118.9)
#357, 4, 467, 5	0.6 (0.2)	0.34 (0.10)	1.14 (32.3)	0.4 (0.12)	1.6 (45.3)
#56, 57	0.1 (0.03)	0.06 (0.02)	0.19 (5.4)	0.07 (0.02)	0.26 (7.36)

** Flows listed are one direction only and are based on Darcy' equation of Q = kiA. Assumptions include a hydraulic gradient equal to the height of chamber, 6" of foundation stone, no water ponded in the adjacent chamber row, and a flow path length of 41 inches for the SC-740 and 30 inches for the SC-310.*

The StormTech Technical Services Department can assist the design professional in specifying StormTech stormwater systems. As part of this assistance StormTech has developed a proprietary sizing tool for the inlet manifolds based on the common equations and assumptions listed in this Tech Sheet. Please contact the StormTech Technical Services Department for assistance with sizing inlet manifolds.

Disclaimer: The hydraulic performance of manifolds for detention systems is dependent upon many variables including but not limited to; headwater and tail water conditions, the inflow hydrograph and headloss through the piping system. StormTech has used assumptions to simplify the manifold design process. The design engineer for the project must verify that the assumptions and calculations are appropriate for the specific application.

[1] Brater, E.F. and King, H. W., Handbook of Hydraulics for the Solution of Hydraulic Engineering Problems, 6th ed., McGraw-Hill, New York, 1976
[2] Cassidy, J.J, Chaudhry, M.H., and Roberson, J. A., Hydraulic Engineering, 1 st ed., Houghton Mifflin, Boston, 1988
[3] Gerhart, P.M., Gross, R.J., and Hochstien, J.I. Fundamentals of Fluid Mechanics, 2 nd ed., Addison-Wesley, New York, 1992
[4] Munson, B.R., Okiishi, T.H., and Young, D.F., Fundamentals of Fluid Mechanics, 5 th ed., John Wiley & Sons, Danvers, 2006
[5] Cedergren, H.R., Seepage, Drainage, and Flow Nets, 3rd ed., John Wiley & Sons, New York, 1989

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Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

UNIT HYDROGRAPHS AND INFILTRATION BASIN DATA PROVIDED

FLOOD HYDROGRAPH ROUTING PROVIDED WITH FINAL WQMP

NOAA Atlas 14, Volume 6, Version 2
Location name: Lake Elsinore, California, USA*
Latitude: 33.6868°, Longitude: -117.3721°
Elevation: 1309.14 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.085 (0.072-0.103)	0.115 (0.096-0.138)	0.154 (0.129-0.187)	0.187 (0.155-0.229)	0.234 (0.187-0.296)	0.271 (0.212-0.350)	0.310 (0.236-0.411)	0.350 (0.259-0.478)	0.407 (0.288-0.581)	0.451 (0.308-0.668)
10-min	0.122 (0.103-0.147)	0.164 (0.138-0.198)	0.221 (0.185-0.268)	0.269 (0.222-0.328)	0.335 (0.268-0.424)	0.388 (0.303-0.502)	0.444 (0.338-0.589)	0.502 (0.371-0.686)	0.583 (0.412-0.832)	0.647 (0.441-0.958)
15-min	0.148 (0.124-0.178)	0.199 (0.166-0.240)	0.267 (0.223-0.324)	0.325 (0.269-0.397)	0.406 (0.324-0.513)	0.470 (0.367-0.607)	0.537 (0.408-0.712)	0.607 (0.448-0.829)	0.705 (0.498-1.01)	0.782 (0.533-1.16)
30-min	0.228 (0.191-0.274)	0.306 (0.256-0.369)	0.412 (0.344-0.498)	0.500 (0.414-0.610)	0.625 (0.499-0.790)	0.723 (0.565-0.935)	0.826 (0.629-1.10)	0.934 (0.690-1.28)	1.09 (0.767-1.55)	1.20 (0.821-1.78)
60-min	0.359 (0.301-0.432)	0.482 (0.404-0.581)	0.649 (0.542-0.785)	0.788 (0.652-0.962)	0.984 (0.786-1.25)	1.14 (0.890-1.47)	1.30 (0.991-1.73)	1.47 (1.09-2.01)	1.71 (1.21-2.44)	1.90 (1.29-2.81)
2-hr	0.546 (0.458-0.658)	0.706 (0.591-0.852)	0.926 (0.773-1.12)	1.11 (0.920-1.36)	1.38 (1.10-1.74)	1.59 (1.24-2.05)	1.81 (1.38-2.40)	2.04 (1.51-2.79)	2.38 (1.68-3.39)	2.64 (1.80-3.91)
3-hr	0.681 (0.571-0.821)	0.873 (0.731-1.05)	1.14 (0.948-1.37)	1.36 (1.12-1.66)	1.67 (1.34-2.12)	1.93 (1.51-2.49)	2.19 (1.67-2.91)	2.48 (1.83-3.39)	2.88 (2.03-4.11)	3.20 (2.18-4.73)
6-hr	0.981 (0.822-1.18)	1.26 (1.05-1.52)	1.63 (1.36-1.97)	1.95 (1.61-2.38)	2.39 (1.91-3.03)	2.75 (2.15-3.55)	3.12 (2.37-4.14)	3.51 (2.60-4.80)	4.06 (2.87-5.80)	4.50 (3.07-6.67)
12-hr	1.28 (1.08-1.55)	1.71 (1.43-2.06)	2.27 (1.89-2.74)	2.73 (2.26-3.33)	3.36 (2.68-4.24)	3.84 (3.00-4.97)	4.34 (3.31-5.76)	4.86 (3.59-6.64)	5.57 (3.94-7.95)	6.11 (4.17-9.06)
24-hr	1.71 (1.51-1.97)	2.39 (2.11-2.76)	3.28 (2.88-3.80)	3.99 (3.48-4.65)	4.94 (4.18-5.95)	5.66 (4.70-6.97)	6.39 (5.18-8.05)	7.13 (5.62-9.23)	8.12 (6.15-10.9)	8.88 (6.51-12.4)
2-day	2.04 (1.81-2.36)	2.96 (2.61-3.42)	4.14 (3.65-4.80)	5.10 (4.45-5.95)	6.39 (5.40-7.70)	7.37 (6.11-9.06)	8.36 (6.77-10.5)	9.38 (7.39-12.1)	10.7 (8.14-14.5)	11.8 (8.64-16.4)
3-day	2.22 (1.96-2.56)	3.26 (2.88-3.76)	4.62 (4.07-5.35)	5.72 (5.00-6.68)	7.23 (6.11-8.71)	8.38 (6.95-10.3)	9.56 (7.74-12.0)	10.8 (8.50-13.9)	12.4 (9.41-16.7)	13.7 (10.1-19.1)
4-day	2.40 (2.12-2.77)	3.54 (3.13-4.09)	5.06 (4.45-5.86)	6.30 (5.50-7.36)	8.00 (6.77-9.64)	9.32 (7.73-11.5)	10.7 (8.64-13.4)	12.1 (9.52-15.6)	14.0 (10.6-18.9)	15.5 (11.4-21.6)
7-day	2.72 (2.40-3.14)	4.02 (3.55-4.65)	5.78 (5.09-6.70)	7.25 (6.34-8.47)	9.31 (7.88-11.2)	10.9 (9.06-13.4)	12.6 (10.2-15.9)	14.4 (11.4-18.6)	16.9 (12.8-22.8)	18.9 (13.8-26.3)
10-day	2.87 (2.54-3.32)	4.25 (3.75-4.91)	6.13 (5.40-7.11)	7.73 (6.75-9.03)	9.99 (8.45-12.0)	11.8 (9.78-14.5)	13.7 (11.1-17.2)	15.7 (12.4-20.3)	18.6 (14.1-25.0)	20.9 (15.3-29.1)
20-day	3.41 (3.01-3.93)	5.06 (4.47-5.85)	7.38 (6.50-8.56)	9.39 (8.20-11.0)	12.3 (10.4-14.8)	14.7 (12.2-18.0)	17.2 (13.9-21.7)	19.9 (15.7-25.8)	23.8 (18.1-32.1)	27.1 (19.8-37.7)
30-day	4.00 (3.54-4.62)	5.92 (5.22-6.84)	8.63 (7.60-10.0)	11.0 (9.61-12.9)	14.5 (12.2-17.5)	17.3 (14.4-21.3)	20.4 (16.5-25.7)	23.8 (18.7-30.8)	28.6 (21.7-38.5)	32.6 (23.9-45.4)
45-day	4.67 (4.13-5.39)	6.84 (6.04-7.90)	9.95 (8.76-11.5)	12.7 (11.1-14.8)	16.7 (14.2-20.2)	20.1 (16.7-24.7)	23.8 (19.2-29.9)	27.8 (21.9-35.9)	33.6 (25.4-45.2)	38.4 (28.1-53.5)
60-day	5.38 (4.76-6.21)	7.77 (6.86-8.98)	11.2 (9.88-13.0)	14.3 (12.5-16.7)	18.8 (15.9-22.7)	22.6 (18.7-27.8)	26.7 (21.6-33.6)	31.2 (24.6-40.4)	37.8 (28.7-51.0)	43.4 (31.8-60.4)

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

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

Please refer to NOAA Atlas 14 document for more information.

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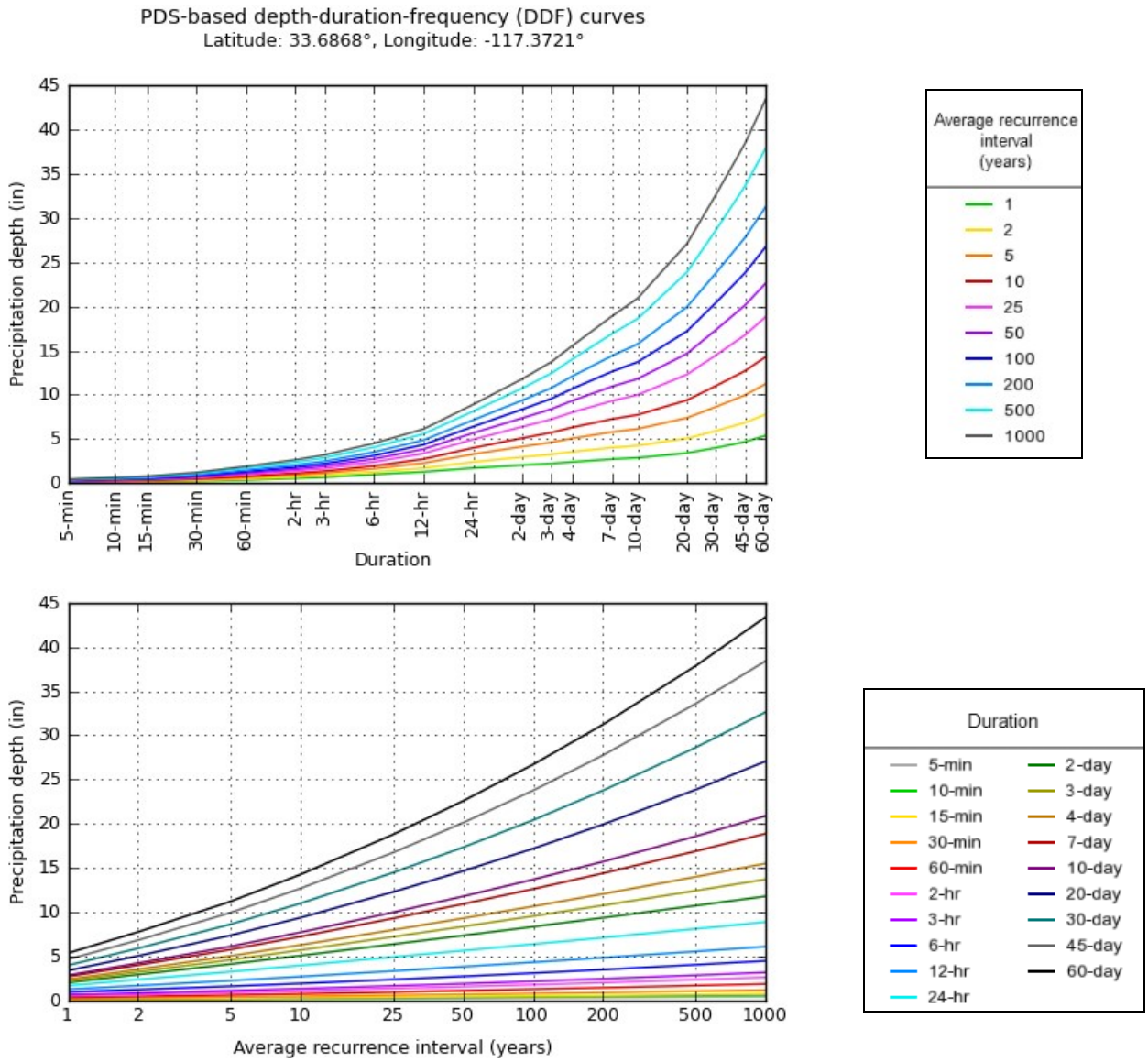
PF graphical



NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Sat Feb 18 16:19:36 2017

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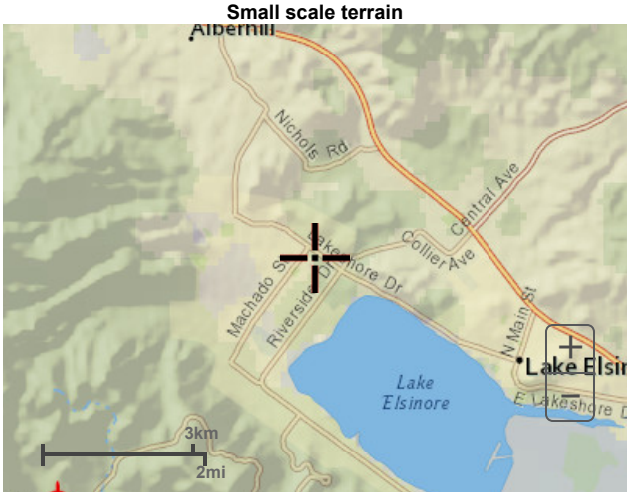
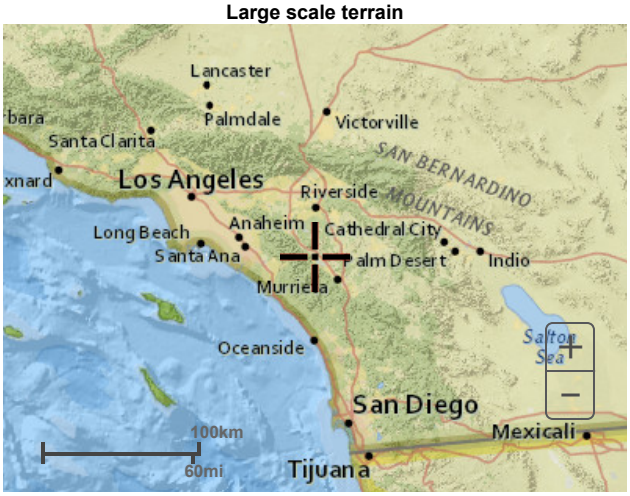
Maps & aerials

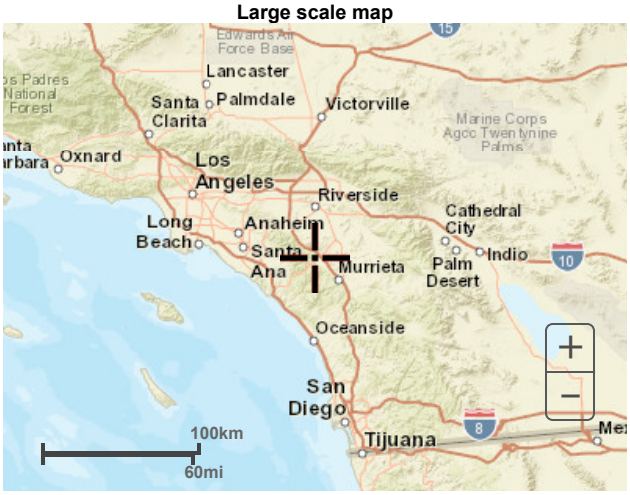
Small scale terrain



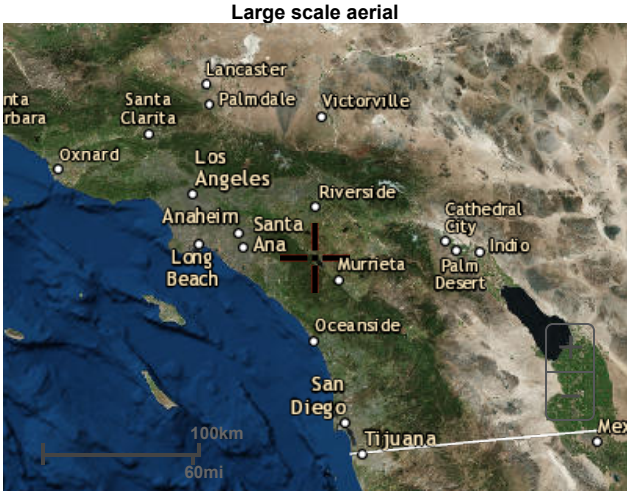
Large scale terrain



Large scale map



Large scale aerial



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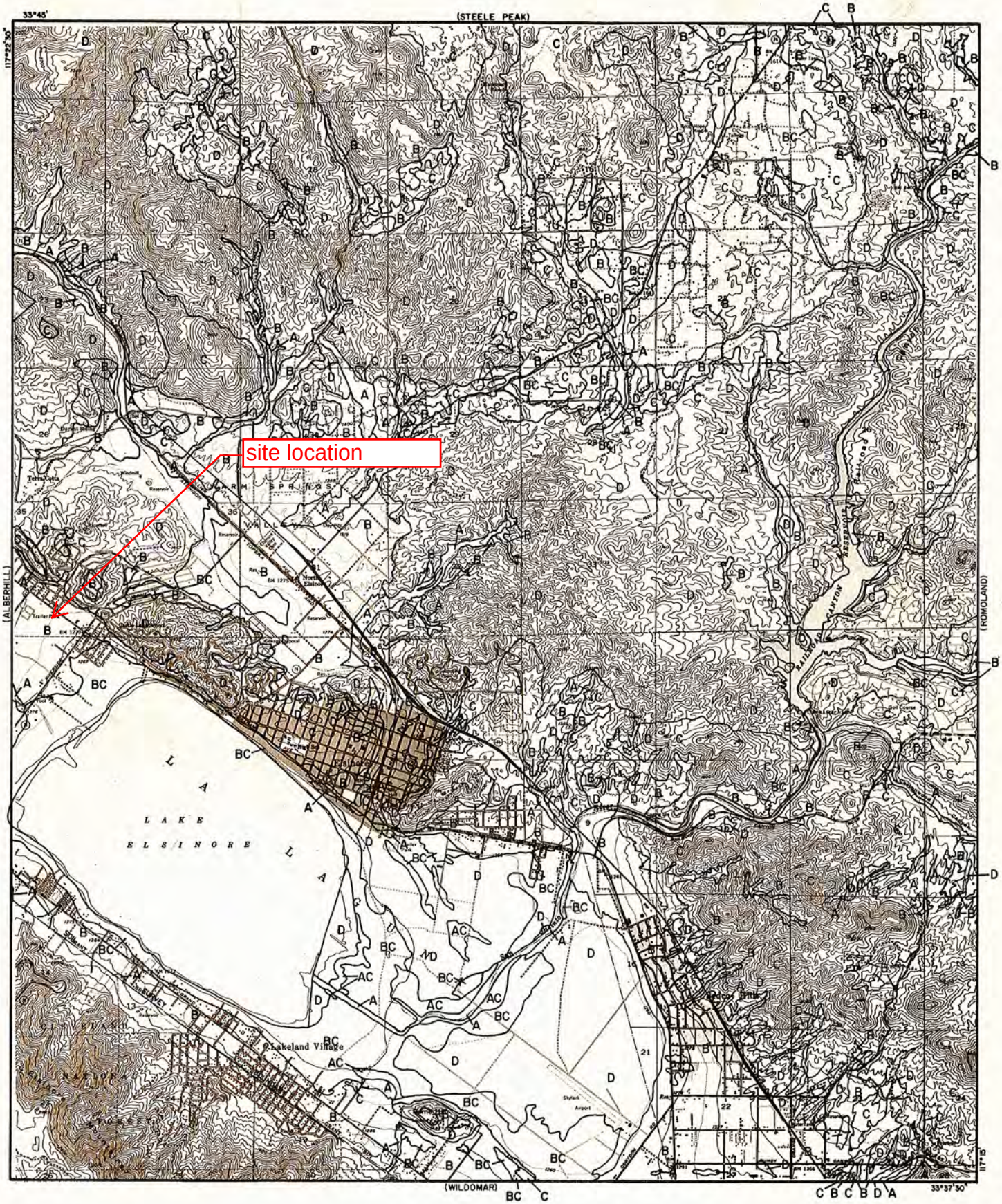
US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer



LEGEND

—— SOILS GROUP BOUNDARY

A SOILS GROUP DESIGNATION

RCFC & WCD

HYDROLOGY MANUAL

N

0 FEET 5000

HYDROLOGIC SOILS GROUP MAP FOR ELSINORE

PLATE C-1.41

lakeshore242

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 - 2014, Version 9.0
Study date 04/10/17 File: lakeshore242.out

++

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

Program License Serial Number 6387

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

English Units used in output format

---

2 year 24 hour storm event unit hydrograph
existing site condition
modified per redlined comments

Drainage Area = 7.50(Ac.) = 0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 7.50(Ac.) = 0.012 Sq. Mi.
Length along longest watercourse = 1211.00(Ft.)
Length along longest watercourse measured to centroid = 686.53(Ft.)
Length along longest watercourse = 0.229 Mi.
Length along longest watercourse measured to centroid = 0.130 Mi.
Difference in elevation = 9.50(Ft.)
Slope along watercourse = 41.4203 Ft./Mi.
Average Manning's 'N' = 0.020
Lag time = 0.062 Hr.
Lag time = 3.74 Min.
25% of lag time = 0.93 Min.
40% of lag time = 1.49 Min.
Unit time = 5.00 Min.
Duration of storm = 24 Hour(s)
User Entered Base Flow = 0.00(CFS)

lakeshore242

2 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.50	2.39	17.93

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.50	6.39	47.92

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 2.390(In)
Area Averaged 100-Year Rainfall = 6.390(In)

Point rain (area averaged) = 2.390(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 2.390(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
7.500	56.00	0.100

Total Area Entered = 7.50(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	36.0	0.706	0.100	0.642	1.000	0.642
					Sum (F) =	0.642

Area averaged mean soil loss (F) (In/Hr) = 0.642
Minimum soil loss rate ((In/Hr)) = 0.321
(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 (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	133.821	29.055	2.196
2	0.167	267.642	48.084	3.634
3	0.250	401.463	12.226	0.924
4	0.333	535.284	5.432	0.411

5	0.417	669.105	2.963	0.224
6	0.500	802.926	2.241	0.169
			Sum = 100.000	Sum= 7.559

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	0.019	(1.139)	0.016	0.003
2	0.17	0.07	0.019	(1.134)	0.016	0.003
3	0.25	0.07	0.019	(1.130)	0.016	0.003
4	0.33	0.10	0.029	(1.126)	0.024	0.005
5	0.42	0.10	0.029	(1.121)	0.024	0.005
6	0.50	0.10	0.029	(1.117)	0.024	0.005
7	0.58	0.10	0.029	(1.113)	0.024	0.005
8	0.67	0.10	0.029	(1.108)	0.024	0.005
9	0.75	0.10	0.029	(1.104)	0.024	0.005
10	0.83	0.13	0.038	(1.100)	0.031	0.007
11	0.92	0.13	0.038	(1.095)	0.031	0.007
12	1.00	0.13	0.038	(1.091)	0.031	0.007
13	1.08	0.10	0.029	(1.087)	0.024	0.005
14	1.17	0.10	0.029	(1.082)	0.024	0.005
15	1.25	0.10	0.029	(1.078)	0.024	0.005
16	1.33	0.10	0.029	(1.074)	0.024	0.005
17	1.42	0.10	0.029	(1.069)	0.024	0.005
18	1.50	0.10	0.029	(1.065)	0.024	0.005
19	1.58	0.10	0.029	(1.061)	0.024	0.005
20	1.67	0.10	0.029	(1.057)	0.024	0.005
21	1.75	0.10	0.029	(1.052)	0.024	0.005
22	1.83	0.13	0.038	(1.048)	0.031	0.007
23	1.92	0.13	0.038	(1.044)	0.031	0.007
24	2.00	0.13	0.038	(1.040)	0.031	0.007
25	2.08	0.13	0.038	(1.036)	0.031	0.007
26	2.17	0.13	0.038	(1.031)	0.031	0.007
27	2.25	0.13	0.038	(1.027)	0.031	0.007
28	2.33	0.13	0.038	(1.023)	0.031	0.007
29	2.42	0.13	0.038	(1.019)	0.031	0.007
30	2.50	0.13	0.038	(1.015)	0.031	0.007
31	2.58	0.17	0.048	(1.011)	0.039	0.009
32	2.67	0.17	0.048	(1.006)	0.039	0.009
33	2.75	0.17	0.048	(1.002)	0.039	0.009
34	2.83	0.17	0.048	(0.998)	0.039	0.009
35	2.92	0.17	0.048	(0.994)	0.039	0.009
36	3.00	0.17	0.048	(0.990)	0.039	0.009
37	3.08	0.17	0.048	(0.986)	0.039	0.009

38	3.17	0.17	0.048	(0.982)	0.039	0.009
39	3.25	0.17	0.048	(0.978)	0.039	0.009
40	3.33	0.17	0.048	(0.974)	0.039	0.009
41	3.42	0.17	0.048	(0.969)	0.039	0.009
42	3.50	0.17	0.048	(0.965)	0.039	0.009
43	3.58	0.17	0.048	(0.961)	0.039	0.009
44	3.67	0.17	0.048	(0.957)	0.039	0.009
45	3.75	0.17	0.048	(0.953)	0.039	0.009
46	3.83	0.20	0.057	(0.949)	0.047	0.010
47	3.92	0.20	0.057	(0.945)	0.047	0.010
48	4.00	0.20	0.057	(0.941)	0.047	0.010
49	4.08	0.20	0.057	(0.937)	0.047	0.010
50	4.17	0.20	0.057	(0.933)	0.047	0.010
51	4.25	0.20	0.057	(0.929)	0.047	0.010
52	4.33	0.23	0.067	(0.925)	0.055	0.012
53	4.42	0.23	0.067	(0.921)	0.055	0.012
54	4.50	0.23	0.067	(0.917)	0.055	0.012
55	4.58	0.23	0.067	(0.914)	0.055	0.012
56	4.67	0.23	0.067	(0.910)	0.055	0.012
57	4.75	0.23	0.067	(0.906)	0.055	0.012
58	4.83	0.27	0.076	(0.902)	0.063	0.014
59	4.92	0.27	0.076	(0.898)	0.063	0.014
60	5.00	0.27	0.076	(0.894)	0.063	0.014
61	5.08	0.20	0.057	(0.890)	0.047	0.010
62	5.17	0.20	0.057	(0.886)	0.047	0.010
63	5.25	0.20	0.057	(0.882)	0.047	0.010
64	5.33	0.23	0.067	(0.879)	0.055	0.012
65	5.42	0.23	0.067	(0.875)	0.055	0.012
66	5.50	0.23	0.067	(0.871)	0.055	0.012
67	5.58	0.27	0.076	(0.867)	0.063	0.014
68	5.67	0.27	0.076	(0.863)	0.063	0.014
69	5.75	0.27	0.076	(0.859)	0.063	0.014
70	5.83	0.27	0.076	(0.856)	0.063	0.014
71	5.92	0.27	0.076	(0.852)	0.063	0.014
72	6.00	0.27	0.076	(0.848)	0.063	0.014
73	6.08	0.30	0.086	(0.844)	0.071	0.015
74	6.17	0.30	0.086	(0.841)	0.071	0.015
75	6.25	0.30	0.086	(0.837)	0.071	0.015
76	6.33	0.30	0.086	(0.833)	0.071	0.015
77	6.42	0.30	0.086	(0.829)	0.071	0.015
78	6.50	0.30	0.086	(0.826)	0.071	0.015
79	6.58	0.33	0.096	(0.822)	0.078	0.017
80	6.67	0.33	0.096	(0.818)	0.078	0.017
81	6.75	0.33	0.096	(0.814)	0.078	0.017
82	6.83	0.33	0.096	(0.811)	0.078	0.017
83	6.92	0.33	0.096	(0.807)	0.078	0.017
84	7.00	0.33	0.096	(0.803)	0.078	0.017
85	7.08	0.33	0.096	(0.800)	0.078	0.017

86	7.17	0.33	0.096	(0.796)	0.078	0.017
87	7.25	0.33	0.096	(0.793)	0.078	0.017
88	7.33	0.37	0.105	(0.789)	0.086	0.019
89	7.42	0.37	0.105	(0.785)	0.086	0.019
90	7.50	0.37	0.105	(0.782)	0.086	0.019
91	7.58	0.40	0.115	(0.778)	0.094	0.021
92	7.67	0.40	0.115	(0.775)	0.094	0.021
93	7.75	0.40	0.115	(0.771)	0.094	0.021
94	7.83	0.43	0.124	(0.767)	0.102	0.022
95	7.92	0.43	0.124	(0.764)	0.102	0.022
96	8.00	0.43	0.124	(0.760)	0.102	0.022
97	8.08	0.50	0.143	(0.757)	0.118	0.026
98	8.17	0.50	0.143	(0.753)	0.118	0.026
99	8.25	0.50	0.143	(0.750)	0.118	0.026
100	8.33	0.50	0.143	(0.746)	0.118	0.026
101	8.42	0.50	0.143	(0.743)	0.118	0.026
102	8.50	0.50	0.143	(0.739)	0.118	0.026
103	8.58	0.53	0.153	(0.736)	0.125	0.028
104	8.67	0.53	0.153	(0.732)	0.125	0.028
105	8.75	0.53	0.153	(0.729)	0.125	0.028
106	8.83	0.57	0.163	(0.725)	0.133	0.029
107	8.92	0.57	0.163	(0.722)	0.133	0.029
108	9.00	0.57	0.163	(0.719)	0.133	0.029
109	9.08	0.63	0.182	(0.715)	0.149	0.033
110	9.17	0.63	0.182	(0.712)	0.149	0.033
111	9.25	0.63	0.182	(0.708)	0.149	0.033
112	9.33	0.67	0.191	(0.705)	0.157	0.034
113	9.42	0.67	0.191	(0.702)	0.157	0.034
114	9.50	0.67	0.191	(0.698)	0.157	0.034
115	9.58	0.70	0.201	(0.695)	0.165	0.036
116	9.67	0.70	0.201	(0.692)	0.165	0.036
117	9.75	0.70	0.201	(0.688)	0.165	0.036
118	9.83	0.73	0.210	(0.685)	0.172	0.038
119	9.92	0.73	0.210	(0.682)	0.172	0.038
120	10.00	0.73	0.210	(0.678)	0.172	0.038
121	10.08	0.50	0.143	(0.675)	0.118	0.026
122	10.17	0.50	0.143	(0.672)	0.118	0.026
123	10.25	0.50	0.143	(0.669)	0.118	0.026
124	10.33	0.50	0.143	(0.665)	0.118	0.026
125	10.42	0.50	0.143	(0.662)	0.118	0.026
126	10.50	0.50	0.143	(0.659)	0.118	0.026
127	10.58	0.67	0.191	(0.656)	0.157	0.034
128	10.67	0.67	0.191	(0.652)	0.157	0.034
129	10.75	0.67	0.191	(0.649)	0.157	0.034
130	10.83	0.67	0.191	(0.646)	0.157	0.034
131	10.92	0.67	0.191	(0.643)	0.157	0.034
132	11.00	0.67	0.191	(0.640)	0.157	0.034
133	11.08	0.63	0.182	(0.637)	0.149	0.033

134	11.17	0.63	0.182	(0.634)	0.149	0.033
135	11.25	0.63	0.182	(0.630)	0.149	0.033
136	11.33	0.63	0.182	(0.627)	0.149	0.033
137	11.42	0.63	0.182	(0.624)	0.149	0.033
138	11.50	0.63	0.182	(0.621)	0.149	0.033
139	11.58	0.57	0.163	(0.618)	0.133	0.029
140	11.67	0.57	0.163	(0.615)	0.133	0.029
141	11.75	0.57	0.163	(0.612)	0.133	0.029
142	11.83	0.60	0.172	(0.609)	0.141	0.031
143	11.92	0.60	0.172	(0.606)	0.141	0.031
144	12.00	0.60	0.172	(0.603)	0.141	0.031
145	12.08	0.83	0.239	(0.600)	0.196	0.043
146	12.17	0.83	0.239	(0.597)	0.196	0.043
147	12.25	0.83	0.239	(0.594)	0.196	0.043
148	12.33	0.87	0.249	(0.591)	0.204	0.045
149	12.42	0.87	0.249	(0.588)	0.204	0.045
150	12.50	0.87	0.249	(0.585)	0.204	0.045
151	12.58	0.93	0.268	(0.582)	0.219	0.048
152	12.67	0.93	0.268	(0.579)	0.219	0.048
153	12.75	0.93	0.268	(0.576)	0.219	0.048
154	12.83	0.97	0.277	(0.573)	0.227	0.050
155	12.92	0.97	0.277	(0.570)	0.227	0.050
156	13.00	0.97	0.277	(0.567)	0.227	0.050
157	13.08	1.13	0.325	(0.564)	0.267	0.059
158	13.17	1.13	0.325	(0.562)	0.267	0.059
159	13.25	1.13	0.325	(0.559)	0.267	0.059
160	13.33	1.13	0.325	(0.556)	0.267	0.059
161	13.42	1.13	0.325	(0.553)	0.267	0.059
162	13.50	1.13	0.325	(0.550)	0.267	0.059
163	13.58	0.77	0.220	(0.547)	0.180	0.040
164	13.67	0.77	0.220	(0.545)	0.180	0.040
165	13.75	0.77	0.220	(0.542)	0.180	0.040
166	13.83	0.77	0.220	(0.539)	0.180	0.040
167	13.92	0.77	0.220	(0.536)	0.180	0.040
168	14.00	0.77	0.220	(0.534)	0.180	0.040
169	14.08	0.90	0.258	(0.531)	0.212	0.046
170	14.17	0.90	0.258	(0.528)	0.212	0.046
171	14.25	0.90	0.258	(0.526)	0.212	0.046
172	14.33	0.87	0.249	(0.523)	0.204	0.045
173	14.42	0.87	0.249	(0.520)	0.204	0.045
174	14.50	0.87	0.249	(0.517)	0.204	0.045
175	14.58	0.87	0.249	(0.515)	0.204	0.045
176	14.67	0.87	0.249	(0.512)	0.204	0.045
177	14.75	0.87	0.249	(0.510)	0.204	0.045
178	14.83	0.83	0.239	(0.507)	0.196	0.043
179	14.92	0.83	0.239	(0.504)	0.196	0.043
180	15.00	0.83	0.239	(0.502)	0.196	0.043
181	15.08	0.80	0.229	(0.499)	0.188	0.041

182	15.17	0.80	0.229	(0.497)	0.188	0.041
183	15.25	0.80	0.229	(0.494)	0.188	0.041
184	15.33	0.77	0.220	(0.492)	0.180	0.040
185	15.42	0.77	0.220	(0.489)	0.180	0.040
186	15.50	0.77	0.220	(0.487)	0.180	0.040
187	15.58	0.63	0.182	(0.484)	0.149	0.033
188	15.67	0.63	0.182	(0.482)	0.149	0.033
189	15.75	0.63	0.182	(0.479)	0.149	0.033
190	15.83	0.63	0.182	(0.477)	0.149	0.033
191	15.92	0.63	0.182	(0.474)	0.149	0.033
192	16.00	0.63	0.182	(0.472)	0.149	0.033
193	16.08	0.13	0.038	(0.469)	0.031	0.007
194	16.17	0.13	0.038	(0.467)	0.031	0.007
195	16.25	0.13	0.038	(0.465)	0.031	0.007
196	16.33	0.13	0.038	(0.462)	0.031	0.007
197	16.42	0.13	0.038	(0.460)	0.031	0.007
198	16.50	0.13	0.038	(0.458)	0.031	0.007
199	16.58	0.10	0.029	(0.455)	0.024	0.005
200	16.67	0.10	0.029	(0.453)	0.024	0.005
201	16.75	0.10	0.029	(0.451)	0.024	0.005
202	16.83	0.10	0.029	(0.448)	0.024	0.005
203	16.92	0.10	0.029	(0.446)	0.024	0.005
204	17.00	0.10	0.029	(0.444)	0.024	0.005
205	17.08	0.17	0.048	(0.442)	0.039	0.009
206	17.17	0.17	0.048	(0.439)	0.039	0.009
207	17.25	0.17	0.048	(0.437)	0.039	0.009
208	17.33	0.17	0.048	(0.435)	0.039	0.009
209	17.42	0.17	0.048	(0.433)	0.039	0.009
210	17.50	0.17	0.048	(0.431)	0.039	0.009
211	17.58	0.17	0.048	(0.428)	0.039	0.009
212	17.67	0.17	0.048	(0.426)	0.039	0.009
213	17.75	0.17	0.048	(0.424)	0.039	0.009
214	17.83	0.13	0.038	(0.422)	0.031	0.007
215	17.92	0.13	0.038	(0.420)	0.031	0.007
216	18.00	0.13	0.038	(0.418)	0.031	0.007
217	18.08	0.13	0.038	(0.416)	0.031	0.007
218	18.17	0.13	0.038	(0.414)	0.031	0.007
219	18.25	0.13	0.038	(0.412)	0.031	0.007
220	18.33	0.13	0.038	(0.410)	0.031	0.007
221	18.42	0.13	0.038	(0.408)	0.031	0.007
222	18.50	0.13	0.038	(0.406)	0.031	0.007
223	18.58	0.10	0.029	(0.404)	0.024	0.005
224	18.67	0.10	0.029	(0.402)	0.024	0.005
225	18.75	0.10	0.029	(0.400)	0.024	0.005
226	18.83	0.07	0.019	(0.398)	0.016	0.003
227	18.92	0.07	0.019	(0.396)	0.016	0.003
228	19.00	0.07	0.019	(0.394)	0.016	0.003
229	19.08	0.10	0.029	(0.392)	0.024	0.005

230	19.17	0.10	0.029	(0.391)	0.024	0.005
231	19.25	0.10	0.029	(0.389)	0.024	0.005
232	19.33	0.13	0.038	(0.387)	0.031	0.007
233	19.42	0.13	0.038	(0.385)	0.031	0.007
234	19.50	0.13	0.038	(0.383)	0.031	0.007
235	19.58	0.10	0.029	(0.382)	0.024	0.005
236	19.67	0.10	0.029	(0.380)	0.024	0.005
237	19.75	0.10	0.029	(0.378)	0.024	0.005
238	19.83	0.07	0.019	(0.376)	0.016	0.003
239	19.92	0.07	0.019	(0.375)	0.016	0.003
240	20.00	0.07	0.019	(0.373)	0.016	0.003
241	20.08	0.10	0.029	(0.371)	0.024	0.005
242	20.17	0.10	0.029	(0.370)	0.024	0.005
243	20.25	0.10	0.029	(0.368)	0.024	0.005
244	20.33	0.10	0.029	(0.367)	0.024	0.005
245	20.42	0.10	0.029	(0.365)	0.024	0.005
246	20.50	0.10	0.029	(0.363)	0.024	0.005
247	20.58	0.10	0.029	(0.362)	0.024	0.005
248	20.67	0.10	0.029	(0.360)	0.024	0.005
249	20.75	0.10	0.029	(0.359)	0.024	0.005
250	20.83	0.07	0.019	(0.357)	0.016	0.003
251	20.92	0.07	0.019	(0.356)	0.016	0.003
252	21.00	0.07	0.019	(0.355)	0.016	0.003
253	21.08	0.10	0.029	(0.353)	0.024	0.005
254	21.17	0.10	0.029	(0.352)	0.024	0.005
255	21.25	0.10	0.029	(0.350)	0.024	0.005
256	21.33	0.07	0.019	(0.349)	0.016	0.003
257	21.42	0.07	0.019	(0.348)	0.016	0.003
258	21.50	0.07	0.019	(0.346)	0.016	0.003
259	21.58	0.10	0.029	(0.345)	0.024	0.005
260	21.67	0.10	0.029	(0.344)	0.024	0.005
261	21.75	0.10	0.029	(0.343)	0.024	0.005
262	21.83	0.07	0.019	(0.342)	0.016	0.003
263	21.92	0.07	0.019	(0.340)	0.016	0.003
264	22.00	0.07	0.019	(0.339)	0.016	0.003
265	22.08	0.10	0.029	(0.338)	0.024	0.005
266	22.17	0.10	0.029	(0.337)	0.024	0.005
267	22.25	0.10	0.029	(0.336)	0.024	0.005
268	22.33	0.07	0.019	(0.335)	0.016	0.003
269	22.42	0.07	0.019	(0.334)	0.016	0.003
270	22.50	0.07	0.019	(0.333)	0.016	0.003
271	22.58	0.07	0.019	(0.332)	0.016	0.003
272	22.67	0.07	0.019	(0.331)	0.016	0.003
273	22.75	0.07	0.019	(0.330)	0.016	0.003
274	22.83	0.07	0.019	(0.329)	0.016	0.003
275	22.92	0.07	0.019	(0.328)	0.016	0.003
276	23.00	0.07	0.019	(0.328)	0.016	0.003
277	23.08	0.07	0.019	(0.327)	0.016	0.003

278	23.17	0.07	0.019	(0.326)	0.016	0.003
279	23.25	0.07	0.019	(0.325)	0.016	0.003
280	23.33	0.07	0.019	(0.325)	0.016	0.003
281	23.42	0.07	0.019	(0.324)	0.016	0.003
282	23.50	0.07	0.019	(0.324)	0.016	0.003
283	23.58	0.07	0.019	(0.323)	0.016	0.003
284	23.67	0.07	0.019	(0.323)	0.016	0.003
285	23.75	0.07	0.019	(0.322)	0.016	0.003
286	23.83	0.07	0.019	(0.322)	0.016	0.003
287	23.92	0.07	0.019	(0.321)	0.016	0.003
288	24.00	0.07	0.019	(0.321)	0.016	0.003

(Loss Rate Not Used)

Sum = 100.0 Sum = 5.2

Flood volume = Effective rainfall 0.43(In)
times area 7.5(Ac.)/[(In)/(Ft.)] = 0.3(Ac.Ft)
Total soil loss = 1.96(In)
Total soil loss = 1.225(Ac.Ft)
Total rainfall = 2.39(In)
Flood volume = 11712.0 Cubic Feet
Total soil loss = 53354.8 Cubic Feet

Peak flow rate of this hydrograph = 0.442(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	0.0001	0.01	Q	|	|	|	|
0+10	0.0002	0.02	Q	|	|	|	|
0+15	0.0004	0.02	Q	|	|	|	|
0+20	0.0005	0.03	Q	|	|	|	|
0+25	0.0008	0.04	Q	|	|	|	|
0+30	0.0011	0.04	Q	|	|	|	|
0+35	0.0013	0.04	Q	|	|	|	|
0+40	0.0016	0.04	Q	|	|	|	|
0+45	0.0019	0.04	Q	|	|	|	|
0+50	0.0021	0.04	Q	|	|	|	|
0+55	0.0025	0.05	Q	|	|	|	|
1+ 0	0.0028	0.05	Q	|	|	|	|
1+ 5	0.0032	0.05	Q	|	|	|	|
1+10	0.0034	0.04	Q	|	|	|	|
1+15	0.0037	0.04	Q	|	|	|	|
1+20	0.0040	0.04	Q	|	|	|	|

```
1+25        0.0043      0.04  Q          |          |          |          |
1+30        0.0045      0.04  Q          |          |          |          |
1+35        0.0048      0.04  Q          |          |          |          |
1+40        0.0051      0.04  Q          |          |          |          |
1+45        0.0053      0.04  Q          |          |          |          |
1+50        0.0056      0.04  Q          |          |          |          |
1+55        0.0060      0.05  Q          |          |          |          |
2+ 0        0.0063      0.05  Q          |          |          |          |
2+ 5        0.0067      0.05  Q          |          |          |          |
2+10        0.0070      0.05  QV         |          |          |          |
2+15        0.0074      0.05  QV         |          |          |          |
2+20        0.0078      0.05  QV         |          |          |          |
2+25        0.0081      0.05  QV         |          |          |          |
2+30        0.0085      0.05  QV         |          |          |          |
2+35        0.0089      0.06  QV         |          |          |          |
2+40        0.0093      0.06  QV         |          |          |          |
2+45        0.0097      0.06  QV         |          |          |          |
2+50        0.0102      0.06  QV         |          |          |          |
2+55        0.0106      0.06  QV         |          |          |          |
3+ 0        0.0111      0.07  QV         |          |          |          |
3+ 5        0.0115      0.07  QV         |          |          |          |
3+10        0.0120      0.07  QV         |          |          |          |
3+15        0.0124      0.07  QV         |          |          |          |
3+20        0.0129      0.07  QV         |          |          |          |
3+25        0.0133      0.07  QV         |          |          |          |
3+30        0.0137      0.07  Q V        |          |          |          |
3+35        0.0142      0.07  Q V        |          |          |          |
3+40        0.0146      0.07  Q V        |          |          |          |
3+45        0.0151      0.07  Q V        |          |          |          |
3+50        0.0156      0.07  Q V        |          |          |          |
3+55        0.0161      0.08  Q V        |          |          |          |
4+ 0        0.0166      0.08  Q V        |          |          |          |
4+ 5        0.0171      0.08  Q V        |          |          |          |
4+10        0.0177      0.08  Q V        |          |          |          |
4+15        0.0182      0.08  Q V        |          |          |          |
4+20        0.0188      0.08  Q V        |          |          |          |
4+25        0.0194      0.09  Q V        |          |          |          |
4+30        0.0200      0.09  Q V        |          |          |          |
4+35        0.0206      0.09  Q  V       |          |          |          |
4+40        0.0213      0.09  Q  V       |          |          |          |
4+45        0.0219      0.09  Q  V       |          |          |          |
4+50        0.0225      0.09  Q  V       |          |          |          |
4+55        0.0232      0.10  Q  V       |          |          |          |
5+ 0        0.0239      0.10  Q  V       |          |          |          |
5+ 5        0.0246      0.10  Q  V       |          |          |          |
5+10        0.0252      0.08  Q  V       |          |          |          |
5+15        0.0257      0.08  Q  V       |          |          |          |
5+20        0.0263      0.08  Q  V       |          |          |          |
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5+25       0.0269      0.09  Q   V     |          |          |          |
5+30       0.0275      0.09  Q   V     |          |          |          |
5+35       0.0282      0.09  Q   V     |          |          |          |
5+40       0.0289      0.10  Q   V     |          |          |          |
5+45       0.0296      0.10  Q   V     |          |          |          |
5+50       0.0303      0.10  Q   V     |          |          |          |
5+55       0.0310      0.10  Q   V     |          |          |          |
6+ 0       0.0317      0.10  Q   V     |          |          |          |
6+ 5       0.0325      0.11  Q   V     |          |          |          |
6+10       0.0333      0.11  Q   V     |          |          |          |
6+15       0.0341      0.12  Q    V    |          |          |          |
6+20       0.0349      0.12  Q    V    |          |          |          |
6+25       0.0357      0.12  Q    V    |          |          |          |
6+30       0.0365      0.12  Q    V    |          |          |          |
6+35       0.0373      0.12  Q    V    |          |          |          |
6+40       0.0382      0.13  Q    V    |          |          |          |
6+45       0.0391      0.13  Q    V    |          |          |          |
6+50       0.0400      0.13  Q    V    |          |          |          |
6+55       0.0409      0.13  Q     V   |          |          |          |
7+ 0       0.0417      0.13  Q     V   |          |          |          |
7+ 5       0.0426      0.13  Q     V   |          |          |          |
7+10       0.0435      0.13  Q     V   |          |          |          |
7+15       0.0444      0.13  Q     V   |          |          |          |
7+20       0.0454      0.13  Q     V   |          |          |          |
7+25       0.0463      0.14  Q     V   |          |          |          |
7+30       0.0473      0.14  Q      V  |          |          |          |
7+35       0.0483      0.15  Q      V  |          |          |          |
7+40       0.0494      0.15  Q      V  |          |          |          |
7+45       0.0504      0.15  Q      V  |          |          |          |
7+50       0.0515      0.16  Q      V  |          |          |          |
7+55       0.0527      0.17  Q      V  |          |          |          |
8+ 0       0.0538      0.17  Q       V |          |          |          |
8+ 5       0.0550      0.18  Q       V |          |          |          |
8+10       0.0563      0.19  Q       V |          |          |          |
8+15       0.0577      0.19  Q       V |          |          |          |
8+20       0.0590      0.19  Q       V |          |          |          |
8+25       0.0603      0.19  Q       V |          |          |          |
8+30       0.0617      0.20  Q        V|          |          |          |
8+35       0.0631      0.20  Q        V|          |          |          |
8+40       0.0645      0.21  Q        V|          |          |          |
8+45       0.0659      0.21  Q        V|          |          |          |
8+50       0.0673      0.21  Q         V          |          |          |
8+55       0.0688      0.22  Q         V          |          |          |
9+ 0       0.0704      0.22  Q         V          |          |          |
9+ 5       0.0719      0.23  Q         V          |          |          |
9+10       0.0736      0.24  Q         V          |          |          |
9+15       0.0753      0.24  Q         |V         |          |          |
9+20       0.0770      0.25  Q         |V         |          |          |
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 9+25       0.0788      0.26  |Q         |V         |          |          |
 9+30       0.0805      0.26  |Q         |V         |          |          |
 9+35       0.0824      0.26  |Q         | V        |          |          |
 9+40       0.0842      0.27  |Q         | V        |          |          |
 9+45       0.0861      0.27  |Q         | V        |          |          |
 9+50       0.0880      0.28  |Q         |  V       |          |          |
 9+55       0.0899      0.28  |Q         |  V       |          |          |
10+ 0       0.0919      0.28  |Q         |  V       |          |          |
10+ 5       0.0937      0.26  |Q         |  V       |          |          |
10+10       0.0952      0.22  Q          |   V      |          |          |
10+15       0.0966      0.20  Q          |   V      |          |          |
10+20       0.0980      0.20  Q          |   V      |          |          |
10+25       0.0993      0.20  Q          |   V      |          |          |
10+30       0.1007      0.20  Q          |   V      |          |          |
10+35       0.1021      0.21  Q          |    V     |          |          |
10+40       0.1038      0.25  Q          |    V     |          |          |
10+45       0.1056      0.25  |Q         |    V     |          |          |
10+50       0.1073      0.26  |Q         |    V     |          |          |
10+55       0.1091      0.26  |Q         |     V    |          |          |
11+ 0       0.1109      0.26  |Q         |     V    |          |          |
11+ 5       0.1127      0.26  |Q         |     V    |          |          |
11+10       0.1144      0.25  |Q         |      V   |          |          |
11+15       0.1161      0.25  Q          |      V   |          |          |
11+20       0.1178      0.25  Q          |      V   |          |          |
11+25       0.1195      0.25  Q          |      V   |          |          |
11+30       0.1212      0.25  Q          |       V  |          |          |
11+35       0.1229      0.24  Q          |       V  |          |          |
11+40       0.1245      0.23  Q          |       V  |          |          |
11+45       0.1260      0.22  Q          |       V  |          |          |
11+50       0.1276      0.23  Q          |       V  |          |          |
11+55       0.1292      0.23  Q          |        V|          |          |
12+ 0       0.1308      0.23  Q          |        V|          |          |
12+ 5       0.1325      0.26  |Q         |        V|          |          |
12+10       0.1346      0.30  |Q         |         V          |          |
12+15       0.1368      0.32  |Q         |         V          |          |
12+20       0.1390      0.32  |Q         |         V          |          |
12+25       0.1413      0.33  |Q         |         |V         |          |
12+30       0.1437      0.34  |Q         |         |V         |          |
12+35       0.1460      0.35  |Q         |         |V         |          |
12+40       0.1485      0.36  |Q         |         | V        |          |
12+45       0.1510      0.36  |Q         |         | V        |          |
12+50       0.1535      0.37  |Q         |         | V        |          |
12+55       0.1561      0.37  |Q         |         |  V       |          |
13+ 0       0.1587      0.38  |Q         |         |  V       |          |
13+ 5       0.1614      0.40  |Q         |         |   V      |          |
13+10       0.1644      0.43  |Q         |         |   V      |          |
13+15       0.1674      0.44  |Q         |         |   V      |          |
13+20       0.1704      0.44  |Q         |         |    V     |          |
```

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13+25       0.1734      0.44  |Q         |          |    V    |          |
13+30       0.1765      0.44  |Q         |          |     V   |          |
13+35       0.1792      0.40  |Q         |          |     V   |          |
13+40       0.1815      0.33  |Q         |          |      V  |          |
13+45       0.1837      0.31  |Q         |          |      V  |          |
13+50       0.1858      0.31  |Q         |          |      V  |          |
13+55       0.1879      0.30  |Q         |          |      V  |          |
14+ 0       0.1899      0.30  |Q         |          |       V |          |
14+ 5       0.1921      0.31  |Q         |          |       V |          |
14+10       0.1944      0.34  |Q         |          |       V |          |
14+15       0.1968      0.35  |Q         |          |        V|          |
14+20       0.1992      0.34  |Q         |          |        V|          |
14+25       0.2015      0.34  |Q         |          |        V|          |
14+30       0.2039      0.34  |Q         |          |         V          |
14+35       0.2062      0.34  |Q         |          |         V          |
14+40       0.2085      0.34  |Q         |          |         |V         |
14+45       0.2109      0.34  |Q         |          |         |V         |
14+50       0.2132      0.33  |Q         |          |         |V         |
14+55       0.2154      0.33  |Q         |          |         | V        |
15+ 0       0.2177      0.33  |Q         |          |         | V        |
15+ 5       0.2199      0.32  |Q         |          |         | V        |
15+10       0.2221      0.32  |Q         |          |         |  V       |
15+15       0.2242      0.31  |Q         |          |         |  V       |
15+20       0.2264      0.31  |Q         |          |         |  V       |
15+25       0.2285      0.30  |Q         |          |         |  V       |
15+30       0.2305      0.30  |Q         |          |         |   V      |
15+35       0.2325      0.28  |Q         |          |         |   V      |
15+40       0.2343      0.26  |Q         |          |         |   V      |
15+45       0.2360      0.25  |Q         |          |         |    V     |
15+50       0.2377      0.25  Q          |          |         |    V     |
15+55       0.2395      0.25  Q          |          |         |    V     |
16+ 0       0.2412      0.25  Q          |          |         |    V     |
16+ 5       0.2425      0.19  Q          |          |         |     V    |
16+10       0.2431      0.10  Q          |          |         |     V    |
16+15       0.2436      0.07  Q          |          |         |     V    |
16+20       0.2441      0.06  Q          |          |         |     V    |
16+25       0.2445      0.06  Q          |          |         |     V    |
16+30       0.2448      0.05  Q          |          |         |     V    |
16+35       0.2451      0.05  Q          |          |         |     V    |
16+40       0.2454      0.04  Q          |          |         |     V    |
16+45       0.2457      0.04  Q          |          |         |     V    |
16+50       0.2460      0.04  Q          |          |         |     V    |
16+55       0.2463      0.04  Q          |          |         |     V    |
17+ 0       0.2465      0.04  Q          |          |         |     V    |
17+ 5       0.2468      0.05  Q          |          |         |     V    |
17+10       0.2473      0.06  Q          |          |         |     V    |
17+15       0.2477      0.06  Q          |          |         |     V    |
17+20       0.2481      0.06  Q          |          |         |     V    |
```

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17+25       0.2486      0.06  Q          |          |          |      V   |
17+30       0.2490      0.07  Q          |          |          |       V  |
17+35       0.2495      0.07  Q          |          |          |       V  |
17+40       0.2499      0.07  Q          |          |          |       V  |
17+45       0.2504      0.07  Q          |          |          |       V  |
17+50       0.2508      0.06  Q          |          |          |       V  |
17+55       0.2512      0.06  Q          |          |          |       V  |
18+ 0       0.2515      0.05  Q          |          |          |       V  |
18+ 5       0.2519      0.05  Q          |          |          |       V  |
18+10       0.2522      0.05  Q          |          |          |       V  |
18+15       0.2526      0.05  Q          |          |          |       V  |
18+20       0.2530      0.05  Q          |          |          |       V  |
18+25       0.2533      0.05  Q          |          |          |       V  |
18+30       0.2537      0.05  Q          |          |          |       V  |
18+35       0.2540      0.05  Q          |          |          |       V  |
18+40       0.2543      0.04  Q          |          |          |       V  |
18+45       0.2546      0.04  Q          |          |          |       V  |
18+50       0.2548      0.04  Q          |          |          |       V  |
18+55       0.2550      0.03  Q          |          |          |       V  |
19+ 0       0.2552      0.03  Q          |          |          |       V  |
19+ 5       0.2554      0.03  Q          |          |          |        V |
19+10       0.2557      0.04  Q          |          |          |        V |
19+15       0.2559      0.04  Q          |          |          |        V |
19+20       0.2562      0.04  Q          |          |          |        V |
19+25       0.2566      0.05  Q          |          |          |        V |
19+30       0.2569      0.05  Q          |          |          |        V |
19+35       0.2572      0.05  Q          |          |          |        V |
19+40       0.2575      0.04  Q          |          |          |        V |
19+45       0.2578      0.04  Q          |          |          |        V |
19+50       0.2581      0.04  Q          |          |          |        V |
19+55       0.2583      0.03  Q          |          |          |        V |
20+ 0       0.2584      0.03  Q          |          |          |        V |
20+ 5       0.2587      0.03  Q          |          |          |        V |
20+10       0.2589      0.04  Q          |          |          |        V |
20+15       0.2592      0.04  Q          |          |          |        V |
20+20       0.2594      0.04  Q          |          |          |        V |
20+25       0.2597      0.04  Q          |          |          |        V |
20+30       0.2600      0.04  Q          |          |          |        V |
20+35       0.2602      0.04  Q          |          |          |        V |
20+40       0.2605      0.04  Q          |          |          |        V |
20+45       0.2608      0.04  Q          |          |          |        V |
20+50       0.2610      0.04  Q          |          |          |        V |
20+55       0.2612      0.03  Q          |          |          |        V |
21+ 0       0.2614      0.03  Q          |          |          |        V |
21+ 5       0.2616      0.03  Q          |          |          |        V |
21+10       0.2619      0.04  Q          |          |          |        V |
21+15       0.2621      0.04  Q          |          |          |        V |
21+20       0.2624      0.03  Q          |          |          |         V|
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   21+25       0.2626      0.03  Q          |          |          |         V|
   21+30       0.2627      0.03  Q          |          |          |         V|
   21+35       0.2630      0.03  Q          |          |          |         V|
   21+40       0.2632      0.04  Q          |          |          |         V|
   21+45       0.2635      0.04  Q          |          |          |         V|
   21+50       0.2637      0.03  Q          |          |          |         V|
   21+55       0.2639      0.03  Q          |          |          |         V|
   22+ 0       0.2641      0.03  Q          |          |          |         V|
   22+ 5       0.2643      0.03  Q          |          |          |         V|
   22+10       0.2646      0.04  Q          |          |          |         V|
   22+15       0.2648      0.04  Q          |          |          |         V|
   22+20       0.2651      0.03  Q          |          |          |         V|
   22+25       0.2652      0.03  Q          |          |          |         V|
   22+30       0.2654      0.03  Q          |          |          |         V|
   22+35       0.2656      0.03  Q          |          |          |         V|
   22+40       0.2658      0.03  Q          |          |          |         V|
   22+45       0.2660      0.03  Q          |          |          |         V|
   22+50       0.2662      0.03  Q          |          |          |         V|
   22+55       0.2663      0.03  Q          |          |          |         V|
   23+ 0       0.2665      0.03  Q          |          |          |         V|
   23+ 5       0.2667      0.03  Q          |          |          |         V|
   23+10       0.2669      0.03  Q          |          |          |         V|
   23+15       0.2671      0.03  Q          |          |          |         V|
   23+20       0.2672      0.03  Q          |          |          |         V|
   23+25       0.2674      0.03  Q          |          |          |         V|
   23+30       0.2676      0.03  Q          |          |          |         V|
   23+35       0.2678      0.03  Q          |          |          |         V|
   23+40       0.2680      0.03  Q          |          |          |         V|
   23+45       0.2681      0.03  Q          |          |          |         V|
   23+50       0.2683      0.03  Q          |          |          |         V|
   23+55       0.2685      0.03  Q          |          |          |         V|
   24+ 0       0.2687      0.03  Q          |          |          |         V|
   24+ 5       0.2688      0.02  Q          |          |          |         V|
   24+10       0.2688      0.01  Q          |          |          |         V|
   24+15       0.2689      0.00  Q          |          |          |         V|
   24+20       0.2689      0.00  Q          |          |          |         V|
   24+25       0.2689      0.00  Q          |          |          |          V
----------------------------------------------------------------------
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lakeshorep242

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 04/10/17 File: lakeshorep242.out

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

Program License Serial Number 6387

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

English Units used in output format

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unit hydrograph analysis for the 2 year 24 hour storm event
proposed site conditions
modified per redlined comments

Drainage Area = 7.50(Ac.) = 0.012 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment = 7.50(Ac.) = 0.012 Sq. Mi.
Length along longest watercourse = 1150.00(Ft.)
Length along longest watercourse measured to centroid = 475.21(Ft.)
Length along longest watercourse = 0.218 Mi.
Length along longest watercourse measured to centroid = 0.090 Mi.
Difference in elevation = 9.50(Ft.)
Slope along watercourse = 43.6174 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time = 0.039 Hr.
Lag time = 2.37 Min.
25% of lag time = 0.59 Min.
40% of lag time = 0.95 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]
7.50	2.39	17.93

100 YEAR Area rainfall data:

Area(Ac.)[1]	Rainfall(In)[2]	Weighting[1*2]
7.50	6.39	47.92

STORM EVENT (YEAR) = 2.00
Area Averaged 2-Year Rainfall = 2.390(In)
Area Averaged 100-Year Rainfall = 6.390(In)

Point rain (area averaged) = 2.390(In)
Areal adjustment factor = 100.00 %
Adjusted average point rain = 2.390(In)

Sub-Area Data:

Area(Ac.)	Runoff Index	Impervious %
7.500	56.00	0.700

Total Area Entered = 7.50(Ac.)

RI AMC2	RI AMC-1	Infil. Rate (In/Hr)	Impervious (Dec.%)	Adj. Infil. Rate (In/Hr)	Area% (Dec.)	F (In/Hr)
56.0	36.0	0.706	0.700	0.261	1.000	0.261
					Sum (F) =	0.261

Area averaged mean soil loss (F) (In/Hr) = 0.261
Minimum soil loss rate ((In/Hr)) = 0.131
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.260

U n i t H y d r o g r a p h
VALLEY S-Curve

Unit Hydrograph Data

Unit time period (hrs)		Time % of lag	Distribution Graph %	Unit Hydrograph (CFS)
1	0.083	211.335	45.293	3.424
2	0.167	422.670	42.584	3.219
3	0.250	634.005	8.351	0.631
4	0.333	845.340	3.771	0.285

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Sum = 100.000 Sum= 7.559

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	0.019	(0.463)	0.005	0.014
2	0.17	0.07	0.019	(0.461)	0.005	0.014
3	0.25	0.07	0.019	(0.459)	0.005	0.014
4	0.33	0.10	0.029	(0.458)	0.007	0.021
5	0.42	0.10	0.029	(0.456)	0.007	0.021
6	0.50	0.10	0.029	(0.454)	0.007	0.021
7	0.58	0.10	0.029	(0.452)	0.007	0.021
8	0.67	0.10	0.029	(0.451)	0.007	0.021
9	0.75	0.10	0.029	(0.449)	0.007	0.021
10	0.83	0.13	0.038	(0.447)	0.010	0.028
11	0.92	0.13	0.038	(0.445)	0.010	0.028
12	1.00	0.13	0.038	(0.444)	0.010	0.028
13	1.08	0.10	0.029	(0.442)	0.007	0.021
14	1.17	0.10	0.029	(0.440)	0.007	0.021
15	1.25	0.10	0.029	(0.438)	0.007	0.021
16	1.33	0.10	0.029	(0.437)	0.007	0.021
17	1.42	0.10	0.029	(0.435)	0.007	0.021
18	1.50	0.10	0.029	(0.433)	0.007	0.021
19	1.58	0.10	0.029	(0.431)	0.007	0.021
20	1.67	0.10	0.029	(0.430)	0.007	0.021
21	1.75	0.10	0.029	(0.428)	0.007	0.021
22	1.83	0.13	0.038	(0.426)	0.010	0.028
23	1.92	0.13	0.038	(0.424)	0.010	0.028
24	2.00	0.13	0.038	(0.423)	0.010	0.028
25	2.08	0.13	0.038	(0.421)	0.010	0.028
26	2.17	0.13	0.038	(0.419)	0.010	0.028
27	2.25	0.13	0.038	(0.418)	0.010	0.028
28	2.33	0.13	0.038	(0.416)	0.010	0.028
29	2.42	0.13	0.038	(0.414)	0.010	0.028
30	2.50	0.13	0.038	(0.413)	0.010	0.028
31	2.58	0.17	0.048	(0.411)	0.012	0.035
32	2.67	0.17	0.048	(0.409)	0.012	0.035
33	2.75	0.17	0.048	(0.408)	0.012	0.035
34	2.83	0.17	0.048	(0.406)	0.012	0.035
35	2.92	0.17	0.048	(0.404)	0.012	0.035
36	3.00	0.17	0.048	(0.402)	0.012	0.035
37	3.08	0.17	0.048	(0.401)	0.012	0.035
38	3.17	0.17	0.048	(0.399)	0.012	0.035
39	3.25	0.17	0.048	(0.397)	0.012	0.035

40	3.33	0.17	0.048	(0.396)	0.012	0.035
41	3.42	0.17	0.048	(0.394)	0.012	0.035
42	3.50	0.17	0.048	(0.393)	0.012	0.035
43	3.58	0.17	0.048	(0.391)	0.012	0.035
44	3.67	0.17	0.048	(0.389)	0.012	0.035
45	3.75	0.17	0.048	(0.388)	0.012	0.035
46	3.83	0.20	0.057	(0.386)	0.015	0.042
47	3.92	0.20	0.057	(0.384)	0.015	0.042
48	4.00	0.20	0.057	(0.383)	0.015	0.042
49	4.08	0.20	0.057	(0.381)	0.015	0.042
50	4.17	0.20	0.057	(0.379)	0.015	0.042
51	4.25	0.20	0.057	(0.378)	0.015	0.042
52	4.33	0.23	0.067	(0.376)	0.017	0.050
53	4.42	0.23	0.067	(0.375)	0.017	0.050
54	4.50	0.23	0.067	(0.373)	0.017	0.050
55	4.58	0.23	0.067	(0.371)	0.017	0.050
56	4.67	0.23	0.067	(0.370)	0.017	0.050
57	4.75	0.23	0.067	(0.368)	0.017	0.050
58	4.83	0.27	0.076	(0.367)	0.020	0.057
59	4.92	0.27	0.076	(0.365)	0.020	0.057
60	5.00	0.27	0.076	(0.363)	0.020	0.057
61	5.08	0.20	0.057	(0.362)	0.015	0.042
62	5.17	0.20	0.057	(0.360)	0.015	0.042
63	5.25	0.20	0.057	(0.359)	0.015	0.042
64	5.33	0.23	0.067	(0.357)	0.017	0.050
65	5.42	0.23	0.067	(0.356)	0.017	0.050
66	5.50	0.23	0.067	(0.354)	0.017	0.050
67	5.58	0.27	0.076	(0.353)	0.020	0.057
68	5.67	0.27	0.076	(0.351)	0.020	0.057
69	5.75	0.27	0.076	(0.349)	0.020	0.057
70	5.83	0.27	0.076	(0.348)	0.020	0.057
71	5.92	0.27	0.076	(0.346)	0.020	0.057
72	6.00	0.27	0.076	(0.345)	0.020	0.057
73	6.08	0.30	0.086	(0.343)	0.022	0.064
74	6.17	0.30	0.086	(0.342)	0.022	0.064
75	6.25	0.30	0.086	(0.340)	0.022	0.064
76	6.33	0.30	0.086	(0.339)	0.022	0.064
77	6.42	0.30	0.086	(0.337)	0.022	0.064
78	6.50	0.30	0.086	(0.336)	0.022	0.064
79	6.58	0.33	0.096	(0.334)	0.025	0.071
80	6.67	0.33	0.096	(0.333)	0.025	0.071
81	6.75	0.33	0.096	(0.331)	0.025	0.071
82	6.83	0.33	0.096	(0.330)	0.025	0.071
83	6.92	0.33	0.096	(0.328)	0.025	0.071
84	7.00	0.33	0.096	(0.327)	0.025	0.071
85	7.08	0.33	0.096	(0.325)	0.025	0.071
86	7.17	0.33	0.096	(0.324)	0.025	0.071
87	7.25	0.33	0.096	(0.322)	0.025	0.071

88	7.33	0.37	0.105	(0.321)	0.027	0.078
89	7.42	0.37	0.105	(0.319)	0.027	0.078
90	7.50	0.37	0.105	(0.318)	0.027	0.078
91	7.58	0.40	0.115	(0.316)	0.030	0.085
92	7.67	0.40	0.115	(0.315)	0.030	0.085
93	7.75	0.40	0.115	(0.313)	0.030	0.085
94	7.83	0.43	0.124	(0.312)	0.032	0.092
95	7.92	0.43	0.124	(0.311)	0.032	0.092
96	8.00	0.43	0.124	(0.309)	0.032	0.092
97	8.08	0.50	0.143	(0.308)	0.037	0.106
98	8.17	0.50	0.143	(0.306)	0.037	0.106
99	8.25	0.50	0.143	(0.305)	0.037	0.106
100	8.33	0.50	0.143	(0.303)	0.037	0.106
101	8.42	0.50	0.143	(0.302)	0.037	0.106
102	8.50	0.50	0.143	(0.301)	0.037	0.106
103	8.58	0.53	0.153	(0.299)	0.040	0.113
104	8.67	0.53	0.153	(0.298)	0.040	0.113
105	8.75	0.53	0.153	(0.296)	0.040	0.113
106	8.83	0.57	0.163	(0.295)	0.042	0.120
107	8.92	0.57	0.163	(0.294)	0.042	0.120
108	9.00	0.57	0.163	(0.292)	0.042	0.120
109	9.08	0.63	0.182	(0.291)	0.047	0.134
110	9.17	0.63	0.182	(0.289)	0.047	0.134
111	9.25	0.63	0.182	(0.288)	0.047	0.134
112	9.33	0.67	0.191	(0.287)	0.050	0.141
113	9.42	0.67	0.191	(0.285)	0.050	0.141
114	9.50	0.67	0.191	(0.284)	0.050	0.141
115	9.58	0.70	0.201	(0.283)	0.052	0.149
116	9.67	0.70	0.201	(0.281)	0.052	0.149
117	9.75	0.70	0.201	(0.280)	0.052	0.149
118	9.83	0.73	0.210	(0.279)	0.055	0.156
119	9.92	0.73	0.210	(0.277)	0.055	0.156
120	10.00	0.73	0.210	(0.276)	0.055	0.156
121	10.08	0.50	0.143	(0.275)	0.037	0.106
122	10.17	0.50	0.143	(0.273)	0.037	0.106
123	10.25	0.50	0.143	(0.272)	0.037	0.106
124	10.33	0.50	0.143	(0.271)	0.037	0.106
125	10.42	0.50	0.143	(0.269)	0.037	0.106
126	10.50	0.50	0.143	(0.268)	0.037	0.106
127	10.58	0.67	0.191	(0.267)	0.050	0.141
128	10.67	0.67	0.191	(0.265)	0.050	0.141
129	10.75	0.67	0.191	(0.264)	0.050	0.141
130	10.83	0.67	0.191	(0.263)	0.050	0.141
131	10.92	0.67	0.191	(0.261)	0.050	0.141
132	11.00	0.67	0.191	(0.260)	0.050	0.141
133	11.08	0.63	0.182	(0.259)	0.047	0.134
134	11.17	0.63	0.182	(0.258)	0.047	0.134
135	11.25	0.63	0.182	(0.256)	0.047	0.134

136	11.33	0.63	0.182	(0.255)	0.047	0.134
137	11.42	0.63	0.182	(0.254)	0.047	0.134
138	11.50	0.63	0.182	(0.253)	0.047	0.134
139	11.58	0.57	0.163	(0.251)	0.042	0.120
140	11.67	0.57	0.163	(0.250)	0.042	0.120
141	11.75	0.57	0.163	(0.249)	0.042	0.120
142	11.83	0.60	0.172	(0.248)	0.045	0.127
143	11.92	0.60	0.172	(0.246)	0.045	0.127
144	12.00	0.60	0.172	(0.245)	0.045	0.127
145	12.08	0.83	0.239	(0.244)	0.062	0.177
146	12.17	0.83	0.239	(0.243)	0.062	0.177
147	12.25	0.83	0.239	(0.241)	0.062	0.177
148	12.33	0.87	0.249	(0.240)	0.065	0.184
149	12.42	0.87	0.249	(0.239)	0.065	0.184
150	12.50	0.87	0.249	(0.238)	0.065	0.184
151	12.58	0.93	0.268	(0.237)	0.070	0.198
152	12.67	0.93	0.268	(0.235)	0.070	0.198
153	12.75	0.93	0.268	(0.234)	0.070	0.198
154	12.83	0.97	0.277	(0.233)	0.072	0.205
155	12.92	0.97	0.277	(0.232)	0.072	0.205
156	13.00	0.97	0.277	(0.231)	0.072	0.205
157	13.08	1.13	0.325	(0.230)	0.085	0.241
158	13.17	1.13	0.325	(0.228)	0.085	0.241
159	13.25	1.13	0.325	(0.227)	0.085	0.241
160	13.33	1.13	0.325	(0.226)	0.085	0.241
161	13.42	1.13	0.325	(0.225)	0.085	0.241
162	13.50	1.13	0.325	(0.224)	0.085	0.241
163	13.58	0.77	0.220	(0.223)	0.057	0.163
164	13.67	0.77	0.220	(0.221)	0.057	0.163
165	13.75	0.77	0.220	(0.220)	0.057	0.163
166	13.83	0.77	0.220	(0.219)	0.057	0.163
167	13.92	0.77	0.220	(0.218)	0.057	0.163
168	14.00	0.77	0.220	(0.217)	0.057	0.163
169	14.08	0.90	0.258	(0.216)	0.067	0.191
170	14.17	0.90	0.258	(0.215)	0.067	0.191
171	14.25	0.90	0.258	(0.214)	0.067	0.191
172	14.33	0.87	0.249	(0.213)	0.065	0.184
173	14.42	0.87	0.249	(0.211)	0.065	0.184
174	14.50	0.87	0.249	(0.210)	0.065	0.184
175	14.58	0.87	0.249	(0.209)	0.065	0.184
176	14.67	0.87	0.249	(0.208)	0.065	0.184
177	14.75	0.87	0.249	(0.207)	0.065	0.184
178	14.83	0.83	0.239	(0.206)	0.062	0.177
179	14.92	0.83	0.239	(0.205)	0.062	0.177
180	15.00	0.83	0.239	(0.204)	0.062	0.177
181	15.08	0.80	0.229	(0.203)	0.060	0.170
182	15.17	0.80	0.229	(0.202)	0.060	0.170
183	15.25	0.80	0.229	(0.201)	0.060	0.170

184	15.33	0.77	0.220	(0.200)	0.057	0.163
185	15.42	0.77	0.220	(0.199)	0.057	0.163
186	15.50	0.77	0.220	(0.198)	0.057	0.163
187	15.58	0.63	0.182	(0.197)	0.047	0.134
188	15.67	0.63	0.182	(0.196)	0.047	0.134
189	15.75	0.63	0.182	(0.195)	0.047	0.134
190	15.83	0.63	0.182	(0.194)	0.047	0.134
191	15.92	0.63	0.182	(0.193)	0.047	0.134
192	16.00	0.63	0.182	(0.192)	0.047	0.134
193	16.08	0.13	0.038	(0.191)	0.010	0.028
194	16.17	0.13	0.038	(0.190)	0.010	0.028
195	16.25	0.13	0.038	(0.189)	0.010	0.028
196	16.33	0.13	0.038	(0.188)	0.010	0.028
197	16.42	0.13	0.038	(0.187)	0.010	0.028
198	16.50	0.13	0.038	(0.186)	0.010	0.028
199	16.58	0.10	0.029	(0.185)	0.007	0.021
200	16.67	0.10	0.029	(0.184)	0.007	0.021
201	16.75	0.10	0.029	(0.183)	0.007	0.021
202	16.83	0.10	0.029	(0.182)	0.007	0.021
203	16.92	0.10	0.029	(0.181)	0.007	0.021
204	17.00	0.10	0.029	(0.180)	0.007	0.021
205	17.08	0.17	0.048	(0.180)	0.012	0.035
206	17.17	0.17	0.048	(0.179)	0.012	0.035
207	17.25	0.17	0.048	(0.178)	0.012	0.035
208	17.33	0.17	0.048	(0.177)	0.012	0.035
209	17.42	0.17	0.048	(0.176)	0.012	0.035
210	17.50	0.17	0.048	(0.175)	0.012	0.035
211	17.58	0.17	0.048	(0.174)	0.012	0.035
212	17.67	0.17	0.048	(0.173)	0.012	0.035
213	17.75	0.17	0.048	(0.172)	0.012	0.035
214	17.83	0.13	0.038	(0.172)	0.010	0.028
215	17.92	0.13	0.038	(0.171)	0.010	0.028
216	18.00	0.13	0.038	(0.170)	0.010	0.028
217	18.08	0.13	0.038	(0.169)	0.010	0.028
218	18.17	0.13	0.038	(0.168)	0.010	0.028
219	18.25	0.13	0.038	(0.167)	0.010	0.028
220	18.33	0.13	0.038	(0.167)	0.010	0.028
221	18.42	0.13	0.038	(0.166)	0.010	0.028
222	18.50	0.13	0.038	(0.165)	0.010	0.028
223	18.58	0.10	0.029	(0.164)	0.007	0.021
224	18.67	0.10	0.029	(0.163)	0.007	0.021
225	18.75	0.10	0.029	(0.163)	0.007	0.021
226	18.83	0.07	0.019	(0.162)	0.005	0.014
227	18.92	0.07	0.019	(0.161)	0.005	0.014
228	19.00	0.07	0.019	(0.160)	0.005	0.014
229	19.08	0.10	0.029	(0.160)	0.007	0.021
230	19.17	0.10	0.029	(0.159)	0.007	0.021
231	19.25	0.10	0.029	(0.158)	0.007	0.021

232	19.33	0.13	0.038	(0.157)	0.010	0.028
233	19.42	0.13	0.038	(0.157)	0.010	0.028
234	19.50	0.13	0.038	(0.156)	0.010	0.028
235	19.58	0.10	0.029	(0.155)	0.007	0.021
236	19.67	0.10	0.029	(0.154)	0.007	0.021
237	19.75	0.10	0.029	(0.154)	0.007	0.021
238	19.83	0.07	0.019	(0.153)	0.005	0.014
239	19.92	0.07	0.019	(0.152)	0.005	0.014
240	20.00	0.07	0.019	(0.152)	0.005	0.014
241	20.08	0.10	0.029	(0.151)	0.007	0.021
242	20.17	0.10	0.029	(0.150)	0.007	0.021
243	20.25	0.10	0.029	(0.150)	0.007	0.021
244	20.33	0.10	0.029	(0.149)	0.007	0.021
245	20.42	0.10	0.029	(0.148)	0.007	0.021
246	20.50	0.10	0.029	(0.148)	0.007	0.021
247	20.58	0.10	0.029	(0.147)	0.007	0.021
248	20.67	0.10	0.029	(0.147)	0.007	0.021
249	20.75	0.10	0.029	(0.146)	0.007	0.021
250	20.83	0.07	0.019	(0.145)	0.005	0.014
251	20.92	0.07	0.019	(0.145)	0.005	0.014
252	21.00	0.07	0.019	(0.144)	0.005	0.014
253	21.08	0.10	0.029	(0.144)	0.007	0.021
254	21.17	0.10	0.029	(0.143)	0.007	0.021
255	21.25	0.10	0.029	(0.142)	0.007	0.021
256	21.33	0.07	0.019	(0.142)	0.005	0.014
257	21.42	0.07	0.019	(0.141)	0.005	0.014
258	21.50	0.07	0.019	(0.141)	0.005	0.014
259	21.58	0.10	0.029	(0.140)	0.007	0.021
260	21.67	0.10	0.029	(0.140)	0.007	0.021
261	21.75	0.10	0.029	(0.139)	0.007	0.021
262	21.83	0.07	0.019	(0.139)	0.005	0.014
263	21.92	0.07	0.019	(0.138)	0.005	0.014
264	22.00	0.07	0.019	(0.138)	0.005	0.014
265	22.08	0.10	0.029	(0.137)	0.007	0.021
266	22.17	0.10	0.029	(0.137)	0.007	0.021
267	22.25	0.10	0.029	(0.137)	0.007	0.021
268	22.33	0.07	0.019	(0.136)	0.005	0.014
269	22.42	0.07	0.019	(0.136)	0.005	0.014
270	22.50	0.07	0.019	(0.135)	0.005	0.014
271	22.58	0.07	0.019	(0.135)	0.005	0.014
272	22.67	0.07	0.019	(0.135)	0.005	0.014
273	22.75	0.07	0.019	(0.134)	0.005	0.014
274	22.83	0.07	0.019	(0.134)	0.005	0.014
275	22.92	0.07	0.019	(0.134)	0.005	0.014
276	23.00	0.07	0.019	(0.133)	0.005	0.014
277	23.08	0.07	0.019	(0.133)	0.005	0.014
278	23.17	0.07	0.019	(0.133)	0.005	0.014
279	23.25	0.07	0.019	(0.132)	0.005	0.014

```
280  23.33     0.07      0.019       (  0.132)       0.005        0.014
281  23.42     0.07      0.019       (  0.132)       0.005        0.014
282  23.50     0.07      0.019       (  0.132)       0.005        0.014
283  23.58     0.07      0.019       (  0.131)       0.005        0.014
284  23.67     0.07      0.019       (  0.131)       0.005        0.014
285  23.75     0.07      0.019       (  0.131)       0.005        0.014
286  23.83     0.07      0.019       (  0.131)       0.005        0.014
287  23.92     0.07      0.019       (  0.131)       0.005        0.014
288  24.00     0.07      0.019       (  0.131)       0.005        0.014
                (Loss Rate Not Used)
   Sum =     100.0                                    Sum =    21.2
      Flood volume = Effective rainfall      1.77(In)
       times area       7.5(Ac.)/[(In)/(Ft.)] =       1.1(Ac.Ft)
      Total soil loss =      0.62(In)
      Total soil loss =     0.388(Ac.Ft)
      Total rainfall =      2.39(In)
      Flood volume =       48149.4 Cubic Feet
      Total soil loss =       16917.4 Cubic Feet
      ---------------------------------------------------------------------
       Peak flow rate of this hydrograph =      1.819(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       0.0003      0.05  Q         |         |         |         |
   0+10       0.0010      0.09  Q         |         |         |         |
   0+15       0.0017      0.10  Q         |         |         |         |
   0+20       0.0026      0.13  Q         |         |         |         |
   0+25       0.0037      0.15  Q         |         |         |         |
   0+30       0.0047      0.16  Q         |         |         |         |
   0+35       0.0059      0.16  Q         |         |         |         |
   0+40       0.0070      0.16  Q         |         |         |         |
   0+45       0.0081      0.16  Q         |         |         |         |
   0+50       0.0093      0.18  Q         |         |         |         |
   0+55       0.0108      0.21  Q         |         |         |         |
   1+ 0       0.0122      0.21  Q         |         |         |         |
   1+ 5       0.0135      0.19  Q         |         |         |         |
   1+10       0.0147      0.17  Q         |         |         |         |
   1+15       0.0158      0.16  Q         |         |         |         |
   1+20       0.0169      0.16  Q         |         |         |         |
   1+25       0.0180      0.16  Q         |         |         |         |
   1+30       0.0191      0.16  Q         |         |         |         |
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1+35       0.0202      0.16  Q          |          |          |          |
1+40       0.0213      0.16  Q          |          |          |          |
1+45       0.0224      0.16  Q          |          |          |          |
1+50       0.0237      0.18  Q          |          |          |          |
1+55       0.0251      0.21  Q          |          |          |          |
2+ 0       0.0266      0.21  Q          |          |          |          |
2+ 5       0.0281      0.21  QV         |          |          |          |
2+10       0.0295      0.21  QV         |          |          |          |
2+15       0.0310      0.21  QV         |          |          |          |
2+20       0.0325      0.21  QV         |          |          |          |
2+25       0.0340      0.21  QV         |          |          |          |
2+30       0.0354      0.21  QV         |          |          |          |
2+35       0.0371      0.24  QV         |          |          |          |
2+40       0.0389      0.26  |Q         |          |          |          |
2+45       0.0407      0.27  |Q         |          |          |          |
2+50       0.0425      0.27  |Q         |          |          |          |
2+55       0.0444      0.27  |Q         |          |          |          |
3+ 0       0.0462      0.27  |Q         |          |          |          |
3+ 5       0.0481      0.27  |Q         |          |          |          |
3+10       0.0499      0.27  |Q         |          |          |          |
3+15       0.0518      0.27  |Q         |          |          |          |
3+20       0.0536      0.27  |Q         |          |          |          |
3+25       0.0554      0.27  |QV        |          |          |          |
3+30       0.0573      0.27  |QV        |          |          |          |
3+35       0.0591      0.27  |QV        |          |          |          |
3+40       0.0610      0.27  |QV        |          |          |          |
3+45       0.0628      0.27  |QV        |          |          |          |
3+50       0.0648      0.29  |QV        |          |          |          |
3+55       0.0670      0.31  |QV        |          |          |          |
4+ 0       0.0692      0.32  |QV        |          |          |          |
4+ 5       0.0714      0.32  |QV        |          |          |          |
4+10       0.0736      0.32  |QV        |          |          |          |
4+15       0.0758      0.32  |QV        |          |          |          |
4+20       0.0782      0.35  |QV        |          |          |          |
4+25       0.0807      0.37  |QV        |          |          |          |
4+30       0.0833      0.37  |Q V       |          |          |          |
4+35       0.0859      0.37  |Q V       |          |          |          |
4+40       0.0885      0.37  |Q V       |          |          |          |
4+45       0.0910      0.37  |Q V       |          |          |          |
4+50       0.0938      0.40  |Q V       |          |          |          |
4+55       0.0967      0.42  |Q V       |          |          |          |
5+ 0       0.0996      0.43  |Q V       |          |          |          |
5+ 5       0.1022      0.38  |Q V       |          |          |          |
5+10       0.1045      0.33  |Q V       |          |          |          |
5+15       0.1068      0.33  |Q V       |          |          |          |
5+20       0.1091      0.35  |Q V       |          |          |          |
5+25       0.1117      0.37  |Q  V      |          |          |          |
5+30       0.1142      0.37  |Q  V      |          |          |          |
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5+35       0.1170      0.40  |Q  V     |          |          |          |
5+40       0.1199      0.42  |Q  V     |          |          |          |
5+45       0.1228      0.43  |Q  V     |          |          |          |
5+50       0.1258      0.43  |Q  V     |          |          |          |
5+55       0.1287      0.43  |Q  V     |          |          |          |
6+ 0       0.1317      0.43  |Q  V     |          |          |          |
6+ 5       0.1348      0.45  |Q  V     |          |          |          |
6+10       0.1381      0.48  |Q  V     |          |          |          |
6+15       0.1414      0.48  |Q   V    |          |          |          |
6+20       0.1447      0.48  |Q   V    |          |          |          |
6+25       0.1480      0.48  |Q   V    |          |          |          |
6+30       0.1513      0.48  |Q   V    |          |          |          |
6+35       0.1548      0.51  | Q  V    |          |          |          |
6+40       0.1584      0.53  | Q  V    |          |          |          |
6+45       0.1621      0.53  | Q  V    |          |          |          |
6+50       0.1658      0.53  | Q  V    |          |          |          |
6+55       0.1695      0.53  | Q   V   |          |          |          |
7+ 0       0.1732      0.53  | Q   V   |          |          |          |
7+ 5       0.1768      0.53  | Q   V   |          |          |          |
7+10       0.1805      0.53  | Q   V   |          |          |          |
7+15       0.1842      0.53  | Q   V   |          |          |          |
7+20       0.1881      0.56  | Q   V   |          |          |          |
7+25       0.1921      0.58  | Q   V   |          |          |          |
7+30       0.1961      0.59  | Q    V  |          |          |          |
7+35       0.2003      0.61  | Q    V  |          |          |          |
7+40       0.2047      0.64  | Q    V  |          |          |          |
7+45       0.2091      0.64  | Q    V  |          |          |          |
7+50       0.2137      0.67  | Q    V  |          |          |          |
7+55       0.2184      0.69  | Q    V  |          |          |          |
8+ 0       0.2232      0.69  | Q     V |          |          |          |
8+ 5       0.2283      0.74  | Q     V |          |          |          |
8+10       0.2338      0.79  |  Q    V |          |          |          |
8+15       0.2393      0.80  |  Q    V |          |          |          |
8+20       0.2448      0.80  |  Q    V |          |          |          |
8+25       0.2503      0.80  |  Q     V|          |          |          |
8+30       0.2559      0.80  |  Q     V|          |          |          |
8+35       0.2616      0.83  |  Q     V|          |          |          |
8+40       0.2674      0.85  |  Q     V|          |          |          |
8+45       0.2733      0.85  |  Q     V|          |          |          |
8+50       0.2793      0.88  |  Q      V          |          |          |
8+55       0.2856      0.90  |  Q      V          |          |          |
9+ 0       0.2918      0.91  |  Q      V          |          |          |
9+ 5       0.2984      0.96  |  Q      V          |          |          |
9+10       0.3053      1.00  |   Q     |V         |          |          |
9+15       0.3123      1.01  |   Q     |V         |          |          |
9+20       0.3195      1.04  |   Q     |V         |          |          |
9+25       0.3268      1.06  |   Q     |V         |          |          |
9+30       0.3341      1.07  |   Q     | V        |          |          |
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 9+35       0.3417      1.09  |   Q     | V       |         |         |
 9+40       0.3494      1.12  |   Q     | V       |         |         |
 9+45       0.3571      1.12  |   Q     | V       |         |         |
 9+50       0.3650      1.15  |   Q     |  V      |         |         |
 9+55       0.3731      1.17  |   Q     |  V      |         |         |
10+ 0       0.3812      1.17  |   Q     |  V      |         |         |
10+ 5       0.3881      1.01  |   Q     |   V     |         |         |
10+10       0.3939      0.85  |  Q      |   V     |         |         |
10+15       0.3996      0.82  |  Q      |   V     |         |         |
10+20       0.4051      0.80  |  Q      |   V     |         |         |
10+25       0.4106      0.80  |  Q      |   V     |         |         |
10+30       0.4161      0.80  |  Q      |    V    |         |         |
10+35       0.4225      0.92  |  Q      |    V    |         |         |
10+40       0.4296      1.04  |   Q     |    V    |         |         |
10+45       0.4369      1.06  |   Q     |    V    |         |         |
10+50       0.4443      1.07  |   Q     |     V   |         |         |
10+55       0.4517      1.07  |   Q     |     V   |         |         |
11+ 0       0.4590      1.07  |   Q     |     V   |         |         |
11+ 5       0.4663      1.05  |   Q     |     V   |         |         |
11+10       0.4733      1.02  |   Q     |      V  |         |         |
11+15       0.4803      1.02  |   Q     |      V  |         |         |
11+20       0.4873      1.02  |   Q     |      V  |         |         |
11+25       0.4943      1.02  |   Q     |      V  |         |         |
11+30       0.5013      1.02  |   Q     |       V |         |         |
11+35       0.5080      0.97  |  Q      |       V |         |         |
11+40       0.5143      0.92  |  Q      |       V |         |         |
11+45       0.5206      0.91  |  Q      |       V |         |         |
11+50       0.5271      0.93  |  Q      |        V|         |         |
11+55       0.5336      0.96  |  Q      |        V|         |         |
12+ 0       0.5403      0.96  |  Q      |        V|         |         |
12+ 5       0.5481      1.13  |   Q     |        V|         |         |
12+10       0.5570      1.29  |    Q    |         V         |         |
12+15       0.5661      1.32  |    Q    |         V         |         |
12+20       0.5755      1.36  |    Q    |         V         |         |
12+25       0.5850      1.38  |    Q    |         |V        |         |
12+30       0.5946      1.39  |    Q    |         |V        |         |
12+35       0.6045      1.44  |    Q    |         |V        |         |
12+40       0.6147      1.49  |    Q    |         | V       |         |
12+45       0.6250      1.49  |    Q    |         | V       |         |
12+50       0.6355      1.52  |     Q   |         | V       |         |
12+55       0.6461      1.54  |     Q   |         |  V      |         |
13+ 0       0.6568      1.55  |     Q   |         |  V      |         |
13+ 5       0.6683      1.67  |     Q   |         |   V     |         |
13+10       0.6806      1.79  |      Q  |         |   V     |         |
13+15       0.6931      1.81  |      Q  |         |    V    |         |
13+20       0.7056      1.82  |      Q  |         |    V    |         |
13+25       0.7181      1.82  |      Q  |         |    V    |         |
13+30       0.7306      1.82  |      Q  |         |     V   |         |
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13+35       0.7413      1.55  |     Q   |          |     V   |          |
13+40       0.7503      1.30  |    Q    |          |      V  |          |
13+45       0.7589      1.25  |    Q    |          |      V  |          |
13+50       0.7674      1.23  |   Q     |          |      V  |          |
13+55       0.7759      1.23  |   Q     |          |       V |          |
14+ 0       0.7843      1.23  |   Q     |          |       V |          |
14+ 5       0.7935      1.33  |    Q    |          |       V |          |
14+10       0.8033      1.42  |    Q    |          |        V|          |
14+15       0.8132      1.44  |    Q    |          |        V|          |
14+20       0.8229      1.42  |    Q    |          |        V|          |
14+25       0.8326      1.40  |    Q    |          |         V          |
14+30       0.8422      1.39  |    Q    |          |         V          |
14+35       0.8517      1.39  |    Q    |          |         V          |
14+40       0.8613      1.39  |    Q    |          |         |V         |
14+45       0.8709      1.39  |    Q    |          |         |V         |
14+50       0.8803      1.37  |    Q    |          |         |V         |
14+55       0.8896      1.34  |    Q    |          |         | V        |
15+ 0       0.8988      1.34  |    Q    |          |         | V        |
15+ 5       0.9078      1.31  |    Q    |          |         | V        |
15+10       0.9167      1.29  |    Q    |          |         |  V       |
15+15       0.9256      1.29  |    Q    |          |         |  V       |
15+20       0.9343      1.26  |    Q    |          |         |  V       |
15+25       0.9428      1.24  |   Q     |          |         |   V      |
15+30       0.9513      1.23  |   Q     |          |         |   V      |
15+35       0.9591      1.13  |   Q     |          |         |   V      |
15+40       0.9662      1.04  |   Q     |          |         |   V      |
15+45       0.9733      1.02  |   Q     |          |         |    V     |
15+50       0.9803      1.02  |   Q     |          |         |    V     |
15+55       0.9873      1.02  |   Q     |          |         |    V     |
16+ 0       0.9943      1.02  |   Q     |          |         |    V     |
16+ 5       0.9988      0.65  | Q       |          |         |     V    |
16+10       1.0009      0.31  |Q        |          |         |     V    |
16+15       1.0026      0.24  Q         |          |         |     V    |
16+20       1.0041      0.21  Q         |          |         |     V    |
16+25       1.0056      0.21  Q         |          |         |     V    |
16+30       1.0070      0.21  Q         |          |         |     V    |
16+35       1.0084      0.19  Q         |          |         |     V    |
16+40       1.0095      0.17  Q         |          |         |     V    |
16+45       1.0106      0.16  Q         |          |         |     V    |
16+50       1.0117      0.16  Q         |          |         |     V    |
16+55       1.0128      0.16  Q         |          |         |     V    |
17+ 0       1.0139      0.16  Q         |          |         |     V    |
17+ 5       1.0154      0.21  Q         |          |         |     V    |
17+10       1.0171      0.25  |Q        |          |         |     V    |
17+15       1.0189      0.26  |Q        |          |         |     V    |
17+20       1.0208      0.27  |Q        |          |         |     V    |
17+25       1.0226      0.27  |Q        |          |         |      V   |
17+30       1.0245      0.27  |Q        |          |         |      V   |
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17+35       1.0263      0.27  |Q         |          |          |       V  |
17+40       1.0282      0.27  |Q         |          |          |       V  |
17+45       1.0300      0.27  |Q         |          |          |       V  |
17+50       1.0317      0.24  Q          |          |          |       V  |
17+55       1.0332      0.22  Q          |          |          |       V  |
18+ 0       1.0347      0.22  Q          |          |          |       V  |
18+ 5       1.0362      0.21  Q          |          |          |       V  |
18+10       1.0376      0.21  Q          |          |          |       V  |
18+15       1.0391      0.21  Q          |          |          |       V  |
18+20       1.0406      0.21  Q          |          |          |       V  |
18+25       1.0420      0.21  Q          |          |          |       V  |
18+30       1.0435      0.21  Q          |          |          |       V  |
18+35       1.0448      0.19  Q          |          |          |       V  |
18+40       1.0460      0.17  Q          |          |          |       V  |
18+45       1.0471      0.16  Q          |          |          |       V  |
18+50       1.0480      0.14  Q          |          |          |       V  |
18+55       1.0488      0.11  Q          |          |          |       V  |
19+ 0       1.0496      0.11  Q          |          |          |       V  |
19+ 5       1.0505      0.13  Q          |          |          |        V |
19+10       1.0515      0.15  Q          |          |          |        V |
19+15       1.0526      0.16  Q          |          |          |        V |
19+20       1.0539      0.18  Q          |          |          |        V |
19+25       1.0553      0.21  Q          |          |          |        V |
19+30       1.0568      0.21  Q          |          |          |        V |
19+35       1.0581      0.19  Q          |          |          |        V |
19+40       1.0592      0.17  Q          |          |          |        V |
19+45       1.0604      0.16  Q          |          |          |        V |
19+50       1.0613      0.14  Q          |          |          |        V |
19+55       1.0621      0.11  Q          |          |          |        V |
20+ 0       1.0628      0.11  Q          |          |          |        V |
20+ 5       1.0637      0.13  Q          |          |          |        V |
20+10       1.0648      0.15  Q          |          |          |        V |
20+15       1.0659      0.16  Q          |          |          |        V |
20+20       1.0670      0.16  Q          |          |          |        V |
20+25       1.0681      0.16  Q          |          |          |        V |
20+30       1.0692      0.16  Q          |          |          |        V |
20+35       1.0703      0.16  Q          |          |          |        V |
20+40       1.0714      0.16  Q          |          |          |        V |
20+45       1.0725      0.16  Q          |          |          |        V |
20+50       1.0735      0.14  Q          |          |          |        V |
20+55       1.0742      0.11  Q          |          |          |        V |
21+ 0       1.0750      0.11  Q          |          |          |        V |
21+ 5       1.0759      0.13  Q          |          |          |        V |
21+10       1.0770      0.15  Q          |          |          |        V |
21+15       1.0780      0.16  Q          |          |          |         V|
21+20       1.0790      0.14  Q          |          |          |         V|
21+25       1.0798      0.11  Q          |          |          |         V|
21+30       1.0805      0.11  Q          |          |          |         V|
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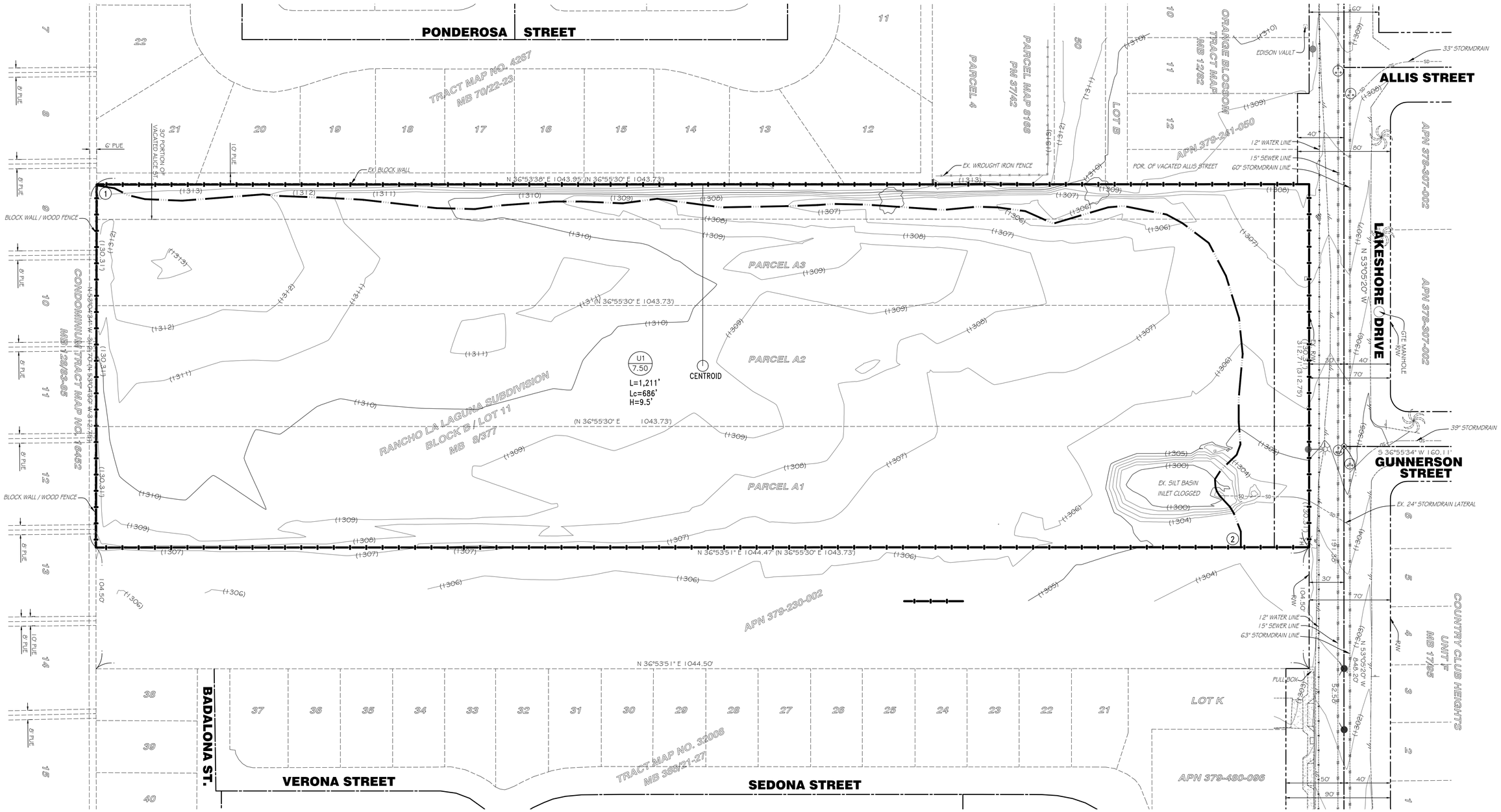
   21+35       1.0814      0.13  Q          |          |          |         V|
   21+40       1.0825      0.15  Q          |          |          |         V|
   21+45       1.0836      0.16  Q          |          |          |         V|
   21+50       1.0845      0.14  Q          |          |          |         V|
   21+55       1.0853      0.11  Q          |          |          |         V|
   22+ 0       1.0860      0.11  Q          |          |          |         V|
   22+ 5       1.0870      0.13  Q          |          |          |         V|
   22+10       1.0880      0.15  Q          |          |          |         V|
   22+15       1.0891      0.16  Q          |          |          |         V|
   22+20       1.0900      0.14  Q          |          |          |         V|
   22+25       1.0908      0.11  Q          |          |          |         V|
   22+30       1.0916      0.11  Q          |          |          |         V|
   22+35       1.0923      0.11  Q          |          |          |         V|
   22+40       1.0930      0.11  Q          |          |          |         V|
   22+45       1.0938      0.11  Q          |          |          |         V|
   22+50       1.0945      0.11  Q          |          |          |         V|
   22+55       1.0953      0.11  Q          |          |          |         V|
   23+ 0       1.0960      0.11  Q          |          |          |         V|
   23+ 5       1.0967      0.11  Q          |          |          |         V|
   23+10       1.0975      0.11  Q          |          |          |         V|
   23+15       1.0982      0.11  Q          |          |          |         V|
   23+20       1.0989      0.11  Q          |          |          |         V|
   23+25       1.0997      0.11  Q          |          |          |         V|
   23+30       1.1004      0.11  Q          |          |          |         V|
   23+35       1.1012      0.11  Q          |          |          |         V|
   23+40       1.1019      0.11  Q          |          |          |         V|
   23+45       1.1026      0.11  Q          |          |          |         V|
   23+50       1.1034      0.11  Q          |          |          |         V|
   23+55       1.1041      0.11  Q          |          |          |         V|
   24+ 0       1.1048      0.11  Q          |          |          |         V|
   24+ 5       1.1052      0.06  Q          |          |          |         V|
   24+10       1.1053      0.01  Q          |          |          |         V|
   24+15       1.1054      0.00  Q          |          |          |         V|
----------------------------------------------------------------------
```

EXISTING CONDITION UNIT HYDROGRAPH HYDROLOGY



GRAPHIC SCALE

40 0 20 40 80 120

(IN FEET)
1 inch =40 ft.

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CIVIL / STRUCTURAL / SURVEYING
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Phone: (951) 252-1034 Web: WWW.KOLIBRIEN.BIZ

EXISTING SITE LEGEND

- POWER POLE
- VAULT AS NOTED
- GUY ANCHOR
- VALVE
- STREET LIGHT
- STREET SIGN
- SEWER MANHOLE
- SEWER CLEANOUT
- STORM DRAIN MANHOLE
- FIRE HYDRANT
- PULL BOX
- (1301) MINOR CONTOUR 1 FT. INTERVAL
- (1300) MAJOR CONTOUR 5 FT. INTERVAL
- BLOCK WALL
- FENCE AS NOTED
- SS — SANITARY SEWER LINE
- W — WATER LINE
- SD — STORM DRAIN LINE
- EDGE OF ASPHALT PAVEMENT
- PROPERTY LINE
- RIGHT-OF-WAY LINE
- STREET CENTERLINE
- CONCRETE SURFACE
- BUILDING
- TREE
- PALM TREE

PRE-CONSTRUCTION CONDITION

10 YEAR UNIT HYDROGRAPH STORM SCENARIOS

Storm	Qp = Peak Flowrate (cfs)	V=storm volume (ft³)
1 hour	13.0	19,128
3 hour	8.5	22,893
6 hour	7.8	25,297
24 hour	1.9	20,109

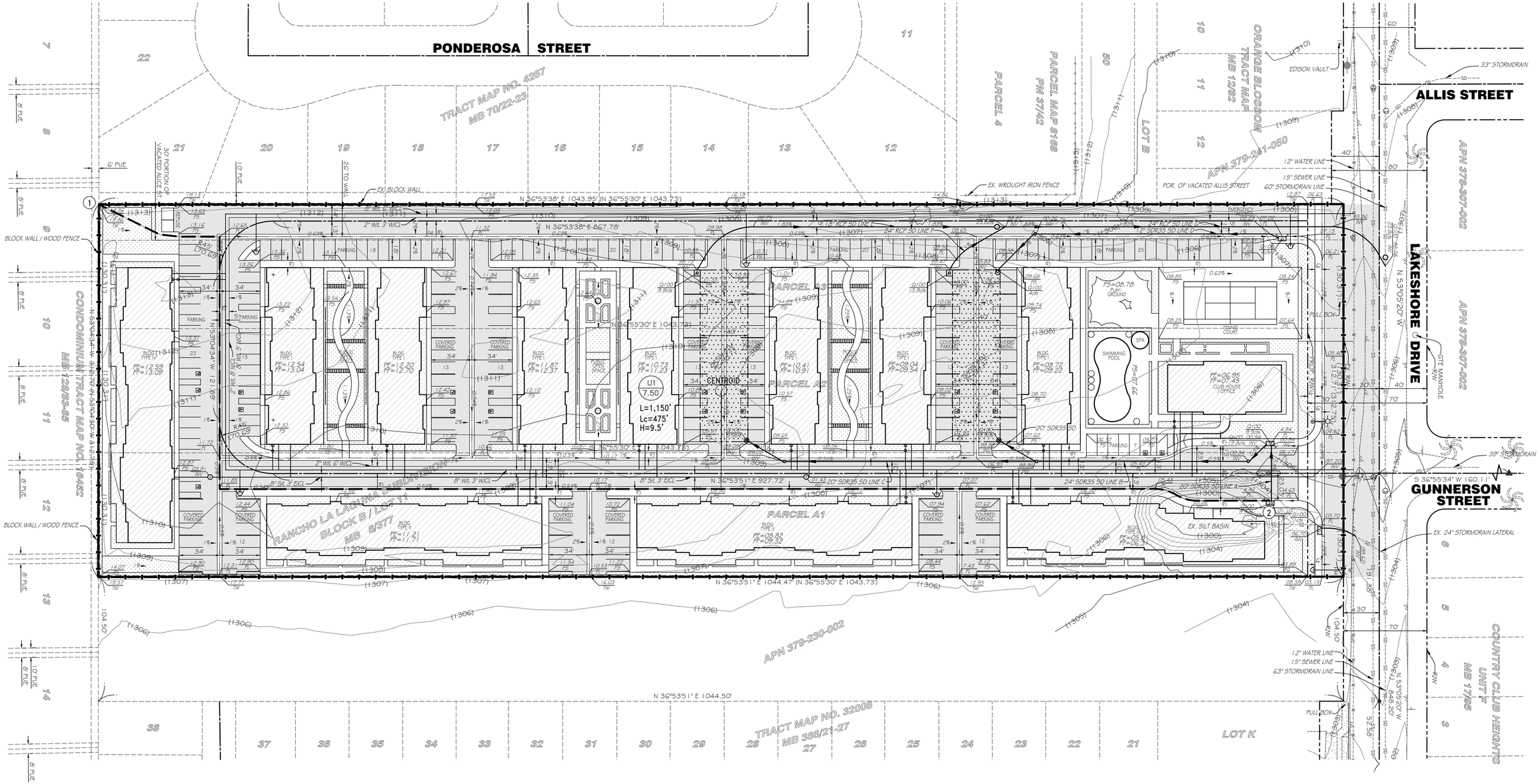
100 YEAR UNIT HYDROGRAPH STORM SCENARIOS

Storm	Qp = Peak Flowrate (cfs)	V=storm volume (ft³)
1 hour	22.2	37,233
3 hour	15.2	57,256
6 hour	14.2	73,848
24 hour	4.3	73,356

HYDROLOGY LEGEND

- L=XXX' INDICATES FLOW PATH LENGTH
- Lc=XXX' LENGTH UPSTREAM TO CENTROID
- H=XXX' CHANGE IN HEIGHT BETWEEN NODES
- U1 / 7.50 INDICATES SUBAREA DESIGNATION / INDICATES AREA IN ACRES
- X INDICATES NODE
- INDICATES SUBAREA BOUNDARY
- INDICATES FLOWLINE

POST-CONSTRUCTION UNIT HYDROGRAPH HYDROLOGY



PROPOSED LEGEND

- STREET LIGHT
- SEWER MANHOLE
- STORMDRAIN CLEANOUT
- STORMDRAIN MANHOLE
- FIRE HYDRANT
- 7' WIDE CATCH BASIN
- STORMDRAIN BASIN OUTLET STRUCTURE
- STORMDRAIN BASIN INLET STRUCTURE
- 6" SEWER LATERAL
- 2" WATER LATERAL & BFP
- 4" FIRE LATERAL, DCDA, PIV & FCA
- 8" SANITARY SEWER LINE
- 2" IRRIGATION WATER LINE
- 8" WATER LINE
- STORM DRAIN LINE (SIZE/TYPE PER PLAN)
- BLOCK WALL
- 6" CURB
- 6" CURB & GUTTER
- 4' WIDE VALLEY GUTTER
- PROPERTY LINE
- RIGHT-OF-WAY LINE
- STREET CENTERLINE
- BUILDING
- ASPHALT PAVEMENT
- LANDSCAPING
- UNDERGROUND DETENTION BASIN

ABBREVIATIONS

CENTER LINE	CL
PARCEL MAP	PM
MAP BOOK	MB
FLOW LINE	FL
POWER POLE	PP
STORM DRAIN	SD
TOP OF CURB	TC
TOP OF BERM	TB
SEWER LINE	SAL
WATER LINE	WL
BOTTOM	BTM
PARCEL	PAR
FINISHED SURFACE	FS
FINISH GRADE	FG
CUBIC FEET PER SECOND	CFS
PAD ELEVATION	PE
FINISHED FLOOR	FF
EDGE OF PAVEMENT	EP
PROPERTY LINE	P/L
RIGHT-OF-WAY	R/W
INVERT ELEVATION	INV
PUBLIC UTILITY EASEMENT	PUE
TOP OF WALL	TW
ASSESSORS PARCEL NO.	APN
OFFSET DIRECTION FROM C/L	(N,S,E,W)/CL

POST-CONSTRUCTION CONDITION

10 YEAR UNIT HYDROGRAPH STORM SCENARIOS

Storm	Qp = Peak Flowrate (cfs)	V=storm volume (ft^3)
1 hour	14.5	21,263
3 hour	9.6	28,991
6 hour	6.9	34,344
24 hour	2.4	57,072

100 YEAR UNIT HYDROGRAPH STORM SCENARIOS

Storm	Qp = Peak Flowrate (cfs)	V=storm volume (ft^3)
1 hour	23.8	37,758
3 hour	16.2	58,832
6 hour	15.1	77,067
24 hour	4.4	96,050

HYDROLOGY LEGEND

- L=XXX' — INDICATES FLOW PATH LENGTH
- Lc=XXX' — LENGTH UPSTREAM TO CENTROID
- H=XXX' — CHANGE IN HEIGHT BETWEEN NODES
- U1 / 7.50 — INDICATES SUBAREA DESIGNATION / INDICATES AREA IN ACRES
- X — INDICATES NODE
- INDICATES SUBAREA BOUNDARY
- INDICATES FLOWLINE

GRAPHIC SCALE

40 0 20 40 80 120

(IN FEET)
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File: C02001

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**

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

TO BE PROVIDED WITH FINAL WQMP

Stormwater BMP Operation & Maintenance Plan

*A Template for Projects located within the **Santa Ana Watershed** Region of Riverside County*

I. Inspection Log

Site Inspection Log

Maintenance Engineer/Company:	
Date:	
Reason for Inspection:	

Inspection Item	A	M	U	N/A	Corrective Action Required
I. Landscaping					
Are grounds in good condition, clean and free of debris?					
Are lawn areas mowed and trimmed?					
Are plant beds and/or planter boxes well maintained?					
Are shrubs trimmed and maintained?					
Are dead trees or shrubs evident?					
Are lawn sprinkler systems operable?					
Are areas around trash receptacles clean?					
Do a sufficient quantity of receptacles exist?					
II. Hardscape					
Are sidewalks and trails in good condition, clean, and free of debris?					
III. Storm Drain System					
Are all stencils in good condition, visible and legible?					
Are all drains clean and free of obstructions?					
IV. Bioretention BMPs					
Is the BMP in good condition, clean and free of debris?					
Is the BMP free of burrows?					
Is the BMP free of sediment accumulation?					
Is the BMP free of standing water					
V. Tree Wells					
Is the Tree Well in good condition, clean and free of debris? Is the vegetation healthy and the planter mix at a proper depth?					
Is the BMP free of sediment accumulation?					
Is the BMP free of standing water?					

Comments:

A Acceptable M Marginal U Unacceptable N/A Not Applicable

II. Updates, Revisions, Errata

Revision No.	Date	Brief Description of Revision, include section and page number	Prepared and Approved By:
			Name: Title:
			Name: Title:
			Name: Title:
			Name: Title:
			Name: Title:
			Name: Title:
			Name: Title:

III. Introduction

The project site comprises approximately 7.28 net acres and is located on Lakeshore Dr., in the City of Lake Elsinore, California. The project proposes 11 2 story condominium buildings with 144 proposed units, a club house, a pool, tennis court and a playground. The project site is located approximately 4 miles westerly of the 15 freeway, along Lakeshore Dr. The project site drains into an existing sediment basin and then into the existing 60 inch storm drain within Lakeshore Dr, and is then conveyed directly to Lake Elsinore. The project site is partially developed along lakeshore with existing rough grading improvements from the previous adjacent Lakeshore Village tract. The current site is a previously rough graded pad that now has natural plant and weed vegetation growing on it. The street fronting the property are also developed AC pavement with some improvements. The project site was previously developed as a part of the prior subdivision development and is currently vacant land. The project site is the site has gentle slopes of about 1%-2% with existing street slopes roughly 1.5%. The site drains northerly and easterly. The elevation of the project site ranges from 1313 to 1304 feet above mean sea level (msl). Stormwater in the proposed condition shall be conveyed into two proposed underground infiltration basins with a metered outlet to mitigate increased flowrates back into the ms-4 system. The basins are designed for both water quality and stormwater flowrate/ volume mitigation.

IV. Responsibility for Maintenance and Funding

A. General

1) Responsible Party during Construction

Identify the parties responsible for maintenance during construction phase of BMPs identified and source controls specified.

Developer's Name	TBD		
Address			
	City:	State: CA	Zip:
Email Address			
Phone Number			
Engineer of Work	Kolibrien Corp.		
Engineer's Phone Number	(951) 252-1034		

2) Responsible Party for Ongoing Maintenance

Owner Responsible for Negotiating and Executing Contracts Responsible for Maintenance

Owner's Name	CHYIILUU CHII		
Address	14785 JEFFREY RD. #201		
	City: Irvine	State: CA	Zip: 92618
Email Address			
Phone Number	949-232-9239		

Supervisor Responsible for Responding to problems with Stormwater BMPs

Supervisor's Name	TBD		
Address			
	City:	State:	Zip:
Email Address			
Phone Number			

3) Employees or Contractors Responsible for conducting Stormwater BMP Operation and Maintenance

Employees	
Name	TBD
Title	
Phone	
Email	
Contractors	
Company	TBD
Employee	
Title	
Phone	
Email	

4) Funding

Funding for installation, operation, and maintenance of all stormwater BMPs will be the responsibility of the property owner. Funding for stormwater facility maintenance shall be paid for from ordinary incomes generated from the apartment complex. Any future owners will be required to maintain BMPs as per manufacturer's specifications.

Budget for Maintenance will be determined by property owner/management.

B. Training

Training of employees responsible for BMP maintenance procedures will be provided by the owner and the type of training will be at the discretion of the owner. Any contractors will be trained by their respective company and this will not be the property owner's responsibility.

C. Records

Insert maintenance records here.

Storm Water BMP Maintenance Log

Maintenance Engineer/ Company	Maintenance Type	Date	Comments

D. Safety

Insert Company's Safety Training Documentation here.

Employee Training Log

Training Type: _____

_____

Instructor: _____ Date: _____

Company: _____

Attendees

Name	Signature	Name	Signature

V. Summary of Drainage Management Areas and Stormwater BMPs

A. Drainage Areas

This site includes landscaping that is considered self-treating or buffering; these areas will not require specialized O&M or inspections, but will require typical landscape maintenance. Landscape maintenance activities are described in Section VII. Maintenance Schedule.

DMA Name or ID	Surface Type(s)[1]	Area (Sq. Ft.)	DMA Type
R/1	Roofs	33459.51	TYPE D, DRAINS TO L/1
R/2	Roofs	10433.9	TYPE D, DRAINS TO L/1
R/3	Roofs	6801.96	TYPE D, DRAINS TO L/1
R/4	Roofs	3943.91	TYPE D, DRAINS TO L/1
P/1	Concrete or Asphalt	5338.38	TYPE D, DRAINS TO H/1
P/2	Concrete or Asphalt	3523.33	TYPE D, DRAINS TO H/1
T/1	Concrete or Asphalt	7200	TYPE D, DRAINS TO H/1
H/1	Concrete or Asphalt	153885	TYPE D, DRAINS TO BMP
L/1	Natural	92543.77	TYPE A, DRAINS TO H/1

Final treated runoff drains into City MS-4 and then into Lake Elsinore

B. Structural Post-Construction BMPs

Selected Treatment Control BMP Name or ID[1]	Priority Pollutant(s) of Concern to Mitigate[2]	Removal Efficiency Percentage[3]
INFILTRATION BASIN Per RCFC&WCD and referencing CASQA TC-11	Sediment, nutrients, trash, metals, bacteria, oil and grease, organics	high
LANDSCAPE BUFFER AREAS Per RCFC&WCD and referencing CASQA TC-31	Sediment, metals, oil and grease Organics Nutrients, bacteria	High Medium Low
STORM DRAIN INSERTS per CASQA MP-32	Sediment, nutrients, trash, metals, bacteria, oil and grease, organics	Low

VI. Stormwater BMP Design Documentation

These BMPs will be "As Built" by a licensed civil/geotechnical engineer registered in the state of California and submitted to the Co-Permittee.

VII. Maintenance Schedule or Matrix

A. Maintenance Schedule

BMP	Responsible Party	Maintenance Activity	Inspection/Maintenance Frequency
Self-Treating Areas			
Landscape Maintenance	Property Owner	Inspect landscape areas for litter and debris daily. Weekly preform landscape area inspections and preform required landscape maintenance activities when it is needed. These maintenance activities include irrigating, weeding, applying fertilizers and pesticides in minimum required quantities, remulching, trimming vegetation, raking leaves, removing detritus, and replacing diseased or dead plants.	Continuous, as needed
Source Control BMPs {Structural and Nonstructural)			
Education for Property Owner	Property Owner	Education program as it would apply to future tenants and maintenance staff. The owner shall prepare manual{s) for tenants and maintenance staff.	Continuous. Provide regular training to field employees regarding all the BMPs proposed in this document.
Activity Restriction	Property Owner	No sidewalk or driveway washing.	Continuous
Common Area Landscape Maintenance	Property Owner	Manage landscaping in accordance with: the City Regulations, and with management guidelines for use of fertilizers and pesticides and with the County of Riverside.	Monthly during regular maintenance.
BMP Maintenance	Property Owner	The maintenance staff and tenants will be instructed in environmental procedures regarding contamination and cleanup.	Per established maintenance BMP schedule.
Common Area Litter Control/ Refuse	Property Owner	A contract for trash management and litter control and landscaped maintenance will be made with outside contractors as necessary.	Daily, during regular maintenance. Litter patrol and emptying trash receptacles.
Employee Training	Property Owner	Educational materials.	When maintenance staff are hired or for new tenants, and once every six months.

Common catch basin Inspection	Property Owner	Inspect inlet for debris and clean with required.	Monthly, after rain events and prior to October 1st each year.
Private Street Sweeping	Property Owner	Post "No Littering" signs and enforce anti-litter laws. A contract for street sweeping and litter control will be mad with outside contractors as necessary. The contractor will clean out and cover litter receptacles frequently to prevent spillage. The contractor will routinely sweep, shovel, and dispose of litter in the trash. The contractor will use dry cleaning methods to prevent the discharge of pollutants into the stormwater conveyance system. A contract for oil and petroleum hydrocarbons removal will be made with cleaning services contractor.	Sweep private alleys and parking lots weekly and prior to the storm season. Remove oil and petroleum hydrocarbons if any at the drive-way once every 6 months.
Storm Drain System Stenciling and Signage	Property Owner	Inspect for re-stenciling needs and re-stencil as necessary.	Once every 6 months.
Efficient Irrigation System	Property Owner	Verify that the runoff minimizing landscape design continues to function by checking that water sensors are functioning properly, that irrigation heads are adjusted properly to eliminate overspray to landscape areas, and to verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of day or night time temperatures.	Once a week with maintenance activities.

BMP Maintenance			
Infiltration Basins	Property Owner	• Inspections and maintenance to ensure that water infiltrates into the subsurface completely {recommended infiltration rate of 72 hours or less). • Observe drain time for the design storm after completion or modification of the facility to confirm that the designed drain time has been obtained. • Inspect for standing water at the end of the wet season. • Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10% of the basin. • See isolator row requirements from Stormtech and reference Stormtech O&M data sheets for further maintenance and operational proceedures.	Monthly, after rain events and prior to October 1st each year.

B. Service Agreement Information

Insert Service Agreement here.

Appendix 10: Educational Materials

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

TO BE PROVIDED WITH FINAL WQMP