# Appendix F

## Preliminary Project Specific Water Quality Management Plan

Albert A. Webb Associates

January 2022

FOR REVIEW ONLY

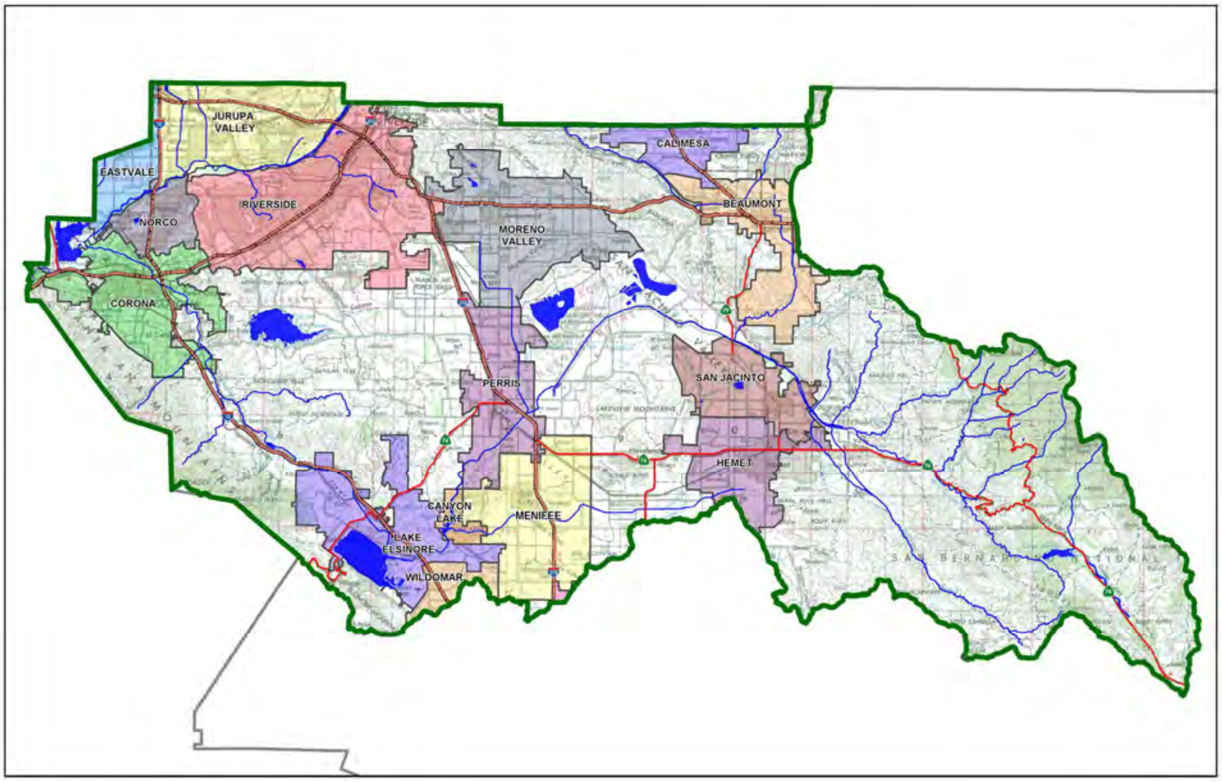
# Project Specific Water Quality Management Plan

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

**Project Title:** Redlands East Industrial

**Development No:**

**Design Review/Case No:** 20-00021




**Contact Information:**

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☒ **Preliminary**
☐ **Final**

**Original Date Prepared**: May 2021

**Revision Date(s)**: January 2022

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

**Prepared by:**
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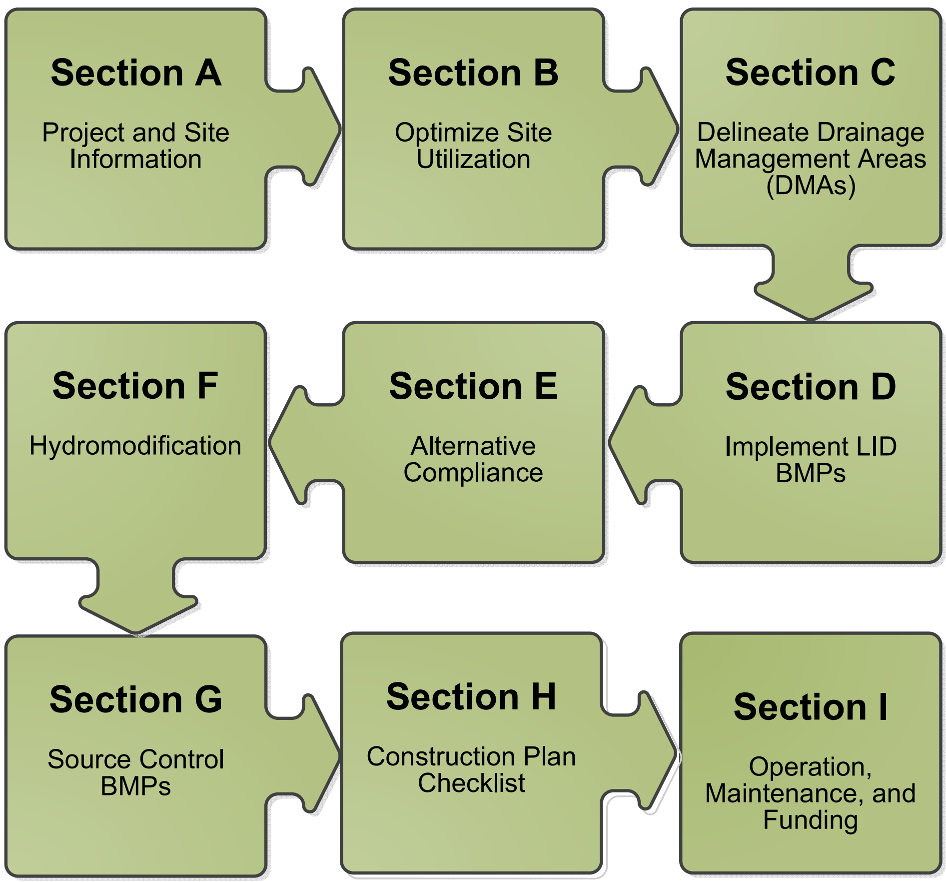
Attn: Teresa (Teri) Gibbs

## A Brief Introduction

This Project-Specific WQMP Template for the **Santa Ana Region** has been prepared to help guide you in documenting compliance for your project. Because this document has been designed to specifically document compliance, you will need to utilize the WQMP Guidance Document as your "how-to" manual to help guide you through this process. Both the Template and Guidance Document go hand-in-hand, and will help facilitate a well prepared Project-Specific WQMP. Below is a flowchart for the layout of this Template that will provide the steps required to document compliance.



## OWNER'S CERTIFICATION

This Project-Specific Water Quality Management Plan (WQMP) has been prepared for **Lake Creek Industrial LLC** by **Albert A. Webb Associates** for the **Redlands East Industrial** project.

This WQMP is intended to comply with the requirements of **City of Perris** for **Water Quality Ordinance 1194** 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 Perris Water Quality Ordinance 1194**.

"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."

| | |
|---|---|
| [signature] | 12/08/21 |
| Owner's Signature | Date |
| Michael Johnson | Sole Member |
| Owner's Printed Name | Owner's Title/Position |

See Attached Certificate

DEC 07 2021

[X] Acknowledgment
[ ] Jurat
[ ] Copy Certificate

## 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."

| | |
|---|---|
| [signature] | December 15, 2021 |
| Preparer's Signature | Date |
| Teresa M. Gibbs, P.E. | Senior Engineer |
| Preparer's Printed Name | Preparer's Title/Position |

Preparer's Licensure:

REGISTERED PROFESSIONAL ENGINEER
TERESA M. GIBBS
No. C84290
CIVIL
STATE OF CALIFORNIA

CALIFORNIA ALL-PURPOSE ACKNOWLEDGEMENT

A Notary Public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California }

County of Orange

On Dec 8, 2021 before me Celinda S. Kennedy, Notary Public, Notary Public, personally appeared

Michael Johnson

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

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

WITNESS my hand and official seal.

SIGNATURE ______________________

CELINDA S. KENNEDY
COMM...2370808
NOTARY PUBLIC-CALIFORNIA
ORANGE COUNTY
My Term Exp. August 15, 2025
BCT3

PLACE NOTARY SEAL ABOVE

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

**Description of attached document**

Title or type of document: Owners Certification

## Table of Contents

## List of Tables



## List of Appendices

# Section A: Project and Site Information

| | | |
|---|---|---|
| **Project Information** | | |
| Type of Project: | Industrial | |
| Planning Area: | Perris Valley Commercial Center Specific Plan | |
| Community Name: | Perris Valley Commercial Center Specific Plan | |
| Development Name: | Redlands East Industrial DPR 20-00021 | |
| **Project Location** | | |
| Latitude & Longitude (DMS): 33° 49’ 34.47”N / 117° 12’ 58.50” W | | |
| Project Watershed and Sub-Watershed: Santa Ana Watershed, San Jacinto Sub-Watershed | | |
| APN(s): 300-210-006 – 008 & 300-210-026 – 028 | | |
| Map Book and Page No.: Thomas Bros. Map Page 777, Grid H-4 | | |
| **Project Characteristics** | | |
| Proposed or Potential Land Use(s) | | Light Industrial |
| Proposed or Potential SIC Code(s) | | 1541 – General Contractors-Industrial Buildings and Warehouses |
| Area of Impervious Project Footprint (SF) | | 486,723 SF |
| Total Area of <u>proposed</u> Impervious Surfaces within the Project Limits (SF)/or Replacement | | 486,723 SF |
| 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 <u>existing</u> Impervious Surfaces within the project limits (SF) | | 23,571 SF |
| Is the project located within any MSHCP Criteria Cell? | | ☐ Y ☒ N |
| If so, identify the Cell number: | | N/A |
| 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 & C |
| What is the Water Quality Design Storm Depth for the project? | | 0.2 in/hr |

## Project Description

*The Redlands East Industrial project proposes a warehouse/industrial building (approximately 254,511 SF) within the City of Perris on approximately 12.6 acres of currently vacant land. The proposed project cover will be a combination of approximately 254,511 square feet of building, 232,212 square feet of pavement, and 61,752 square feet of landscape. The project is bounded by Redlands Ave to its west, existing structures to its south, vacant land to its east and northeast, and existing structures to its northwest. The surrounding roads are Rider St to the north and Placentia Ave to the south. The Redlands East project consists of a proposed industrial building along with all associated utilities, drive aisles, parking stalls, walkways, and landscaped areas.*

*In the existing condition, the project site generally drains from west to east but is quite flat overall (slopes under 1%). Runoff discharges off the site into natural conditions along the eastern boundary of* *the project site. From there, flows eventually end up being conveyed towards the Perris Valley Storm Drain (PVSD) Channel and ultimately discharged into the San Jacinto River.*

*For the proposed conditions, runoff is captured through a series of catch basins and inlets located throughout the site. Captured flows are then directed towards proposed treatment devices for water quality requirements. Treated flows are then directed towards proposed underground storage chambers in order to mitigate the peak flow rates exiting the site. The storage chambers proposed are 45-inch tall ADS MC-3500 Stormtech chamber with varying widths of perimeter stone within an approximate footprint of 316'x30' that contribute to the total storage volume, design calculations and drawings can be found in Appendix 6. Mitigated flows are then discharged into the proposed extension of Lateral A-B-10 located along Redlands Ave via a proposed pump (preliminarily sized with a capacity of Q= 5.0 cfs). These mitigated flows are conveyed north towards the existing MDP Line A-B which ultimately discharges into the PVSD Channel.*

*Due to site constraints, including poor infiltration rates of the existing soil, three (3) Modular Wetland System (MWS) treatment vaults are being proposed in tandem with any inlets (or roof drains) in order to treat for water quality requirements. There are multiple MWS treatment vaults being proposed that will vary in size (4'x17', 8'x20', and 8'x24'), to properly convey the flows from each drainage management area. The proposed MWS treatment vaults are classified as biotreatment devices per the WQMP guidelines. All captured onsite runoff will then be directed towards proposed underground storage chambers. The storage chambers ensure that the capacity of MDP Line A-B is not exceeded by the development of the Redlands East project. Details regarding the reallocated capacity of MDP Line A-B can be found in the Technical Memorandum titled "Perris Valley MDP: Line A-B and Line A-C Tributary Watershed Modification" dated February 12, 2020, see Appendix 10. Mitigation design calculations and drawings can be found in the separate drainage study prepared for P20-00021.*

## A.1 Maps and Site Plans

When completing your Project-Specific WQMP, include a map of the local vicinity and existing site. In addition, include all grading, drainage, landscape/plant palette and other pertinent construction plans in Appendix 2. At a **minimum**, your WQMP Site Plan should include the following:

- Drainage Management Areas
- Proposed Structural BMPs
- Drainage Path
- Drainage Infrastructure, Inlets, Overflows
- Source Control BMPs
- Buildings, Roof Lines, Downspouts
- Impervious Surfaces
- Standard Labeling

Use your discretion on whether or not you may need to create multiple sheets or can appropriately accommodate these features on one or two sheets. Keep in mind that the Co-Permittee plan reviewer must be able to easily analyze your project utilizing this template and its associated site plans and maps.

## A.2 Identify Receiving Waters

Using Table A.1 below, list in order of upstream to downstream, the receiving waters that the project site is tributary to. Continue to fill each row with the Receiving Water's 303(d) listed impairments (if any), designated beneficial uses, and proximity, if any, to a RARE beneficial use. Include a map of the receiving waters in Appendix 1.

**Table A.1** Identification of Receiving Waters

| Receiving Waters | EPA Approved 303(d) List Impairments | Designated Beneficial Uses | Proximity to RARE Beneficial Use |
|---|---|---|---|
| Perris Valley Storm Drain Channel | N/A | AGR, GWR, MUN, REC1, REC2, WARM, WILD | N/A |
| San Jacinto River Reach 3 (HU 802.11) | N/A | AGR, GWR, MUN, REC1, REC2, WARM, WILD | N/A |
| San Jacinto River Reach 2 (HU 802.11) | N/A | GWR, AGR, WILD, WARM, REC1, REC2, MUN | N/A |
| Canyon Lake (Railroad Canyon Reservoir) (HU 802.11) | Pathogens, Nutrients | AGR, REC1, MUN, GWR, WARM, REC2, WILD | N/A |
| San Jacinto River Reach 1 (HU 802.32) | N/A | AGR, GWR, MUN, REC1, REC2, WARM, WILD | N/A |
| Lake Elsinore (HU 802.31) | PCBs, Nutrients, Organic Enrichment/Low Dissolved Oxygen, Sediment Toxicity, Unknown Toxicity | MUN, REC1, REC2, WARM, WILD, AGR, PROC | N/A |

## 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 *(dependent on tenant)* | ☒ Y | ☐ N |
| Western Riverside MSHCP Consistency Approval (e.g., JPR, DBESP) | ☐ Y | ☐ N |
| Other *(please list in the space below as required)*<br>City of Perris Grading Permit | ☒ Y | ☐ N |

If yes is answered to any of the questions above, the Co-Permittee may require proof of approval/coverage from those agencies as applicable including documentation of any associated requirements that may affect this Project-Specific WQMP.

# Section B: Optimize Site Utilization (LID Principles)

Review of the information collected in Section 'A' will aid in identifying the principal constraints on site design and selection of LID BMPs as well as opportunities to reduce imperviousness and incorporate LID Principles into the site and landscape design. For example, **constraints** might include impermeable soils, high groundwater, groundwater pollution or contaminated soils, steep slopes, geotechnical instability, high-intensity land use, heavy pedestrian or vehicular traffic, utility locations or safety concerns. **Opportunities** might include existing natural areas, low areas, oddly configured or otherwise unbuildable parcels, easements and landscape amenities including open space and buffers (which can double as locations for bioretention BMPs), and differences in elevation (which can provide hydraulic head). Prepare a brief narrative for each of the site optimization strategies described below. This narrative will help you as you proceed with your LID design and explain your design decisions to others.

The 2010 Santa Ana MS4 Permit further requires that LID Retention BMPs (Infiltration Only or Harvest and Use) be used unless it can be shown that those BMPs are infeasible. Therefore, it is important that your narrative identify and justify if there are any constraints that would prevent the use of those categories of LID BMPs. Similarly, you should also note opportunities that exist which will be utilized during project design. Upon completion of identifying Constraints and Opportunities, include these on your WQMP Site plan in Appendix 1.

## Site Optimization

The following questions are based upon Section 3.2 of the WQMP Guidance Document. Review of the WQMP Guidance Document will help you determine how best to optimize your site and subsequently identify opportunities and/or constraints, and document compliance.

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

*The existing site is very flat but generally drains from west to east. Runoff exits the site through the eastern boundary and ultimately drains towards the PVSD Channel located approximately 2000 feet east of the site. In the developed condition, a network of catch basins and inlets will collect flows. After being treated by MWS vaults and mitigated by proposed underground storage chambers, a proposed pump will discharge flows west towards Redlands Ave. From there flows enter the extension of Lateral A-B-10 and are conveyed north into the existing MDP Line A-B. MDP Line A-B ultimately conveys these flows from west to east into the PVSD Channel similar to the existing flows.*

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

*The existing vegetation is very minimal. The existing project site is primarily barren, so no existing vegetation is proposed to be protected.*

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

*Per a geotechnical investigation, the recommended design infiltration rates vary from 0.7 to 1.5 throughout the site. Due to poor infiltration capacities within the underlying soils of the project site, an infiltration-based BMP is not feasible to treat for water quality requirements. A copy of the investigation report can be found in Appendix 3.*

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

*The impervious area will be minimized as much as possible while maintaining safe and usable facilities onsite. Landscaped areas have been provided throughout the project site along concrete walkways,* *around the proposed building, adjacent to parking areas, and in other feasible locations throughout the site.*

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

*Yes, however, based on the nature of the industrial development, not all runoff can feasibly be directed towards a pervious area before being captured. Pervious landscaped areas are proposed around the proposed buildings in order to maximize the chances of runoff dispersing into landscaped areas before being captured. All inlets located onsite are provided with an MWS Treatment Vault to provide water quality treatment.*

# Section C: Delineate Drainage Management Areas (DMAs)

Utilizing the procedure in Section 3.3 of the WQMP Guidance Document which discusses the methods of delineating and mapping your project site into individual DMAs, complete Table C.1 below to appropriately categorize the types of classification (e.g., Type A, Type B, etc.) per DMA for your project site. Upon completion of this table, this information will then be used to populate and tabulate the corresponding tables for their respective DMA classifications.

**Table C.1** DMA Classifications

| DMA Name or ID | Surface Type(s)[1] | Area (Sq. Ft.) | DMA Type |
|---|---|---|---|
| DMA 1 | Mixed Use – Roofs, Concrete/Asphalt and Ornamental Landscaping | 184,491 | D-Biotreatment |
| DMA 2 | Mixed Use – Concrete/Asphalt and Ornamental Landscaping | 188,107 | D-Biotreatment |
| DMA 3 | Roofs | 133,283 | D-Biotreatment |
| DMA 4 | Mixed Use – Concrete/Asphalt and Ornamental Landscaping | 42,319 | D-Biotreatment |

*[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) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

**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] |
| DMA 1 - Self-Retaining | LANDSCAPE | 6,308 | 0.64 | N/A | N/A | N/A |
| DMA 2 - Self-Retaining | LANDSCAPE | 12,049 | 0.64 | N/A | N/A | N/A |
| | | | | | | |

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

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

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

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

| DMA Name or ID | BMP Name or ID |
|---|---|
| DMA 1 | MWS Vault (8' x 24') |
| DMA 2 | MWS Vault (8' x 20') |
| DMA 3 | MWS Vault (8' x 20') |
| DMA 4 | MWS Vault (4' x 17') |
| DMA 1-4 | ADS Underground Storage Chambers |

*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

If yes has been checked, Infiltration BMPs shall not be used for the site. If no, continue working through this section to implement your LID BMPs. It is recommended that you contact your Co-Permittee to verify whether or not your project discharges to an approved downstream 'Highest and Best Use' feature.

### Geotechnical Report

A Geotechnical Report or Phase I Environmental Site Assessment may be required by the Copermittee to confirm present and past site characteristics that may affect the use of Infiltration BMPs. In addition, the Co-Permittee, at their discretion, may not require a geotechnical report for small projects as described in Chapter 2 of the WQMP Guidance Document. If a geotechnical report has been prepared, include it in Appendix 3. In addition, if a Phase I Environmental Site Assessment has been prepared, include it in Appendix 4.

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 below is meant to provide a simple means of assessing which DMAs on your site support Infiltration BMPs and is discussed in the WQMP Guidance Document in Chapter 2.4.5. Check the appropriate box for each question and then list affected DMAs as applicable. If additional space is needed, add a row below the corresponding answer.

**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? | X | |
| If Yes, list affected DMAs: **All 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: | | |

If you answered "Yes" to any of the questions above for any DMA, Infiltration BMPs should not be used for those DMAs and you should proceed to the assessment for Harvest and Use below.

## 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).

☐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. If neither of the above criteria applies, follow the steps below to assess the feasibility of irrigation use, toilet use and other non-potable uses (e.g., industrial use).

### Irrigation Use Feasibility

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*: N/A

*Type of Landscaping (Conservation Design or Active Turf)*: N/A

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:* N/A

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*: N/A

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*: N/A

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) |
|---|---|
| N/A | N/A |

### Toilet Use Feasibility

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:* N/A

*Project Type:* N/A

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:* N/A

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:* N/A

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:* N/A

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)** |
|---|---|
| N/A | N/A |

### Other Non-Potable Use Feasibility

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.

N/A

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:* N/A

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:* N/A

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:* N/A

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:* N/A

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) |
|---|---|
| N/A | N/A |

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:*

☒ 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

From the Infiltration, Harvest and Use, Bioretention and Biotreatment Sections above, complete Table D.2 below to summarize which LID BMPs are technically feasible, and which are not, based upon the established hierarchy.

**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 | |
| DMA 1 | ☐ | ☐ | ☐ | ☐ | ☒ |
| DMA 2 | ☐ | ☐ | ☐ | ☐ | ☒ |
| DMA 3 | ☐ | ☐ | ☐ | ☐ | ☒ |
| DMA 4 | ☐ | ☐ | ☐ | ☐ | ☒ |
| | ☐ | ☐ | ☐ | ☐ | ☐ |
| | ☐ | ☐ | ☐ | ☐ | ☐ |

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.

## D.5 LID BMP Sizing

Each LID BMP must be designed to ensure that the Design Capture Volume will be addressed by the selected BMPs. First, calculate the Design Capture Volume for each LID BMP using the $V_{BMP}$ worksheet in Appendix F of the LID BMP Design Handbook. Second, design the LID BMP to meet the required $V_{BMP}$ using a method approved by the Copermittee. Utilize the worksheets found in the LID BMP Design Handbook or consult with your Copermittee to assist you in correctly sizing your LID BMPs. Complete Table D.3 below to document the Design Capture Volume and the Proposed Volume for each LID BMP. Provide the completed design procedure sheets for each LID BMP in Appendix 6. You may add additional rows to the table below as needed.

**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 | *BMP ID - DMA 1* | | |
|---|---|---|---|---|---|---|---|---|
| | [A] | | [B] | [C] | [A] x [C] | | | |
| | | | | | | *Design Rainfall Intensity (in/hr)* | *Design Flow Rate, $Q_{BMP}$ (cfs)* | *Proposed Flow Rate (cfs)* |
| ***DMA 1 – Concrete / Asphalt*** | *45817* | *Concrete or Asphalt* | *1* | *0.89* | *40868.8* | | | |
| ***DMA 1 - L/S*** | *15231* | *Ornamental Landscaping* | *0.1* | *0.11* | *1682.4* | | | |
| ***DMA 1 - Roofs*** | *117135* | *Roofs* | *1* | *0.89* | *104484.4* | | | |
| ***DMA 1 – Self-Retaining*** | *6308* | *Ornamental Landscaping* | *0.1* | *0.11* | *696.8* | | | |
| | $A_T = \Sigma[A]$ **184491** | | | | Σ= [D] **147732.4** | [E] **0.2** | $[F] = \frac{[D]x[E]}{12}$ **0.7** | [G] **0.7** |

[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

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | *BMP ID - DMA 2* | | |
|---|---|---|---|---|---|---|---|---|
| | [A] | | [B] | [C] | [A] x [C] | | | |
| | | | | | | *Design Rainfall Intensity (in/hr)* | *Design Flow Rate, $Q_{BMP}$ (cfs)* | *Proposed Flow Rate (cfs)* |
| ***DMA 2 – Concrete / Asphalt*** | *148486* | *Concrete or Asphalt* | *1* | *0.89* | *132449.5* | | | |
| ***DMA 2 - L/S*** | *27572* | *Ornamental Landscaping* | *0.1* | *0.11* | *3045.5* | | | |
| ***DMA 1 – Self-Retaining*** | *12049* | *Ornamental Landscaping* | *0.1* | *0.11* | *1330.9* | | | |
| | $A_T = \Sigma[A]$ **188107** | | | | Σ= [D] **136825.9** | [E] **0.2** | $[F] = \frac{[D]x[E]}{12}$ **0.6** | [G] **0.6** |

[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

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | BMP ID - DMA 3 | | |
|---|---|---|---|---|---|---|---|---|
| | [A] | | [B] | [C] | [A] x [C] | | | |
| ***DMA 3 – Roofs*** | *133283* | *Roofs* | *1* | *0.89* | *118888.4* | *Design Rainfall Intensity (in/hr)* | *Design Flow Rate,* $Q_{BMP}$ *(cfs)* | *Proposed Flow Rate (cfs)* |
| | | | | | | | | |
| | $A_T = \Sigma[A]$ **133283** | | | | $\Sigma = [D]$ **118888.4** | [E] **0.2** | $[F] = \frac{[D]x[E]}{12}$ **0.5** | [G] **0.6** |

[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

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | BMP ID – DMA 4 (Redlands Ave) | | |
|---|---|---|---|---|---|---|---|---|
| | [A] | | [B] | [C] | [A] x [C] | | | |
| ***DMA 4 – Concrete / Asphalt*** | *37068* | *Concrete or Asphalt* | *1* | *0.89* | *33064.7* | *Design Rainfall Intensity (in/hr)* | *Design Flow Rate,* $Q_{BMP}$ *(cfs)* | *Proposed Flow Rate (cfs)* |
| ***DMA 4 - L/S*** | *5251* | *Ornamental Landscaping* | *0.1* | *0.11* | *580* | | | |
| | $A_T = \Sigma[A]$ **42319** | | | | $\Sigma = [D]$ **33644.7** | [E] **0.2** | $[F] = \frac{[D]x[E]}{12}$ **0.2** | [G] **0.2** |

[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

This section is for water quality treatment, which is being considered as flow based and will be treated by the proposed MWS vaults. Although this project is HCOC exempt, due to inadequate infiltration rates, the underground chambers are proposed only for storage in order to mitigate discharged flows from large storm events to an acceptable rate for Lat A-B-10. Mitigation design calculations and drawings can be found in the separate drainage study prepared for P20-00021.

# 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:

☒ 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.

N/A

## E.1 Identify Pollutants of Concern

Utilizing Table A.1 from Section A above which noted your project's receiving waters and their associated EPA approved 303(d) listed impairments, cross reference this information with that of your selected Priority Development Project Category in Table E.1 below. If the identified General Pollutant Categories are the same as those listed for your receiving waters, then these will be your Pollutants of Concern and the appropriate box or boxes will be checked on the last row. The purpose of this is to document compliance and to help you appropriately plan for mitigating your Pollutants of Concern in lieu of implementing LID BMPs.

**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 ft²) | P | N | N | N | N | N | P | P |
| ☐ Hillside Development (>5,000 ft²) | P | N | P | P | N | P | P | P |
| ☐ Parking Lots (>5,000 ft²) | 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

After you appropriately considered Stormwater Credits for your project, utilize Table E.3 below to appropriately size them to the DCV, or Design Flow Rate, as applicable. Please reference Chapter 3.5.2 of the WQMP Guidance Document for further information.

**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] | | | | |
| **N/A** | | | | | | *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)* |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | $A_T = \Sigma[A]$ | | | | 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

The sizing information for the proposed MWS treatment vaults can be found in Table D.3. The underground chambers are intended to be used for mitigation/storage purposes only and not as a BMP. The design calculations and drawings for the underground storage chambers can be found in Appendix 6 and the separate drainage study prepared for P20-00021.

## E.4 Treatment Control BMP Selection

Treatment Control BMPs typically provide proprietary treatment mechanisms to treat potential pollutants in runoff, but do not sustain significant biological processes. Treatment Control BMPs must have a removal efficiency of a medium or high effectiveness as quantified below:

- **High**: equal to or greater than 80% removal efficiency
- **Medium**: between 40% and 80% removal efficiency

Such removal efficiency documentation (e.g., studies, reports, etc.) as further discussed in Chapter 3.5.2 of the WQMP Guidance Document, must be included in Appendix 6. In addition, ensure that proposed Treatment Control BMPs are properly identified on the WQMP Site Plan in Appendix 1.

**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] |
|---|---|---|
| DMA 1-4 | Bacteria/Pathogens | Medium |
| | Sediment | High |
| | | |
| | | |

*[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

Once you have determined that the LID design is adequate to address water quality requirements, you will need to assess if the proposed LID Design may still create a HCOC. Review Chapters 2 and 3 (including Figure 3-7) of the WQMP Guidance Document to determine if your project must mitigate for Hydromodification impacts. If your project meets one of the following criteria which will be indicated by the check boxes below, you do not need to address Hydromodification at this time. However, if the project does not qualify for Exemptions 1, 2 or 3, then additional measures must be added to the design to comply with HCOC criteria. This is discussed in further detail below in Section F.2.

**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** | N/A | N/A | N/A |
| **Volume (Cubic Feet)** | N/A | N/A | N/A |

[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:

N/A.

## 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.

Be sure to include all pertinent documentation used in your analysis of the items a, b or c in Appendix 7.

*Project is located within the Hydromodification exemption area based on Riverside County WAP geodatabase approved April 20, 2017. See Appendix 7.*

*This project is HCOC exempt, however, mitigation is still being proposed due to Line A-B not being originally sized to accept flows from this area. Calculations for storage and routing can be found in Appendix 7. Information regarding the tributary area reallocations can be found in the technical memorandum titled "Perris Valley MDP: Line A-B and Line A-C Tributary Watershed Modification" dated February 12, 2020.*

# Section G: Source Control BMPs

Source control BMPs include permanent, structural features that may be required in your project plans — such as roofs over and berms around trash and recycling areas — and Operational BMPs, such as regular sweeping and "housekeeping", that must be implemented by the site's occupant or user. The MEP standard typically requires both types of BMPs. In general, Operational BMPs cannot be substituted for a feasible and effective permanent BMP. Using the Pollutant Sources/Source Control Checklist in Appendix 8, review the following procedure to specify Source Control BMPs for your site:

1. ***Identify Pollutant Sources*****:** Review Column 1 in the Pollutant Sources/Source Control Checklist. Check off the potential sources of Pollutants that apply to your site.

2. ***Note Locations on Project-Specific WQMP Exhibit*****:** Note the corresponding requirements listed in Column 2 of the Pollutant Sources/Source Control Checklist. Show the location of each Pollutant source and each permanent Source Control BMP in your Project-Specific WQMP Exhibit located in Appendix 1.

3. ***Prepare a Table and Narrative*****:** Check off the corresponding requirements listed in Column 3 in the Pollutant Sources/Source Control Checklist. In the left column of Table G.1 below, list each potential source of runoff Pollutants on your site (from those that you checked in the Pollutant Sources/Source Control Checklist). In the middle column, list the corresponding permanent, Structural Source Control BMPs (from Columns 2 and 3 of the Pollutant Sources/Source Control Checklist) used to prevent Pollutants from entering runoff. **Add additional narrative** in this column that explains any special features, materials or methods of construction that will be used to implement these permanent, Structural Source Control BMPs.

4. ***Identify Operational Source Control BMPs:*** To complete your table, refer once again to the Pollutant Sources/Source Control Checklist. List in the right column of your table the Operational BMPs that should be implemented as long as the anticipated activities continue at the site. Copermittee stormwater ordinances require that applicable Source Control BMPs be implemented; the same BMPs may also be required as a condition of a use permit or other revocable Discretionary Approval for use of the site.

**Table G.1** Permanent and Operational Source Control Measures

| Potential Sources of Runoff pollutants | Permanent Structural Source Control BMPs | Operational Source Control BMPs |
|---|---|---|
| *A. On-site storm drain 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.*<br>*Provide stormwater pollution prevention information to new site owners, lessees, or operators.*<br>*See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com* |
| *B. Interior floor drains and elevator shaft sump* | *The interior floor drains and elevator shaft sump pumps will be plumbed to* | *Inspect and maintain drains to prevent blockages and overflow.* |

| | | |
|---|---|---|
| | *sanitary sewer* | |
| *C. Landscape/Outdoor Pesticide Use* | *Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.*<br><br>*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.*<br><br>*Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions.*<br><br>*Consider using pest-resistant plants, especially adjacent to hardscape.*<br><br>*To ensure 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.*<br><br>*See applicable operational BMPs in "What you should know for…..Landscape and Gardening" at http://rcflood.org/stormwater/*<br><br>*Provide IPM information to new owners, lessees and operators.*<br><br>*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.* |
| *D. Refuse Areas* | *Trash container storage areas shall be paved with an impervious surface, designed not to allow run-on from adjoining areas, designed to divert drainage from adjoining roofs and pavements from the surrounding area, and screened or walled to prevent off-site transport of trash.*<br><br>*Trash dumpsters (containers) shall be leak proof and have attached covers or lids.*<br><br>*Trash enclosures shall be roofed per City standards.*<br><br>*Trash compactors shall be roofed and set on a concrete pad per City standards. The pad shall be a minimum of one foot larger all around than the trash compactor and sloped to drain to a sanitary sewer line. Connection of trash area drains to the MS4 is prohibited.*<br><br>*See CASQA SD-32 BMP Fact Sheets in Appendix 10 for additional information.*<br><br>*Signs shall be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.* | *Adequate number of receptacles shall be provided. 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, in Appendix 10, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbook at www.cabmphandbooks.com* |
| *E. Vehicle and Equipment* | *If a car wash area is not provided,* | *Washwater from vehicle and* |

| | | |
|---|---|---|
| *Cleaning* | *describe any measures taken to discourage on-site car washing and explain how these will be enforced.* | *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/](http://rcflood.org/stormwater/)* |
| *F. 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.* |
| *G. 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.*<br><br>*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.*<br><br>*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.*<br><br>*See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at [www.cabmphandbooks.com](www.cabmphandbooks.com)* |
| *H. Fire Sprinkler Test Water* | *Water discharged from the fire sprinkler systems shall not enter the storm drain system. Discharged water from fire sprinkler testing shall be collected and used for onsite landscape or disposed of at a local waste water treatment plant.* | *See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at [www.cabmphandbooks.com](www.cabmphandbooks.com)* |
| *I.* Fuel Dispensing Areas | | *The property owner shall dry sweep the fueling area routinely.*<br><br>*See the Fact Sheet SD-30, "Fueling Areas" in the CASQA Stormwater* |

| | | |
|---|---|---|
| | | *Quality Handbooks at www.cabmphandbooks.com* |

# Section H: Construction Plan Checklist

Populate Table H.1 below to assist the plan checker in an expeditious review of your project. The first two columns will contain information that was prepared in previous steps, while the last column will be populated with the corresponding plan sheets. This table is to be completed with the submittal of your final Project-Specific WQMP.

**Table H.1** Construction Plan Cross-reference

| BMP No. or ID | BMP Identifier and Description | Corresponding Plan Sheet(s) |
| --- | --- | --- |
| DMA 1-4 | MWS Treatment Vaults | PWQMP Exhibit Sheet 2 |
| | | |
| | | |
| | | |
| | | |

Note that the updated table — or Construction Plan WQMP Checklist — is **only a reference tool** to facilitate an easy comparison of the construction plans to your Project-Specific WQMP. Co-Permittee staff can advise you regarding the process required to propose changes to the approved Project-Specific WQMP.

***Section H will be completed and addressed during Final WQMP.***

# Section I: Operation, Maintenance and Funding

The Copermittee will periodically verify that Stormwater BMPs on your site are maintained and continue to operate as designed. To make this possible, your Copermittee will require that you include in Appendix 9 of this Project-Specific WQMP:

1. A means to finance and implement facility maintenance in perpetuity, including replacement cost.
2. Acceptance of responsibility for maintenance from the time the BMPs are constructed until responsibility for operation and maintenance is legally transferred. A warranty covering a period following construction may also be required.
3. An outline of general maintenance requirements for the Stormwater BMPs you have selected.
4. Figures delineating and designating pervious and impervious areas, location, and type of Stormwater BMP, and tables of pervious and impervious areas served by each facility. Geo-locating the BMPs using a coordinate system of latitude and longitude is recommended to help facilitate a future statewide database system.
5. A separate list and location of self-retaining areas or areas addressed by LID Principles that do not require specialized O&M or inspections but will require typical landscape maintenance as noted in Chapter 5, pages 85-86, in the WQMP Guidance. Include a brief description of typical landscape maintenance for these areas.

Your local Co-Permittee will also require that you prepare and submit a detailed Stormwater BMP Operation and Maintenance Plan that sets forth a maintenance schedule for each of the Stormwater BMPs built on your site. An agreement assigning responsibility for maintenance and providing for inspections and certification may also be required.

Details of these requirements and instructions for preparing a Stormwater BMP Operation and Maintenance Plan are in Chapter 5 of the WQMP Guidance Document.

**Maintenance Mechanism:** Privately maintained by Owner.

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

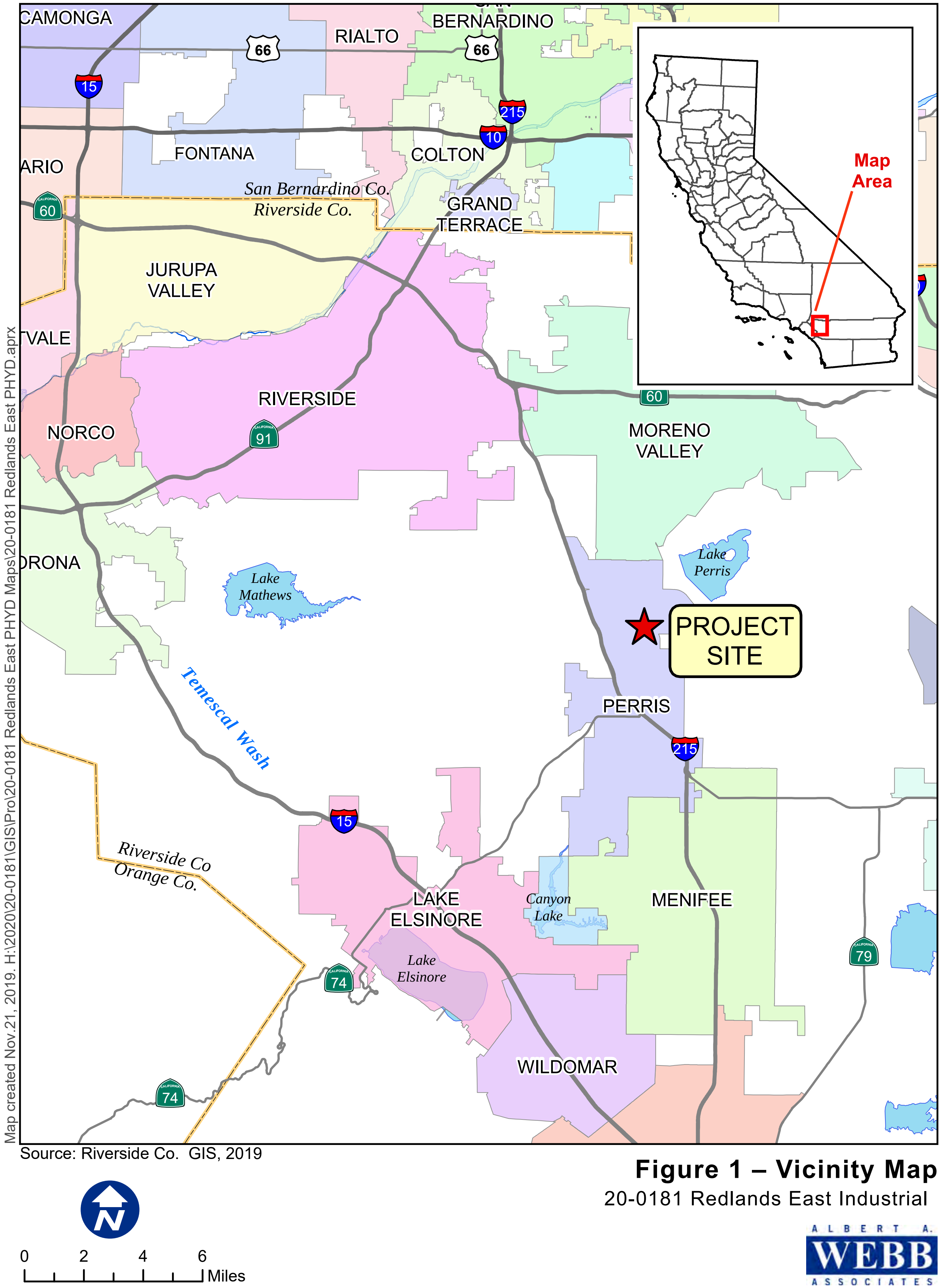
☒ Y ☐ N

Include your Operation and Maintenance Plan and Maintenance Mechanism in Appendix 9. Additionally, include all pertinent forms of educational materials for those personnel that will be maintaining the proposed BMPs within this Project-Specific WQMP in Appendix 10.

***Section I will be completed and addressed during Final WQMP.***

# Appendix 1: Maps and Site Plans

*Location Map, WQMP Site Plan and Receiving Waters Map*




Source: Riverside Co. GIS, 2019

**Figure 1 – Vicinity Map**

20-0181 Redlands East Industrial

ALBERT A. WEBB ASSOCIATES

H:\2020\20-0181\GIS\Pro\20-0181 Redlands East PHYD\20-0181 Redlands East PHYD.aprx; Map created 08 Dec 2020; AliS

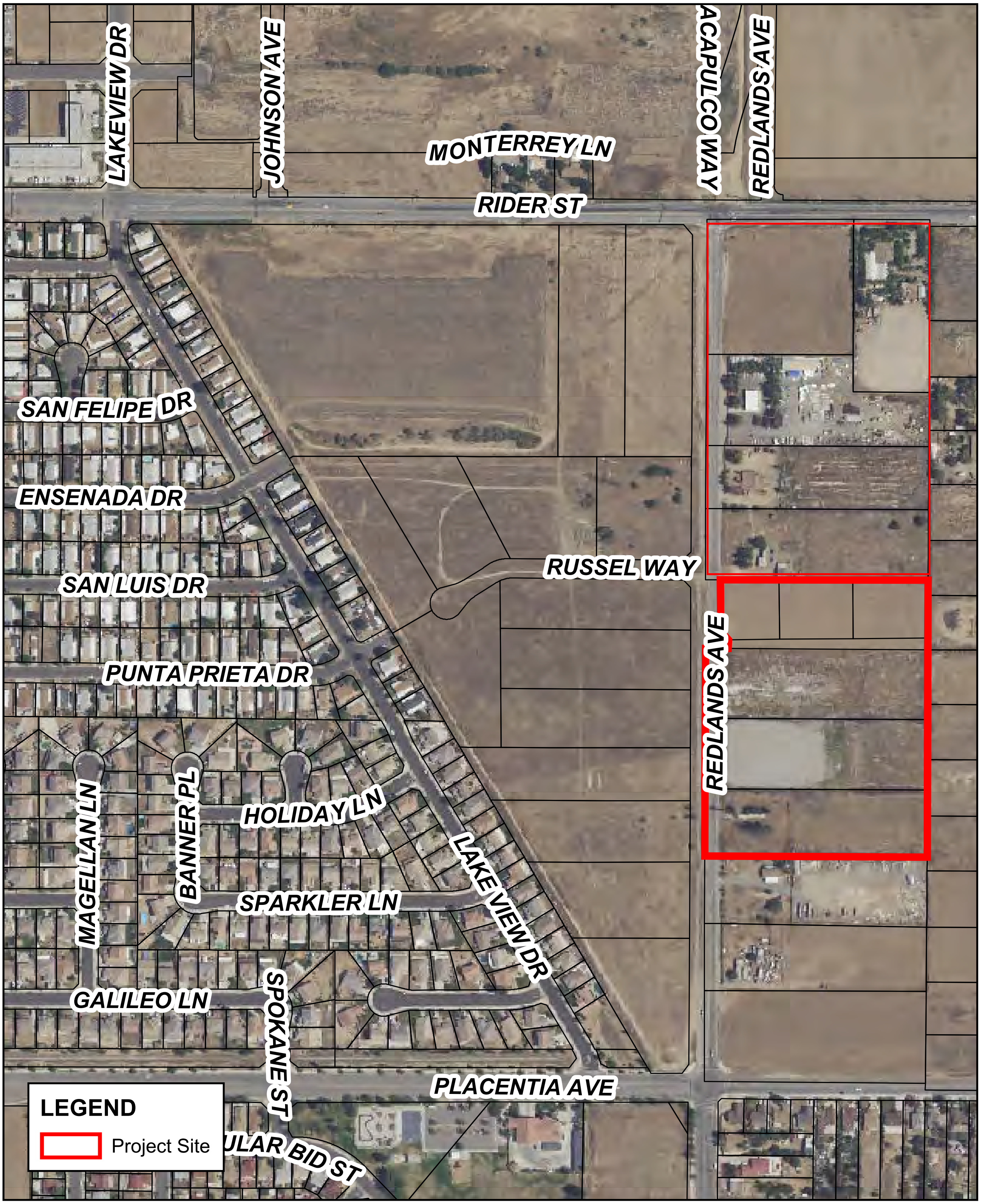

Sources: ESRI / USGS 7.5min Quad
DRGs: PERRIS

0 1,000 2,000 3,000 Feet

# Figure 2 - USGS Map

20-0181 Redlands East Industrial

ALBERT A. WEBB ASSOCIATES




H:\2020\20-0181\GIS\Pro\20-0181 Redlands East PHYD Maps\20-0181 Redlands East PHYD.aprx; Map created 08 Dec 2020

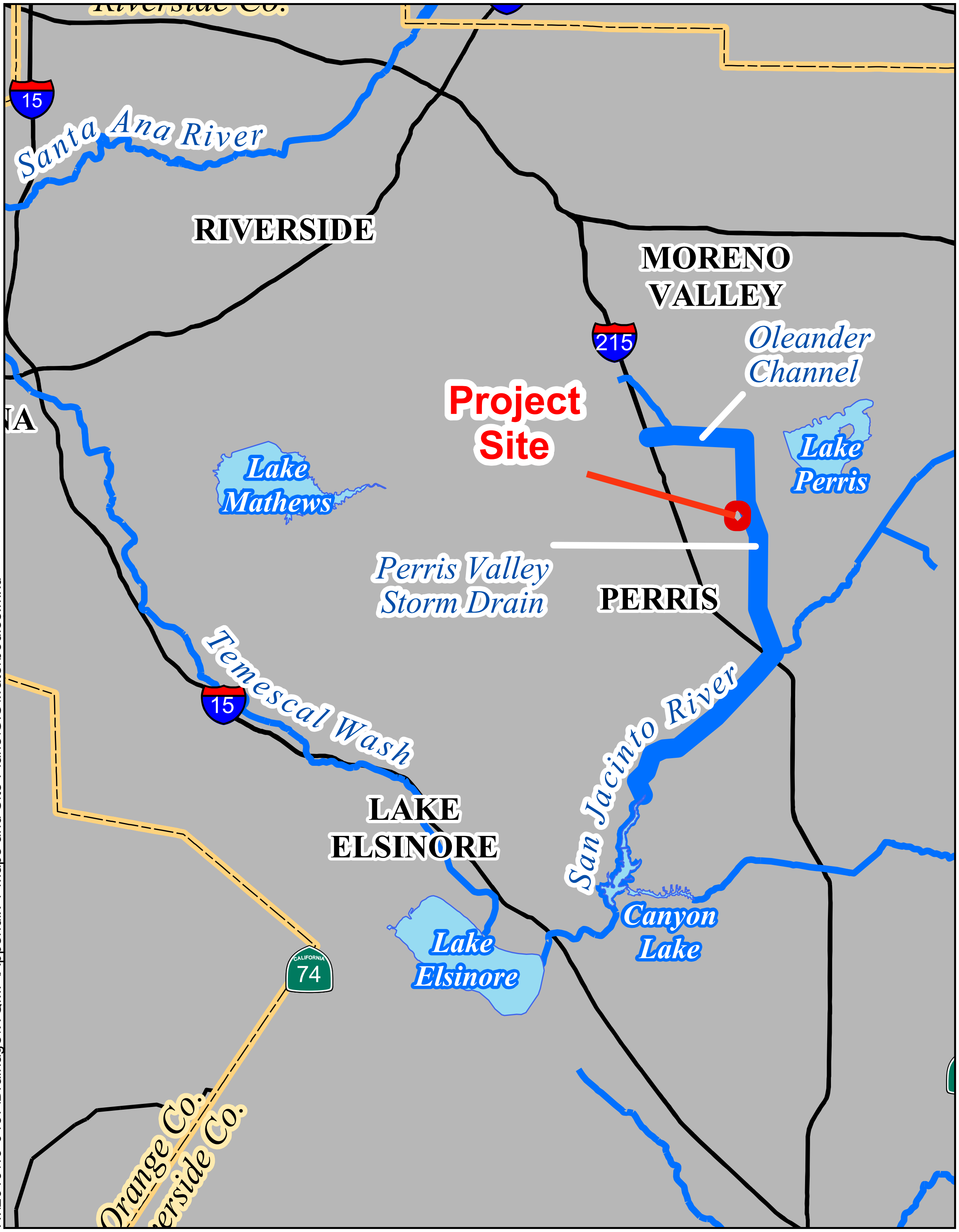
Source: Riverside Co. GIS, Jan. 2020.

**Figure 3 - Aerial Map**

20-0186 Redlands West Industrial

0 600 1,200 1,800 Feet

ALBERT A. WEBB ASSOCIATES




H:\2019\19-0137\Drainage\WQMP\Appendix 1-Maps and Site Plans\GIS\waterbodies.mxd

Sources: USGS 30 Meter DEM;
USGS Digital Line Graph

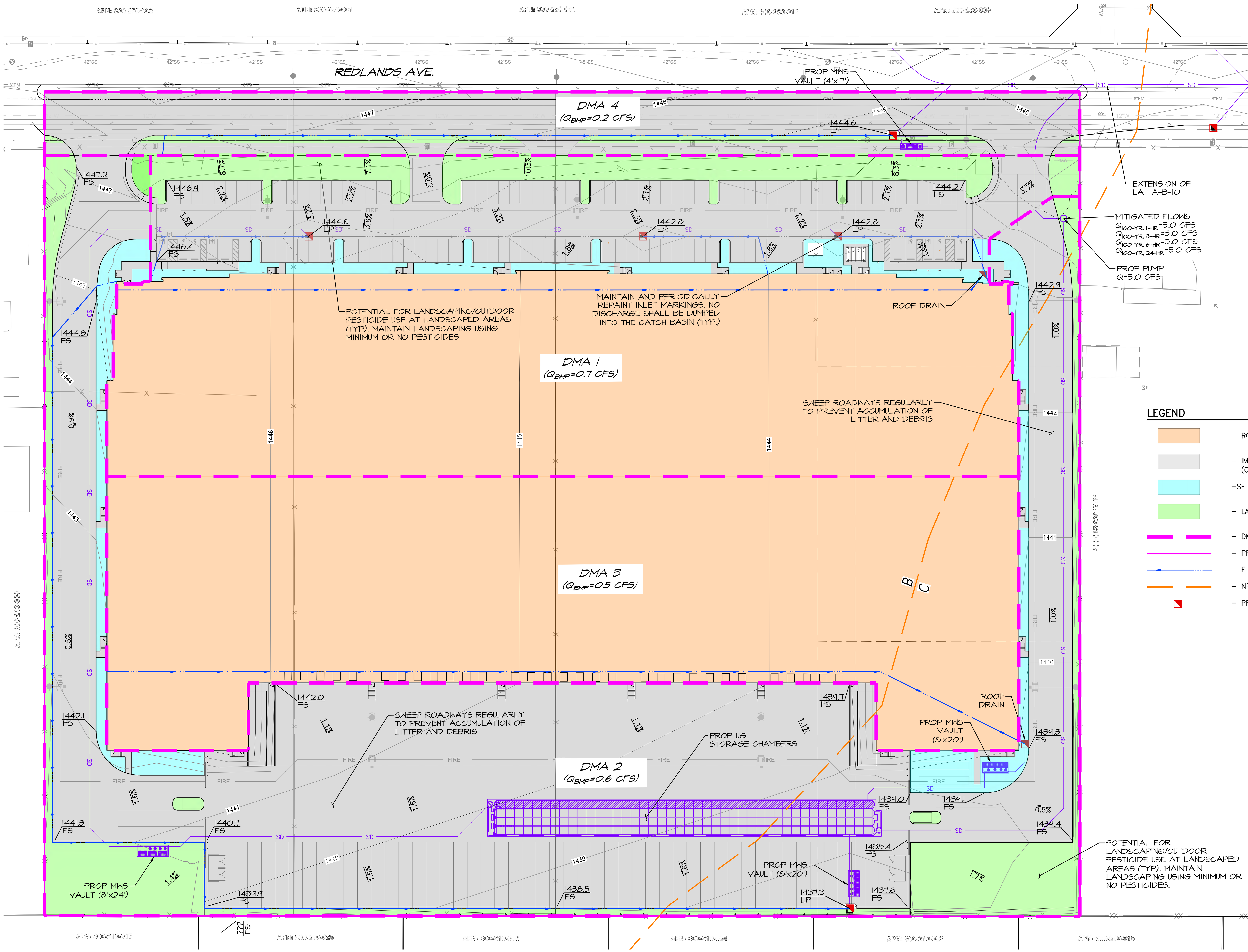
**Figure 4. Receiving Waterbodies**

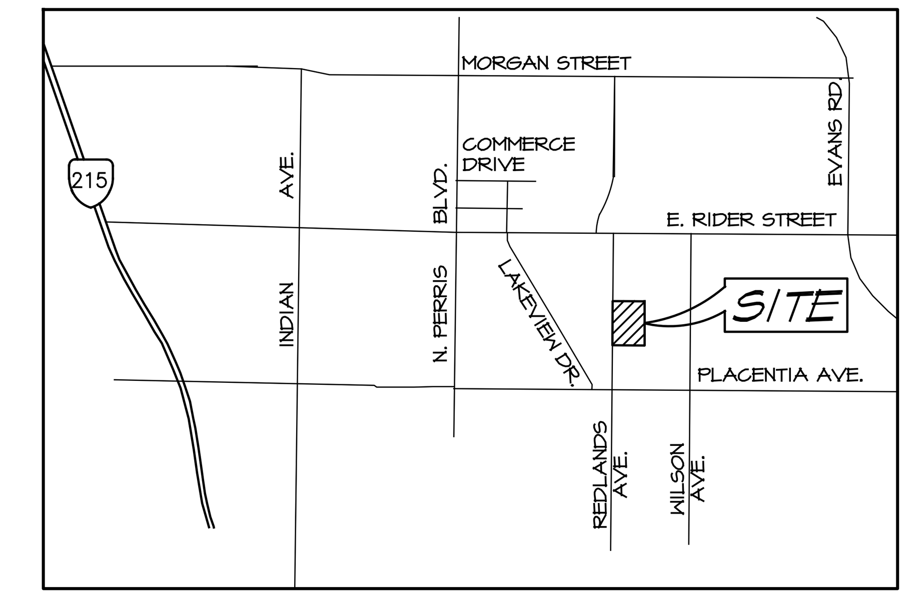
N

Flowpath

0 2 4 6 Miles

# PRELIMINARY WQMP EXHIBIT
# REDLANDS EAST




VICINITY MAP
*N.T.S.*

## GENERAL NOTES:

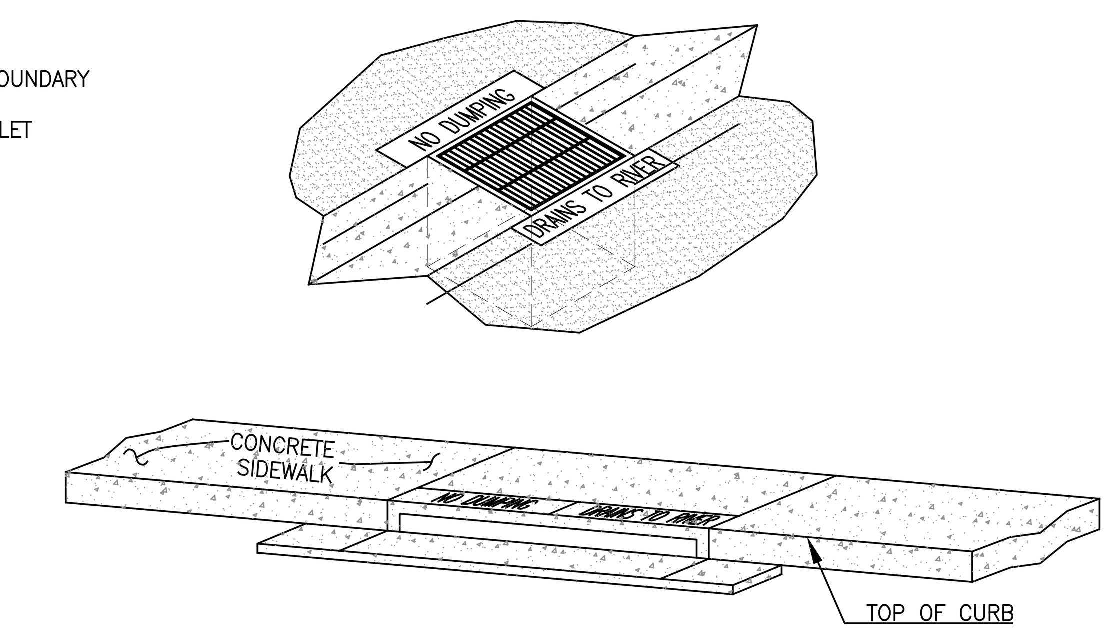
1. ALL PROPOSED STORM DRAIN CURB OPENING CATCH BASINS AND DROP INLETS SHALL BE STENCILED PER THE REQUIREMENTS OF THE CITY OF PERRIS AND THE DETAIL ON SHEET 2 (SEE CASQA SD-13).
2. ALL ROOF RUN-OFF SHALL BE DISCHARGED DIRECTLY INTO THE PROPOSED MWS TREATMENT VAULTS OR DIRECTLY INTO UNDERGROUND STORM DRAIN FACILITIES PER DETAIL ON SHEET 2 AND BE TREATED BY THE PROPOSED TREATMENT DEVICES BEFORE DISCHARGING INTO THE OFF-SITE MS4 STORM DRAIN FACILITY.
3. ALL ON-SITE FLOWS WILL DRAIN TO THE PROPOSED UNDERGROUND STORAGE CHAMBERS AND DISCHARGE INTO MDP LINE A-B LOCATED NORTH OF THE PROJECT SITE VIA THE EXTENSION OF THE EXISTING STUB-OUT LAT A-B-10.
4. A PROPOSED PUMP, PRELIMINARILY SIZED WITH A CAPACITY OF 5.0 CFS WILL LIMIT THE AMOUNT OF RUNOFF DISCHARGING OFF THE SITE.
5. FOR FLOWRATES AND OTHER HYDROLOGIC INFORMATION, SEE THE PRELIMINARY DRAINAGE REPORT. NO FLOWRATES OR VOLUMES CALCULATED FOR FLOOD CONTROL PURPOSES AFFECT THIS WATER QUALITY MANAGEMENT PLAN POST CONSTRUCTION BMP EXHIBIT (FLOW RATE BASED TREATMENT).
6. NO OFF-SITE RUN-ON WILL ENTER THE PROJECT SITE.

## SITE CONSTRAINTS:

1. THE USE OF INFILTRATION LID BMPs WAS FOUND INFEASIBLE FOR THE SITE DUE TO THE UNDERLYING SOILS.
2. THE USE OF HARVEST AND USE LID BMPs WAS FOUND INFEASIBLE FOR THE SITE DUE TO THE USE OF RECYCLED WATER FOR IRRIGATION PURPOSES.

## LEGEND

- ROOF
- IMPERVIOUS (CONCRETE/ASPHALT)
- SELF RETAINING
- LANDSCAPE
- DMA BOUNDARY
- PROJECT BOUNDARY
- FLOWLINE
- NRCS SOIL BOUNDARY
- PROPOSED INLET




1. STENCILS TO HAVE 2" LETTERS AS FOLLOWS: "NO DUMPING – DRAINS TO RIVER"
2. PLACE BOTH STENCILS CENTERED WITHIN THE CATCHBASIN OPENINGS AND WITHIN THE TOP OF THE CURB.
3. SPRAY BOTH STENCILS WITH WHITE PAINT.
4. REMOVE STENCILS WHEN PAINT IS DRY.

*CATCH BASIN STENCILING DETAIL*

NTS

1" = 40'

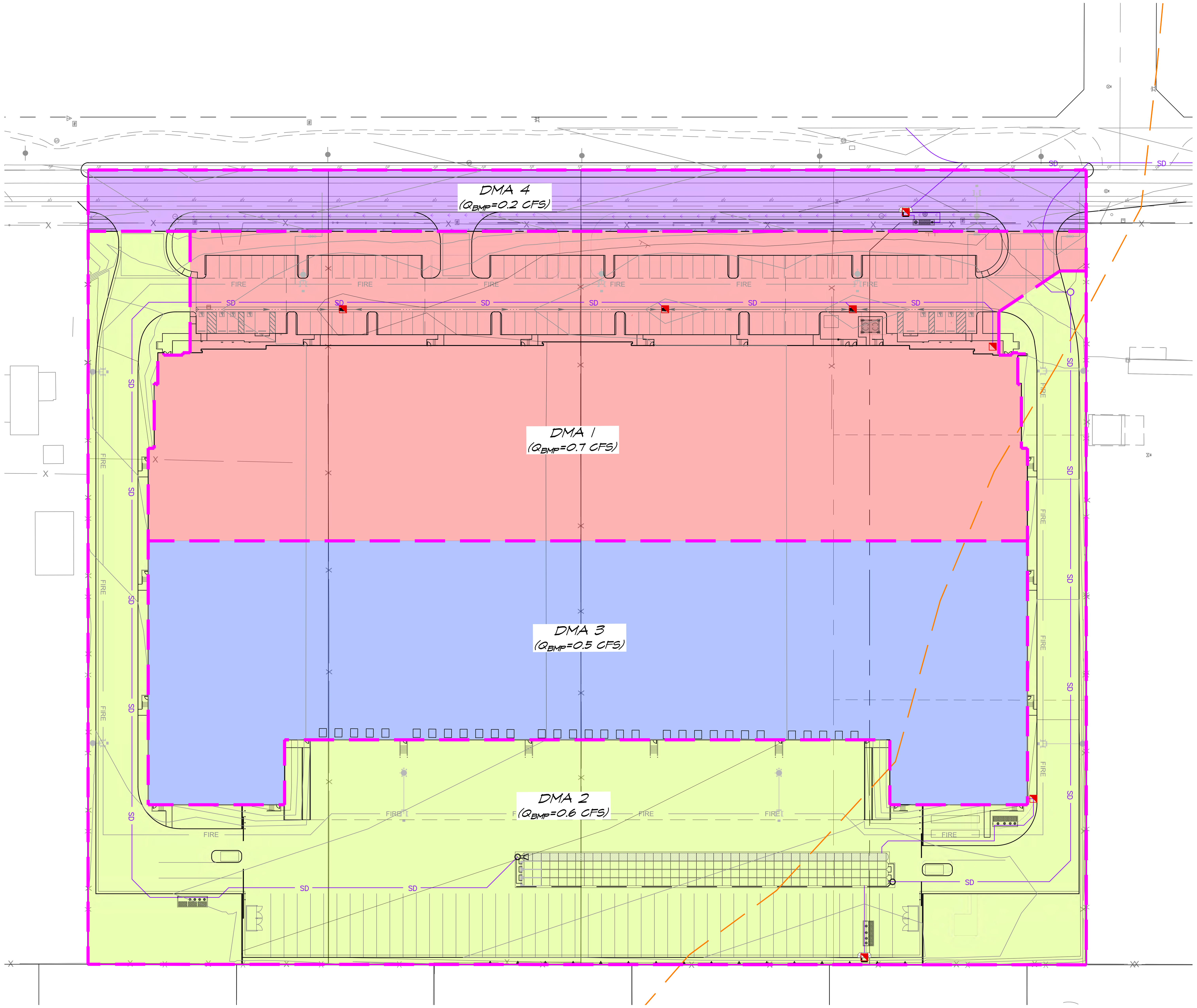
CITY OF PERRIS, CALIFORNIA

REDLANDS EAST
P20-00021
POST CONSTRUCTION BMP SITE PLAN

| | | | |
|---|---|---|---|
| SCALE: 1"=40' | ALBERT A. WEBB ASSOCIATES | ENGINEERING CONSULTANTS 3788 McCRAY STREET RIVERSIDE CA. 92506 PH. (951) 686-1070 FAX (951) 788-1256 | W.O. 20-0181 |
| DATE: 11/16/2020 | | | SHEET 1 OF 3 SHEETS |
| DESIGNED: AYS | | | |
| CHECKED: JRG | | | |
| PLN CK REF: | | | DWG. NO. |
| F.B. | | | |

H:\2020\20-0181\DRAINAGE\PWQMP\DWG DRAWINGS\20-0181-PWQMP EXHIBIT.DWG 3/23/2022 6:27:20 PM

# PRELIMINARY WQMP EXHIBIT
# REDLANDS EAST




DMA MAP

- DMA-A
- DMA-B
- DMA-C
- DMA-D

| DMA AREA TABLE | | | | |
|---|---|---|---|---|
| | DMA 1 | DMA 2 | DMA 3 | DMA 4 |
| CONCRETE (SF) | 45,817 | 148,486 | – | 37,068 |
| LANDSCAPE (SF) | 15,231 | 27,572 | – | 5,251 |
| SELF-RETAINING (SF) | 6,308 | 12,049 | – | – |
| ROOF (SF) | 117,135 | – | 133,283 | – |
| QBMP (CF) | 0.7 | 0.6 | 0.5 | 0.2 |
| QTREAT (CF) | 0.7 | 0.6 | 0.6 | 0.2 |

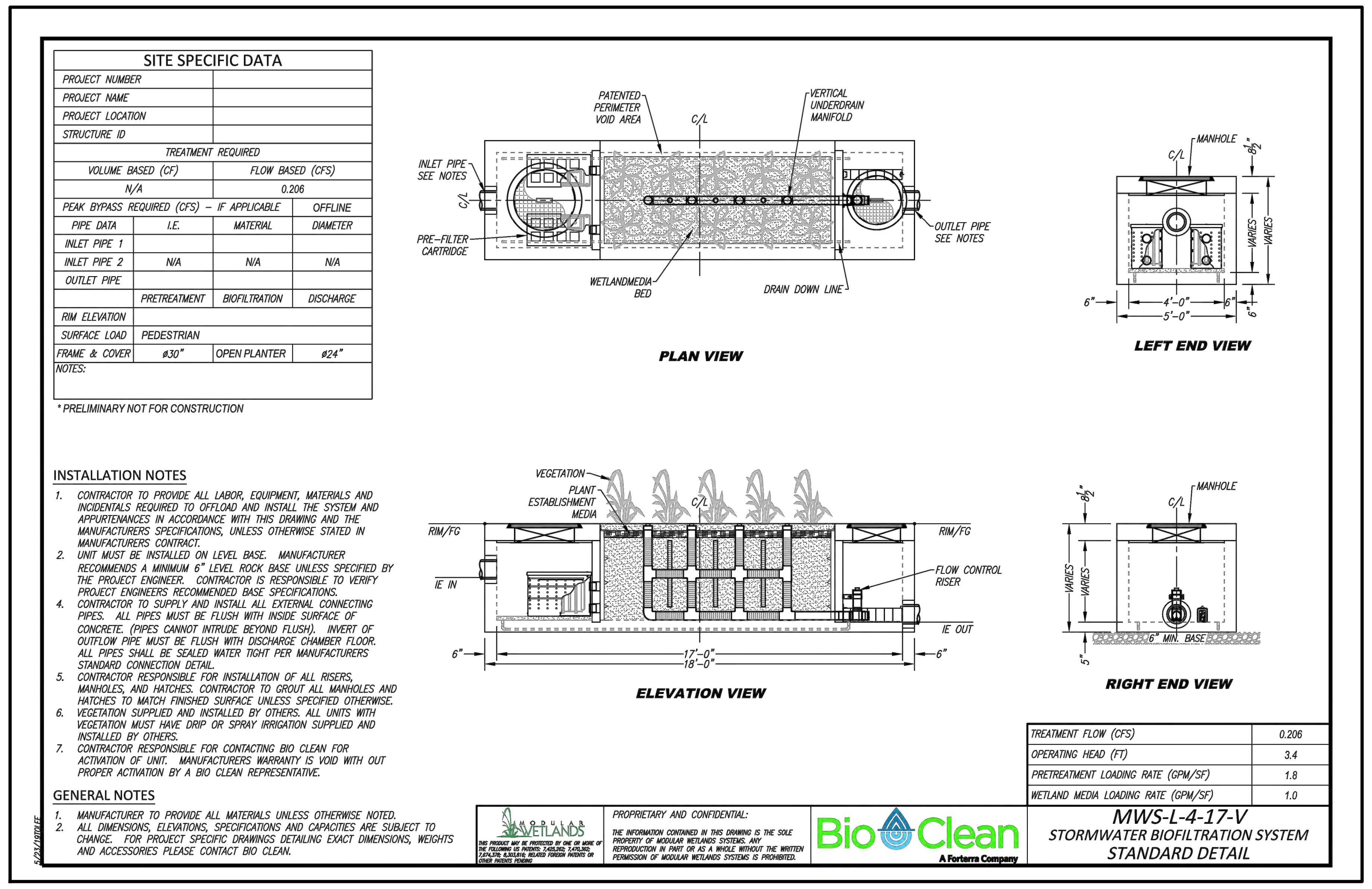
CITY OF PERRIS, CALIFORNIA

REDLANDS EAST
P20-00021
DMA PLAN
PWQMP EXHIBIT

| | | | |
|---|---|---|---|
| SCALE: N/A | ALBERT A. WEBB ASSOCIATES | ENGINEERING CONSULTANTS<br>3788 McCRAY STREET<br>RIVERSIDE CA. 92506<br>PH. (951) 686-1070<br>FAX (951) 788-1256 | W.O. 20-0181 |
| DATE: 11/16/2020 | | | SHEET 2 OF 3 SHEETS |
| DESIGNED: AYS | | | |
| CHECKED: JRG | | | |
| PLN CK REF: | | | DWG. NO. |
| F.B. | | | |

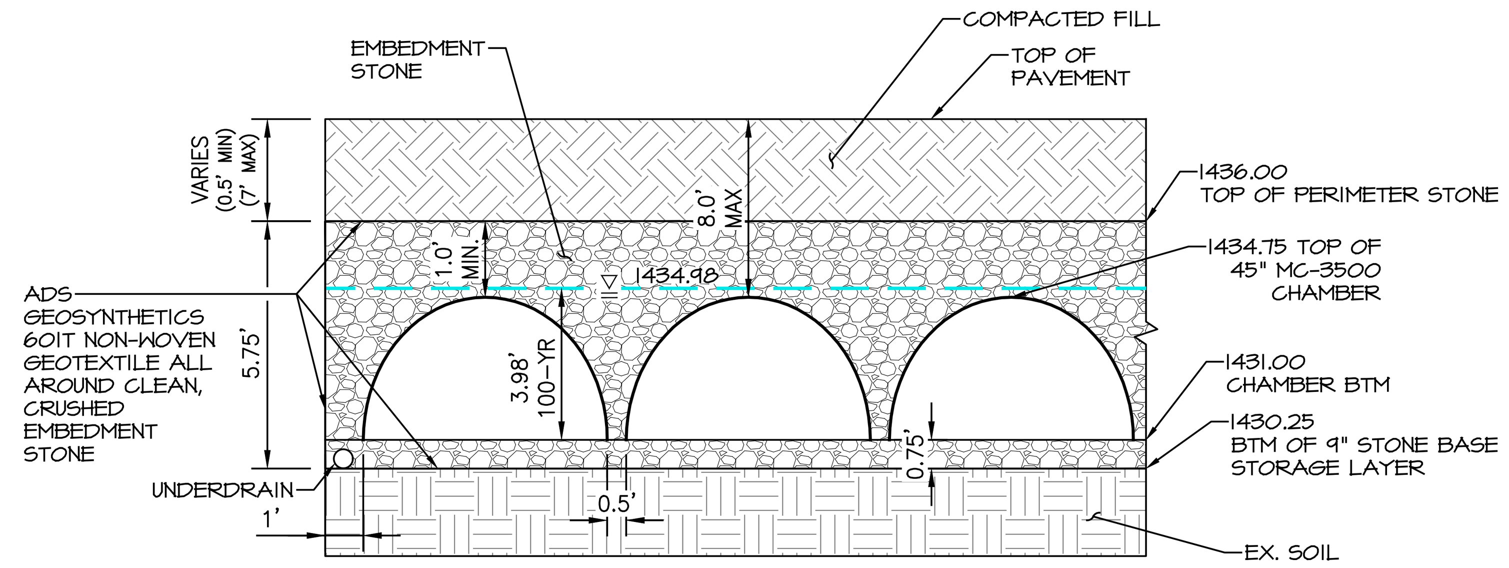
H:\2020\20-0181\DRAINAGE\PWQMP\DWG DRAWINGS\20-0181-PWQMP EXHIBIT.DWG 3/23/2022 6:27:20 PM

# PRELIMINARY WQMP EXHIBIT
# REDLANDS EAST



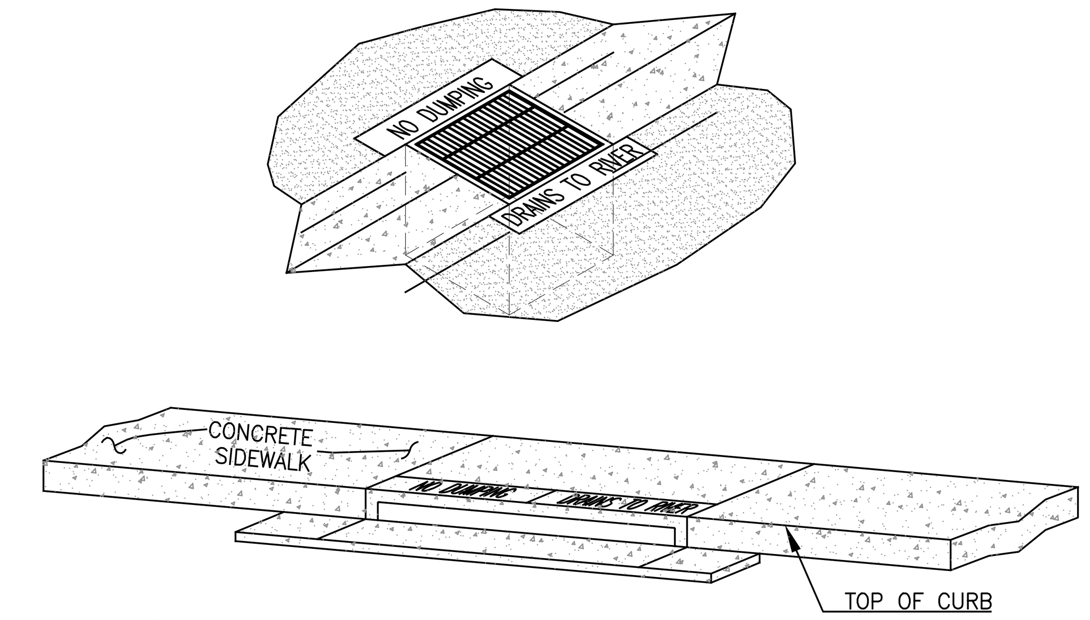

MWS VAULT - 4'X17'

DMA 4




UNDERGROUND STORAGE CROSS SECTION

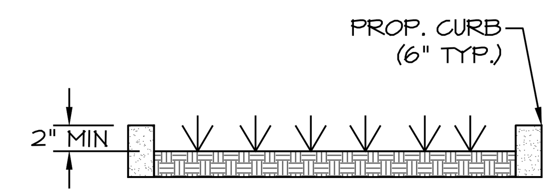
N.T.S.




1. STENCILS TO HAVE 2" LETTERS AS FOLLOWS: "NO DUMPING – DRAINS TO RIVER"
2. PLACE BOTH STENCILS CENTERED WITHIN THE CATCHBASIN OPENINGS AND WITHIN THE TOP OF THE CURB.
3. SPRAY BOTH STENCILS WITH WHITE PAINT.
4. REMOVE STENCILS WHEN PAINT IS DRY.

CATCH BASIN STENCILING DETAIL

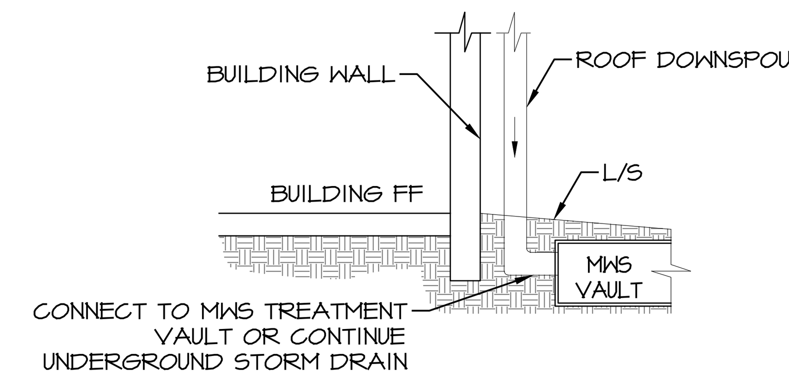
NTS




SELF-RETAINING FINGER ISLAND

N.T.S.

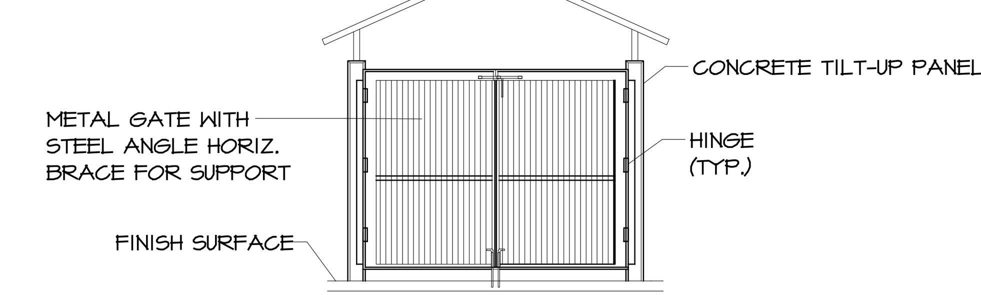
ALL SELF-RETAINING AREAS WILL BE DEPRESSED A MINIMUM OF 2-INCHES




CONCEPTUAL ROOF DRAIN DETAIL

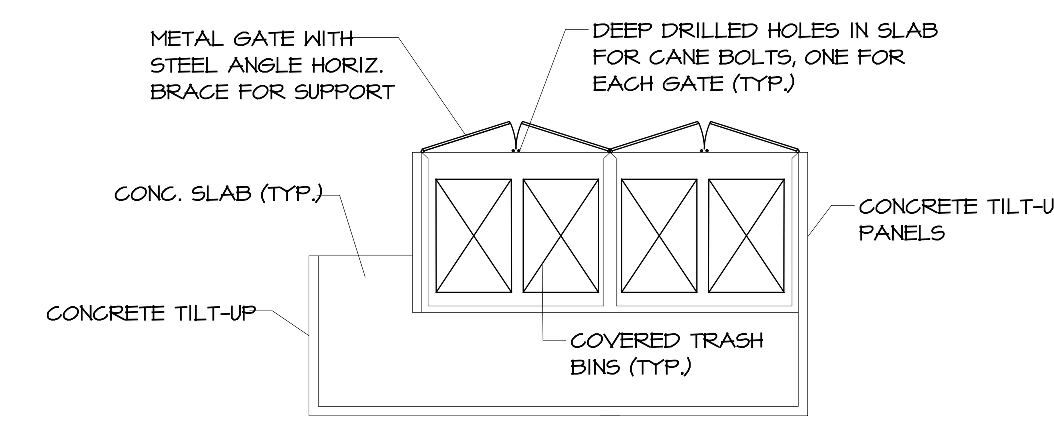
N.T.S.

ALL TRASH ENCLOSURES SHALL BE COVERED PER CITY STANDARDS



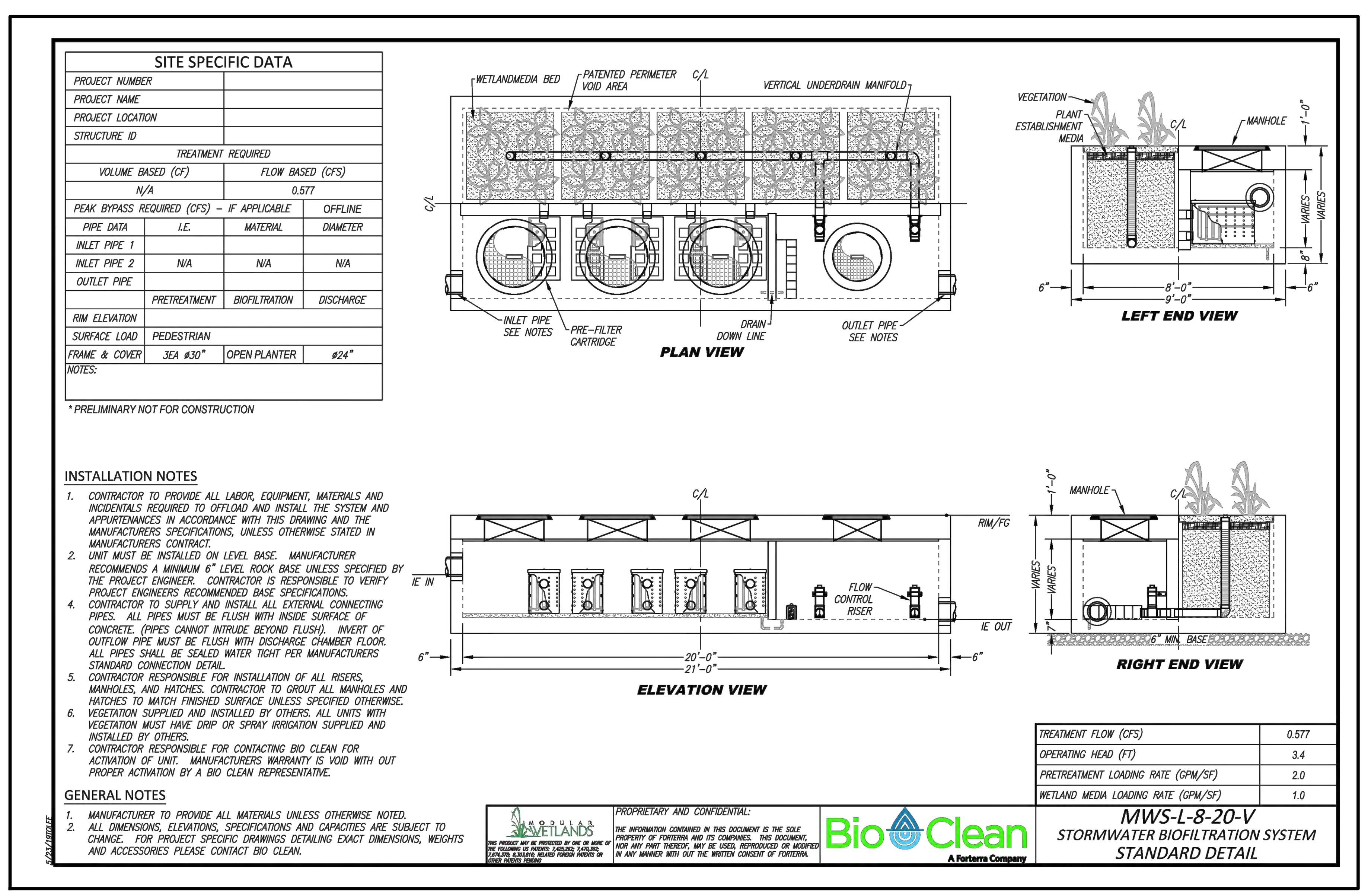

TRASH ENCLOSURE GATE ELEVATION

N.T.S.



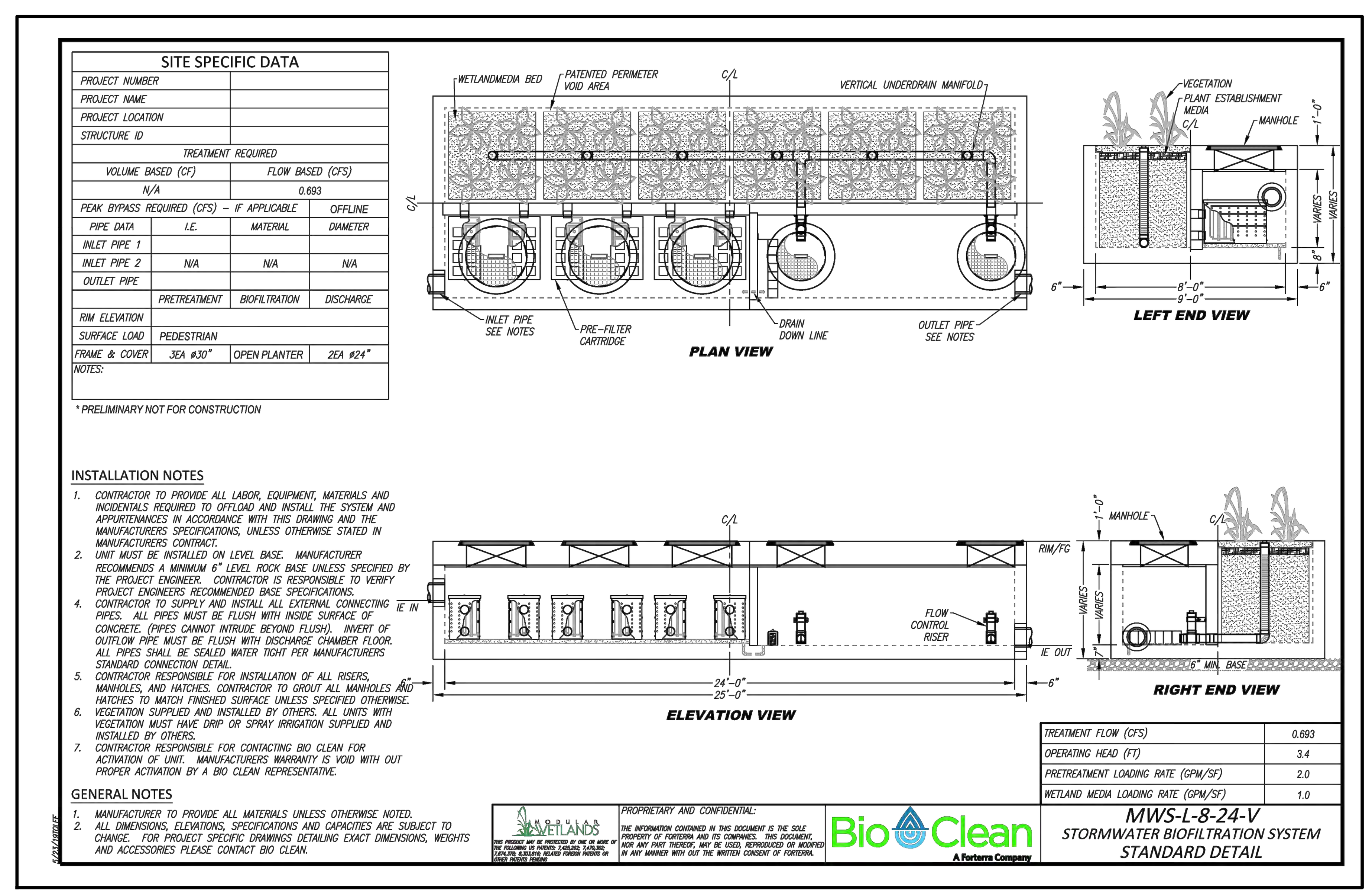

TRASH ENCLOSURE PLAN DETAIL

N.T.S.




MWS VAULT - 8'X20'

DMA 2 & DMA 3




MWS VAULT - 8'X24'

DMA 1

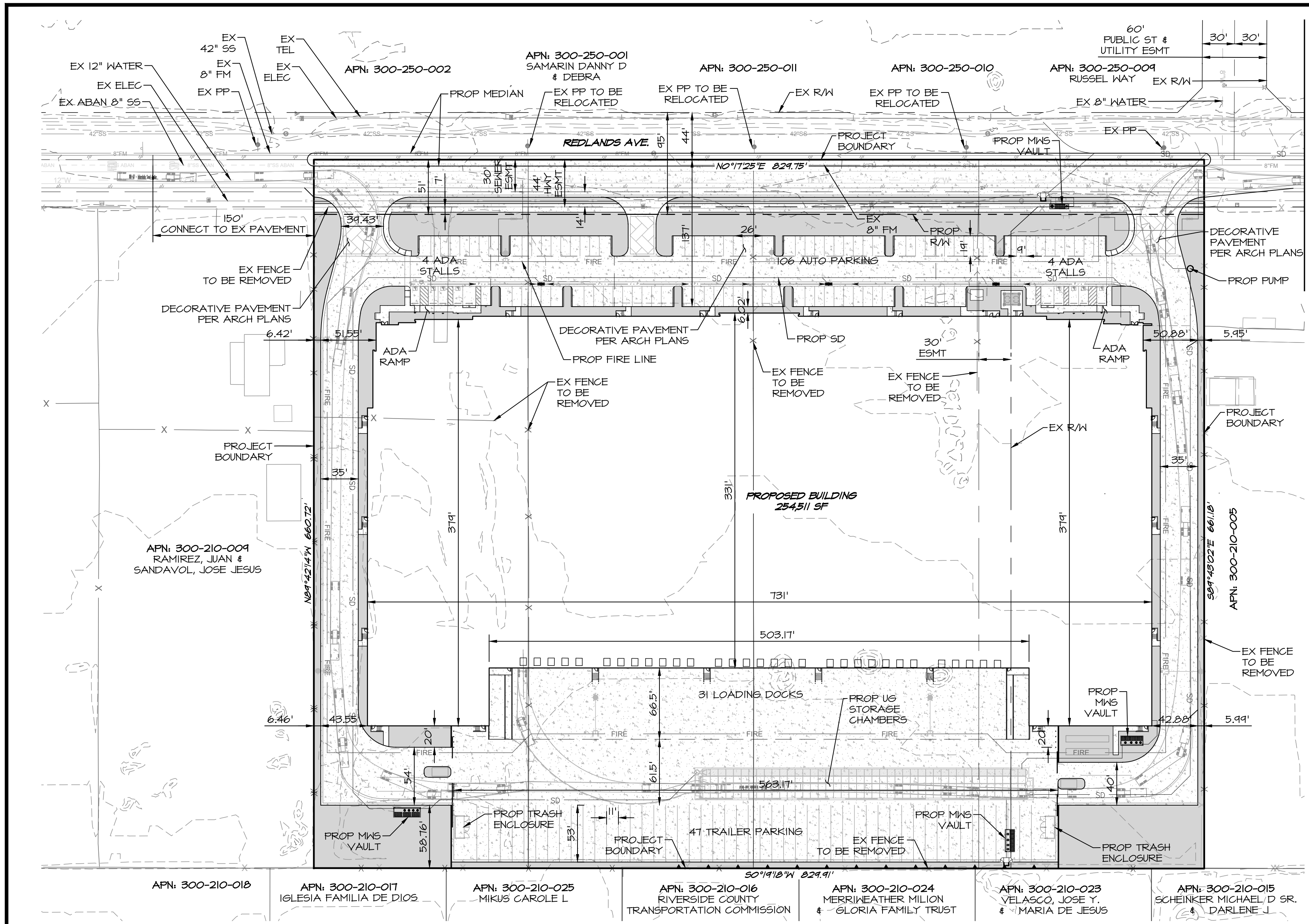
CITY OF PERRIS, CALIFORNIA

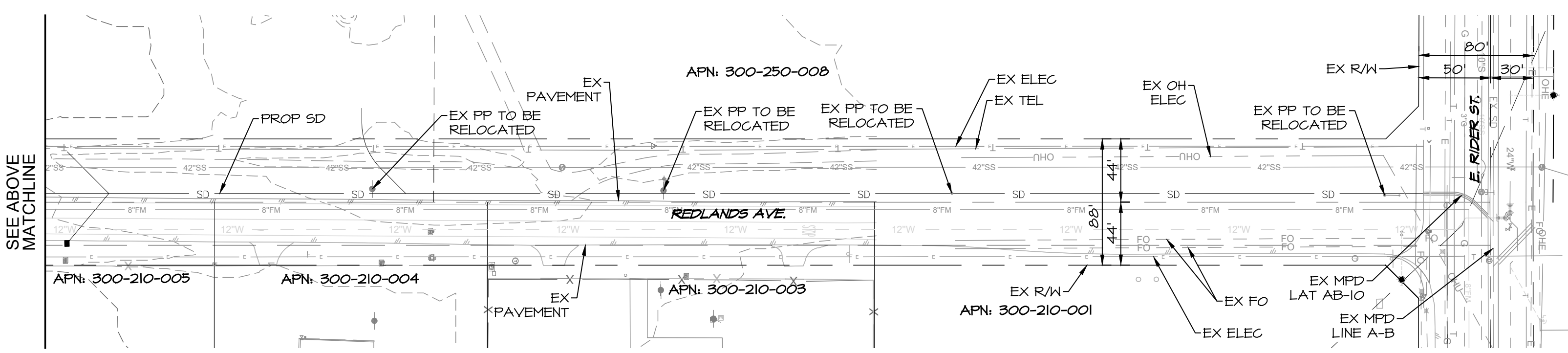
REDLANDS EAST
P20-00021
DETAILS
PWQMP EXHIBIT

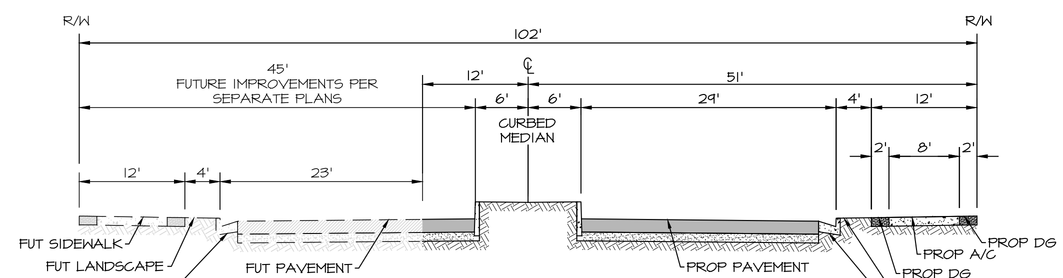
| | | | |
|---|---|---|---|
| SCALE: N/A | ALBERT A. WEBB ASSOCIATES | ENGINEERING CONSULTANTS 3788 McCRAY STREET RIVERSIDE CA. 92506 PH. (951) 686-1070 FAX (951) 788-1256 | W.O. 20-0181 |
| DATE: 11/16/2020 | | | SHEET 3 |
| DESIGNED: AYS | | | OF 3 SHEETS |
| CHECKED: JRG | | | DWG. NO. |
| PLN CK REF: | | | |
| F.B. | | | |

# Appendix 2:  Construction Plans

*Grading and Drainage Plans*



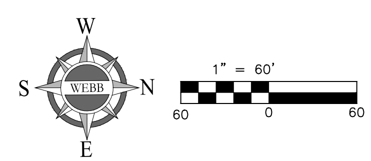



## TYPICAL SECTION REDLANDS AVE.

(ALONG PROJECT FRONTAGE)

SECONDARY ARTERIAL

NTS




## NOTES

1. 2010 THOMAS BROS. MAP - PAGE 777, GRID H-4
2. THIS AREA IS NOT SUBJECT TO LIQUEFACTION OR OTHER GEOLOGIC HAZARDS WITHIN A SPECIAL STUDIES ZONE.
3. FEMA COMMUNITY PANEL NO. 06065C1430H ZONE X (AREA OF MINIMAL FLOOD HAZARD), CITY OF PERRIS.
4. CONTOUR INTERVAL, ONE FOOT.
5. THIS AREA IS WITHIN THE PERRIS VALLEY COMMERCE CENTER SPECIFIC PLAN.
6. THIS PROJECT IS NOT WITHIN A COMMUNITY SERVICES DISTRICT.
7. THIS PROPERTY IS NOT SUBJECT TO OVERFLOW, INUNDATION, OR FLOOD HAZARD.
8. SUBSURFACE SEPTIC SEWAGE IS NOT INTENDED FOR THIS SITE.
9. ALL GATES ARE AT LEAST 24' IN WIDTH, AUTOMATIC WITH THE KNOX RAPID ENTRY SYSTEM.

## UTILITIES

| | |
|---|---|
| WATER | - EASTERN MUNICIPAL WATER DISTRICT |
| SEWER | - EASTERN MUNICIPAL WATER DISTRICT |
| GAS | - SOUTHERN CALIFORNIA GAS COMPANY |
| ELECTRIC | - SOUTHERN CALIFORNIA EDISON |
| TELEPHONE | - SPECTRUM |
| SCHOOL DIST. | - VAL VERDE SCHOOL DISTRICT |

## LEGAL DESCRIPTION

THE LAND REFERRED TO HEREIN IS SITUATED IN THE CITY OF PERRIS, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AND IS DESCRIBED AS FOLLOWS:

PARCEL 4, AS SHOWN BY PARCEL MAP NO. 10002, IN THE CITY OF PERRIS, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS SHOWN BY MAP ON FILE IN BOOK 42 PAGE 23 OF PARCEL MAPS, RECORDS OF RIVERSIDE COUNTY

PARCEL 1 OF PARCEL MAP NO. 11104, IN THE CITY OF PERRIS, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA, AS SHOWN BY MAP ON FILE IN BOOK 47, PAGE 62 OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

PARCEL 3 AS SHOWN ON PARCEL MAP 10002, RECORDED NOVEMBER 17, 1977 IN BOOK 42 PAGE 23 OF PARCEL MAPS, RECORDS OF RIVERSIDE COUNTY, CALIFORNIA.

PARCEL 1 TO PARCEL 3, INCLUSIVE TOGETHER WITH LETTERED LOTS "B", "C" AND "D" OF PARCEL MAP NO. 16345 AS SHOWN BY MAP ON FILE IN BOOK 142 OF PARCEL MAPS, AT PAGE 58 RECORDS OF RIVERSIDE COUNTY, CALIFORNIA, THE EXTERIOR BOUNDARY OF WHICH IS DESCRIBED BY MEETS AND BOUNDS AS FOLLOWS:

BEGINNING AT THE SOUTHWEST CORNER OF LOT "B" AS SHOWN ON SAID MAP;

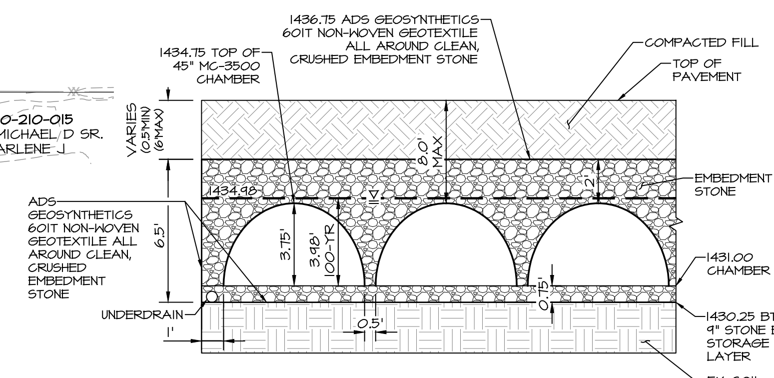
THENCE NORTH 0° 29' 07" WEST, ALONG THE WEST LINES OF SAID LOT "B" AND PARCEL 1 AS SHOWN ON SAID MAP, A DISTANCE 210.00 FEET TO THE NORTHWEST CORNER OF SAID PARCEL 1;

THENCE NORTH 89° 30' 53" EAST, ALONG THE NORTH LINES OF PARCEL 1, PARCEL 2 AND PARCEL 3 AS SHOWN ON SAID MAP, A DISTANCE OF 617.02 FEET TO THE NORTHEAST CORNER OF SAID PARCEL 3;

THENCE SOUTH 0° 27' 00" WEST, ALONG THE EAST LINES OF PARCEL 3 AND LOT "D" AS SHOWN ON SAID MAP, A DISTANCE OF 210.00 FEET TO THE SOUTHEAST CORNER OF SAID LOT "D";

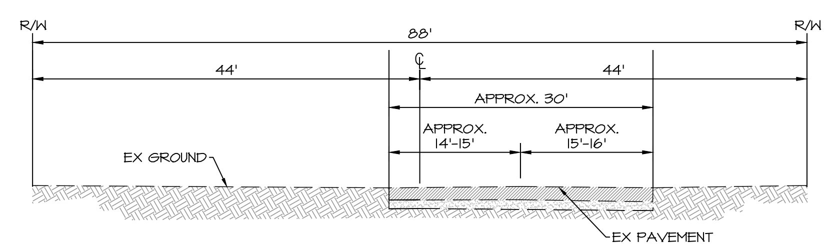
THENCE SOUTH 89° 30' 53" WEST, ALONG THE SOUTH LINES OF LOT "D", LOT "C" AND LOT "B", A DISTANCE OF 616.84 FEET TO THE POINT OF BEGINNING.

THIS LEGAL IS PURSUANT TO "CERTIFICATE OF COMPLIANCE PARCEL MERGER NO. 01-0106" RECORDED SEPTEMBER 11, 2002 AS INSTRUMENT NO. 2002-503549 OF OFFICIAL RECORDS.




## UNDERGROUND STORAGE CROSS SECTION

N.T.S.

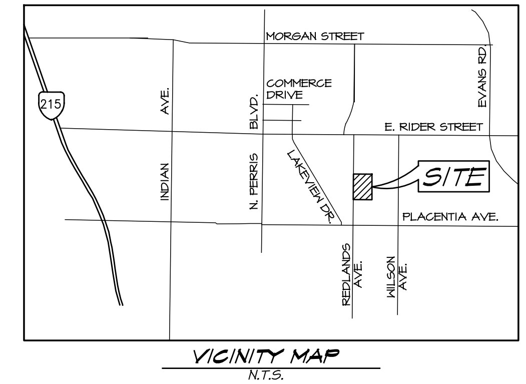



## EXISTING TYPICAL SECTION REDLANDS AVE.

(OUTSIDE PROJECT FRONTAGE)

SECONDARY ARTERIAL

NTS




## VICINITY MAP

N.T.S.

## APPLICANT

LAKE CREEK INDUSTRIAL LLC
1302 BRITTANY CROSS ROAD
SANTA ANA, CA 92705
CONTACT: MICHAEL JOHNSON
TEL:786-200-9681

## OWNER

LAKE CREEK INDUSTRIAL LLC
1302 BRITTANY CROSS ROAD
SANTA ANA, CA 92705

## APN

300-210-006 300-210-026
300-210-007 300-210-027
300-210-008 300-210-028

## LAND USE/ZONING

| | |
|---|---|
| EX LAND USE: | LIGHT INDUSTRIAL |
| PROPOSED LAND USE: | LIGHT INDUSTRIAL |
| EX ZONING: | LIGHT INDUSTRIAL |
| PROPOSED ZONING: | LIGHT INDUSTRIAL |
| EX GENERAL PLAN: | PVCC SP |
| PROPOSED GENERAL PLAN: | PVCC SP |

## ACREAGE

12.6 ACRES GROSS
11.7 ACRES NET

## TOPOGRAPHY

INLAND AERIAL SURVEYS, INC.
AUGUST 10, 2020

## EARTHWORK ESTIMATE

| | CUT | FILL |
|---|---|---|
| RAW CUT/FILL | 21,919 C.Y. | 21,919 C.Y. |

## PROJECT DATA

| | |
|---|---|
| SITE AREA | 548,475 SF<br>12.6 ACRES GROSS AREA<br>11.7 ACRES NET AREA |
| BUILDING AREA | |
| WAREHOUSE | 254,511 SF |
| LOT COVERAGE | 49.5% |
| PARKING REQUIRED | |
| 8,000 OFFICE PARKING (LESS THAN 10%) | 00 STALLS |
| 0-20K SF (1/1000 SF) | 20 STALLS |
| 20K-40K SF (1/2000 SF) | 10 STALLS |
| 40K+ SF (1/5000 SF) | 43 STALLS |
| TOTAL PARKING REQUIRED | 73 STALLS |
| PARKING PROVIDED | |
| ACCESSIBLE STALLS | 8 STALLS |
| STANDARD STALLS | 106 STALLS |
| FUTURE STALLS | 00 STALLS |
| TOTAL PROVIDED | 114 STALLS |
| LANDSCAPING | |
| AREA | 61,752 SF |
| AREA REQUIRED | 12.0% |
| AREA PROVIDED | 12.2% |
| GROSS IMPERVIOUS AREA | |
| AREA | 483,067 SF |

## LEGEND

- PROPOSED CONCRETE/ASPHALT
- PROPOSED LANDSCAPE
- PROPOSED COMBO RETAINING WALL / PERIMETER WALL
- PROPOSED 8' HIGH CHAIN LINK FENCE
- PROPOSED MWS WATER QUALITY TREATMENT VAULT (SIZE VARIES)
- EX POWER POLE
- FIRE LINE
- EX STORM DRAIN
- PROP STORM DRAIN
- PROP FH

| REVISIONS | DATE | BY |
|---|---|---|
| | | F.B. |

SCALE: 1"=60'
DATE: 12/2/21
DESIGNED: AYS
CHECKED: JRG
PLN CK REF:

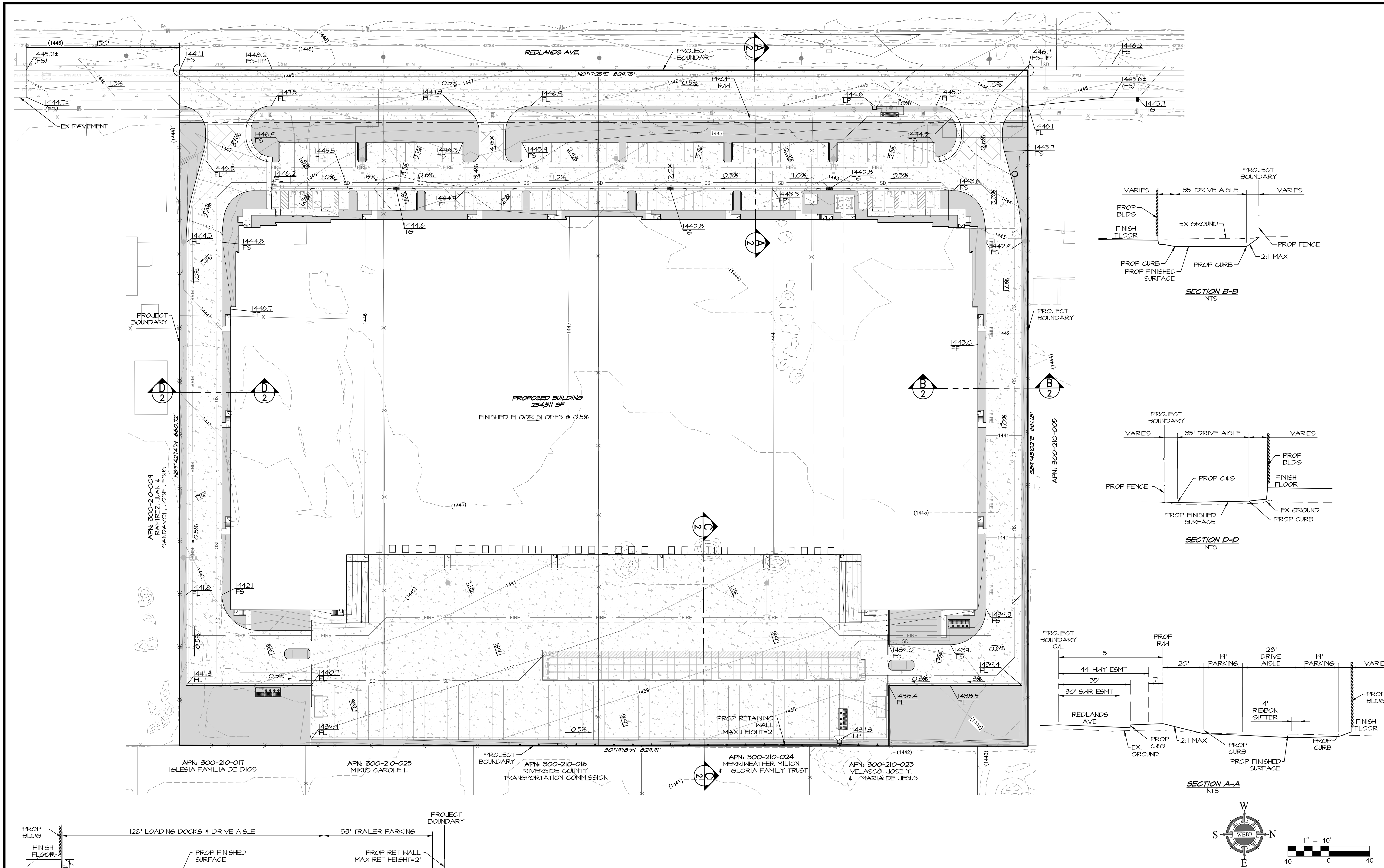
ALBERT A. WEBB ASSOCIATES
ENGINEERING CONSULTANTS
3788 McCRAY STREET
RIVERSIDE CA. 92506
PH. (951) 686-1070
FAX (951) 788-1256

PLOT DATE: 2-Dec-21

CITY OF PERRIS
DEVELOPMENT PLAN REVIEW
DPR 20-00021

W.O. 20-0181
SHEET 1 OF 2 SHEETS
DWG. NO.

H:\2020\20-0181\DRAWINGS\ENTITLEMENT\DPR\20-181-C-DPR.DWG 12/2/2021 2:15:31 PM




| | | | |
|---|---|---|---|
| REVISIONS | DATE | BY | |

SCALE: 1"=40'
DATE: 12/2/21
DESIGNED: AYS
CHECKED: JRG
PLN CK REF:
F.B.

ALBERT A. WEBB ASSOCIATES
ENGINEERING CONSULTANTS
3788 McCRAY STREET
RIVERSIDE CA. 92506
PH. (951) 686-1070
FAX (951) 788-1256

PLOT DATE: 2-Dec-21

CITY OF PERRIS
DEVELOPMENT PLAN REVIEW
DPR 20-00021
CONCEPTUAL GRADING & DRAINAGE PLAN

W.O. 20-0181
SHEET 2
OF 2 SHEETS
DWG. NO.

H:\2020\20-0181\DRAWINGS\ENTITLEMENT\DPR\20-181-C-DPR.DWG 12/2/2021 2:15:31 PM

# Appendix 3: Soils Information

*Geotechnical Study and Other Infiltration Testing Data*

GEOTECHNICAL INVESTIGATION
PROPOSED REDLANDS EAST
DEVELOPMENT

Redlands Avenue, South of Rider Street
Perris, California
for
Lake Creek Industrial, LLC

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

August 14, 2020

Lake Creek Industrial, LLC
1302 Brittany Cross Road
Santa Ana, California 92705

Attention: Mr. Bob Kubichek
Senior Vice President

Project No.: 20G180-1

Subject: Geotechnical Investigation
Proposed Redlands East Development
Redlands Avenue, South of Rider Street
Perris, California

Dear Mr. Kubichek:

In accordance with your request, we have conducted a geotechnical investigation at the subject site. We are pleased to present this report summarizing the conclusions and recommendations developed from our investigation.

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

**SOUTHERN CALIFORNIA GEOTECHNICAL, INC.**

Joseph Lozano Leon
Staff Engineer

Robert G. Trazo, GE 2655
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
ROBERT TRAZO
No. 2655
GEOTECHNICAL
STATE OF CALIFORNIA

Distribution: (1) Addressee

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# 1.0 EXECUTIVE SUMMARY

Presented below is a brief summary of the conclusions and recommendations of this investigation. Since this summary is not all inclusive, it should be read in complete context with the entire report.

### Geotechnical Design Considerations

- The Riverside County GIS website indicates that the eastern half of the subject site is located within a zone of moderate liquefaction susceptibility. Therefore, the scope of this investigation included a detailed liquefaction evaluation in order to determine the site-specific liquefaction potential.
- Our site-specific liquefaction evaluation indicates that the on-site soils are not subject to liquefaction during the design seismic event. No design considerations related to liquefaction are considered warranted for this project.
- Artificial fill soils were encountered at one of the boring locations within the proposed building area, extending to a depth of 3± feet. No documentation regarding the placement or compaction of these fill soils has been provided nor is expected to be available. The existing fill soils, in their present condition, are not considered suitable to support the foundations loads of new structure.
- Therefore, remedial grading is recommended within the proposed building area in order to remove a portion of the near-surface alluvial soils, all of the artificial fill soils, and any soils disturbed during demolition.

### Site Preparation

- Demolition of the existing structure, including foundations, floor slabs, pavements, concrete flatwork, and any subsurface improvements, which will not be utilized as part of the new development, will be required. Debris resulting from demolition activities should be disposed of off-site in accordance with local regulations.
- Initial site stripping should include removal of the surficial vegetation from the site. Stripping should include native grass, weeds, shrubs and trees. Root systems associated with the trees should be removed in their entirety, and the resultant excavations should be backfilled with compacted structural fill soils. These materials should be properly disposed of off-site.
- The proposed building pad area should be overexcavated to a depth of at least 5 feet below existing grade and to a depth of at least 5 feet below proposed pad grade, whichever is deeper. Overexcavation within the new foundation areas is recommended to extend to a depth of at least 3 feet below proposed foundation bearing grade.
- After overexcavation has been completed, the subgrade soils should be evaluated by the geotechnical engineer to identify any additional soils that should be overexcavated. The resulting subgrade should then be scarified to a depth of 12 inches, moisture conditioned or air dried to 0 to 4 percent above optimum, and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. The previously excavated soils may then be replaced as compacted structural fill.
- The new pavement and flatwork subgrade soils are recommended to be scarified to a depth of 12± inches, moisture conditioned and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density.

### Building Foundations

- Spread footing foundations, supported in newly placed structural fill soils.
- Maximum, net allowable soil bearing pressure: 2,500 lbs/ft$^2$.
- Reinforcement consisting of at least two (4) No. 5 rebars (2 top and 2 bottom) in strip footings.
- Additional reinforcement may be necessary for structural considerations.

### Building Floor Slab

- Conventional Slab on Grade, at least 6 inches thick
- Modulus of Subgrade Reaction: k = 125 psi/in
- Minimum slab reinforcement: Not required for geotechnical considerations. The actual floor slab reinforcement should be determined by the structural engineer, based upon the imposed loading.
- The actual thickness and reinforcement of the floor slab should be determined by the structural engineer.

### Pavements

| ASPHALT PAVEMENTS (R = 30) | | | | | |
|---|---|---|---|---|---|
| Materials | Thickness (inches) | | | | |
| | Auto Parking and Auto Drive Lanes (TI = 4.0 to 5.0) | Truck Traffic | | | |
| | | TI = 6.0 | TI = 7.0 | TI = 8.0 | TI = 9.0 |
| Asphalt Concrete | 3 | 3½ | 4 | 5 | 6 |
| Aggregate Base | 6 | 8 | 10 | 11 | 12 |
| Compacted Subgrade | 12 | 12 | 12 | 12 | 12 |

| PORTLAND CEMENT CONCRETE PAVEMENTS (R = 30) | | | | |
|---|---|---|---|---|
| Materials | Thickness (inches) | | | |
| | Autos and Light Truck Traffic (TI = 6.0) | Truck Traffic | | |
| | | (TI =7.0) | (TI =8.0) | (TI =9.0) |
| PCC | 5 | 5½ | 6½ | 8 |
| Compacted Subgrade (95% minimum compaction) | 12 | 12 | 12 | 12 |

# 2.0 SCOPE OF SERVICES

The scope of services performed for this project was in accordance with our Proposal No. 20P208, dated April 22, 2020. The scope of services included a visual site reconnaissance, subsurface exploration, field and laboratory testing, and geotechnical engineering analysis to provide criteria for preparing the design of the building foundations, building floor slab, and parking lot pavements along with site preparation recommendations and construction considerations for the proposed development. Based on the location of this site, the geotechnical investigation also included a site-specific liquefaction evaluation. The evaluation of the environmental aspects of this site was beyond the scope of services for this geotechnical investigation.

# 3.0 SITE AND PROJECT DESCRIPTION

## 3.1 Site Conditions

The subject site is located on the east side of Redlands Avenue, approximately 1,050 feet south of Rider Street in Perris, California. The site is bounded to the west by Redlands Avenue and to the north, east, and south by existing single-family residences (SFRs) and vacant lots. The general location of the site is illustrated on the Site Location Map, included as Plate 1 in Appendix A of this report.

The site consists of six (6) rectangular-shaped parcels which total 12.59± acres in size. The site is generally vacant and undeveloped, with the exception of southern-most parcel. This parcel contains remnants of a previous SFR, including the original concrete floor slab and flatwork, in the western region. Large trees and trash/debris are also present within this parcel. Ground surface cover for the remainder of the site generally consists of exposed soils with moderate native grass and weed growth.

Detailed topographic information was not available at the time of this report. However, based on topographic information obtained from Google Earth, the overall site topography slopes gently to the east at a gradient of less than 1 percent.

## 3.2 Proposed Development

The most current preliminary site plan, prepared by RGA, was provided to our office by the client. The plan indicates that the new development will consist of one (1) new commercial/industrial building, 255,472± ft$^2$ in size, located in the western region of the subject site. Dock-high doors and a truck court will be constructed on the east side of the proposed building. The new building is expected to be surrounded by asphaltic concrete pavements in the parking and drive areas and Portland cement concrete pavements in the loading dock areas. Several landscaped planters and concrete flatwork are also expected to be included throughout the site.

Detailed structural information has not been provided. However, it is our understanding that the new building will be a single-story structure of tilt-up concrete construction, generally supported on conventional shallow foundations with a concrete slab-on-grade floor. The construction may include second floor mezzanine offices. Based on the assumed construction, maximum column and wall loads are expected to be on the order of 100 kips and 3 to 5 kips per linear foot, respectively.

Grading plans for the proposed development were not available at the time of this report. The proposed development is not expected to include any significant amounts of below-grade construction such as basements or crawl spaces.

# 4.0 SUBSURFACE EXPLORATION

## 4.1 Scope of Exploration/Sampling Methods

The subsurface exploration for the current project consisted of five (5) borings (identified as Boring Nos. B-1 through B-5) advanced to depths of 25 to 50± feet below the existing site grades. Boring Nos. B-2 and B-4 were advanced to depths of 50± feet as a part of the liquefaction analysis for this site. All of the borings were logged during drilling by a member of our staff.

The borings were advanced with hollow-stem augers, by a conventional truck-mounted drilling rig. Representative bulk and relatively undisturbed soil samples were taken during drilling. Relatively undisturbed soil samples were taken with a split barrel "California Sampler" containing a series of one inch long, 2.416± inch diameter brass rings. This sampling method is described in ASTM Test Method D-3550. In-situ samples were also taken using a 1.4± inch inside diameter split spoon sampler, in general accordance with ASTM D-1586. Both of these samplers are driven into the ground with successive blows of a 140-pound weight falling 30 inches. The blow counts obtained during driving are recorded for further analysis. Bulk samples were collected in plastic bags to retain their original moisture content. The relatively undisturbed ring samples were placed in molded plastic sleeves that were then sealed and transported to our laboratory.

The approximate locations of the borings are indicated on the Boring Location Plan, included as Plate 2 in Appendix A of this report. The Boring Logs, which illustrate the conditions encountered at the boring locations, as well as the results of some of the laboratory testing, are included in Appendix B.

## 4.2 Geotechnical Conditions

### Artificial Fill

Artificial fill soils were encountered at the ground surface at Boring No. B-3, extending to a depth of 3± feet below the existing grades. The fill soils generally consist of medium dense silty sands with trace to little clay content. The fill soils possess a disturbed mottled appearance, resulting in their classification as artificial fill.

### Alluvium

Native alluvial soils were encountered beneath the fill soils and at the ground surface at all of the boring locations, extending to at least the maximum depth explored of 50± feet below the existing site grades. The near-surface alluvium generally consists of medium dense to dense sands, silty sands, sandy silts and clayey sands, with occasional very stiff fine sandy clays, extending to depths of 5½ to 12± feet. At greater depths and extending to the maximum depth explored of 50± feet, the alluvial soils generally consist of stiff to hard clayey silts and sandy clays, and medium dense to dense sands, silty sands and clayey sands. Boring No. B-5 encountered a soil stratum consisting of very stiff silty clay to clayey silt at depths of 17 to 20± feet.

Groundwater

Free water was not encountered during the drilling of any of the borings. Based on the lack of any water within the borings, and the moisture contents of the recovered soil samples, the static groundwater table is considered to have existed at a depth in excess of 50± feet below the existing site grades, at the time of the subsurface investigation.

As part of our research, we reviewed available groundwater data in order to determine the historic high groundwater level for the site. The primary reference used to determine the historic groundwater depths in this area is the Western Municipal Water District and the San Bernardino Valley Water Conservation District Cooperative Well Measuring Program. High water level from the nearest well is included below:

| State Well ID | Approximate Distance from Subject Site | High Water Level MSL (feet) |
|---|---|---|
| 04S/03W-10M01 | < 2640 feet | 1,424.00 |

Based on topographic information obtained from Google Earth, the elevation at the subject site ranges from 1440± feet msl to 1446± feet msl. The elevation of the high water level in the well is 1424± feet msl. Based on this well data, the depth of the high water level at the subject site, measured from the lowest elevation at the subject site, is 16± feet below the existing site grades. Therefore, a groundwater depth of 16± feet is considered to be conservative with respect to the more recent site conditions.

# 5.0 LABORATORY TESTING

The soil samples recovered from the subsurface exploration were returned to our laboratory for further testing to determine selected physical and engineering properties of the soils. The tests are briefly discussed below. It should be noted that the test results are specific to the actual samples tested, and variations could be expected at other locations and depths.

Classification

All recovered soil samples were classified using the Unified Soil Classification System (USCS), in accordance with ASTM D-2488. Field identifications were then supplemented with additional visual classifications and/or by laboratory testing. The USCS classifications are shown on the Boring Logs and are periodically referenced throughout this report.

Dry Density and Moisture Content

The density has been determined for selected relatively undisturbed ring samples. These densities were determined in general accordance with the method presented in ASTM D-2937. The results are recorded as dry unit weight in pounds per cubic foot. The moisture contents are determined in accordance with ASTM D-2216, and are expressed as a percentage of the dry weight. These test results are presented on the Boring Logs.

Consolidation

Selected soil samples have been tested to determine their consolidation potential, in accordance with ASTM D-2435. The testing apparatus is designed to accept either natural or remolded samples in a one-inch high ring, approximately 2.416 inches in diameter. Each sample is then loaded incrementally in a geometric progression and the resulting deflection is recorded at selected time intervals. Porous stones are in contact with the top and bottom of the sample to permit the addition or release of pore water. The samples are typically inundated with water at an intermediate load to determine their potential for collapse or heave. The results of the consolidation testing are plotted on Plates C-1 through C-4 in Appendix C of this report.

Maximum Dry Density and Optimum Moisture Content

A representative bulk sample has been tested for its maximum dry density and optimum moisture content. The results have been obtained using the Modified Proctor procedure, per ASTM D-1557 and are presented on Plate C-5 in Appendix C of this report. This test is generally used to compare the in-situ densities of undisturbed field samples, and for later compaction testing. Additional testing of other soil types or soil mixes may be necessary at a later date.

Expansion Index (EI)

The expansion potential of the on-site soils was determined in general accordance with ASTM D-4829. The testing apparatus is designed to accept a 4-inch diameter, 1-in high, remolded sample. The sample is initially remolded to 50± 1 percent saturation and then loaded with a surcharge equivalent to 144 pounds per square foot. The sample is then inundated with water, and allowed to swell against the surcharge. The resultant swell or consolidation is recorded after a 24-hour period. The result of the EI testing is as follows:

| Sample Identification | Expansion Index | Expansive Potential |
|---|---|---|
| B-4 @ 0 to 5 feet | 5 | Very Low |

Soluble Sulfates

A representative sample of the near-surface soil was submitted to a subcontracted analytical laboratory for determination of soluble sulfate content. Soluble sulfates are naturally present in soils, and if the concentration is high enough, can result in degradation of concrete which comes into contact with these soils. The results of the soluble sulfate testing are presented below, and are discussed further in a subsequent section of this report.

| Sample Identification | Soluble Sulfates (%) | Sulfate Classification |
|---|---|---|
| B-4 @ 0 to 5 feet | 0.002 | Not Applicable (S0) |

Corrosivity Testing

One representative bulk sample of the near-surface soils was submitted to a subcontracted corrosion engineering laboratory to identify potentially corrosive characteristics with respect to common construction materials. The corrosivity testing included a determination of the electrical resistivity, pH, and chloride and nitrate concentrations of the soils, as well as other tests. The results of some of these tests are presented below.

| Sample Identification | Saturated Resistivity (ohm-cm) | pH | Chlorides (mg/kg) | Nitrates (mg/kg) |
|---|---|---|---|---|
| B-4 @ 0 to 5 feet | 6,000 | 7.6 | 7.7 | 15 |

Grain Size Analysis

Limited grain size analyses have been performed on six (6) selected samples, in accordance with ASTM D-1140. These samples were washed over a #200 sieve to determine the percentage of fine-grained material in each sample, which is defined as the material which passes the #200 sieve. The weight of the portion of the sample retained on each screen is recorded and the percentage finer or coarser of the total weight is calculated. The results of these laboratory tests are shown on the enclosed boring logs.

# 6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our review, field exploration, laboratory testing and geotechnical analysis, the proposed development is considered feasible from a geotechnical standpoint. The recommendations contained in this report should be taken into the design, construction, and grading considerations.

The recommendations are contingent upon all grading and foundation construction activities being monitored by the geotechnical engineer of record. The recommendations are provided with the assumption that an adequate program of client consultation, construction monitoring, and testing will be performed during the final design and construction phases to verify compliance with these recommendations. Maintaining Southern California Geotechnical, Inc., (SCG) as the geotechnical consultant from the beginning to the end of the project will provide continuity of services. The geotechnical engineering firm providing testing and observation services shall assume the responsibility of Geotechnical Engineer of Record.

The Grading Guide Specifications, included as Appendix D, should be considered part of this report, and should be incorporated into the project specifications. The contractor and/or owner of the development should bring to the attention of the geotechnical engineer any conditions that differ from those stated in this report, or which may be detrimental for the development.

## 6.1 Seismic Design Considerations

The subject site is located in an area which is subject to strong ground motions due to earthquakes. The performance of a site specific seismic hazards analysis was beyond the scope of this investigation. However, numerous faults capable of producing significant ground motions are located near the subject site. Due to economic considerations, it is not generally considered reasonable to design a structure that is not susceptible to earthquake damage. Therefore, significant damage to structures may be unavoidable during large earthquakes. The proposed structures should, however, be designed to resist structural collapse and thereby provide reasonable protection from serious injury, catastrophic property damage and loss of life.

### Faulting and Seismicity

Research of available maps indicates that the subject site is not located within an Alquist-Priolo Earthquake Fault Zone. Furthermore, SCG did not identify any evidence of faulting during the geotechnical investigation. Therefore, the possibility of significant fault rupture on the site is considered to be low.

The potential for other geologic hazards such as seismically induced settlement, lateral spreading, tsunamis, inundation, seiches, flooding, and subsidence affecting the site is considered low.

## Seismic Design Parameters

The 2019 California Building Code (CBC) provides procedures for earthquake resistant structural design that include considerations for on-site soil conditions, occupancy, and the configuration of the structure including the structural system and height. The seismic design parameters presented below are based on the soil profile and the proximity of known faults with respect to the subject site.

Based on standards in place at the time of this report, the proposed development is expected to be designed in accordance with the requirements of the 2019 edition of the California Building Code (CBC), which was adopted on January 1, 2020.

The 2019 CBC Seismic Design Parameters have been generated using the SEAOC/OSHPD Seismic Design Maps Tool, a web-based software application available at the website www.seismicmaps.org. This software application calculates seismic design parameters in accordance with several building code reference documents, including ASCE 7-16, upon which the 2019 CBC is based. The application utilizes a database of risk-targeted maximum considered earthquake ($MCE_R$) site accelerations at 0.01-degree intervals for each of the code documents. The table below was created using data obtained from the application. The output generated from this program is included as Plate E-1 in Appendix E of this report.

The 2019 CBC requires that a site-specific ground motion study be performed in accordance with Section 11.4.8 of ASCE 7-16 for Site Class D sites with a mapped $S_1$ value greater than 0.2. However, Section 11.4.8 of ASCE 7-16 also indicates an exception to the requirement for a site-specific ground motion hazard analysis for certain structures on Site Class D sites. The commentary for Section 11 of ASCE 7-16 (Page 534 of Section C11 of ASCE 7-16) indicates that "In general, this exception effectively limits the requirements for site-specific hazard analysis to very tall and or flexible structures at Site Class D sites." Based on our understanding of the proposed development, the seismic design parameters presented below were calculated assuming that the exception in Section 11.4.8 applies to the proposed structure at this site. However, the structural engineer should verify that this exception is applicable to the proposed structure. Based on the exception, the spectral response accelerations presented below were calculated using the site coefficients ($F_a$ and $F_v$) from Tables 1613.2.3(1) and 1613.2.3(2) presented in Section 16.4.4 of the 2019 CBC.

2019 CBC SEISMIC DESIGN PARAMETERS

| Parameter | | Value |
|---|---|---|
| Mapped Spectral Acceleration at 0.2 sec Period | $S_S$ | 1.500 |
| Mapped Spectral Acceleration at 1.0 sec Period | $S_1$ | 0.570 |
| Site Class | --- | D |
| Site Modified Spectral Acceleration at 0.2 sec Period | $S_{MS}$ | 1.500 |
| Site Modified Spectral Acceleration at 1.0 sec Period | $S_{M1}$ | 0.986 |
| Design Spectral Acceleration at 0.2 sec Period | $S_{DS}$ | 1.000 |
| Design Spectral Acceleration at 1.0 sec Period | $S_{D1}$ | 0.657 |

It should be noted that the site coefficient $F_v$ and the parameters $S_{M1}$ and $S_{D1}$ were not included in the SEAOC/OSHPD Seismic Design Maps Tool output for the 2019 CBC. We calculated these parameters-based on Table 1613.2.3(2) in Section 16.4.4 of the 2019 CBC using the value of $S_1$ obtained from the Seismic Design Maps Tool, assuming that a site-specific ground motion hazards analysis is not required for the proposed building at this site.

Ground Motion Parameters

For the liquefaction evaluation, we utilized a site acceleration consistent with maximum considered earthquake ground motions, as required by the 2019 CBC. The peak ground acceleration ($PGA_M$) was determined in accordance with Section 11.8.3 of ASCE 7-16. The parameter $PGA_M$ is the maximum considered earthquake geometric mean ($MCE_G$) PGA, multiplied by the appropriate site coefficient from Table 11.8-1 of ASCE 7-16. The web-based software application SEAOC/OSHPD Seismic Design Maps Tool (described in the previous section) was used to determine $PGA_M$, based on ASCE 7-16 as the building code reference document. A portion of the program output is included as Plate E-1 in Appendix E of this report. As indicated on Plate E-1, the $PGA_M$ for this site is 0.550g. An associated earthquake magnitude was obtained from the USGS Unified Hazard Tool, Interactive Deaggregation application available on the USGS website. The deaggregated mean magnitude is 7.02, based on the peak ground acceleration and soil classification D.

Liquefaction

The Riverside County GIS website indicates that the eastern half of the subject site is located within a zone of moderate liquefaction susceptibility. Therefore, the scope of this investigation included a detailed liquefaction evaluation in order to determine the site-specific liquefaction potential.

Liquefaction is the loss of strength in generally cohesionless, saturated soils when the pore-water pressure induced in the soil by a seismic event becomes equal to or exceeds the overburden pressure. The primary factors which influence the potential for liquefaction include groundwater table elevation, soil type and plasticity characteristics, relative density of the soil, initial confining pressure, and intensity and duration of ground shaking. The depth within which the occurrence of liquefaction may impact surface improvements is generally identified as the upper 50 feet below the existing ground surface. Liquefaction potential is greater in saturated, loose, poorly graded fine sands with a mean ($d_{50}$) grain size in the range of 0.075 to 0.2 mm (Seed and Idriss, 1971). Non-sensitive clayey (cohesive) soils which possess a plasticity index of at least 18 (Bray and Sancio, 2006) are generally not considered to be susceptible to liquefaction, nor are those soils which are above the historic static groundwater table.

The liquefaction analysis was conducted in accordance with the requirements of Special Publication 117A (CDMG, 2008), and currently accepted practice (SCEC, 1997). The liquefaction potential of the subject site was evaluated using the empirical method developed by Boulanger and Idriss (Boulanger and Idriss, 2008, 2014). This method predicts the earthquake-induced liquefaction potential of the site based on a given design earthquake magnitude and peak ground acceleration at the subject site. This procedure essentially compares the cyclic resistance ratio (CRR) [the cyclic stress ratio required to induce liquefaction for a cohesionless soil stratum at a given depth] with the earthquake-induced cyclic stress ratio (CSR) at that depth from a specified design earthquake (defined by a peak ground surface acceleration and an associated earthquake moment magnitude). CRR is determined as a function of the corrected SPT N-value $(N_1)_{60\text{-}cs}$, adjusted for fines content. The factor of safety against liquefaction is defined as CRR/CSR. Based on Special Publication 117A, a factor of safety of at least 1.3 is required in order to demonstrate that a given soil stratum is non-liquefiable. Additionally, in accordance with Special Publication 117A, clayey soils which do not meet the criteria for liquefiable soils defined by Bray and Sancio (2006), loose soils with a plasticity index (PI) less than 12 and moisture content greater than 85% of the liquid limit, are considered to be insusceptible to liquefaction. Non-sensitive soils with a PI greater than 18 are also considered non-liquefiable.

The liquefaction analysis procedure is tabulated on the spreadsheet forms included in Appendix F of this report. The liquefaction analysis was performed for Boring Nos. B-2 and B-4, which were advanced to depths of 50± feet. The liquefaction potential was analyzed at the boring locations utilizing a $PGA_M$ of 0.550g related to a 7.02 magnitude seismic event. The liquefaction evaluation was performed using the reported historic high groundwater depth of 16 feet.

If liquefiable soils are identified, the potential settlements that could occur as a result of liquefaction are determined using the equation for volumetric strain due to post-cyclic reconsolidation (Yoshimine et. al, 2006). This procedure uses an empirical relationship between the induced cyclic shear strain and the corrected N-value to determine the expected volumetric strain of saturated sands subjected to earthquake shaking. This analysis is also documented on the spreadsheets included in Appendix F.

Conclusions and Recommendations

The results of the liquefaction analysis identified no potentially liquefiable soils at the site. The soils present below the historic groundwater table possess factors of safety in excess of 1.3 and are therefore considered non-liquefiable. Based on the results of this analysis, no design considerations related to liquefaction are considered warranted for this project.

## 6.2 Geotechnical Design Considerations

### General

Artificial fill soils were encountered at one of the boring locations within the proposed building area, extending to a depth of 3± feet. No documentation regarding the placement or compaction of these fill soils has been provided nor is expected to be available. The existing fill soils, in their present condition, are not considered suitable to support the foundations loads of new structures. In addition, laboratory test results indicate that the native alluvium encountered within the proposed warehouse area at depths of 3 to 5± feet possesses a potential for moderate collapse when exposed to moisture infiltration as well as consolidation when exposed to load increases in the range of those that will be exerted by the new foundations. Therefore, remedial grading is considered warranted within the proposed warehouse area in order to remove and replace the artificial fill soils and a portion of the near-surface alluvial soils as compacted structural fill.

Settlement

The recommended remedial grading will remove the existing undocumented fill soils and a portion of the near-surface native alluvial soils and replace these materials as compacted structural fill. The native soils that will remain in place below the recommended depth of overexcavation will not be subject to significant load increases from the foundations of the new structure. Provided that the recommended remedial grading is completed, the post-construction settlements are expected to be within tolerable limits.

Expansion

Laboratory testing performed on a representative sample of the near surface soils indicates that these materials possess a very low expansion potential (EI = 5). Based on this test result, no design considerations related to expansive soils are considered warranted for this project. However, it is recommended that additional expansion index testing be performed at the completion of rough grading in order to confirm the expansion potential of the near-surface soils at this site.

Soluble Sulfates

The result of the soluble sulfate testing indicates that the selected sample of the on-site soils corresponds to Class S0 with respect to the American Concrete Institute (ACI) Publication 318-05 Building Code Requirements for Structural Concrete and Commentary, Section 4.3. Therefore, specialized concrete mix designs are not considered to be necessary, with regard to sulfate protection purposes. It is, however, recommended that additional soluble sulfate testing be conducted at the completion of rough grading to verify the soluble sulfate concentrations of the soils which are present at pad grade within the building area.

Corrosion Potential

The results of laboratory testing indicate that the tested sample of the on-site soils possesses a saturated resistivity value of 6,000 ohm-cm, and a pH value of 7.6. These test results have been evaluated in accordance with guidelines published by the Ductile Iron Pipe Research Association (DIPRA). The DIPRA guidelines consist of a point system by which characteristics of the soils are used to quantify the corrosivity characteristics of the site. Sulfides, and redox potential are factors that are also used in the evaluation procedure. We have evaluated the corrosivity characteristics of the on-site soils using resistivity, pH, and moisture content. Based on these factors, and utilizing the DIPRA procedure, the on-site soils are not considered to be corrosive to ductile iron pipe. However, SCG does not practice in the area of corrosion engineering. Therefore, the client may also wish to contact a corrosion engineer to provide a more thorough evaluation.

A relatively low concentration (7.7 mg/kg) of chlorides was detected in the sample submitted for corrosivity testing. In general, soils possessing chloride concentrations in excess of 500 parts per million (ppm) are considered to be corrosive with respect to steel reinforcement within reinforced concrete. Based on the lack of any significant chlorides in the tested sample, the site is considered to have a C1 chloride exposure in accordance with the American Concrete Institute (ACI) Publication 318 Building Code Requirements for Structural Concrete and Commentary. Therefore, a specialized concrete mix design for reinforced concrete for protection against chloride exposure is not considered warranted.

Shrinkage/Subsidence

Removal and recompaction of the existing fill soils and near-surface alluvium is estimated to result in an average shrinkage of 5 to 10 percent. However, potential shrinkage for individual samples ranged locally between 2 and 13 percent. The potential shrinkage estimate is based on dry density testing performed on small-diameter samples taken at the boring locations. If a more accurate and precise shrinkage estimate is desired, SCG can perform a shrinkage study involving several excavated test-pits where in-place densities are determined using in-situ testing methods instead of laboratory density testing on small-diameter samples. Please contact SCG for details and a cost estimate regarding a shrinkage study, if desired.

Minor ground subsidence is expected to occur in the soils below the zone of removal, due to settlement and machinery working. The subsidence is estimated to be 0.1 feet.

These estimates are based on previous experience and the subsurface conditions encountered at the boring locations. The actual amount of subsidence is expected to be variable and will be dependent on the type of machinery used, repetitions of use, and dynamic effects, all of which are difficult to assess precisely.

Grading and Foundation Plan Review

No grading or foundation plans were available at the time of this report. It is therefore recommended that we be provided with copies of the preliminary plans, when they become available, for review with regard to the conclusions, recommendations, and assumptions contained within this report.

## 6.3 Site Grading Recommendations

The grading recommendations presented below are based on the subsurface conditions encountered at the boring locations and our understanding of the proposed development. We recommend that all grading activities be completed in accordance with the Grading Guide Specifications included as Appendix D of this report, unless superseded by site-specific recommendations presented below.

Site Stripping and Demolition

Demolition of the existing structures and any associated improvements will be necessary to facilitate the construction of the proposed development. Demolition of the existing structures should include all foundations, floor slabs, and any associated utilities. Any septic systems encountered during demolition and/or grading (if present) should be removed in their entirety. Any associated leach fields or other existing underground improvements should also be removed in their entirety. Debris resultant from demolition should be disposed of off-site. All applicable federal, state and local specifications and regulations should be followed in demolition, abandonment, and disposal of the existing structures and resulting debris.

Initial site stripping should include removal of the surficial vegetation from the site. Stripping should include native grass, weeds, shrubs and trees. Root systems associated with the trees should be removed in their entirety, and the resultant excavations should be backfilled with compacted structural fill soils. These materials should be properly disposed of off-site. The actual extent of site stripping should be determined in the field by the geotechnical engineer, based on the organic content and stability of the materials encountered.

Treatment of Existing Soils: Building Pad

Remedial grading will be necessary within the proposed building pad area to remove a portion of the near-surface alluvial soils, all of the artificial fill soils, and any soils disturbed during demolition. Based on conditions encountered at the boring locations, artificial fill soils extend to a depth of up to 3± feet below the existing site grades. These fill soils should be removed in their entirely. At a minimum, the overexcavation is recommended to extend to a depth of at least 5 feet below existing grade and 5 feet below the proposed building pad subgrade elevation, whichever is greater. In addition, the overexcavation should extend to a depth of at least 3 feet below the proposed foundation bearing grade within the influence zones of the new foundations.

The overexcavation areas should extend at least 5 feet beyond the building and foundation perimeters, and to an extent equal to the depth of fill placed below the foundation bearing grade, whichever is greater. If the proposed structure incorporates any exterior columns (such as for a canopy or overhang) the area of overexcavation should also encompass these areas.

Following completion of the overexcavation, the subgrade soils within the building area should be evaluated by the geotechnical engineer to verify their suitability to serve as the structural fill subgrade, as well as to support the foundation loads of the new structures. This evaluation should include proofrolling and probing to identify any soft, loose or otherwise unstable soils that must be removed. Some localized areas of deeper excavation may be required if loose, porous, or low density native soils are encountered at the base of the overexcavation.

Based on conditions encountered at the exploratory boring locations, some zones of moist to very moist soils will be encountered at or near the base of the recommended overexcavation. Stabilization of the exposed overexcavation subgrade soils may be necessary. Scarification and air drying of these materials may be sufficient to obtain a stable subgrade. However, if highly unstable soils are identified, and if the construction schedule does not allow for delays associated with drying, mechanical stabilization, usually consisting of coarse crushed stone or geotextile, could be necessary. In this event, the geotechnical engineer should be contacted for supplementary recommendations.

After a suitable overexcavation subgrade has been achieved, the exposed soils should be scarified to a depth of at least 12 inches, moisture conditioned or air dried to 0 to 4 percent above optimum, and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. The previously excavated soils may then be replaced as compacted structural fill.

Treatment of Existing Soils: Retaining Walls and Site Walls

The existing soils within the areas of any proposed retaining walls and site walls should be overexcavated to a depth of 3 feet below foundation bearing grade and replaced as compacted structural fill as discussed above for the proposed building pad. Any undocumented fill soils or disturbed native alluvium within any of these foundation areas should be removed in their entirety. The overexcavation areas should extend at least 5 feet beyond the foundation perimeters, and to an extent equal to the depth of fill below the new foundations. Any erection pads for tilt-up concrete walls are considered to be part of the foundation system. Therefore, these overexcavation recommendations are applicable to erection pads. The overexcavation subgrade soils should be evaluated by the geotechnical engineer prior to scarifying, moisture conditioning to within 0 to 4 percent above the optimum moisture content, and recompacting the upper 12 inches of exposed subgrade soils. The previously excavated soils may then be replaced as compacted structural fill.

If the full lateral recommended remedial grading cannot be completed for the proposed retaining walls and site walls located along property lines, the foundations for those walls should be designed using a reduced allowable bearing pressure. Furthermore, the contractor should take necessary precautions to protect the adjacent structures during rough grading. Specialized grading techniques, such as A-B-C slot cuts, will likely be required during remedial grading. The geotechnical engineer of record should be contacted if additional recommendations, such as shoring design recommendations, are required during grading.

Treatment of Existing Soils: Flatwork, Parking and Drive Areas

Based on economic considerations, overexcavation of the existing near-surface existing soils in the new flatwork, parking and drive areas is not considered warranted, with the exception of areas where lower strength or unstable soils are identified by the geotechnical engineer during grading. Subgrade preparation in the new flatwork, parking and drive areas should initially consist of removal of all soils disturbed during stripping and demolition operations.

The geotechnical engineer should then evaluate the subgrade to identify any areas of additional unsuitable soils. Any such materials should be removed to a level of firm and unyielding soil. The exposed subgrade soils should then be scarified to a depth of 12± inches, moisture conditioned to 0 to 4 percent above the optimum moisture content, and recompacted to at least 90 percent of the ASTM D-1557 maximum dry density. Based on the presence of variable strength surficial soils throughout the site, it is expected that some isolated areas of additional overexcavation may be required to remove zones of lower strength, unsuitable soils.

The grading recommendations presented above for the proposed flatwork, parking and drive areas assume that the owner and/or developer can tolerate minor amounts of settlement within these areas. The grading recommendations presented above do not mitigate the extent of undocumented fill or compressible/collapsible native alluvium in the flatwork, parking and drive areas. As such, some settlement and associated pavement distress could occur. Typically, repair of such distressed areas involves significantly lower costs than completely mitigating these soils at the time of construction. If the owner cannot tolerate the risk of such settlements, the flatwork, parking and drive areas should be overexcavated to a depth of 2 feet below proposed pavement subgrade elevation, with the resulting soils replaced as compacted structural fill.

Fill Placement

- Fill soils should be placed in thin (6± inches), near-horizontal lifts, moisture conditioned to within 0 to 4 percent above the optimum moisture content, and compacted.
- On-site soils may be used for fill provided they are cleaned of any debris to the satisfaction of the geotechnical engineer.
- All grading and fill placement activities should be completed in accordance with the requirements of the 2019 CBC and the grading code of the city of Perris.
- All fill soils should be compacted to at least 90 percent of the ASTM D-1557 maximum dry density.
- Compaction tests should be performed periodically by the geotechnical engineer as random verification of compaction and moisture content. These tests are intended to aid the contractor. Since the tests are taken at discrete locations and depths, they may not be indicative of the entire fill and therefore should not relieve the contractor of his responsibility to meet the job specifications.

Imported Structural Fill

All imported structural fill should consist of very low expansive (EI < 20), well graded soils possessing at least 10 percent fines (that portion of the sample passing the No. 200 sieve). Additional specifications for structural fill are presented in the Grading Guide Specifications, included as Appendix D.

Utility Trench Backfill

In general, all utility trench backfill should be compacted to at least 90 percent of the ASTM D-1557 maximum dry density. As an alternative, a clean sand (minimum Sand Equivalent of 30) may be placed within trenches and compacted in place (jetting or flooding is not recommended). It is recommended that materials in excess of 3 inches in size not be used for utility trench backfill. Compacted trench backfill should conform to the requirements of the local grading code, and more restrictive requirements may be indicated by the city of Perris. All utility trench backfills should be witnessed by the geotechnical engineer. The trench backfill soils should be compaction tested where possible; probed and visually evaluated elsewhere.

Utility trenches which parallel a footing, and extending below a 1h:1v plane projected from the outside edge of the footing should be backfilled with structural fill soils, compacted to at least 90 percent of the ASTM D-1557 standard. Pea gravel backfill should not be used for these trenches.

Any soils used to backfill voids around subsurface utility structures, such as manholes or vaults, should be placed as compacted structural fill. If it is not practical to place compacted fill in these areas, then such void spaces may be backfilled with lean concrete slurry. Uncompacted pea gravel or sand is not recommended for backfilling these voids since these materials have a potential to settle and thereby cause distress of pavements placed around these subterranean structures.

## 6.4 Construction Considerations

### Excavation Considerations

The near-surface soils generally consist of moderate strength silty sands and fine sandy silts with varying clay content. These materials may be subject to minor caving within shallow excavations. Where caving occurs within shallow excavations, flattened excavation slopes may be sufficient to provide excavation stability. On a preliminary basis, the inclination of temporary slopes should not exceed 2h:1v. Deeper excavations may require some form of external stabilization such as shoring or bracing. Maintaining adequate moisture content within the near-surface soils will improve excavation stability. All excavation activities on this site should be conducted in accordance with Cal-OSHA regulations.

### Moisture Sensitive Subgrade Soils

Most of the near surface soils possess appreciable silt and/or clay content and may become unstable if exposed to significant moisture infiltration or disturbance by construction traffic. In addition, based on their granular content, some of the on-site soils will also be susceptible to erosion. The site should, therefore, be graded to prevent ponding of surface water and to prevent water from running into excavations.

If the construction schedule dictates that site grading will occur during a period of wet weather, allowances should be made for costs and delays associated with drying the on-site soils or import of a drier, less moisture sensitive fill material. Grading during wet or cool weather may also increase the depth of overexcavation in the pad areas as well as the need for a stabilization layer.

### Groundwater

The historic groundwater table at this site is considered to exist at a depth greater than 16± feet. Therefore, groundwater is not expected to impact the grading or foundation construction activities.

## 6.5 Foundation Design and Construction

Based on the preceding grading recommendations, it is assumed that the new building pad will be underlain by structural fill soils used to replace existing undocumented fill soils and the upper portion of the near-surface native alluvium. These new structural fill soils are expected to extend to depths of at least 3 feet below proposed foundation bearing grade. Based on this subsurface profile, the proposed structure may be supported on conventional shallow foundations.

### Foundation Design Parameters

New square and rectangular footings may be designed as follows:

- Maximum, net allowable soil bearing pressure: 2,500 lbs/ft$^2$.

- Minimum wall/column footing width: 14 inches/24 inches.
- Minimum longitudinal steel reinforcement within strip footings: Four (4) No. 5 rebars (2 top and 2 bottom).
- Minimum foundation embedment: 12 inches into suitable structural fill soils, and at least 18 inches below adjacent exterior grade. Interior column footings may be placed immediately beneath the floor slab.
- It is recommended that the perimeter building foundations be continuous across all exterior doorways. Any flatwork adjacent to the exterior doors should be doweled into the perimeter foundations in a manner determined by the structural engineer.

The allowable bearing pressure presented above may be increased by one-third when considering short duration wind or seismic loads. The minimum steel reinforcement recommended above is based on geotechnical considerations; additional reinforcement may be necessary for structural considerations. The actual design of the foundations should be determined by the structural engineer.

Foundation Construction

The foundation subgrade soils should be evaluated at the time of overexcavation, as discussed in Section 6.3 of this report. It is further recommended that the foundation subgrade soils be evaluated by the geotechnical engineer immediately prior to steel or concrete placement. Soils suitable for direct foundation support should consist of newly placed structural fill, compacted to at least 90 percent of the ASTM D-1557 maximum dry density. Any unsuitable materials should be removed to a depth of suitable bearing compacted structural fill or suitable native alluvium (where reduced bearing pressures are utilized), with the resulting excavations backfilled with compacted fill soils. As an alternative, lean concrete slurry (500 to 1,500 psi) may be used to backfill such isolated overexcavations.

The foundation subgrade soils should also be properly moisture conditioned to 0 to 4 percent above the Modified Proctor optimum, to a depth of at least 12 inches below bearing grade. Since it is typically not feasible to increase the moisture content of the floor slab and foundation subgrade soils once rough grading has been completed, care should be taken to maintain the moisture content of the building pad subgrade soils throughout the construction process.

Estimated Foundation Settlements

Post-construction total and differential settlements of shallow foundations designed and constructed in accordance with the previously presented recommendations are estimated to be less than 1.0 and 0.5 inches, respectively. Differential movements are expected to occur over a 30-foot span, thereby resulting in an angular distortion of less than 0.002 inches per inch.

Lateral Load Resistance

Lateral load resistance will be developed by a combination of friction acting at the base of foundations and slabs and the passive earth pressure developed by footings below grade. The following friction and passive pressure may be used to resist lateral forces:

- Passive Earth Pressure: 300 lbs/$ft^3$
- Friction Coefficient: 0.30

These are allowable values, and include a factor of safety. When combining friction and passive resistance, the passive pressure component should be reduced by one-third. These values assume that footings will be poured directly against compacted structural fill. The maximum allowable passive pressure is 2,500 lbs/$ft^2$.

## 6.6 Floor Slab Design and Construction

Subgrades which will support the new floor slab should be prepared in accordance with the recommendations contained in the *Site Grading Recommendations* section of this report. Based on the anticipated grading which will occur at this site, the floor of the proposed structure may be constructed as conventional slab-on-grade supported on newly placed structural fill, extending to a depth of at least 5 feet below finished pad grade. Based on geotechnical considerations, the floor slabs may be designed as follows:

- Minimum slab thickness: 6 inches.

- Modulus of Subgrade Reaction: k = 125 psi/in.

- Minimum slab reinforcement: Not required for geotechnical considerations. The actual floor slab reinforcement should be determined by the structural engineer, based upon the imposed loading.

- Slab underlayment: If moisture sensitive floor coverings will be used then minimum slab underlayment should consist of a moisture vapor barrier constructed below the entire slab area where such moisture sensitive floor coverings are expected. The moisture vapor barrier should meet or exceed the Class A rating as defined by ASTM E 1745-97 and have a permeance rating less than 0.01 perms as described in ASTM E 96-95 and ASTM E 154-88. A polyolefin material such as 15 mil Stego® Wrap Vapor Barrier or equivalent will meet these specifications. The moisture vapor barrier should be properly constructed in accordance with all applicable manufacturer specifications. Given that a rock free subgrade is anticipated and that a capillary break is not required, sand below the barrier is not required. The need for sand and/or the amount of sand above the moisture vapor barrier should be specified by the structural engineer or concrete contractor. The selection of sand above the barrier is not a geotechnical engineering issue and hence outside our purview. Where moisture sensitive floor coverings are not anticipated, the vapor barrier may be eliminated.

- Moisture condition the floor slab subgrade soils to 0 to 4 percent above the Modified Proctor optimum moisture content, to a depth of 12 inches. The moisture content of the floor slab subgrade soils should be verified by the geotechnical engineer within 24 hours prior to concrete placement.

- Proper concrete curing techniques should be utilized to reduce the potential for slab curling or the formation of excessive shrinkage cracks.

The actual design of the floor slab should be completed by the structural engineer to verify adequate thickness and reinforcement.

## 6.7 Exterior Flatwork Design and Construction

Subgrades which will support new exterior slabs-on-grade for sidewalks, patios, and other concrete flatwork, should be prepared in accordance with the recommendations contained in the *Grading Recommendations* section of this report. Based on geotechnical considerations, exterior slabs on grade may be designed as follows:

- Minimum slab thickness: 4½ inches.

- Minimum slab reinforcement: No. 3 bars at 18 inches on center, in both directions.

- The flatwork at building entry areas should be structurally connected to the perimeter foundation that is recommended to span across the door opening. This recommendation is designed to reduce the potential for differential movement at this joint.

- Moisture condition the slab subgrade soils to at least 0 to 4 percent of optimum moisture content, to a depth of at least 12 inches. Adequate moisture conditioning should be verified by the geotechnical engineer 24 hours prior to concrete placement.

- Proper concrete curing techniques should be utilized to reduce the potential for slab curling or the formation of excessive shrinkage cracks.

- Control joints should be provided at a maximum spacing of 8 feet on center in two directions for slabs and at 6 feet on center for sidewalks. Control joints are intended to direct cracking. Minor cracking of exterior concrete slabs on grade should be expected.

Expansion or felt joints should be used at the interface of exterior slabs on grade and any fixed structures to permit relative movement.

## 6.8 Retaining Wall Design and Construction

Small retaining walls are expected to be necessary in the area of the new truck loading docks and may also be required to facilitate the new site grades. The parameters recommended for use in the design of these walls are presented below.

Retaining Wall Design Parameters

Based on the soil conditions encountered at the boring locations, the following parameters may be used in the design of new retaining walls for this site. We have provided parameters assuming the use of on-site soils for retaining wall backfill. The on-site soils generally consist of sands, silty sands and clayey sands. Based on their classification, these materials are expected to possess a friction angle of at least 30 degrees when compacted to 90 percent of the ASTM-1557 maximum dry density.

If desired, SCG could provide design parameters for an alternative select backfill material behind the retaining walls. The use of select backfill material could result in lower lateral earth pressures. In order to use the design parameters for the imported select fill, this material must be placed within the entire active failure wedge. This wedge is defined as extending from the heel of the retaining wall upwards at an angle of approximately 60° from horizontal. If select backfill material behind the retaining wall is desired, SCG should be contacted for supplementary recommendations.

RETAINING WALL DESIGN PARAMETERS

| Design Parameter | | Soil Type |
|---|---|---|
| | | On-Site Silty Sands and Clayey Sands |
| Internal Friction Angle ($\phi$) | | 30° |
| Unit Weight | | 135 lbs/ft$^3$ |
| Equivalent Fluid Pressure: | Active Condition (level backfill) | 45 lbs/ft$^3$ |
| | Active Condition (2h:1v backfill) | 73 lbs/ft$^3$ |
| | At-Rest Condition (level backfill) | 68 lbs/ft$^3$ |

The walls should be designed using a soil-footing coefficient of friction of 0.30 and an equivalent passive pressure of 300 lbs/ft$^3$. The structural engineer should incorporate appropriate factors of safety in the design of the retaining walls.

The active earth pressure may be used for the design of retaining walls that do not directly support structures or support soils that in turn support structures and which will be allowed to deflect. The at-rest earth pressure should be used for walls that will not be allowed to deflect such as those which will support foundation bearing soils, or which will support foundation loads directly.

Where the soils on the toe side of the retaining wall are not covered by a "hard" surface such as a structure or pavement, the upper 1 foot of soil should be neglected when calculating passive resistance due to the potential for the material to become disturbed or degraded during the life of the structure.

Retaining Wall Foundation Design

The retaining wall foundations should be underlain by at least 3 feet of newly placed structural fill. Foundations to support new retaining walls should be designed in accordance with the general Foundation Design Parameters presented in a previous section of this report.

Seismic Lateral Earth Pressures

In accordance with the 2019 CBC, any retaining walls more than 6 feet in height must be designed for seismic lateral earth pressures. If walls 6 feet or more are required for this site, the geotechnical engineer should be contacted for supplementary seismic lateral earth pressure recommendations.

Backfill Material

On-site soils may be used to backfill the retaining walls. However, all backfill material placed within 3 feet of the back-wall face should have a particle size no greater than 3 inches. The retaining wall backfill materials should be well graded.

It is recommended that a minimum 1 foot thick layer of free-draining granular material (less than 5 percent passing the No. 200 sieve) be placed against the face of the retaining walls. This material should extend from the top of the retaining wall footing to within 1 foot of the ground surface on the back side of the retaining wall. This material should be approved by the geotechnical engineer. In lieu of the 1 foot thick layer of free-draining material, a properly installed prefabricated drainage composite such as the MiraDRAIN 6000XL (or approved equivalent), which is specifically designed for use behind retaining walls, may be used. If the layer of free-draining material is not covered by an impermeable surface, such as a structure or pavement, a 12-inch thick layer of a low permeability soil should be placed over the backfill to reduce surface water migration to the underlying soils. The layer of free draining granular material should be separated from the backfill soils by a suitable geotextile, approved by the geotechnical engineer.

All retaining wall backfill should be placed and compacted under engineering controlled conditions in the necessary layer thicknesses to ensure an in-place density between 90 and 93 percent of the maximum dry density as determined by the Modified Proctor test (ASTM D1557-91). Care should be taken to avoid over-compaction of the soils behind the retaining walls, and the use of heavy compaction equipment should be avoided.

Subsurface Drainage

As previously indicated, the retaining wall design parameters are based upon drained backfill conditions. Consequently, some form of permanent drainage system will be necessary in conjunction with the appropriate backfill material. Subsurface drainage may consist of either:

- A weep hole drainage system typically consisting of a series of 4-inch diameter holes in the wall situated slightly above the ground surface elevation on the exposed side of the wall and at an approximate 8-foot on-center spacing. The weep holes should include a pocket of gravel, 2± cubic feet in size, surrounded by a geotextile fabric, at each weep hole location.

- A 4-inch diameter perforated pipe surrounded by 2 cubic feet of gravel per linear foot of drain placed behind the wall, above the retaining wall footing. The gravel layer should be wrapped in a suitable geotextile fabric to reduce the potential for migration of fines. The footing drain should be extended to daylight or tied into a storm drainage system.

## 6.9 Pavement Design Parameters

Site preparation in the pavement area should be completed as previously recommended in the *Site Grading Recommendations* section of this report. The subsequent pavement recommendations assume proper drainage and construction monitoring, and are based on either PCA or CALTRANS design parameters for a twenty (20) year design period. However, these designs also assume a routine pavement maintenance program to obtain the anticipated 20-year pavement service life.

### Pavement Subgrades

It is anticipated that the new pavements will be primarily supported on a layer of compacted structural fill, consisting of scarified, thoroughly moisture conditioned and recompacted existing soils. The near surface soils generally consist of silty sands and clayey sands. These soils are generally considered to possess fair pavement support characteristics with estimated R-values of 30 to 40. R-value testing was outside the scope of services. The subsequent pavement design is therefore based upon an assumed R-value of 30. Any fill material imported to the site should have support characteristics equal to or greater than that of the on-site soils and be placed and compacted under engineering controlled conditions. It is recommended that R-value testing be performed after completion of rough grading. Depending upon the results of the R-value testing, it may be feasible to use thinner pavement sections in some areas of the site.

### Asphaltic Concrete

Presented below are the recommended thicknesses for new flexible pavement structures consisting of asphaltic concrete over a granular base. The pavement designs are based on the traffic indices (TI's) indicated. The client and/or civil engineer should verify that these TI's are representative of the anticipated traffic volumes. If the client and/or civil engineer determine that the expected traffic volume will exceed the applicable traffic index, we should be contacted for supplementary recommendations. The design traffic indices equate to the following approximate daily traffic volumes over a 20-year design life, assuming six operational traffic days per week.

| Traffic Index | No. of Heavy Trucks per Day |
|---|---|
| 4.0 | 0 |
| 5.0 | 1 |
| 6.0 | 3 |
| 7.0 | 11 |
| 8.0 | 35 |
| 9.0 | 93 |

For the purpose of the traffic volumes indicated above, a truck is defined as a 5-axle tractor trailer unit with one 8-kip axle and two 32-kip tandem axles. All of the traffic indices allow for 1,000 automobiles per day.

| ASPHALT PAVEMENTS (R = 30) | | | | | |
|---|---|---|---|---|---|
| Materials | Thickness (inches) | | | | |
| | Auto Parking and Auto Drive Lanes (TI = 4.0 to 5.0) | Truck Traffic | | | |
| | | TI = 6.0 | TI = 7.0 | TI = 8.0 | TI = 9.0 |
| Asphalt Concrete | 3 | 3½ | 4 | 5 | 6 |
| Aggregate Base | 6 | 8 | 10 | 11 | 12 |
| Compacted Subgrade | 12 | 12 | 12 | 12 | 12 |

The aggregate base course should be compacted to at least 95 percent of the ASTM D-1557 maximum dry density. The asphaltic concrete should be compacted to at least 95 percent of the batch plant-reported maximum density. The aggregate base course may consist of crushed aggregate base (CAB) or crushed miscellaneous base (CMB), which is a recycled gravel, asphalt and concrete material. The gradation, R-Value, Sand Equivalent, and Percentage Wear of the CAB or CMB should comply with appropriate specifications contained in the current edition of the "Greenbook" Standard Specifications for Public Works Construction.

Portland Cement Concrete

The preparation of the subgrade soils within concrete pavement areas should be performed as previously described for proposed asphalt pavement areas. The minimum recommended thicknesses for the Portland Cement Concrete pavement sections are as follows:

| PORTLAND CEMENT CONCRETE PAVEMENTS (R = 30) | | | | |
|---|---|---|---|---|
| Materials | Thickness (inches) | | | |
| | Autos and Light Truck Traffic (TI = 6.0) | Truck Traffic | | |
| | | TI = 7.0 | TI = 8.0 | TI = 9.0 |
| PCC | 5 | 5½ | 6½ | 8 |
| Compacted Subgrade (95% minimum compaction) | 12 | 12 | 12 | 12 |

The concrete should have a 28-day compressive strength of at least 3,000 psi. Any reinforcement within the PCC pavements should be determined by the project structural engineer. The maximum joint spacing within all of the PCC pavements is recommended to be equal to or less than 30 times the pavement thickness.

# 7.0 GENERAL COMMENTS

This report has been prepared as an instrument of service for use by the client, in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. This report may be provided to the contractor(s) and other design consultants to disclose information relative to the project. However, this report is not intended to be utilized as a specification in and of itself, without appropriate interpretation by the project architect, civil engineer, and/or structural engineer. The reproduction and distribution of this report must be authorized by the client and Southern California Geotechnical, Inc. Furthermore, any reliance on this report by an unauthorized third party is at such party's sole risk, and we accept no responsibility for damage or loss which may occur. The client(s)' reliance upon this report is subject to the Engineering Services Agreement, incorporated into our proposal for this project.

The analysis of this site was based on a subsurface profile interpolated from limited discrete soil samples. While the materials encountered in the project area are considered to be representative of the total area, some variations should be expected between boring locations and sample depths. If the conditions encountered during construction vary significantly from those detailed herein, we should be contacted immediately to determine if the conditions alter the recommendations contained herein.

This report has been based on assumed or provided characteristics of the proposed development. It is recommended that the owner, client, architect, structural engineer, and civil engineer carefully review these assumptions to ensure that they are consistent with the characteristics of the proposed development. If discrepancies exist, they should be brought to our attention to verify that they do not affect the conclusions and recommendations contained herein. We also recommend that the project plans and specifications be submitted to our office for review to verify that our recommendations have been correctly interpreted.

The analysis, conclusions, and recommendations contained within this report have been promulgated in accordance with generally accepted professional geotechnical engineering practice. No other warranty is implied or expressed.

# 8.0 REFERENCES


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Seed, H. B., and Idriss, I. M., "Simplified Procedure for Evaluating Soil Liquefaction Potential using field Performance Data," Journal of the Soil Mechanics and Foundations Division, American Society of Civil Engineers, September 1971, pp. 1249-1273.

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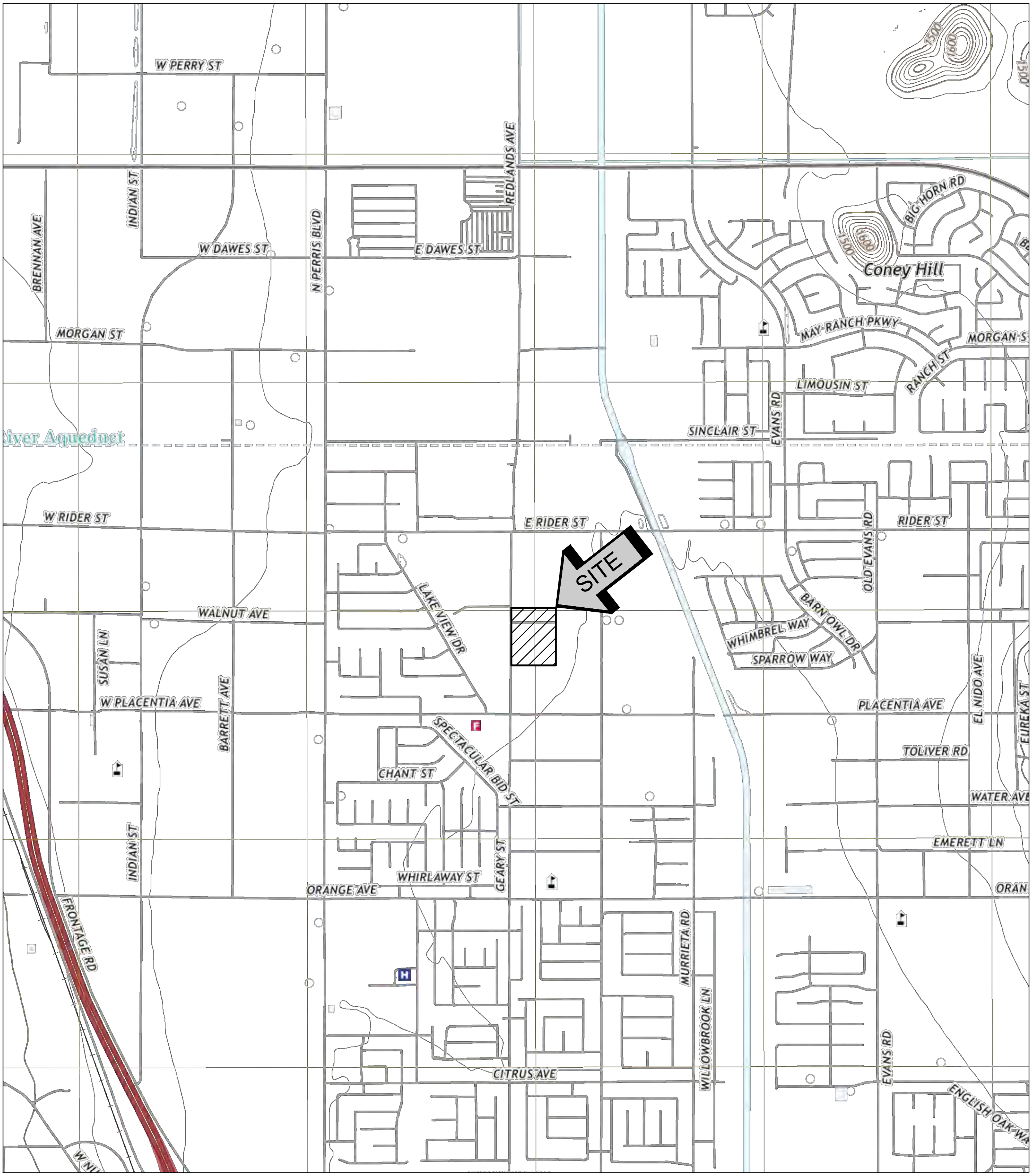
Tokimatsu K., and Seed, H. B., "Evaluation of Settlements in Sands Due to Earthquake Shaking," Journal of the Geotechnical Engineering Division, American society of Civil Engineers, Volume 113, No. 8, August 1987, pp. 861-878.

Tokimatsu, K. and Yoshimi, Y., "*Empirical Correlations of Soil Liquefaction Based on SPT N-value and Fines Content,"* Seismological Research Letters, Eastern Section Seismological Society Of America, Volume 63, Number 1, p. 73.

Youd, T. L. and Idriss, I. M. (Editors), "Proceedings of the NCEER Workshop on Evaluation of Liquefaction Resistance of Soils," Salt Lake City, UT, January 5-6 1996, NCEER Technical Report NCEER-97-0022, Buffalo, NY.

# APPENDIX A




SOURCE: USGS TOPOGRAPHIC MAP OF THE PERRIS QUADRANGLE, RIVERSIDE, CALIFORNIA, 2018.

**SITE LOCATION MAP**

PROPOSED REDLANDS EAST DEVELOPMENT

PERRIS, CALIFORNIA

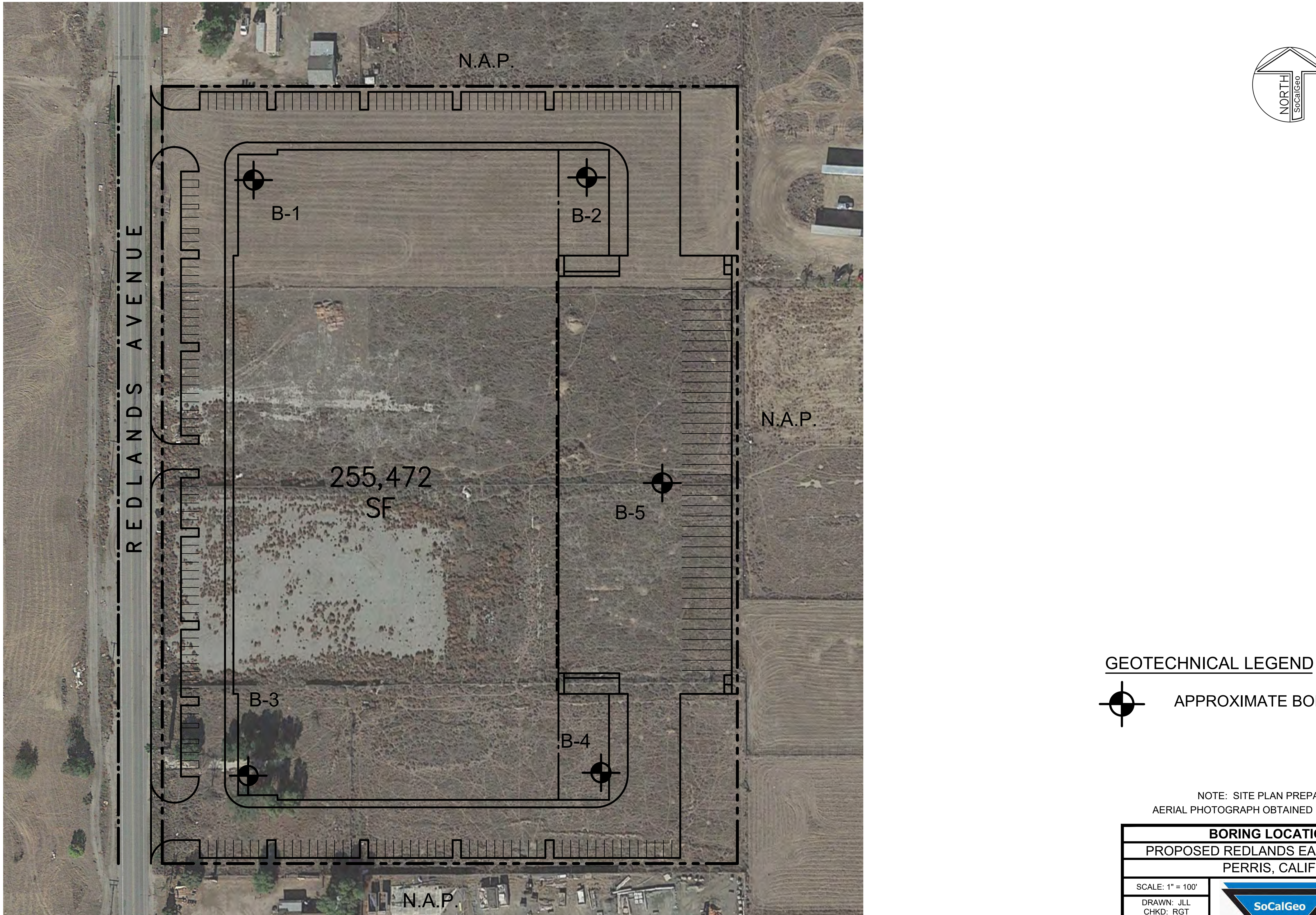
SCALE: 1" = 2000'

DRAWN: JLL
CHKD: RGT

SCG PROJECT
20G180-1

**PLATE 1**

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL




GEOTECHNICAL LEGEND

APPROXIMATE BORING LOCATION

NOTE: SITE PLAN PREPARED BY RGA.
AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH.

**BORING LOCATION PLAN**

PROPOSED REDLANDS EAST DEVELOPMENT

PERRIS, CALIFORNIA

SCALE: 1" = 100'

DRAWN: JLL
CHKD: RGT

SCG PROJECT
20G180-1

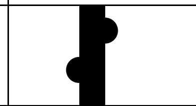
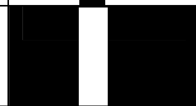
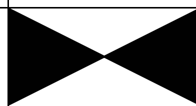
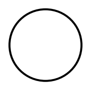
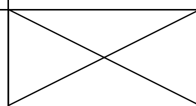
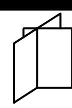
**PLATE 2**

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL

# APPENDIX B

# BORING LOG LEGEND

| SAMPLE TYPE | GRAPHICAL SYMBOL | SAMPLE DESCRIPTION |
|---|---|---|
| AUGER |  | SAMPLE COLLECTED FROM AUGER CUTTINGS, NO FIELD MEASUREMENT OF SOIL STRENGTH. (DISTURBED) |
| CORE |  | ROCK CORE SAMPLE: TYPICALLY TAKEN WITH A DIAMOND-TIPPED CORE BARREL. TYPICALLY USED ONLY IN HIGHLY CONSOLIDATED BEDROCK. |
| GRAB |  | SOIL SAMPLE TAKEN WITH NO SPECIALIZED EQUIPMENT, SUCH AS FROM A STOCKPILE OR THE GROUND SURFACE. (DISTURBED) |
| CS |  | CALIFORNIA SAMPLER: 2-1/2 INCH I.D. SPLIT BARREL SAMPLER, LINED WITH 1-INCH HIGH BRASS RINGS. DRIVEN WITH SPT HAMMER. (RELATIVELY UNDISTURBED) |
| NSR |  | NO RECOVERY: THE SAMPLING ATTEMPT DID NOT RESULT IN RECOVERY OF ANY SIGNIFICANT SOIL OR ROCK MATERIAL. |
| SPT |  | STANDARD PENETRATION TEST: SAMPLER IS A 1.4 INCH INSIDE DIAMETER SPLIT BARREL, DRIVEN 18 INCHES WITH THE SPT HAMMER. (DISTURBED) |
| SH |  | SHELBY TUBE: TAKEN WITH A THIN WALL SAMPLE TUBE, PUSHED INTO THE SOIL AND THEN EXTRACTED. (UNDISTURBED) |
| VANE |  | VANE SHEAR TEST: SOIL STRENGTH OBTAINED USING A 4 BLADED SHEAR DEVICE. TYPICALLY USED IN SOFT CLAYS-NO SAMPLE RECOVERED. |

COLUMN DESCRIPTIONS

DEPTH: Distance in feet below the ground surface.

SAMPLE: Sample Type as depicted above.

BLOW COUNT: Number of blows required to advance the sampler 12 inches using a 140 lb hammer with a 30-inch drop. 50/3” indicates penetration refusal (>50 blows) at 3 inches. WH indicates that the weight of the hammer was sufficient to push the sampler 6 inches or more.

POCKET PEN.: Approximate shear strength of a cohesive soil sample as measured by pocket penetrometer.

GRAPHIC LOG: Graphic Soil Symbol as depicted on the following page.

DRY DENSITY: Dry density of an undisturbed or relatively undisturbed sample in lbs/ft$^3$.

MOISTURE CONTENT: Moisture content of a soil sample, expressed as a percentage of the dry weight.

LIQUID LIMIT: The moisture content above which a soil behaves as a liquid.

PLASTIC LIMIT: The moisture content above which a soil behaves as a plastic.

PASSING #200 SIEVE: The percentage of the sample finer than the #200 standard sieve.

UNCONFINED SHEAR: The shear strength of a cohesive soil sample, as measured in the unconfined state.

# SOIL CLASSIFICATION CHART

| MAJOR DIVISIONS | | | SYMBOLS | | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|---|
| | | | GRAPH | LETTER | |
| COARSE GRAINED SOILS | GRAVEL AND GRAVELLY SOILS | CLEAN GRAVELS | | GW | WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | | (LITTLE OR NO FINES) | | GP | POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | GRAVELS WITH FINES | | GM | SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES |
| | | (APPRECIABLE AMOUNT OF FINES) | | GC | CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES |
| MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE | SAND AND SANDY SOILS | CLEAN SANDS | | SW | WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| | | (LITTLE OR NO FINES) | | SP | POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES |
| | MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE | SANDS WITH FINES | | SM | SILTY SANDS, SAND - SILT MIXTURES |
| | | (APPRECIABLE AMOUNT OF FINES) | | SC | CLAYEY SANDS, SAND - CLAY MIXTURES |
| FINE GRAINED SOILS | SILTS AND CLAYS | LIQUID LIMIT LESS THAN 50 | | ML | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY |
| | | | | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | | | OL | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE | SILTS AND CLAYS | LIQUID LIMIT GREATER THAN 50 | | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS |
| | | | | CH | INORGANIC CLAYS OF HIGH PLASTICITY |
| | | | | OH | ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS |
| HIGHLY ORGANIC SOILS | | | | PT | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS |

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# BORING NO. B-1

| | | |
|---|---|---|
| JOB NO.: 20G180-1 | DRILLING DATE: 7/29/20 | WATER DEPTH: Dry |
| PROJECT: Proposed Redlands East Development | DRILLING METHOD: Hollow Stem Auger | CAVE DEPTH: 17 feet |
| LOCATION: Perris, California | LOGGED BY: Ryan Bremer | READING TAKEN: At Completion |

| FIELD RESULTS | | | | | DESCRIPTION | LABORATORY RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | BLOW COUNT | POCKET PEN. (TSF) | GRAPHIC LOG | SURFACE ELEVATION: --- MSL | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | LIQUID LIMIT | PLASTIC LIMIT | PASSING #200 SIEVE (%) | ORGANIC CONTENT (%) | COMMENTS |
| | | | | | ALLUVIUM: Light Brown Silty fine Sand, trace medium to coarse Sand, trace Clay, trace fine root fibers, slightly porous, medium dense-damp | | | | | | | |
| | X | 29 | | | | 115 | 4 | | | | | |
| | X | 50 | | | @ 3 feet, little to some medium to coarse Sand, dense-damp to moist | 119 | 7 | | | | | |
| 5 | X | 25 | 4.5 | | Light Brown to Brown fine Sandy Clay, trace medium Sand, little Silt, trace Calcareous nodules, very stiff-damp | 104 | 6 | | | | | |
| | X | 28 | 4.5 | | | 113 | 8 | | | | | |
| | | | | | Brown to Gray Brown fine to coarse Sand, trace Calcareous veining, medium dense-damp to moist | | | | | | | |
| | X | 39 | | | Light Brown Silty fine Sand, trace medium Sand, micaceous, medium dense-damp | 117 | 6 | | | | | |
| 10 | | | | | | | | | | | | |
| | | | | | Light Brown to Brown Clayey Silt, trace fine Sand, trace Silt, little Calcareous nodules and veining, hard-very moist | | | | | | | |
| | X | 50/4" | 4.5 | | | 100 | 21 | | | | | |
| 15 | | | | | | | | | | | | |
| | X | 55 | 4.5 | | | 114 | 15 | | | | | |
| 20 | | | | | Boring Terminated at 20' | | | | | | | |

TBL 20G180-1.GPJ SOCALGEO.GDT 8/14/20

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# BORING NO. B-2

JOB NO.: 20G180-1
PROJECT: Proposed Redlands East Development
LOCATION: Perris, California

DRILLING DATE: 7/29/20
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Ryan Bremer

WATER DEPTH: Dry
CAVE DEPTH: 47 feet
READING TAKEN: At Completion

| DEPTH (FEET) | SAMPLE | BLOW COUNT | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION<br>SURFACE ELEVATION: --- MSL | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | LIQUID LIMIT | PLASTIC LIMIT | PASSING #200 SIEVE (%) | ORGANIC CONTENT (%) | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ALLUVIUM: Brown Silty fine Sand, trace medium Sand, trace Clay, trace fine root fibers, dense-damp | | | | | | | |
| | X | 47 | | | | | 4 | | | | | |
| | | | | | Brown Clayey fine Sand, trace medium to coarse Sand, little Silt, trace Calcareous veining, medium dense-moist | | | | | | | |
| | X | 20 | | | | | 10 | | | | | |
| 5 | | | | | | | | | | | | |
| | X | 28 | | | | | 8 | | | | | |
| | | | | | Light Gray Brown Clayey Silt, trace Calcareous veining, stiff to very stiff-very moist | | | | | | | |
| | X | 26 | 4.5 | | | | 22 | | | | | |
| 10 | | | | | | | | | | | | |
| | | | | | Light Brown fine Sandy Clay, little Silt, trace to little Calcareous veining, stiff to very stiff-very moist | | | | | | | |
| | X | 15 | 4.5 | | | | 19 | | | | | |
| 15 | | | | | | | | | | | | |
| | | | | | Brown Gray Clayey fine to medium Sand, little Silt, little Calcareous nodules, dense-moist | | | | | | | |
| | X | 32 | | | | | 11 | | | | | |
| 20 | | | | | | | | | | | | |
| | | | | | Red Brown fine Sandy Clay, trace Silt, trace medium to coarse Sand, hard-moist | | | | | | | |
| | X | 39 | 4.5 | | | | 13 | | | | | |
| 25 | | | | | | | | | | | | |
| | | | | | Red Brown Silty fine Sand, trace medium Sand, trace Clay, medium dense-moist | | | | | | | |
| | X | 22 | | | | | 12 | | | | | |
| 30 | | | | | | | | | | | | |
| | X | 27 | | | @ 33.5 feet, little Clay | | 13 | | | | | |

TBL 20G180-1.GPJ SOCALGEO.GDT 8/14/20

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# BORING NO. B-2

| | | |
|---|---|---|
| JOB NO.: 20G180-1 | DRILLING DATE: 7/29/20 | WATER DEPTH: Dry |
| PROJECT: Proposed Redlands East Development | DRILLING METHOD: Hollow Stem Auger | CAVE DEPTH: 47 feet |
| LOCATION: Perris, California | LOGGED BY: Ryan Bremer | READING TAKEN: At Completion |

| FIELD RESULTS | | | | | | LABORATORY RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | BLOW COUNT | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION (Continued) | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | LIQUID LIMIT | PLASTIC LIMIT | PASSING #200 SIEVE (%) | ORGANIC CONTENT (%) | COMMENTS |
| | | | | | Brown Silty fine Sand to fine Sandy Silt, little Clay, medium dense-moist to very moist | | | | | | | |
| | X | 29 | | | | | 15 | | | 51 | | |
| 40 | | | | | | | | | | | | |
| | | | | | Red Brown Clayey fine Sand, trace medium Sand, little Silt, little Calcareous veining and nodules, trace Silt, medium dense to dense-moist | | | | | | | |
| | X | 25 | | | | | 13 | | | 47 | | |
| 45 | | | | | | | | | | | | |
| | X | 40 | | | | | 14 | | | | | |
| 50 | | | | | | | | | | | | |
| | | | | | Boring Terminated at 50' | | | | | | | |

TBL 20G180-1.GPJ SOCALGEO.GDT 8/14/20

# BORING NO. B-3

JOB NO.: 20G180-1
PROJECT: Proposed Redlands East Development
LOCATION: Perris, California

DRILLING DATE: 7/29/20
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Ryan Bremer

WATER DEPTH: Dry
CAVE DEPTH: 16 feet
READING TAKEN: At Completion

SURFACE ELEVATION: --- MSL

| DEPTH (FEET) | SAMPLE | BLOW COUNT | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | LIQUID LIMIT | PLASTIC LIMIT | PASSING #200 SIEVE (%) | ORGANIC CONTENT (%) | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | FILL: Light Brown Silty fine to coarse Sand, trace to little Clay, medium dense-damp | | | | | | | |
| | X | 19 | | | | | 5 | | | | | |
| | | | | | ALLUVIUM: Gray Brown Silty fine Sand, trace medium to coarse Sand, little Clay, dense-damp | | | | | | | |
| | X | 38 | | | | | 4 | | | | | |
| 5 | | | | | | | | | | | | |
| | X | 36 | | | | | 4 | | | | | |
| | | | | | Gray Brown Clayey Silt, trace fine Sand, little Calcareous veining, very stiff-moist | | | | | | | |
| | X | 26 | 4.0 | | | | 14 | | | | | |
| 10 | | | | | | | | | | | | |
| | | | | | Light Brown fine to medium Sand, trace coarse Sand, trace to little Silt, medium dense to dense-dry to damp | | | | | | | |
| | X | 30 | | | | | 3 | | | | | |
| 15 | | | | | | | | | | | | |
| | | | | | Brown fine to medium Sand, little Clay, some Calcareous veining, trace coarse Sand, dense-moist | | | | | | | |
| | X | 37 | | | | | 13 | | | | | |
| 20 | | | | | | | | | | | | |

Boring Terminated at 20'

TBL 20G180-1.GPJ SOCALGEO.GDT 8/14/20

# TEST BORING LOG

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# BORING NO. B-4

JOB NO.: 20G180-1
PROJECT: Proposed Redlands East Development
LOCATION: Perris, California

DRILLING DATE: 7/29/20
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Ryan Bremer

WATER DEPTH: Dry
CAVE DEPTH: 44 feet
READING TAKEN: At Completion

| FIELD RESULTS | | | | | | LABORATORY RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | BLOW COUNT | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION<br>SURFACE ELEVATION: --- MSL | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | LIQUID LIMIT | PLASTIC LIMIT | PASSING #200 SIEVE (%) | ORGANIC CONTENT (%) | COMMENTS |
| | | | | | ALLUVIUM: Brown Clayey fine Sand, little Silt, trace medium to coarse Sand, slightly porous, medium dense-damp | | | | | | | |
| | X | 25 | | | | 124 | 5 | | | | | EI = 5 @ 0 to 5' |
| | X | 26 | | | | 130 | 7 | | | | | |
| 5 | X | 21 | | | | 125 | 7 | | | | | |
| | X | 33 | | | Light Brown Silty fine to coarse Sand, trace Clay, trace Calcareous veining, medium dense-damp | 117 | 7 | | | | | |
| | X | 42 | | | Light Gray Brown fine Sandy Silt, trace Clay, medium dense-moist | 106 | 12 | | | | | |
| 10 | | | | | Gray Brown Clayey fine to coarse Sand, little Silt, medium dense-damp to moist | 117 | 8 | | | | | |
| | | | | | Light Brown Clayey Silt, trace fine Sand, stiff to hard-moist to very moist | | | | | | | |
| | X | 34 | 4.5 | | | | 18 | | | | | |
| 15 | | | | | | | | | | | | |
| | X | 16 | 3.0 | | | | 20 | | | 92 | | |
| 20 | | | | | | | | | | | | |
| | X | 24 | 3.5 | | | | 14 | | | | | |
| 25 | | | | | | | | | | | | |
| | | | | | Light Gray Clayey fine Sand to fine Sandy Clay, dense to hard-damp | | | | | | | |
| | X | 42 | 4.0 | | | | 9 | | | | | |
| 30 | | | | | | | | | | | | |
| | | | | | Brown fine Sandy Clay, trace medium Sand, trace Calcareous nodules, very stiff-moist | | | | | | | |
| | X | 21 | 2.5 | | | | 16 | | | 60 | | |

TBL 20G180-1.GPJ SOCALGEO.GDT 8/14/20

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# BORING NO. B-4

JOB NO.: 20G180-1
PROJECT: Proposed Redlands East Development
LOCATION: Perris, California

DRILLING DATE: 7/29/20
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Ryan Bremer

WATER DEPTH: Dry
CAVE DEPTH: 44 feet
READING TAKEN: At Completion

| DEPTH (FEET) | SAMPLE | BLOW COUNT | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION (Continued) | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | LIQUID LIMIT | PLASTIC LIMIT | PASSING #200 SIEVE (%) | ORGANIC CONTENT (%) | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Brown Clayey fine to medium Sand, little Silt, dense-damp to moist | | | | | | | |
| | X | 47 | | | | | 9 | | | | | |
| 40 | | | | | | | | | | | | |
| | | | | | Brown Silty fine to medium Sand, trace coarse Sand, trace Clay, some Silt, medium dense-moist to very moist | | | | | | | |
| | X | 28 | | | | | 12 | | | 38 | | |
| 45 | | | | | | | | | | | | |
| | | | | | Red Brown Clayey fine Sand to fine Sandy Clay, little Silt, medium dense to very stiff-moist | | | | | | | |
| | X | 22 | 4.5 | | | | 15 | | | 50 | | |
| 50 | | | | | | | | | | | | |

Boring Terminated at 50'

TBL 20G180-1.GPJ SOCALGEO.GDT 8/14/20

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# BORING NO. B-5

JOB NO.: 20G180-1
PROJECT: Proposed Redlands East Development
LOCATION: Perris, California

DRILLING DATE: 7/29/20
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Ryan Bremer

WATER DEPTH: Dry
CAVE DEPTH: 18 feet
READING TAKEN: At Completion

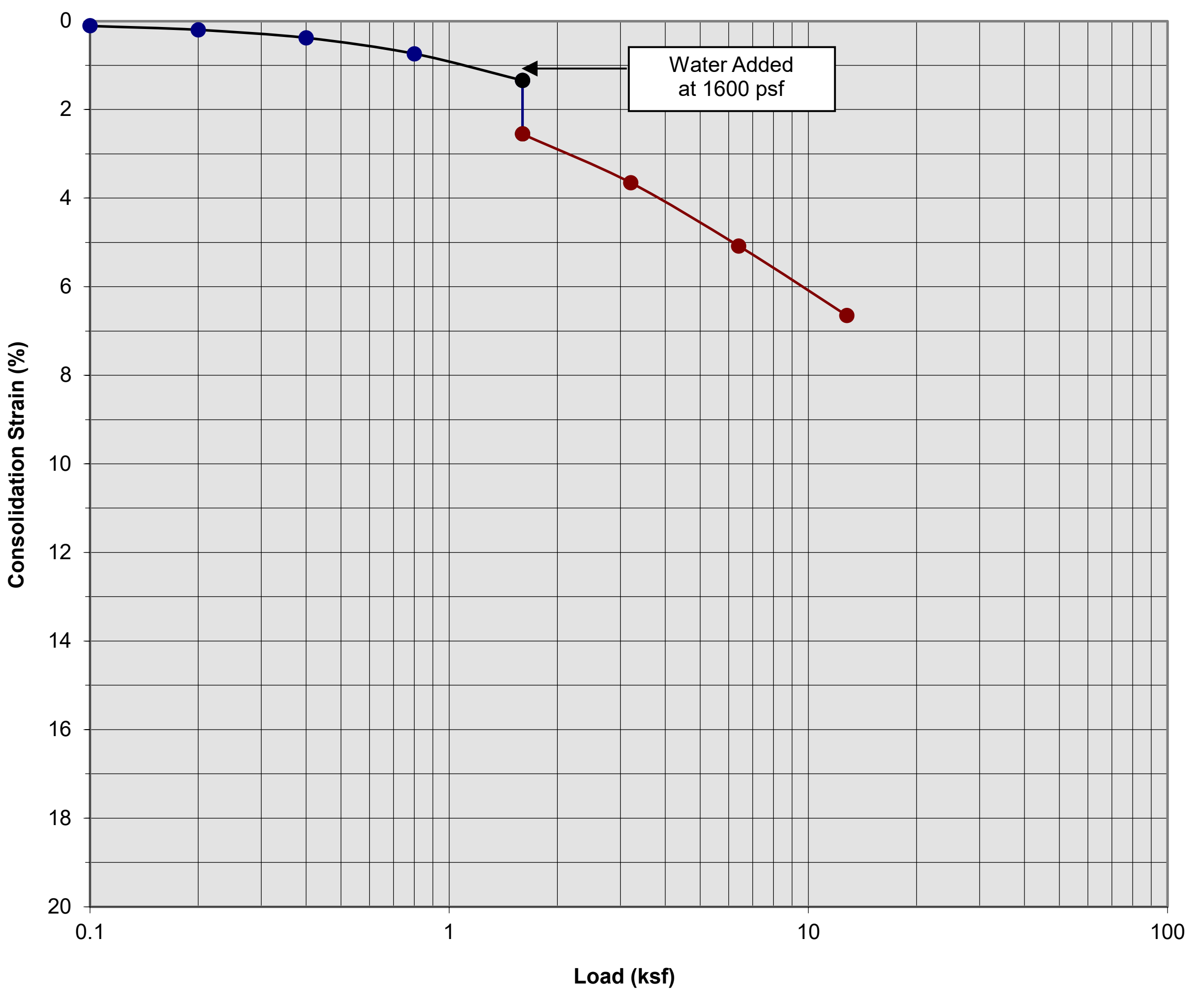
SURFACE ELEVATION: --- MSL

| DEPTH (FEET) | SAMPLE | BLOW COUNT | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | LIQUID LIMIT | PLASTIC LIMIT | PASSING #200 SIEVE (%) | ORGANIC CONTENT (%) | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ALLUVIUM: Brown Clayey fine Sand, little medium to coarse Sand, little Silt, medium dense-damp to moist | | | | | | | |
| | X | 17 | | | | | 8 | | | | | |
| | X | 17 | | | | | 9 | | | | | |
| 5 | | | | | Gray Brown Clayey Silt, little fine Sand, very stiff-moist to very moist | | | | | | | |
| | X | 19 | 4.0 | | | | 16 | | | | | |
| | X | 26 | 4.5 | | | | 25 | | | | | |
| 10 | | | | | | | | | | | | |
| | X | 16 | 4.5 | | | | 20 | | | | | |
| 15 | | | | | | | | | | | | |
| | | | | | Light Gray Brown Silty Clay to Clayey Silt, trace fine Sand, very stiff-moist | | | | | | | |
| | X | 19 | 4.0 | | | | 14 | | | | | |
| 20 | | | | | Boring Terminated at 20' | | | | | | | |

TBL 20G180-1.GPJ SOCALGEO.GDT 8/14/20

# APPENDIX C

## Consolidation/Collapse Test Results

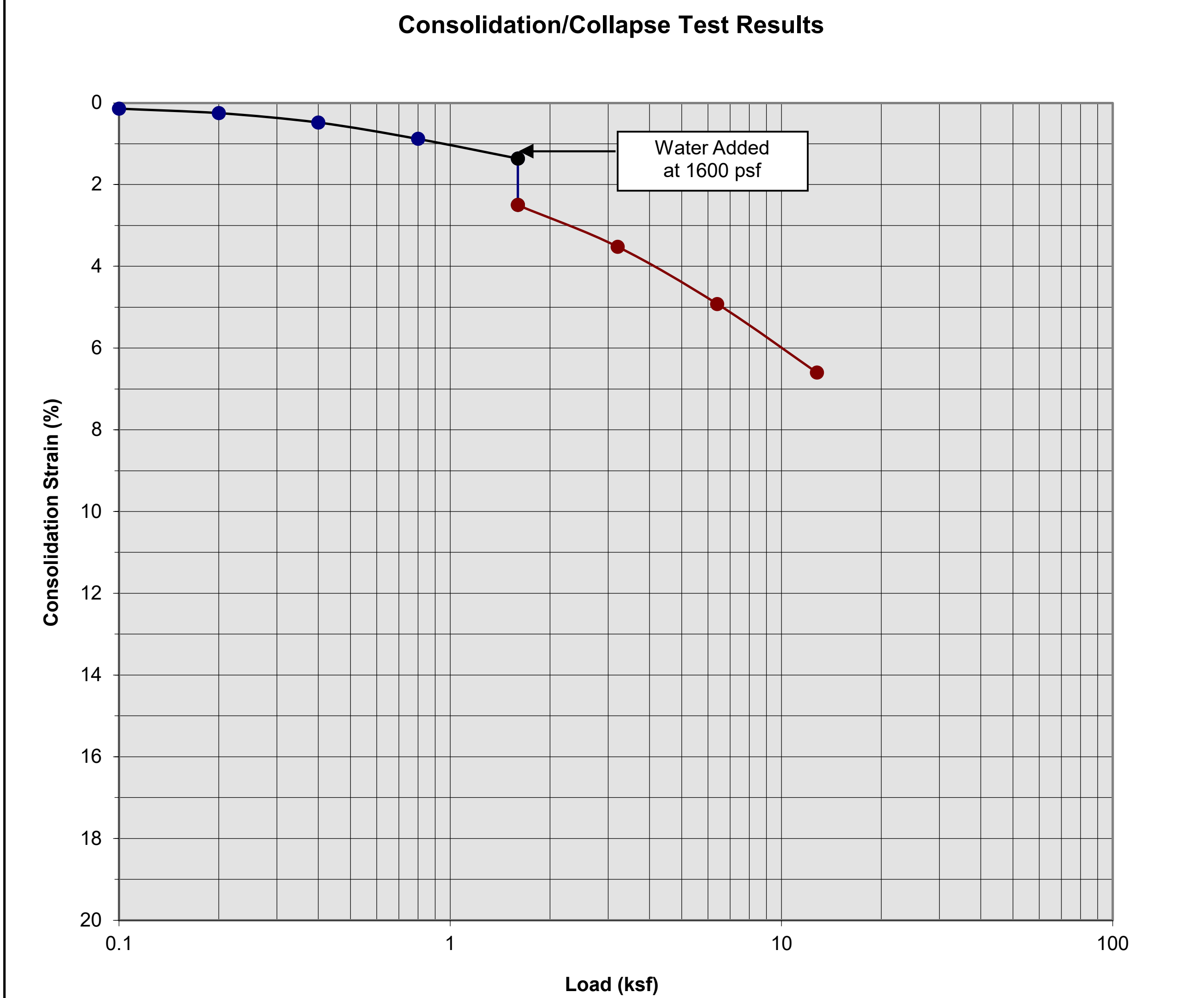



Classification: Brown Clayey fine Sand, trace medium to coarse Sand, little Silt

| | | | |
|---|---|---|---|
| Boring Number: | B-4 | Initial Moisture Content (%) | 7 |
| Sample Number: | --- | Final Moisture Content (%) | 10 |
| Depth (ft) | 3 to 4 | Initial Dry Density (pcf) | 130.1 |
| Specimen Diameter (in) | 2.4 | Final Dry Density (pcf) | 138.7 |
| Specimen Thickness (in) | 1.0 | Percent Collapse (%) | 1.21 |

Proposed Redlands East Development
Perris, California
Project No. 20G180-1
**PLATE C-1**

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
*A California Corporation*

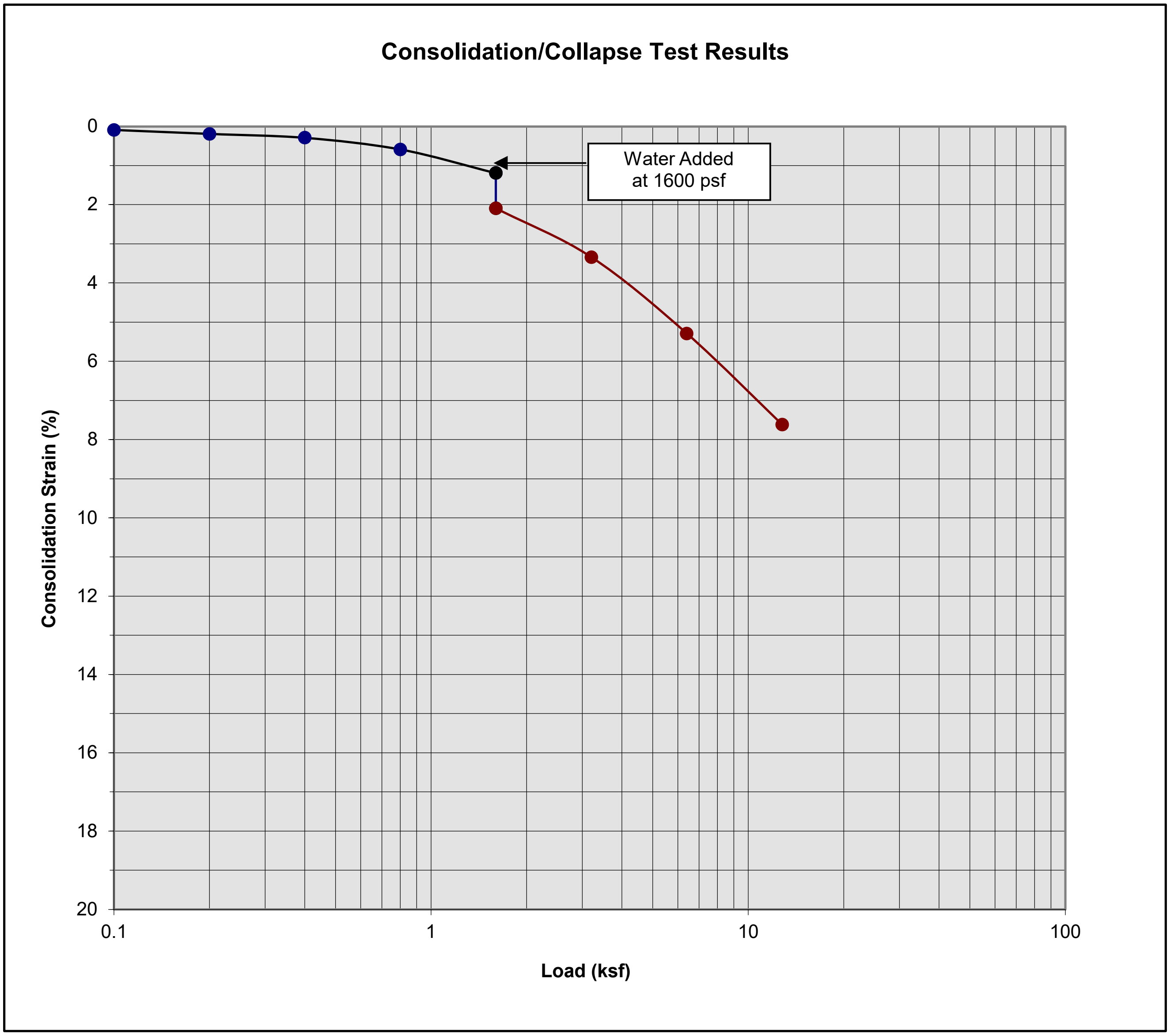



Classification: Brown Clayey fine Sand, trace medium to coarse Sand, little Silt

| | | | |
|---|---|---|---|
| Boring Number: | B-4 | Initial Moisture Content (%) | 7 |
| Sample Number: | --- | Final Moisture Content (%) | 10 |
| Depth (ft) | 5 to 6 | Initial Dry Density (pcf) | 124.7 |
| Specimen Diameter (in) | 2.4 | Final Dry Density (pcf) | 134.3 |
| Specimen Thickness (in) | 1.0 | Percent Collapse (%) | 1.14 |

Proposed Redlands East Development
Perris, California
Project No. 20G180-1
**PLATE C-2**

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation




Classification: Light Brown Silty fine to coarse Sand, trace Clay

| | | | |
|---|---|---|---|
| Boring Number: | B-4 | Initial Moisture Content (%) | 7 |
| Sample Number: | --- | Final Moisture Content (%) | 14 |
| Depth (ft) | 7 to 8 | Initial Dry Density (pcf) | 116.1 |
| Specimen Diameter (in) | 2.4 | Final Dry Density (pcf) | 125.8 |
| Specimen Thickness (in) | 1.0 | Percent Collapse (%) | 0.90 |

Proposed Redlands East Development
Perris, California
Project No. 20G180-1
**PLATE C-3**

SOUTHERN CALIFORNIA GEOTECHNICAL
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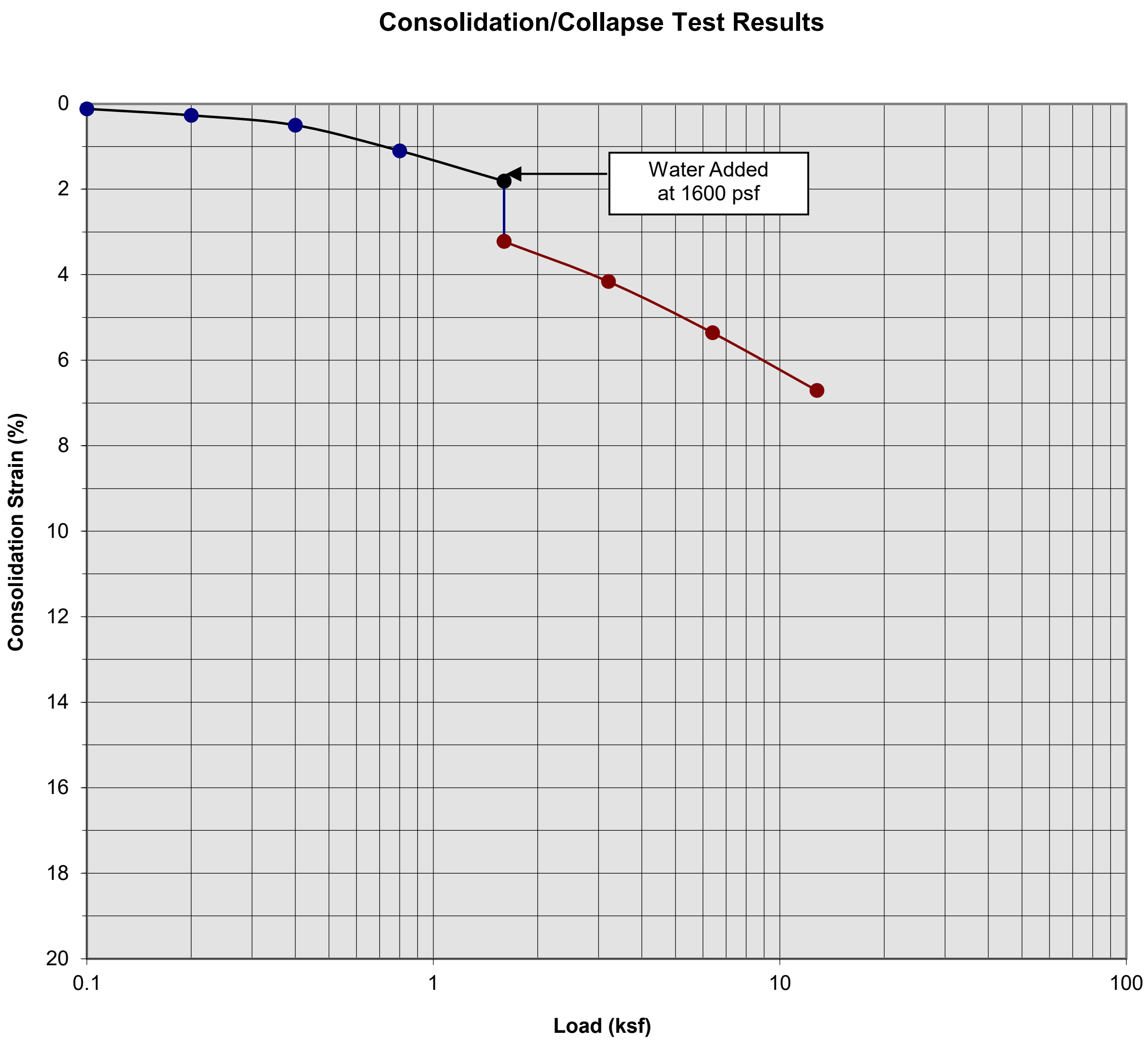
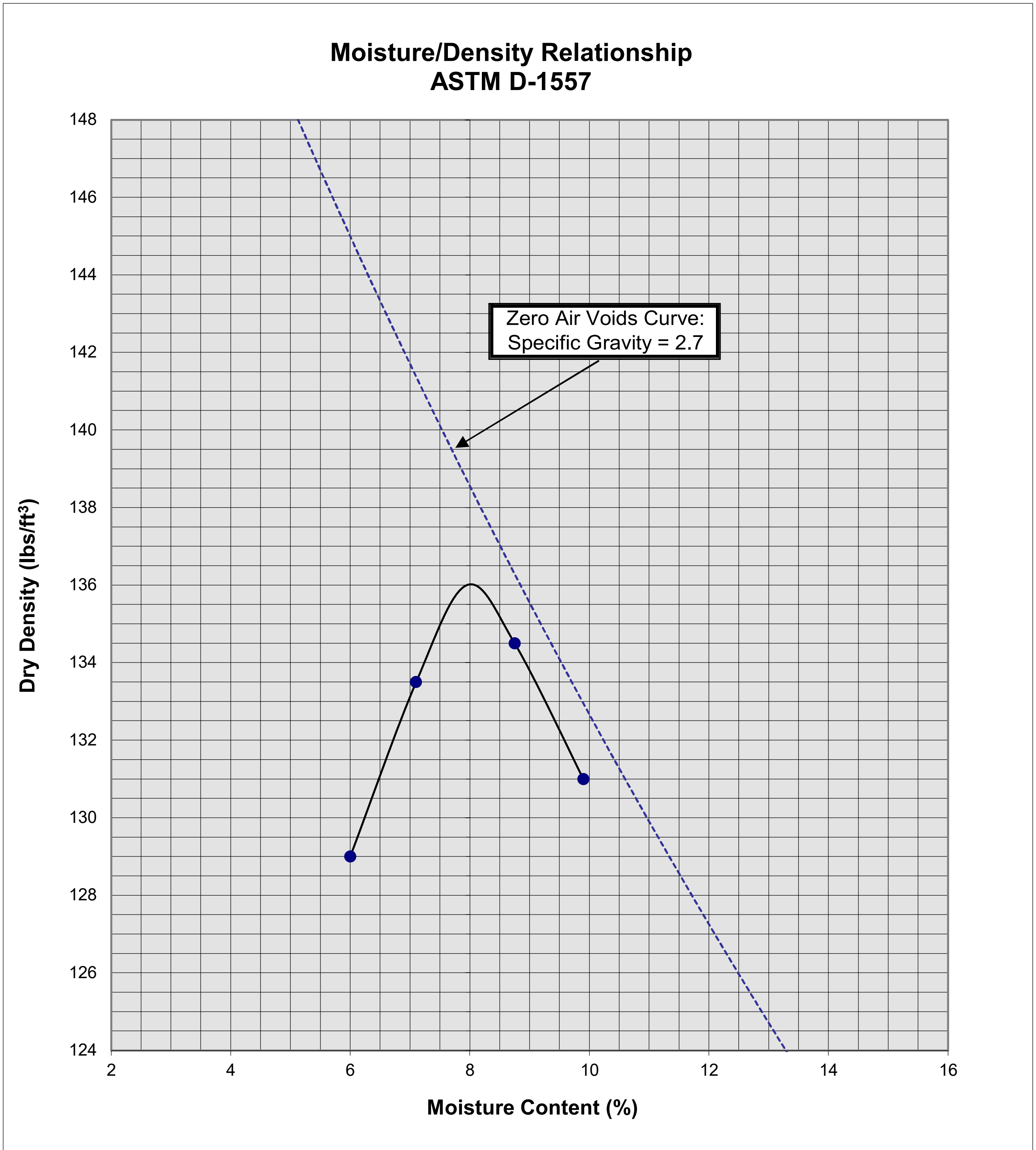



Classification: Gray Brown Clayey fine to coarse Sand, little Silt

| | | | |
|---|---|---|---|
| Boring Number: | B-4 | Initial Moisture Content (%) | 8 |
| Sample Number: | --- | Final Moisture Content (%) | 15 |
| Depth (ft) | 9 to 10 | Initial Dry Density (pcf) | 116.5 |
| Specimen Diameter (in) | 2.4 | Final Dry Density (pcf) | 125.5 |
| Specimen Thickness (in) | 1.0 | Percent Collapse (%) | 1.41 |




| | | |
|---|---|---|
| Soil ID Number | | B-1 @ 0-5' |
| Optimum Moisture (%) | | 8 |
| Maximum Dry Density (pcf) | | 136 |
| Soil Classification | Light Brown Silty fine Sand, trace medium to coarse Sand, trace Clay | |

Proposed Redlands East Development
Perris, California
Project No. 20G180-1
**PLATE C-5**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# APPENDIX D

# GRADING GUIDE SPECIFICATIONS

These grading guide specifications are intended to provide typical procedures for grading operations. They are intended to supplement the recommendations contained in the geotechnical investigation report for this project. Should the recommendations in the geotechnical investigation report conflict with the grading guide specifications, the more site specific recommendations in the geotechnical investigation report will govern.

## General

- The Earthwork Contractor is responsible for the satisfactory completion of all earthwork in accordance with the plans and geotechnical reports, and in accordance with city, county, and applicable building codes.

- The Geotechnical Engineer is the representative of the Owner/Builder for the purpose of implementing the report recommendations and guidelines. These duties are not intended to relieve the Earthwork Contractor of any responsibility to perform in a workman-like manner, nor is the Geotechnical Engineer to direct the grading equipment or personnel employed by the Contractor.

- The Earthwork Contractor is required to notify the Geotechnical Engineer of the anticipated work and schedule so that testing and inspections can be provided. If necessary, work may be stopped and redone if personnel have not been scheduled in advance.

- The Earthwork Contractor is required to have suitable and sufficient equipment on the job-site to process, moisture condition, mix and compact the amount of fill being placed to the approved compaction. In addition, suitable support equipment should be available to conform with recommendations and guidelines in this report.

- Canyon cleanouts, overexcavation areas, processed ground to receive fill, key excavations, subdrains and benches should be observed by the Geotechnical Engineer prior to placement of any fill. It is the Earthwork Contractor's responsibility to notify the Geotechnical Engineer of areas that are ready for inspection.

- Excavation, filling, and subgrade preparation should be performed in a manner and sequence that will provide drainage at all times and proper control of erosion. Precipitation, springs, and seepage water encountered shall be pumped or drained to provide a suitable working surface. The Geotechnical Engineer must be informed of springs or water seepage encountered during grading or foundation construction for possible revision to the recommended construction procedures and/or installation of subdrains.

## Site Preparation

- The Earthwork Contractor is responsible for all clearing, grubbing, stripping and site preparation for the project in accordance with the recommendations of the Geotechnical Engineer.

- If any materials or areas are encountered by the Earthwork Contractor which are suspected of having toxic or environmentally sensitive contamination, the Geotechnical Engineer and Owner/Builder should be notified immediately.

- Major vegetation should be stripped and disposed of off-site. This includes trees, brush, heavy grasses and any materials considered unsuitable by the Geotechnical Engineer.

- Underground structures such as basements, cesspools or septic disposal systems, mining shafts, tunnels, wells and pipelines should be removed under the inspection of the Geotechnical Engineer and recommendations provided by the Geotechnical Engineer and/or city, county or state agencies. If such structures are known or found, the Geotechnical Engineer should be notified as soon as possible so that recommendations can be formulated.

- Any topsoil, slopewash, colluvium, alluvium and rock materials which are considered unsuitable by the Geotechnical Engineer should be removed prior to fill placement.

- Remaining voids created during site clearing caused by removal of trees, foundations basements, irrigation facilities, etc., should be excavated and filled with compacted fill.

- Subsequent to clearing and removals, areas to receive fill should be scarified to a depth of 10 to 12 inches, moisture conditioned and compacted

- The moisture condition of the processed ground should be at or slightly above the optimum moisture content as determined by the Geotechnical Engineer. Depending upon field conditions, this may require air drying or watering together with mixing and/or discing.

Compacted Fills

- Soil materials imported to or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable in the opinion of the Geotechnical Engineer. Unless otherwise approved by the Geotechnical Engineer, all fill materials shall be free of deleterious, organic, or frozen matter, shall contain no chemicals that may result in the material being classified as "contaminated," and shall be very low to non-expansive with a maximum expansion index (EI) of 50. The top 12 inches of the compacted fill should have a maximum particle size of 3 inches, and all underlying compacted fill material a maximum 6-inch particle size, except as noted below.

- All soils should be evaluated and tested by the Geotechnical Engineer. Materials with high expansion potential, low strength, poor gradation or containing organic materials may require removal from the site or selective placement and/or mixing to the satisfaction of the Geotechnical Engineer.

- Rock fragments or rocks less than 6 inches in their largest dimensions, or as otherwise determined by the Geotechnical Engineer, may be used in compacted fill, provided the distribution and placement is satisfactory in the opinion of the Geotechnical Engineer.

- Rock fragments or rocks greater than 12 inches should be taken off-site or placed in accordance with recommendations and in areas designated as suitable by the Geotechnical Engineer. These materials should be placed in accordance with Plate D-8 of these Grading Guide Specifications and in accordance with the following recommendations:

  - Rocks 12 inches or more in diameter should be placed in rows at least 15 feet apart, 15 feet from the edge of the fill, and 10 feet or more below subgrade. Spaces should be left between each rock fragment to provide for placement and compaction of soil around the fragments.

  - Fill materials consisting of soil meeting the minimum moisture content requirements and free of oversize material should be placed between and over the rows of rock or concrete. Ample water and compactive effort should be applied to the fill materials as they are placed in order that all of the voids between each of the fragments are filled and compacted to the specified density.

- Subsequent rows of rocks should be placed such that they are not directly above a row placed in the previous lift of fill. A minimum 5-foot offset between rows is recommended.

- To facilitate future trenching, oversized material should not be placed within the range of foundation excavations, future utilities or other underground construction unless specifically approved by the soil engineer and the developer/owner representative.

- Fill materials approved by the Geotechnical Engineer should be placed in areas previously prepared to receive fill and in evenly placed, near horizontal layers at about 6 to 8 inches in loose thickness, or as otherwise determined by the Geotechnical Engineer for the project.

- Each layer should be moisture conditioned to optimum moisture content, or slightly above, as directed by the Geotechnical Engineer. After proper mixing and/or drying, to evenly distribute the moisture, the layers should be compacted to at least 90 percent of the maximum dry density in compliance with ASTM D-1557-78 unless otherwise indicated.

- Density and moisture content testing should be performed by the Geotechnical Engineer at random intervals and locations as determined by the Geotechnical Engineer. These tests are intended as an aid to the Earthwork Contractor, so he can evaluate his workmanship, equipment effectiveness and site conditions. The Earthwork Contractor is responsible for compaction as required by the Geotechnical Report(s) and governmental agencies.

- Fill areas unused for a period of time may require moisture conditioning, processing and recompaction prior to the start of additional filling. The Earthwork Contractor should notify the Geotechnical Engineer of his intent so that an evaluation can be made.

- Fill placed on ground sloping at a 5-to-1 inclination (horizontal-to-vertical) or steeper should be benched into bedrock or other suitable materials, as directed by the Geotechnical Engineer. Typical details of benching are illustrated on Plates D-2, D-4, and D-5.

- Cut/fill transition lots should have the cut portion overexcavated to a depth of at least 3 feet and rebuilt with fill (see Plate D-1), as determined by the Geotechnical Engineer.

- All cut lots should be inspected by the Geotechnical Engineer for fracturing and other bedrock conditions. If necessary, the pads should be overexcavated to a depth of 3 feet and rebuilt with a uniform, more cohesive soil type to impede moisture penetration.

- Cut portions of pad areas above buttresses or stabilizations should be overexcavated to a depth of 3 feet and rebuilt with uniform, more cohesive compacted fill to impede moisture penetration.

- Non-structural fill adjacent to structural fill should typically be placed in unison to provide lateral support. Backfill along walls must be placed and compacted with care to ensure that excessive unbalanced lateral pressures do not develop. The type of fill material placed adjacent to below grade walls must be properly tested and approved by the Geotechnical Engineer with consideration of the lateral earth pressure used in the design.

Foundations

- The foundation influence zone is defined as extending one foot horizontally from the outside edge of a footing, and proceeding downward at a ½ horizontal to 1 vertical (0.5:1) inclination.

- Where overexcavation beneath a footing subgrade is necessary, it should be conducted so as to encompass the entire foundation influence zone, as described above.

- Compacted fill adjacent to exterior footings should extend at least 12 inches above foundation bearing grade. Compacted fill within the interior of structures should extend to the floor subgrade elevation.

Fill Slopes

- The placement and compaction of fill described above applies to all fill slopes. Slope compaction should be accomplished by overfilling the slope, adequately compacting the fill in even layers, including the overfilled zone and cutting the slope back to expose the compacted core

- Slope compaction may also be achieved by backrolling the slope adequately every 2 to 4 vertical feet during the filling process as well as requiring the earth moving and compaction equipment to work close to the top of the slope. Upon completion of slope construction, the slope face should be compacted with a sheepsfoot connected to a sideboom and then grid rolled. This method of slope compaction should only be used if approved by the Geotechnical Engineer.

- Sandy soils lacking in adequate cohesion may be unstable for a finished slope condition and therefore should not be placed within 15 horizontal feet of the slope face.

- All fill slopes should be keyed into bedrock or other suitable material. Fill keys should be at least 15 feet wide and inclined at 2 percent into the slope. For slopes higher than 30 feet, the fill key width should be equal to one-half the height of the slope (see Plate D-5).

- All fill keys should be cleared of loose slough material prior to geotechnical inspection and should be approved by the Geotechnical Engineer and governmental agencies prior to filling.

- The cut portion of fill over cut slopes should be made first and inspected by the Geotechnical Engineer for possible stabilization requirements. The fill portion should be adequately keyed through all surficial soils and into bedrock or suitable material. Soils should be removed from the transition zone between the cut and fill portions (see Plate D-2).

Cut Slopes

- All cut slopes should be inspected by the Geotechnical Engineer to determine the need for stabilization. The Earthwork Contractor should notify the Geotechnical Engineer when slope cutting is in progress at intervals of 10 vertical feet. Failure to notify may result in a delay in recommendations.

- Cut slopes exposing loose, cohesionless sands should be reported to the Geotechnical Engineer for possible stabilization recommendations.

- All stabilization excavations should be cleared of loose slough material prior to geotechnical inspection. Stakes should be provided by the Civil Engineer to verify the location and dimensions of the key. A typical stabilization fill detail is shown on Plate D-5.

- Stabilization key excavations should be provided with subdrains. Typical subdrain details are shown on Plates D-6.

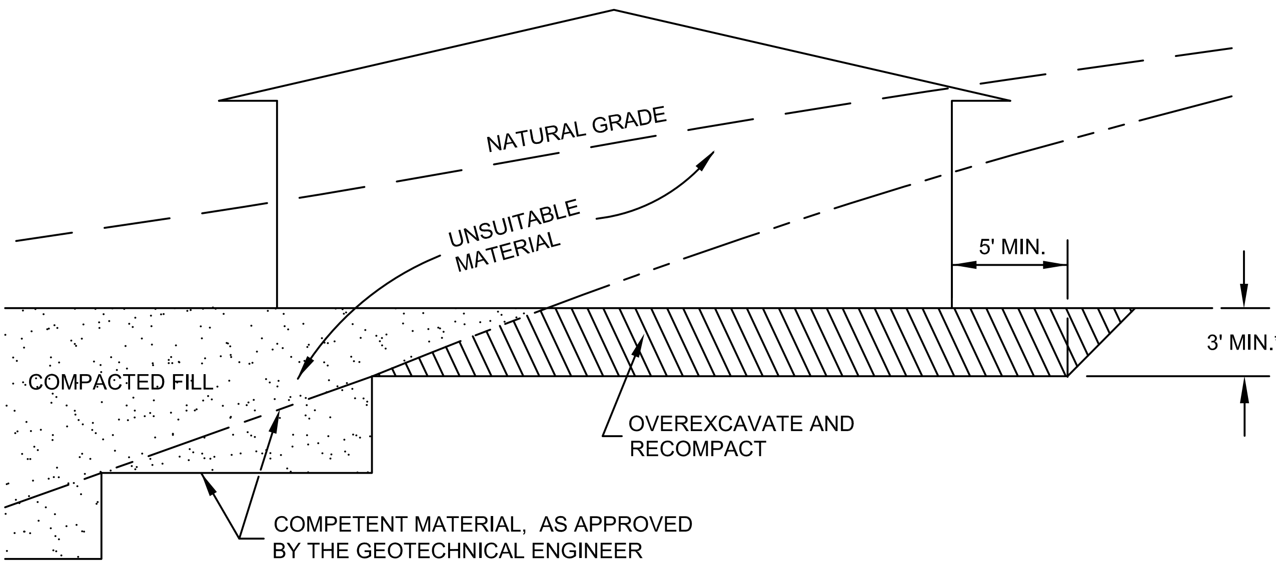
Subdrains

- Subdrains may be required in canyons and swales where fill placement is proposed. Typical subdrain details for canyons are shown on Plate D-3. Subdrains should be installed after approval of removals and before filling, as determined by the Soils Engineer.

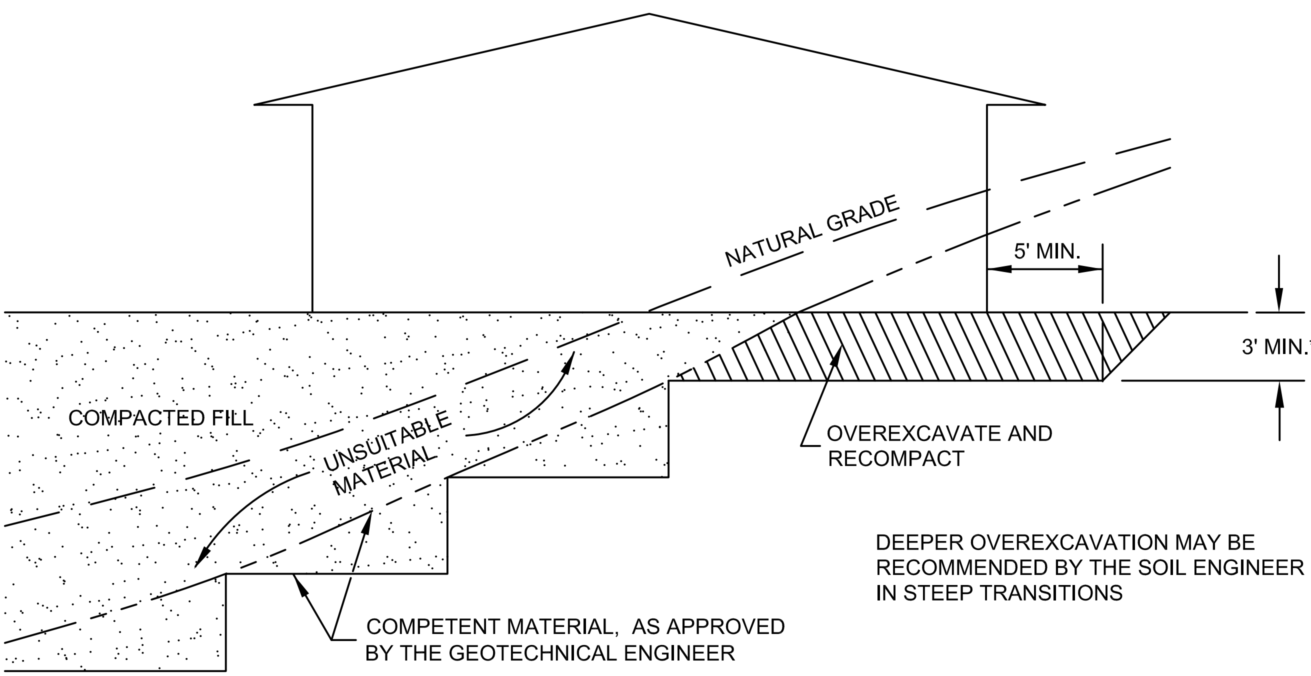
- Plastic pipe may be used for subdrains provided it is Schedule 40 or SDR 35 or equivalent. Pipe should be protected against breakage, typically by placement in a square-cut (backhoe) trench or as recommended by the manufacturer.

- Filter material for subdrains should conform to CALTRANS Specification 68-1.025 or as approved by the Geotechnical Engineer for the specific site conditions. Clean ¾-inch crushed rock may be used provided it is wrapped in an acceptable filter cloth and approved by the Geotechnical Engineer. Pipe diameters should be 6 inches for runs up to 500 feet and 8 inches for the downstream continuations of longer runs. Four-inch diameter pipe may be used in buttress and stabilization fills.

## CUT LOT




## CUT/FILL LOT (TRANSITION)




DEEPER OVEREXCAVATION MAY BE RECOMMENDED BY THE SOIL ENGINEER IN STEEP TRANSITIONS

*SEE TEXT OF REPORT FOR SPECIFIC RECOMMENDATION. ACTUAL DEPTH OF OVEREXCAVATION MAY BE GREATER.

**TRANSITION LOT DETAIL**

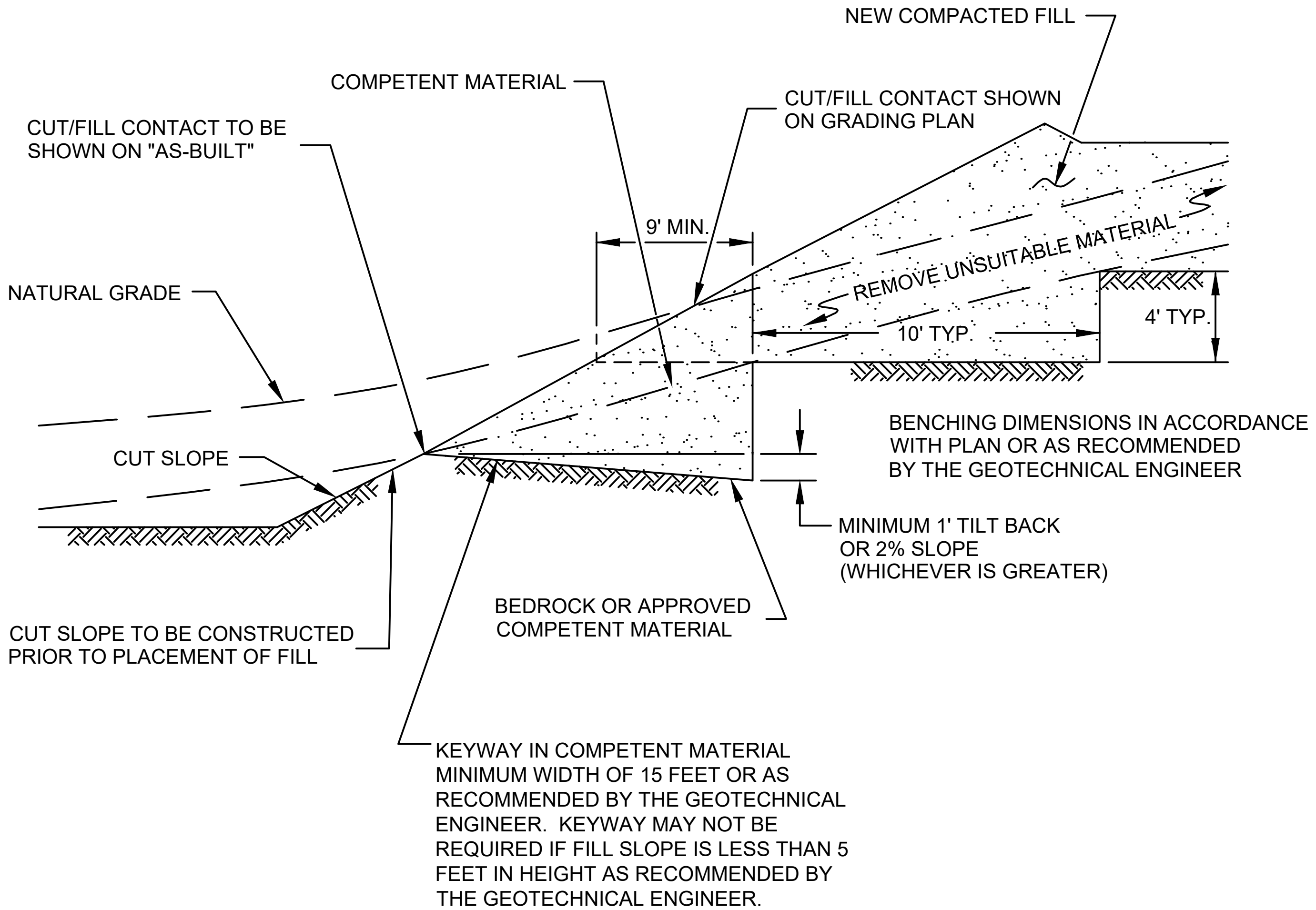
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: JAS
CHKD: GKM

**PLATE D-1**

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL




**FILL ABOVE CUT SLOPE DETAIL**

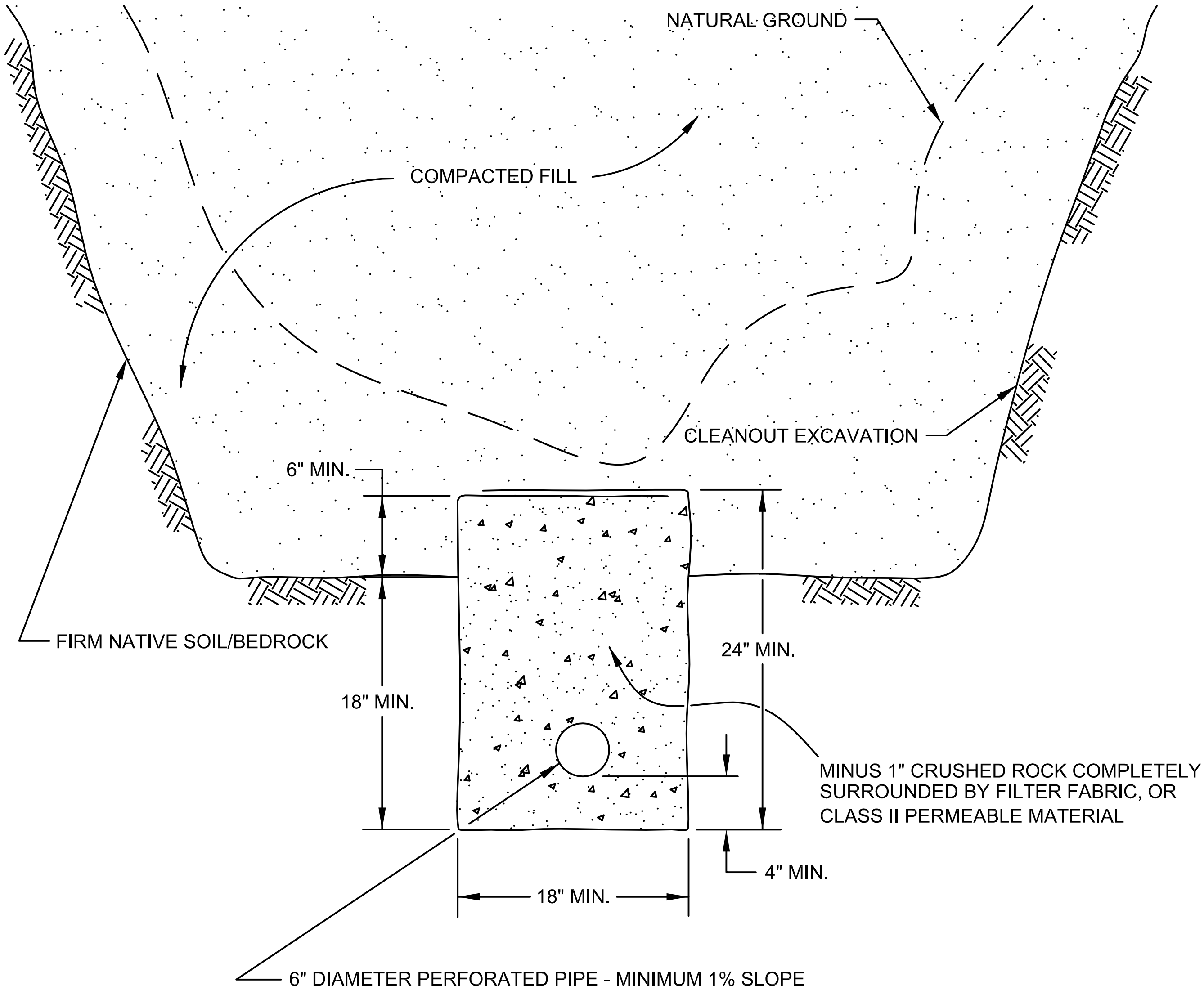
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: JAS
CHKD: GKM

**PLATE D-2**

SOUTHERN CALIFORNIA GEOTECHNICAL




| PIPE MATERIAL | DEPTH OF FILL OVER SUBDRAIN |
|---|---|
| ADS (CORRUGATED POLETHYLENE) | 8 |
| TRANSITE UNDERDRAIN | 20 |
| PVC OR ABS: SDR 35 | 35 |
| SDR 21 | 100 |

**SCHEMATIC ONLY**
**NOT TO SCALE**

**CANYON SUBDRAIN DETAIL**

GRADING GUIDE SPECIFICATIONS

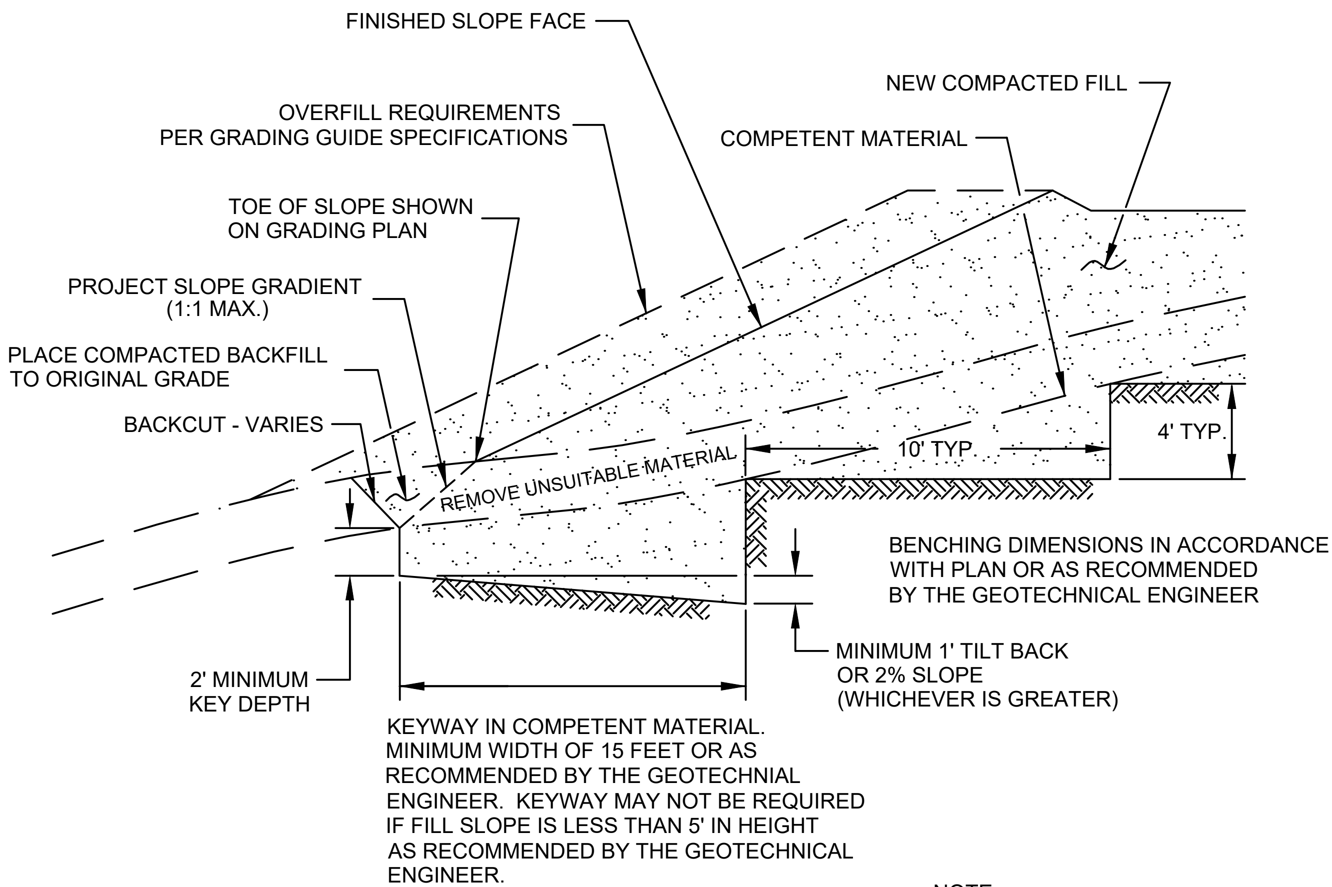
NOT TO SCALE

DRAWN: JAS
CHKD: GKM

**PLATE D-3**

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL




NOTE:
BENCHING SHALL BE REQUIRED WHEN NATURAL SLOPES ARE EQUAL TO OR STEEPER THAN 5:1 OR WHEN RECOMMENDED BY THE GEOTECHNICAL ENGINEER.

**FILL ABOVE NATURAL SLOPE DETAIL**

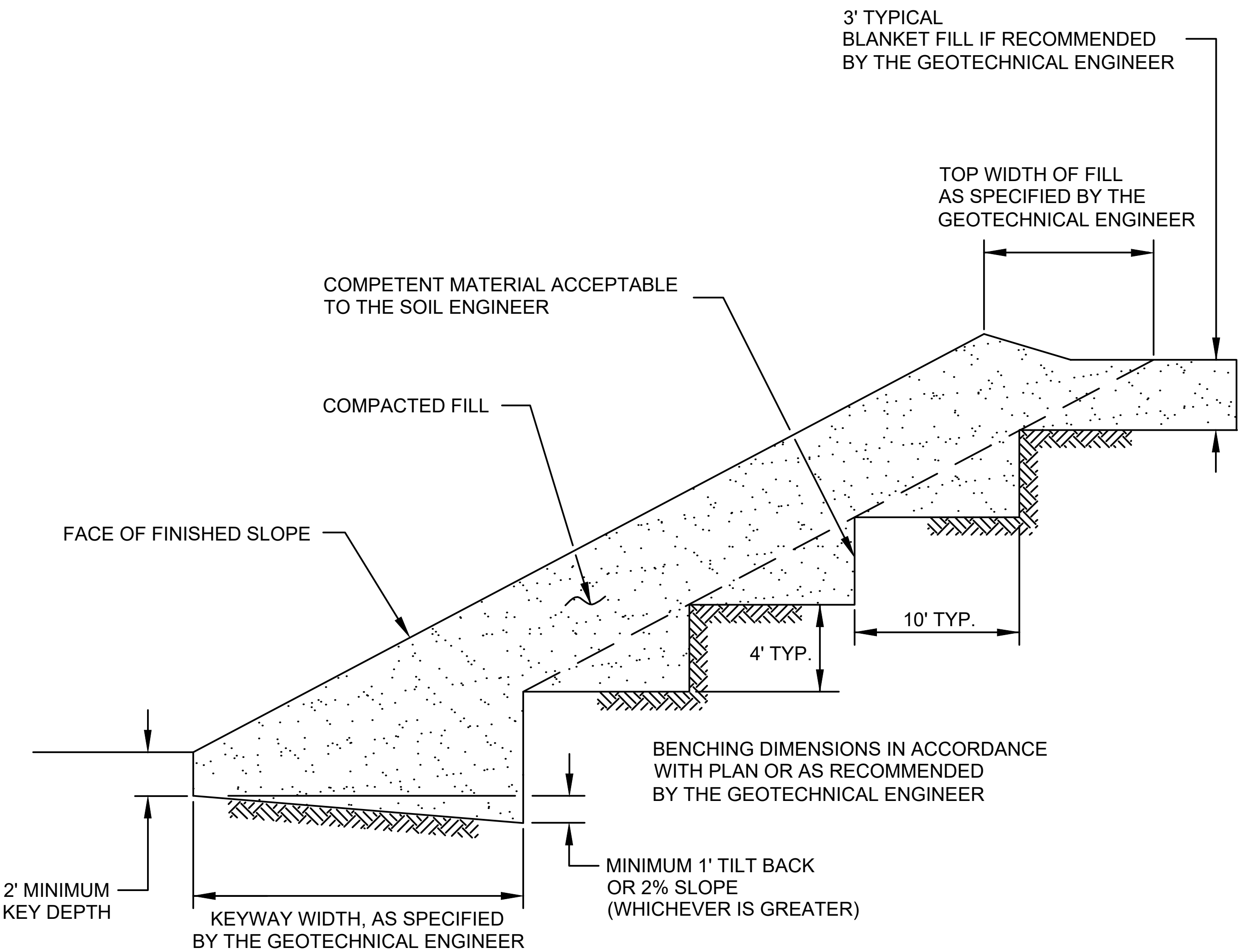
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: JAS
CHKD: GKM

**PLATE D-4**

SOUTHERN CALIFORNIA GEOTECHNICAL




**STABILIZATION FILL DETAIL**

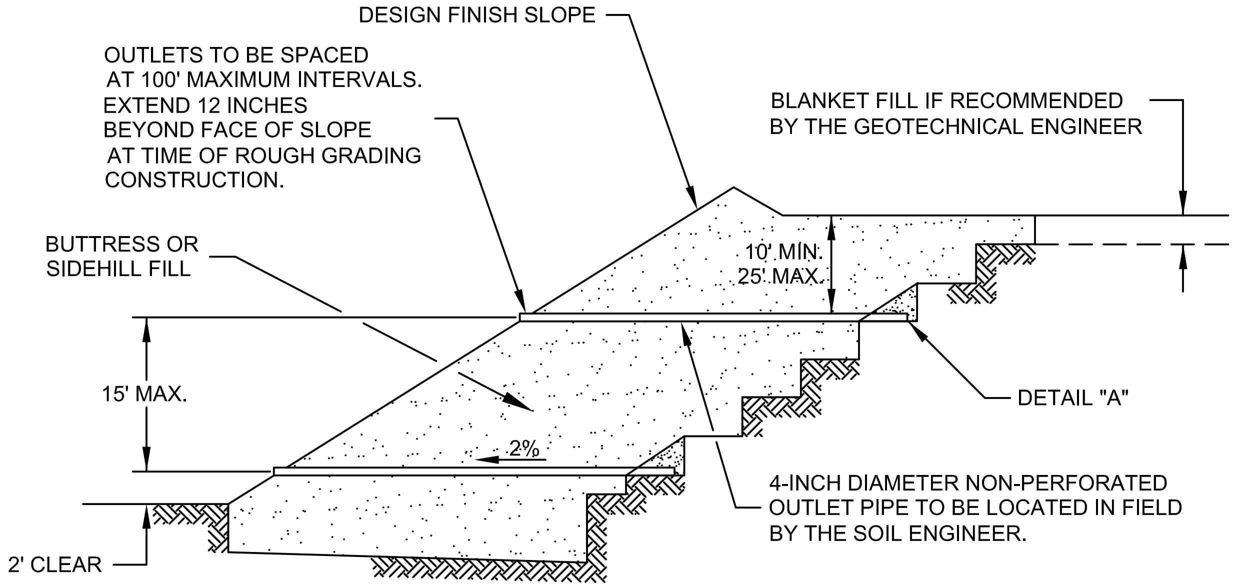
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: JAS
CHKD: GKM

**PLATE D-5**

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL



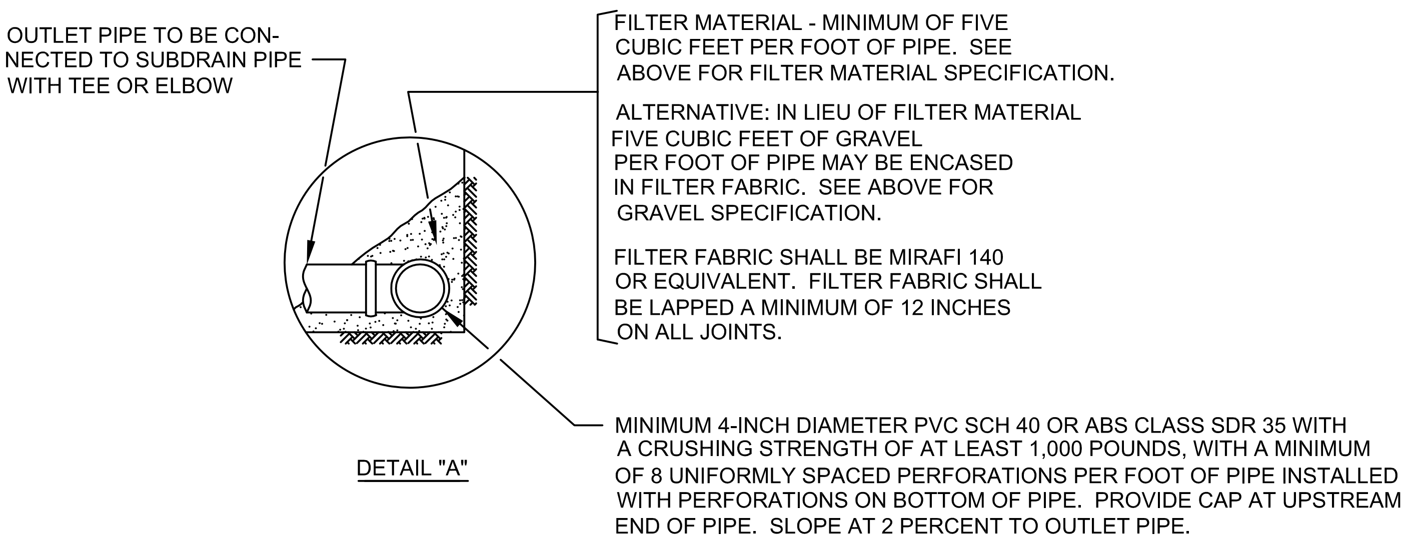

"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

| SIEVE SIZE | PERCENTAGE PASSING |
|---|---|
| 1" | 100 |
| 3/4" | 90-100 |
| 3/8" | 40-100 |
| NO. 4 | 25-40 |
| NO. 8 | 18-33 |
| NO. 30 | 5-15 |
| NO. 50 | 0-7 |
| NO. 200 | 0-3 |

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

| SIEVE SIZE | MAXIMUM PERCENTAGE PASSING |
|---|---|
| 1 1/2" | 100 |
| NO. 4 | 50 |
| NO. 200 | 8 |

SAND EQUIVALENT = MINIMUM OF 50




DETAIL "A"

NOTES:
1. TRENCH FOR OUTLET PIPES TO BE BACKFILLED WITH ON-SITE SOIL.

**SLOPE FILL SUBDRAINS**

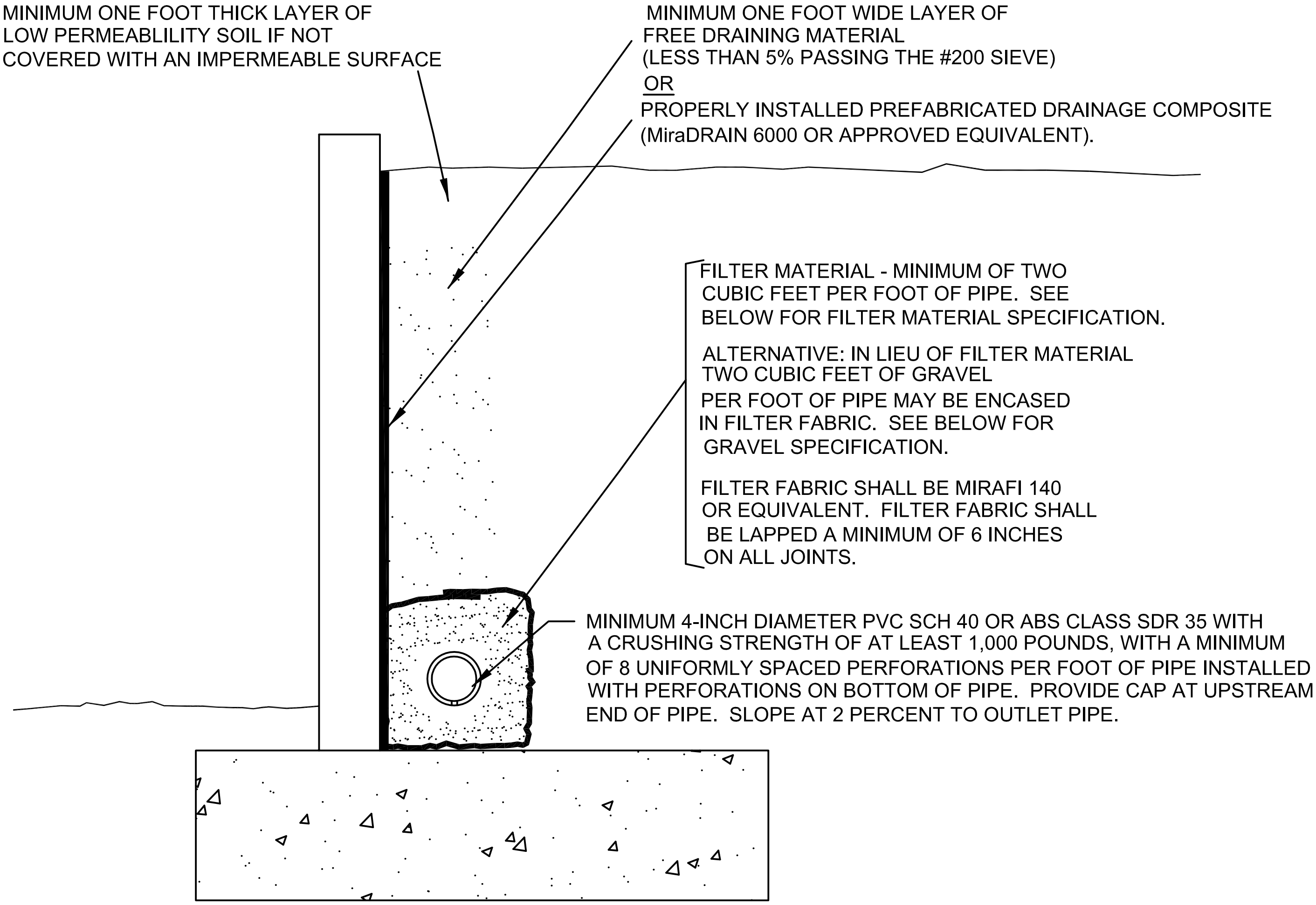
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

DRAWN: JAS
CHKD: GKM

**PLATE D-6**

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL




"FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO EMA STD. PLAN 323)

| SIEVE SIZE | PERCENTAGE PASSING |
|---|---|
| 1" | 100 |
| 3/4" | 90-100 |
| 3/8" | 40-100 |
| NO. 4 | 25-40 |
| NO. 8 | 18-33 |
| NO. 30 | 5-15 |
| NO. 50 | 0-7 |
| NO. 200 | 0-3 |

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

| SIEVE SIZE | MAXIMUM PERCENTAGE PASSING |
|---|---|
| 1 1/2" | 100 |
| NO. 4 | 50 |
| NO. 200 | 8 |

SAND EQUIVALENT = MINIMUM OF 50

**RETAINING WALL BACKDRAINS**

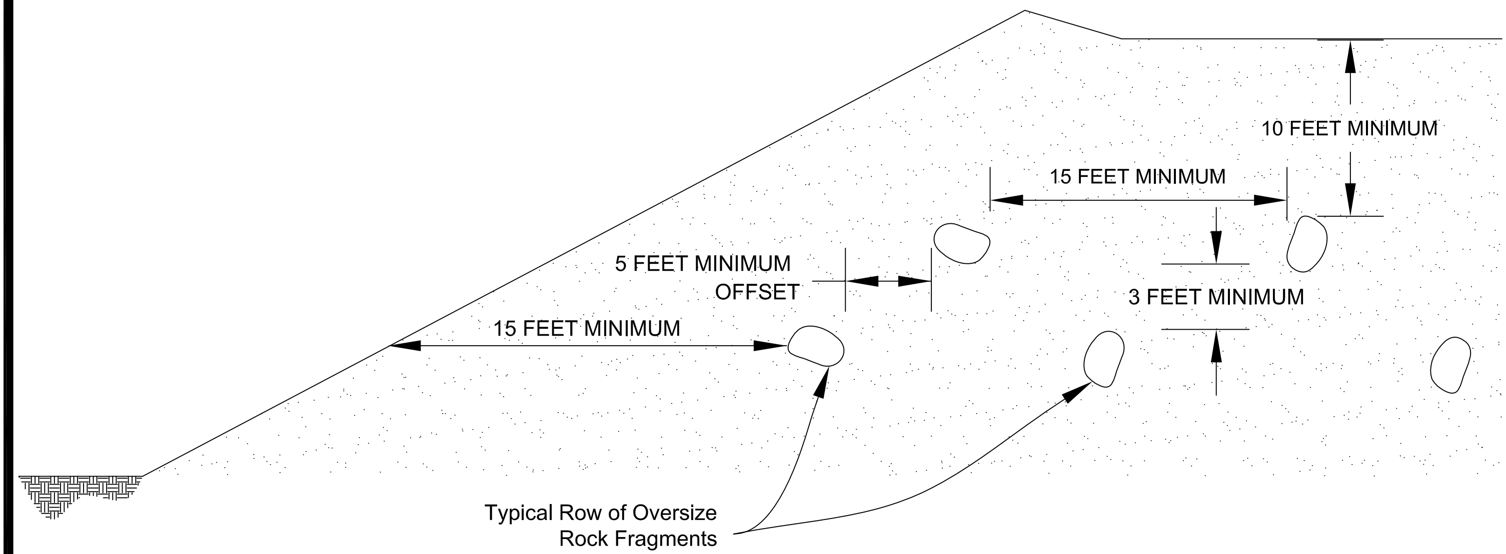
GRADING GUIDE SPECIFICATIONS

NOT TO SCALE

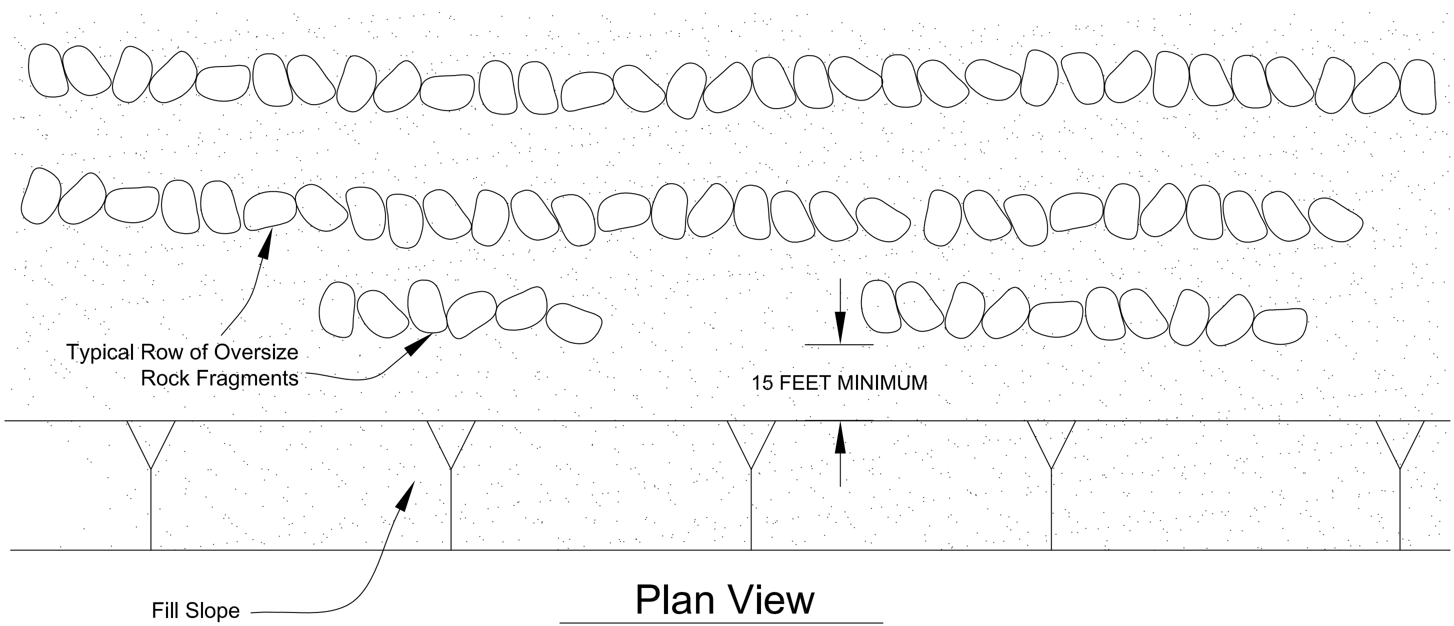
DRAWN: JAS
CHKD: GKM

**PLATE D-7**

SOUTHERN CALIFORNIA GEOTECHNICAL




Section View




Plan View

| PLACEMENT OF OVERSIZED MATERIAL | |
|---|---|
| GRADING GUIDE SPECIFICATIONS | |
| | |
| NOT TO SCALE | SOUTHERN CALIFORNIA GEOTECHNICAL |
| DRAWN: PM<br>CHKD: GKM | |
| | |
| **PLATE D-8** | |

# APPENDIX E

OSHPD

**Latitude, Longitude: 33.825905, -117.216481**


| | |
|---|---|
| **Date** | 8/5/2020, 10:40:59 AM |
| **Design Code Reference Document** | ASCE7-16 |
| **Risk Category** | III |
| **Site Class** | D - Stiff Soil |

| Type | Value | Description |
|---|---|---|
| $S_S$ | 1.5 | $MCE_R$ ground motion. (for 0.2 second period) |
| $S_1$ | 0.57 | $MCE_R$ ground motion. (for 1.0s period) |
| $S_{MS}$ | 1.5 | Site-modified spectral acceleration value |
| $S_{M1}$ | null -See Section 11.4.8 | Site-modified spectral acceleration value |
| $S_{DS}$ | 1 | Numeric seismic design value at 0.2 second SA |
| $S_{D1}$ | null -See Section 11.4.8 | Numeric seismic design value at 1.0 second SA |

| Type | Value | Description |
|---|---|---|
| SDC | null -See Section 11.4.8 | Seismic design category |
| $F_a$ | 1 | Site amplification factor at 0.2 second |
| $F_v$ | null -See Section 11.4.8 | Site amplification factor at 1.0 second |
| PGA | 0.5 | $MCE_G$ peak ground acceleration |
| $F_{PGA}$ | 1.1 | Site amplification factor at PGA |
| $PGA_M$ | 0.55 | Site modified peak ground acceleration |
| $T_L$ | 8 | Long-period transition period in seconds |
| SsRT | 1.523 | Probabilistic risk-targeted ground motion. (0.2 second) |
| SsUH | 1.632 | Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration |
| SsD | 1.5 | Factored deterministic acceleration value. (0.2 second) |
| S1RT | 0.57 | Probabilistic risk-targeted ground motion. (1.0 second) |
| S1UH | 0.625 | Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration. |
| S1D | 0.6 | Factored deterministic acceleration value. (1.0 second) |
| PGAd | 0.5 | Factored deterministic acceleration value. (Peak Ground Acceleration) |
| $C_{RS}$ | 0.933 | Mapped value of the risk coefficient at short periods |
| $C_{R1}$ | 0.912 | Mapped value of the risk coefficient at a period of 1 s |

SOURCE: SEAOC/OSHPD Seismic Design Maps Tool
<https://seismicmaps.org/>

**SEISMIC DESIGN PARAMETERS - 2019 CBC**

PROPOSED REDLANDS EAST DEVELOPMENT

PERRIS, CALIFORNIA

DRAWN: JLL
CHKD: RGT

SCG PROJECT
20G180-1

**PLATE E-1**

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL

# APPENDIX F

**LIQUEFACTION EVALUATION**

| | | | | |
|---|---|---|---|---|
| Project Name | Proposed Redlands East Dev | $MCE_G$ Design Acceleration | 0.550 | (g) |
| Project Location | Perris, CA | Design Magnitude | 7.02 | |
| Project Number | 20G180-1 | Historic High Depth to Groundwater | 16 | (ft) |
| Engineer | JLL | Depth to Groundwater at Time of Drilling | 50 | (ft) |
| | | Borehole Diameter | 6 | (in) |
| Boring No. | B-2 | | | |

| Sample Depth (ft) | Depth to Top of Layer (ft) | Depth to Bottom of Layer (ft) | Depth to Midpoint (ft) | Uncorrected SPT N-Value | Unit Weight of Soil (pcf) | Fines Content (%) | Energy Correction | $C_B$ | $C_S$ | $C_N$ | Rod Length Correction | $(N_1)_{60}$ | $(N_1)_{60CS}$ | Overburden Stress ($\sigma_o$) (psf) | Eff. Overburden Stress (Hist. Water) ($\sigma_o'$) (psf) | Eff. Overburden Stress (Curr. Water) ($\sigma_o'$) (psf) | Stress Reduction Coefficient ($r_d$) | MSF | Ks | Cyclic Resistance Ratio (M=7.5) | Cyclic Resistance Ratio (M=7.02) | Cyclic Stress Ratio Induced by Design Earthquake | Factor of Safety | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | | | | (8) | (9) | (10) | (11) | (12) | (13) | | |
| 14.5 | 0 | 16 | 8 | | 120 | | 1.3 | 1.05 | 1.1 | 1.70 | 0.85 | 0.0 | 0.0 | 960 | 960 | 960 | 0.98 | 1.02 | 1.04 | 0.06 | 0.06 | N/A | N/A | Above Water Table |
| 19.5 | 16 | 22 | 19 | 32 | 120 | | 1.3 | 1.05 | 1.3 | 0.98 | 0.95 | 53.0 | 53.0 | 2280 | 2093 | 2280 | 0.94 | 1.20 | 1 | 2.00 | 2.00 | 0.36 | 5.49 | Nonliquefiable |
| 24.5 | 22 | 27 | 24.5 | 39 | 120 | | 1.3 | 1.05 | 1.3 | 0.94 | 0.95 | 62.0 | 62.0 | 2940 | 2410 | 2940 | 0.91 | 1.20 | 0.96 | 2.00 | 2.00 | 0.40 | 5.05 | Nonliquefiable |
| 29.5 | 27 | 32 | 29.5 | 22 | 120 | | 1.3 | 1.05 | 1.3 | 0.83 | 0.95 | 30.9 | 30.9 | 3540 | 2698 | 3540 | 0.88 | 1.18 | 0.95 | 0.54 | 0.61 | 0.41 | 1.47 | Nonliquefiable |
| 34.5 | 32 | 37 | 34.5 | 27 | 120 | | 1.3 | 1.05 | 1.3 | 0.82 | 1 | 39.1 | 39.1 | 4140 | 2986 | 4140 | 0.86 | 1.20 | 0.9 | 2.00 | 2.00 | 0.42 | 4.72 | Nonliquefiable |
| 39.5 | 37 | 42 | 39.5 | 29 | 120 | 51 | 1.3 | 1.05 | 1.3 | 0.81 | 1 | 41.9 | 47.5 | 4740 | 3274 | 4740 | 0.83 | 1.20 | 0.87 | 2.00 | 2.00 | 0.43 | 4.67 | Nonliquefiable |
| 44.5 | 42 | 47 | 44.5 | 25 | 120 | 47 | 1.3 | 1.05 | 1.3 | 0.75 | 1 | 33.5 | 39.1 | 5340 | 3562 | 5340 | 0.80 | 1.20 | 0.84 | 2.00 | 2.00 | 0.43 | 4.67 | Nonliquefiable |
| 49.5 | 47 | 50 | 48.5 | 40 | 120 | | 1.3 | 1.05 | 1.3 | 0.82 | 1 | 58.0 | 58.0 | 5820 | 3792 | 5820 | 0.78 | 1.20 | 0.83 | 2.00 | 1.99 | 0.43 | 4.65 | Nonliquefiable |

Notes:

(1) Energy Correction for $N_{90}$ of automatic hammer to standard $N_{60}$

(2) Borehole Diameter Correction (Skempton, 1986)

(3) Correction for split-spoon sampler with room for liners, but liners are absent, (Seed et al., 1984, 2001)

(4) Overburden Correction, Caluclated by Eq. 39 (Boulanger and Idriss, 2008)

(5) Rod Length Correction for Samples <10 m in depth

(6) N-value corrected for energy, borehole diameter, sampler with absent liners, rod length, and overburden

(7) N-value corrected for fines content per Eqs. 75 and 76 (Boulanger and Idriss, 2008)

(8) Stress Reduction Coefficient calculated by Eq. 22 (Boulanger and Idriss, 2008)

(9) Magnitude Scaling Factor calculated by Eqns. A.8 & A.10 (Boulanger and Idriss, 2014)

(10) Overburden Correction Factor calcuated by Eq. 54 (Boulanger and Idriss, 2008)

(11) Calcuated by Eq. 70 (Boulanger and Idriss, 2008)

(12) Calcuated by Eq. 72 (Boulanger and Idriss, 2008)

(13) Calcuated by Eq. 25 (Boulanger and Idriss, 2008)

## LIQUEFACTION INDUCED SETTLEMENTS

| | |
|---|---|
| Project Name | Proposed Redlands East Dev |
| Project Location | Perris, CA |
| Project Number | 20G180-1 |
| Engineer | JLL |

Boring No. B-2

| Sample Depth (ft) | Depth to Top of Layer (ft) | Depth to Bottom of Layer (ft) | Depth to Midpoint (ft) | $(N_1)_{60}$ | DN for fines cont | $(N_1)_{60\text{-}CS}$ | Liquefaction Factor of Safety | Limiting Shear Strain $\gamma_{min}$ | Parameter $F\alpha$ | Maximum Shear Strain $\gamma_{max}$ | Height of Layer | | Vertical Reconsolidation Strain $\varepsilon_V$ | | Total Deformation of Layer (in) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | | | (8) | | | |
| 14.5 | 0 | 16 | 8 | 0.0 | 0.0 | 0.0 | N/A | 0.50 | 0.95 | 0.00 | 16.00 | | 0.000 | | 0.00 | Above Water Table |
| 19.5 | 16 | 22 | 19 | 53.0 | 0.0 | 53.0 | 5.49 | 0.00 | -1.84 | 0.00 | 6.00 | | 0.000 | | 0.00 | Nonliquefiable |
| 24.5 | 22 | 27 | 24.5 | 62.0 | 0.0 | 62.0 | 5.05 | 0.00 | -2.59 | 0.00 | 5.00 | | 0.000 | | 0.00 | Nonliquefiable |
| 29.5 | 27 | 32 | 29.5 | 30.9 | 0.0 | 30.9 | 1.47 | 0.04 | -0.15 | 0.00 | 5.00 | | 0.000 | | 0.00 | Nonliquefiable |
| 34.5 | 32 | 37 | 34.5 | 39.1 | 0.0 | 39.1 | 4.72 | 0.01 | -0.73 | 0.00 | 5.00 | | 0.000 | | 0.00 | Nonliquefiable |
| 39.5 | 37 | 42 | 39.5 | 41.9 | 5.6 | 47.5 | 4.67 | 0.00 | -1.39 | 0.00 | 5.00 | | 0.000 | | 0.00 | Nonliquefiable |
| 44.5 | 42 | 47 | 44.5 | 33.5 | 5.6 | 39.1 | 4.67 | 0.01 | -0.74 | 0.00 | 5.00 | | 0.000 | | 0.00 | Nonliquefiable |
| 49.5 | 47 | 50 | 48.5 | 58.0 | 0.0 | 58.0 | 4.65 | 0.00 | -2.26 | 0.00 | 3.00 | | 0.000 | | 0.00 | Nonliquefiable |
| | | | | | | | | | | | **Total Deformation (in)** | | | | 0.00 | |

Notes:

(1) $(N_1)_{60}$ calculated previously for the individual layer

(2) Correction for fines content per Equation 76 (Boulanger and Idriss, 2008)

(3) Corrected $(N_1)_{60}$ for fines content

(4) Factor of Safety against Liquefaction, calculated previously for the individual layer

(5) Calcuated by Eq. 86 (Boulanger and Idriss, 2008)

(6) Calcuated by Eq. 89 (Boulanger and Idriss, 2008)

(7) Calcuated by Eqs. 90, 91, and 92 (Boulanger and Idriss, 2008)

(8) Volumetric Strain Induced in a Liquefiable Layer, Calcuated by Eq. 96 (Boulanger and Idriss, 2008)
(Strain N/A if Factor of Safety against Liquefaction > 1.3)

# LIQUEFACTION EVALUATION

| | |
|---|---|
| Project Name | Proposed Redlands East Dev |
| Project Location | Perris, CA |
| Project Number | 20G180-1 |
| Engineer | JLL |
| Boring No. | B-4 |

| | | |
|---|---|---|
| $MCE_G$ Design Acceleration | 0.550 | (g) |
| Design Magnitude | 7.02 | |
| Historic High Depth to Groundwater | 16 | (ft) |
| Depth to Groundwater at Time of Drilling | 50 | (ft) |
| Borehole Diameter | 6 | (in) |

| Sample Depth (ft) | Depth to Top of Layer (ft) | Depth to Bottom of Layer (ft) | Depth to Midpoint (ft) | Uncorrected SPT N-Value | Unit Weight of Soil (pcf) | Fines Content (%) | Energy Correction | $C_B$ | $C_S$ | $C_N$ | Rod Length Correction | $(N_1)_{60}$ | $(N_1)_{60CS}$ | Overburden Stress ($\sigma_o$) (psf) | Eff. Overburden Stress (Hist. Water) ($\sigma_o'$) (psf) | Eff. Overburden Stress (Curr. Water) ($\sigma_o'$) (psf) | Stress Reduction Coefficient ($r_d$) | MSF | Ks | Cyclic Resistance Ratio (M=7.5) | Cyclic Resistance Ratio (M=7.02) | Cyclic Stress Ratio Induced by Design Earthquake | Factor of Safety | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | | | | (8) | (9) | (10) | (11) | (12) | (13) | | |
| 14.5 | 0 | 16 | 8 | | 120 | | 1.3 | 1.05 | 1.1 | 1.70 | 0.85 | 0.0 | 0.0 | 960 | 960 | 960 | 0.98 | 1.02 | 1.04 | 0.06 | 0.06 | N/A | N/A | Above Water Table |
| 19.5 | 16 | 22 | 19 | 16 | 120 | 92 | 1.3 | 1.05 | 1.253 | 0.97 | 0.95 | 25.3 | 30.8 | 2280 | 2093 | 2280 | 0.94 | 1.18 | 1 | 0.54 | 0.64 | 0.36 | 1.75 | Nonliquefiable |
| 24.5 | 22 | 27 | 24.5 | 24 | 120 | | 1.3 | 1.05 | 1.3 | 0.90 | 0.95 | 36.4 | 36.4 | 2940 | 2410 | 2940 | 0.91 | 1.20 | 0.96 | 1.52 | 1.75 | 0.40 | 4.42 | Nonliquefiable |
| 29.5 | 27 | 32 | 29.5 | 42 | 120 | | 1.3 | 1.05 | 1.3 | 0.92 | 0.95 | 65.1 | 65.1 | 3540 | 2698 | 3540 | 0.88 | 1.20 | 0.93 | 2.00 | 2.00 | 0.41 | 4.83 | Nonliquefiable |
| 34.5 | 32 | 37 | 34.5 | 21 | 120 | 60 | 1.3 | 1.05 | 1.299 | 0.80 | 1 | 29.9 | 35.5 | 4140 | 2986 | 4140 | 0.86 | 1.20 | 0.9 | 1.24 | 1.35 | 0.42 | 3.18 | Nonliquefiable |
| 39.5 | 37 | 42 | 39.5 | 47 | 120 | | 1.3 | 1.05 | 1.3 | 0.91 | 1 | 76.1 | 76.1 | 4740 | 3274 | 4740 | 0.83 | 1.20 | 0.87 | 2.00 | 2.00 | 0.43 | 4.67 | Nonliquefiable |
| 44.5 | 42 | 47 | 44.5 | 28 | 120 | 38 | 1.3 | 1.05 | 1.3 | 0.78 | 1 | 38.6 | 44.1 | 5340 | 3562 | 5340 | 0.80 | 1.20 | 0.84 | 2.00 | 2.00 | 0.43 | 4.67 | Nonliquefiable |
| 49.5 | 47 | 50 | 48.5 | 22 | 120 | 50 | 1.3 | 1.05 | 1.268 | 0.70 | 1 | 26.8 | 32.4 | 5820 | 3792 | 5820 | 0.78 | 1.19 | 0.87 | 0.69 | 0.71 | 0.43 | 1.67 | Nonliquefiable |

Notes:

(1) Energy Correction for $N_{90}$ of automatic hammer to standard $N_{60}$

(2) Borehole Diameter Correction (Skempton, 1986)

(3) Correction for split-spoon sampler with room for liners, but liners are absent, (Seed et al., 1984, 2001)

(4) Overburden Correction, Caluclated by Eq. 39 (Boulanger and Idriss, 2008)

(5) Rod Length Correction for Samples <10 m in depth

(6) N-value corrected for energy, borehole diameter, sampler with absent liners, rod length, and overburden

(7) N-value corrected for fines content per Eqs. 75 and 76 (Boulanger and Idriss, 2008)

(8) Stress Reduction Coefficient calculated by Eq. 22 (Boulanger and Idriss, 2008)

(9) Magnitude Scaling Factor calculated by Eqns. A.8 & A.10 (Boulanger and Idriss, 2014)

(10) Overburden Correction Factor calcuated by Eq. 54 (Boulanger and Idriss, 2008)

(11) Calcuated by Eq. 70 (Boulanger and Idriss, 2008)

(12) Calcuated by Eq. 72 (Boulanger and Idriss, 2008)

(13) Calcuated by Eq. 25 (Boulanger and Idriss, 2008)

## LIQUEFACTION INDUCED SETTLEMENTS

| | |
|---|---|
| Project Name | Proposed Redlands East Dev |
| Project Location | Perris, CA |
| Project Number | 20G180-1 |
| Engineer | JLL |

Boring No. B-4

| Sample Depth (ft) | Depth to Top of Layer (ft) | Depth to Bottom of Layer (ft) | Depth to Midpoint (ft) | $(N_1)_{60}$ | DN for fines cont | $(N_1)_{60\text{-}CS}$ | Liquefaction Factor of Safety | Limiting Shear Strain $\gamma_{min}$ | Parameter $F\alpha$ | Maximum Shear Strain $\gamma_{max}$ | Height of Layer | | Vertical Reconsolidation Strain $\varepsilon_V$ | | Total Deformation of Layer (in) | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | | | (8) | | | |
| 14.5 | 0 | 16 | 8 | 0.0 | 0.0 | 0.0 | N/A | 0.50 | 0.95 | 0.00 | 16.00 | | 0.000 | | 0.00 | Above Water Table |
| 19.5 | 16 | 22 | 19 | 25.3 | 5.5 | 30.8 | 1.75 | 0.04 | -0.14 | 0.00 | 6.00 | | 0.000 | | 0.00 | Nonliquefiable |
| 24.5 | 22 | 27 | 24.5 | 36.4 | 0.0 | 36.4 | 4.42 | 0.02 | -0.54 | 0.00 | 5.00 | | 0.000 | | 0.00 | Nonliquefiable |
| 29.5 | 27 | 32 | 29.5 | 65.1 | 0.0 | 65.1 | 4.83 | 0.00 | -2.86 | 0.00 | 5.00 | | 0.000 | | 0.00 | Nonliquefiable |
| 34.5 | 32 | 37 | 34.5 | 29.9 | 5.6 | 35.5 | 3.18 | 0.02 | -0.47 | 0.00 | 5.00 | | 0.000 | | 0.00 | Nonliquefiable |
| 39.5 | 37 | 42 | 39.5 | 76.1 | 0.0 | 76.1 | 4.67 | 0.00 | -3.84 | 0.00 | 5.00 | | 0.000 | | 0.00 | Nonliquefiable |
| 44.5 | 42 | 47 | 44.5 | 38.6 | 5.6 | 44.1 | 4.67 | 0.00 | -1.12 | 0.00 | 5.00 | | 0.000 | | 0.00 | Nonliquefiable |
| 49.5 | 47 | 50 | 48.5 | 26.8 | 5.6 | 32.4 | 1.67 | 0.03 | -0.25 | 0.00 | 3.00 | | 0.000 | | 0.00 | Nonliquefiable |
| | | | | | | | | | | | **Total Deformation (in)** | | | | 0.00 | |

Notes:

(1) $(N_1)_{60}$ calculated previously for the individual layer

(2) Correction for fines content per Equation 76 (Boulanger and Idriss, 2008)

(3) Corrected $(N_1)_{60}$ for fines content

(4) Factor of Safety against Liquefaction, calculated previously for the individual layer

(5) Calcuated by Eq. 86 (Boulanger and Idriss, 2008)

(6) Calcuated by Eq. 89 (Boulanger and Idriss, 2008)

(7) Calcuated by Eqs. 90, 91, and 92 (Boulanger and Idriss, 2008)

(8) Volumetric Strain Induced in a Liquefiable Layer, Calcuated by Eq. 96 (Boulanger and Idriss, 2008)
(Strain N/A if Factor of Safety against Liquefaction > 1.3)

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

October 30, 2020

Lake Creek Industrial, LLC
1302 Brittany Cross Road
Santa Ana, California 92705

Attention: Mr. Bob Kubichek

Project No.: **20G180-2**

Subject: **Results of Infiltration Testing**
Proposed Redlands East Development
Redlands Avenue, South of Rider Street
Perris, California

Reference: Geotechnical Investigation, Proposed Redlands East Development, Redlands Avenue, South of Rider Street, Perris, California, prepared for Lake Creek by Southern California Geotechnical, Inc. (SCG), SCG Project No. 20G180-1, dated August 14, 2020.

Mr. Kubichek:

In accordance with your request, we have conducted infiltration testing at the subject site. We are pleased to present this report summarizing the results of the infiltration testing and our design recommendations.

## Scope of Services

The scope of services performed for this project was in general accordance with our Proposal 20P208, dated April 22, 2020 and Change Order No. 20G180-CO, dated October 1, 2020. The scope of services included site reconnaissance, subsurface exploration, field testing, and engineering analysis to determine the infiltration rates of the on-site soils. The infiltration testing was performed in general accordance with the guidelines published in Riverside County – Low Impact Development BMP Design Handbook – Section 2.3 of Appendix A, prepared for the Riverside County Department of Environmental Health (RCDEH), dated December, 2013.

## Site and Project Description

The subject site is located on the east side of Redlands Avenue, approximately 1,050 feet south of Rider Street in Perris, California. The site is bounded to the west by Redlands Avenue and to the north, east, and south by existing single-family residences (SFRs) and vacant lots. The general location of the site is illustrated on the Site Location Map, included as Plate 1 of this report.

The site consists of six (6) rectangular-shaped parcels which total 12.59± acres in size. The site is generally vacant and undeveloped, with the exception of southern-most parcel. This parcel contains remnants of a previous SFR, including the original concrete floor slab and flatwork, in the western region. Large trees and trash/debris are also present within this parcel. Ground surface cover for the remainder of the site generally consists of exposed soils with moderate native grass and weed growth.

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voice: (714) 685-1115 ▾ fax: (714) 685-1118 ▾ www.socalgeo.com

Detailed topographic information was not available at the time of this report. However, based on topographic information obtained from Google Earth, the overall site topography slopes gently downward to the south at a gradient of less than 1± percent.

## Proposed Development

Based on a conceptual site plan (Scheme 01) provided to our office by the client, the site will be developed with one (1) new warehouse located in the western area of the site. The building will be 255,472± $ft^2$ in size and dock-high doors will be constructed along a portion of the east building wall. The building will be surrounded by asphaltic concrete pavements in the parking and drive lanes, Portland cement concrete pavements in the loading dock area, concrete flatwork and landscape planters throughout.

The proposed development will include on-site infiltration to dispose of storm water. Based on the infiltration test exhibit provided by Webb Associates, the project civil engineer, that the infiltration system will consist of a below-grade chamber system located in the east-central area of the site. The bottom of the chamber system will be 10± feet below the existing site grades.

## Previous Study

SCG previously conducted a geotechnical investigation at the subject site referenced above. As part of this investigation, five (5) borings advanced to depths of 25 to 50± feet below the existing site grades. Artificial fill soils were encountered at the ground surface at one of the boring locations, extending to a depth of 3± feet below the existing grades. The fill soils generally consist of medium dense silty sands with trace to little clay content. Native alluvial soils were encountered beneath the fill soils or at the ground surface at all of the boring locations. The near-surface alluvium generally consists of medium dense to dense sands, silty sands, sandy silts and clayey sands, with occasional very stiff fine sandy clays, extending to depths up to 12± feet. At greater depths, the alluvial soils generally consist of stiff to hard clayey silts and sandy clays, and medium dense to dense sands, silty sands and clayey sands extending to at least the maximum depth explored of 50 feet. Groundwater was not encountered during the drilling of any of the borings. Therefore, the groundwater table was considered to have existed at a depth in excess of 50 feet below the existing site grades.

## Subsurface Exploration

### Scope of Exploration

The subsurface exploration conducted for the infiltration testing consisted of six (6) infiltration test borings advanced to depths of 10± feet below the existing site grades. The infiltration borings were advanced using a truck-mounted drilling rig, equipped with 8-inch diameter hollow stem augers and were logged during drilling by a member of our staff. The approximate locations of the infiltration test borings (identified as I-1 through I-6) are indicated on the Infiltration Test Location Plan, enclosed as Plate 2 of this report.

Upon the completion of the infiltration borings, the bottom of each test boring was covered with 2± inches of clean ¾-inch gravel. A sufficient length of 3-inch-diameter perforated PVC casing was then placed into each test hole so that the PVC casing extended from the bottom of the test hole to the ground surface. Clean ¾-inch gravel was then installed in the annulus surrounding the PVC casing.

Geotechnical Conditions

Native alluvium was encountered at the ground surface at all six (6) infiltration testing locations. In general, the alluvial soils consist of loose to medium dense silty fine to medium sands with trace coarse sands and fine sandy silts extending to at least the maximum depth explored of 10± feet below the existing site grades. The Boring Logs, which illustrate the conditions encountered at the infiltration test locations, are included with this report.

## Infiltration Testing

As previously mentioned, the infiltration testing was performed in general accordance with the guidelines published in Riverside County – Low Impact Development BMP Design Handbook – Section 2.3 of Appendix A.

Pre-soaking

In accordance with the county infiltration standards, both of the infiltration test borings were pre-soaked prior to the infiltration testing. The pre-soaking process consisted of filling the test borings by inverting a full 5-gallon bottle of clear water supported over each hole so that the water level reaches a level of at least 5 times the hole's radius above the gravel at the bottom of each hole. The pre-soaking was completed after all of the water had percolated through each test hole or after 15 hours since initiating the pre-soak.

Infiltration Testing

Following the pre-soaking process of the infiltration test borings, SCG performed the infiltration testing. Each test hole was filled with water to a depth of at least 5 times the hole's radius above the gravel at the bottom of each test hole, and less than or equal to the water level used during the pre-soaking process. In accordance with the Riverside County guidelines, "non-sandy soils" were encountered at the bottom of Infiltration Nos. I-2 and I-3 (where less than 6 inches of water infiltrated into the surrounding soils for two consecutive 25-minute readings), readings were taken at 30-minute intervals for these two (2) tests locations. Additionally, "sandy soils" were encountered at the bottom of Infiltration Nos. I-1, I-4, I-5, and I-6 (where more than 6 inches of water infiltrated into the surrounding soils for two consecutive 25-minute readings), readings were taken at 10-minute intervals for these four (4) tests locations. After each reading, the borings were refilled to the correct water level above the gravel at the bottom of each test hole. The water level readings are presented on the spreadsheets enclosed with this report. The infiltration rates for each of the timed intervals are also tabulated on the spreadsheets.

The infiltration rates from the test are tabulated in inches per hour. In accordance with the typically accepted practice, it is recommended that the most conservative reading from the latter part of the infiltration tests be used as the design infiltration rate. The rates are summarized below:

| Infiltration Test No. | Soil Description | Infiltration Rate (inches/hour) |
|---|---|---|
| I-1 | Brown Silty fine to medium Sand, trace coarse Sand | 2.5 |
| I-2 | Brown fine Sandy Silt, little to some Clay, trace medium Sand | 0.1 |
| I-3 | Brown Silty fine to medium Sand, trace coarse Sand | 0.7 |
| I-4 | Brown Silty fine to coarse Sand | 1.3 |
| I-5 | Brown fine Sandy Silt, trace medium Sand | 2.2 |
| I-6 | Brown Silty fine to medium Sand, trace coarse Sand | 1.5 |

## Laboratory Testing

### Grain Size Analysis

The grain size distribution of selected soils from the base of each infiltration test boring has been determined using a range of wire mesh screens. These tests were performed in general accordance with ASTM D-422 and/or ASTM D-1140. The weight of the portion of the sample retained on each screen is recorded and the percentage finer or coarser of the total weight is calculated. The results of these tests are presented on Plates C-1 through C-6 of this report.

## Design Recommendations

A total of six (6) infiltration tests were performed at the subject site. As noted above, the calculated infiltration rates at the infiltration test locations range from 0.1 to 2.5 inches per hour due to the varying relative densities, and the silt and clay content of the soil encountered at the bottom of each infiltration boring.

**Based on the infiltration test results, we recommend a design infiltration rate of 0.7 inches per hour to be used for the proposed infiltration/detention system located in the northern portion of the subject site and 1.5 inches per hour to be used in the southern portion.**

The design of the proposed storm water infiltration systems should be performed by the project civil engineer, in accordance with the City of Perris and/or County of Riverside guidelines. However, it is recommended that the systems be constructed so as to facilitate removal of silt and clay, or other deleterious materials from any water that may enter the systems. The presence of such materials would decrease the effective infiltration rates. **It is recommended that the project civil engineer apply an appropriate factor of safety. The infiltration rates recommended above are based on the assumption that only clean water will be introduced to the subsurface profile. Any fines, debris, or organic materials could significantly impact the infiltration rates.** It should be noted that the recommended infiltration rates are based on infiltration testing at six (6) discrete locations and the overall infiltration rates of the storm water infiltration systems could vary considerably.

## Construction Considerations

The infiltration rates presented in this report are specific to the tested locations and tested depths. Infiltration rates can be significantly reduced if the soils are exposed to excessive disturbance or compaction during construction. Therefore, the subgrade soils within proposed infiltration system areas should not be overexcavated, undercut or compacted in any significant manner. **It is recommended that a note to this effect be added to the project plans and/or specifications.**

## Infiltration versus Permeability

Infiltration rates are based on unsaturated flow. As water is introduced into soils by infiltration, the soils become saturated and the wetting front advances from the unsaturated zone to the saturated zone. Once the soils become saturated, infiltration rates become zero, and water can only move through soils by hydraulic conductivity at a rate determined by pressure head and soil permeability. The infiltration rates presented herein were determined in accordance with the ASTM Test Method D-3385-03 standard, and are considered valid for the time and place of the actual test. Changes in soil moisture content will affect these infiltration rates. Infiltration rates should be expected to decrease until the soils become saturated. Soil permeability values will then govern groundwater movement. Permeability values may be on the order of 10 to 20 times less than infiltration rates. The system designer should incorporate adequate factors of safety and allow for overflow design into appropriate traditional storm drain systems, which would transport storm water off-site.

## Location of Infiltration Systems

The use of on-site storm water infiltration systems carries a risk of creating adverse geotechnical conditions. Increasing the moisture content of the soil can cause the soil to lose internal shear strength and increase its compressibility, resulting in a change in the designed engineering properties. Overlying structures and pavements in the infiltration areas could potentially be damaged due to saturation of subgrade soils. **The proposed infiltration systems for the site should be located at least 25 feet away from any structures, including retaining walls.** Even with this provision of locating the infiltration systems at least 25 feet from any building, it is possible that infiltrating water into the subsurface soils could have an adverse effect on any proposed or existing structure. It should also be noted that utility trenches which happen to collect storm water can also serve as conduits to transmit storm water toward the structure, depending on the slope of the utility trench. Therefore, consideration should also be given to the proposed locations of underground utilities which may pass near the proposed infiltration system.

## General Comments

This report has been prepared as an instrument of service for use by the client in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. This report may be provided to the contractor(s) and other design consultants to disclose information relative to the project. However, this report is not intended to be utilized as a specification in and of itself, without appropriate interpretation by the project architect, structural engineer, and/or civil engineer. The design of the infiltration system is the responsibility of the civil engineer. The role of the geotechnical engineer is limited to determination of infiltration rate only. By using the design infiltration rates contained herein, the civil engineer agrees to indemnify, defend, and hold harmless the geotechnical engineer for all aspects of the design and performance of the infiltration system. The reproduction and distribution of this report must be authorized by the client and Southern California Geotechnical, Inc. Furthermore, any reliance on this report by an unauthorized third party is at such party's sole risk, and we accept no responsibility for damage or loss which may occur.

The analysis of this site was based on a subsurface profile interpolated from limited discrete soil samples. While the materials encountered in the project area are considered to be representative of the total area, some variations should be expected between boring locations and testing depths. If the conditions encountered during construction vary significantly from those detailed herein, we should be contacted immediately to determine if the conditions alter the recommendations contained herein.

This report has been based on assumed or provided characteristics of the proposed development. It is recommended that the owner, client, architect, structural engineer, and civil engineer carefully review these assumptions to ensure that they are consistent with the characteristics of the proposed development. If discrepancies exist, they should be brought to our attention to verify that they do not affect the conclusions and recommendations contained herein. We also recommend that the project plans and specifications be submitted to our office for review to verify that our recommendations have been correctly interpreted.

The analysis, conclusions, and recommendations contained within this report have been promulgated in accordance with generally accepted professional geotechnical engineering practice. No other warranty is implied or expressed.

## Closure

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.

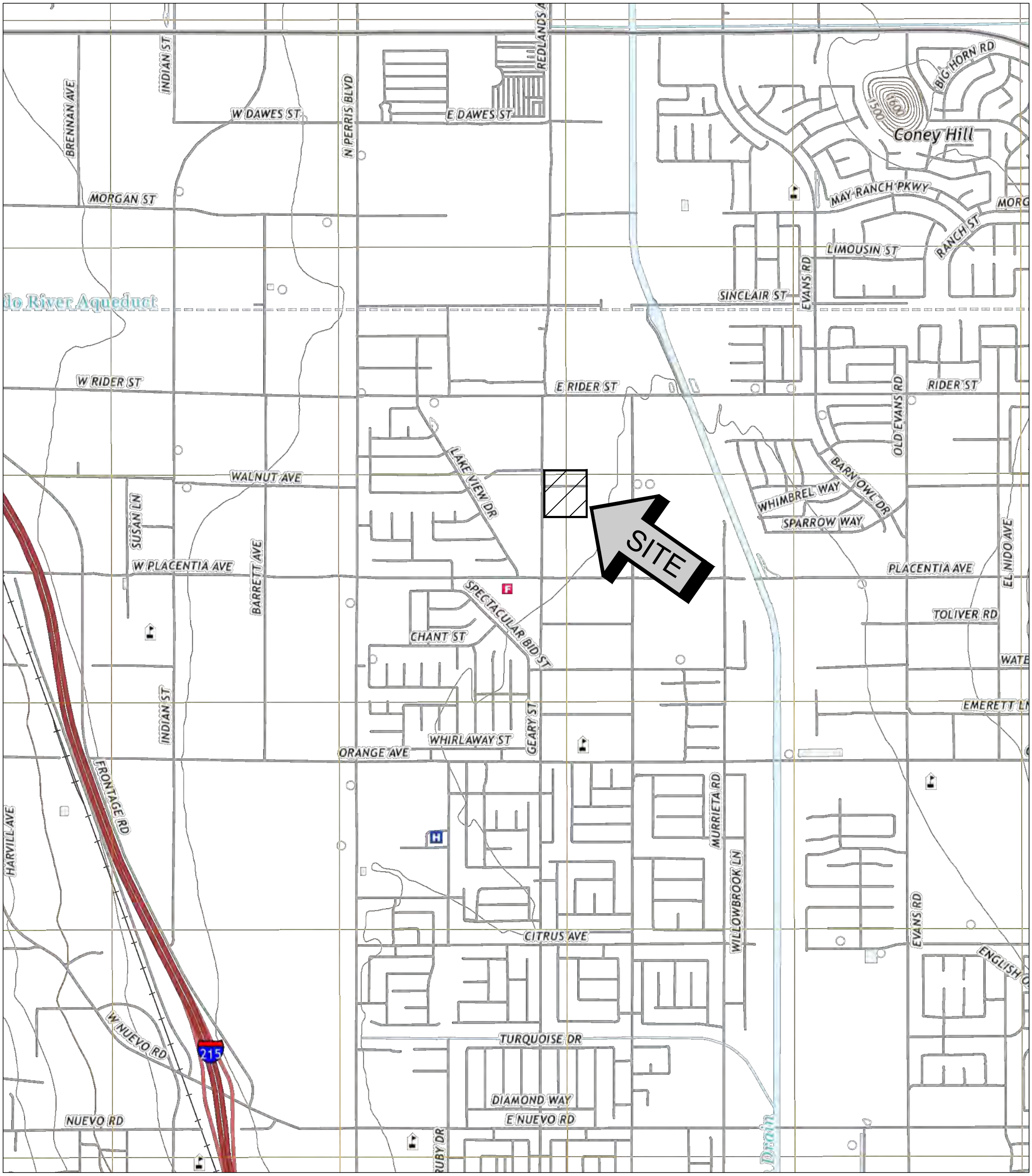
Jose Zuniga
Staff Engineer

Robert G. Trazo, M.Sc., GE 2655
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER ROBERT TRAZO No. 2655 GEOTECHNICAL STATE OF CALIFORNIA

Distribution: (1) Addressee

Enclosures:
Plate 1 - Site Location Map
Plate 2 - Infiltration Test Location Plan
Boring Log Legend and Logs (8 pages)
Infiltration Test Results Spreadsheets (6 pages)
Grain Size Distribution Graphs (6 pages)




SOURCE: USGS TOPOGRAPHIC MAP OF THE PERRIS QUADRANGLE, RIVERSIDE COUNTY, CALIFORNIA, 2018.

**SITE LOCATION MAP**

PROPOSED REDLANDS EAST DEVELOPMENT

PERRIS, CALIFORNIA

SCALE: 1" = 2000'

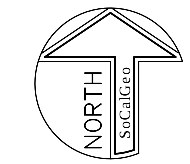
DRAWN: JAZ
CHKD: RGT

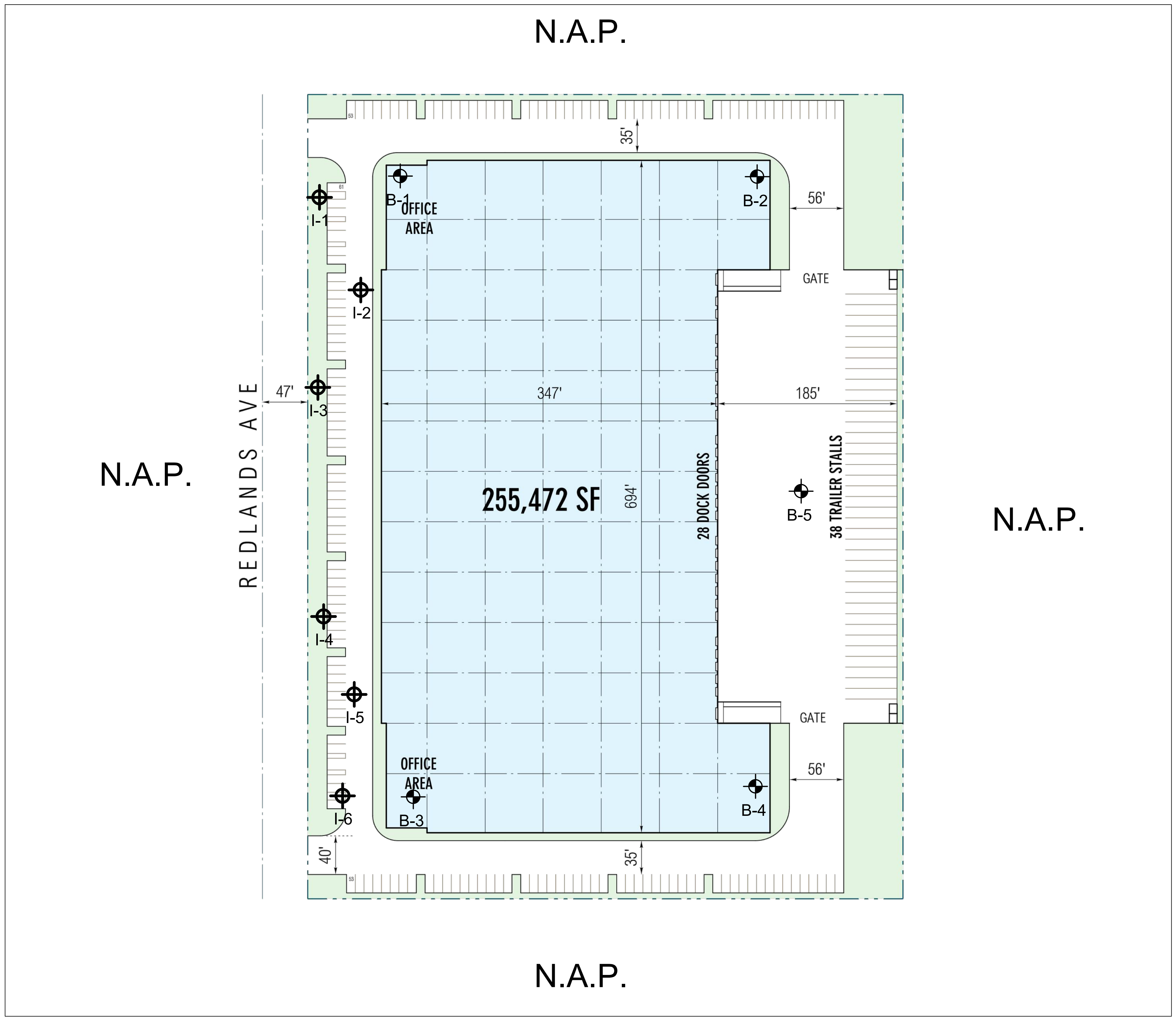
SCG PROJECT
20G180-2

**PLATE 1**

SoCalGeo

SOUTHERN CALIFORNIA GEOTECHNICAL




GEOTECHNICAL LEGEND

- APPROXIMATE INFILTRATION TEST LOCATION
- PREVIOUS BORING LOCATION (SCG PROJECT NO. 20G180-1)

**NOTE: PRELIMINARY SITE PLAN PREPARED BY RGA.**

**INFILTRATION TEST LOCATION PLAN**

PROPOSED REDLANDS EAST DEVELOPMENT

PERRIS, CALIFORNIA

SCALE: 1" = 120'

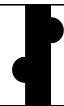
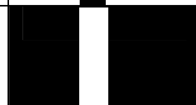
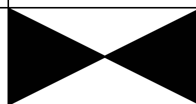
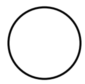
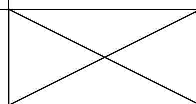
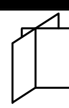
DRAWN: JAZ
CHKD: RGT

SCG PROJECT
20G180-2

**PLATE 2**

SoCalGeo
SOUTHERN CALIFORNIA GEOTECHNICAL

# BORING LOG LEGEND

| SAMPLE TYPE | GRAPHICAL SYMBOL | SAMPLE DESCRIPTION |
|---|---|---|
| AUGER |  | SAMPLE COLLECTED FROM AUGER CUTTINGS, NO FIELD MEASUREMENT OF SOIL STRENGTH. (DISTURBED) |
| CORE |  | ROCK CORE SAMPLE: TYPICALLY TAKEN WITH A DIAMOND-TIPPED CORE BARREL. TYPICALLY USED ONLY IN HIGHLY CONSOLIDATED BEDROCK. |
| GRAB |  | SOIL SAMPLE TAKEN WITH NO SPECIALIZED EQUIPMENT, SUCH AS FROM A STOCKPILE OR THE GROUND SURFACE. (DISTURBED) |
| CS |  | CALIFORNIA SAMPLER: 2-1/2 INCH I.D. SPLIT BARREL SAMPLER, LINED WITH 1-INCH HIGH BRASS RINGS. DRIVEN WITH SPT HAMMER. (RELATIVELY UNDISTURBED) |
| NSR |  | NO RECOVERY: THE SAMPLING ATTEMPT DID NOT RESULT IN RECOVERY OF ANY SIGNIFICANT SOIL OR ROCK MATERIAL. |
| SPT |  | STANDARD PENETRATION TEST: SAMPLER IS A 1.4 INCH INSIDE DIAMETER SPLIT BARREL, DRIVEN 18 INCHES WITH THE SPT HAMMER. (DISTURBED) |
| SH |  | SHELBY TUBE: TAKEN WITH A THIN WALL SAMPLE TUBE, PUSHED INTO THE SOIL AND THEN EXTRACTED. (UNDISTURBED) |
| VANE |  | VANE SHEAR TEST: SOIL STRENGTH OBTAINED USING A 4 BLADED SHEAR DEVICE. TYPICALLY USED IN SOFT CLAYS-NO SAMPLE RECOVERED. |

COLUMN DESCRIPTIONS

DEPTH: Distance in feet below the ground surface.

SAMPLE: Sample Type as depicted above.

BLOW COUNT: Number of blows required to advance the sampler 12 inches using a 140 lb hammer with a 30-inch drop. 50/3" indicates penetration refusal (>50 blows) at 3 inches. WH indicates that the weight of the hammer was sufficient to push the sampler 6 inches or more.

POCKET PEN.: Approximate shear strength of a cohesive soil sample as measured by pocket penetrometer.

GRAPHIC LOG: Graphic Soil Symbol as depicted on the following page.

DRY DENSITY: Dry density of an undisturbed or relatively undisturbed sample in $lbs/ft^3$.

MOISTURE CONTENT: Moisture content of a soil sample, expressed as a percentage of the dry weight.

LIQUID LIMIT: The moisture content above which a soil behaves as a liquid.

PLASTIC LIMIT: The moisture content above which a soil behaves as a plastic.

PASSING #200 SIEVE: The percentage of the sample finer than the #200 standard sieve.

UNCONFINED SHEAR: The shear strength of a cohesive soil sample, as measured in the unconfined state.

# SOIL CLASSIFICATION CHART

| MAJOR DIVISIONS | | | SYMBOLS | | TYPICAL DESCRIPTIONS |
|---|---|---|---|---|---|
| | | | GRAPH | LETTER | |
| COARSE GRAINED SOILS | GRAVEL AND GRAVELLY SOILS | CLEAN GRAVELS | | GW | WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | | (LITTLE OR NO FINES) | | GP | POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES |
| | MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | GRAVELS WITH FINES | | GM | SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES |
| | | (APPRECIABLE AMOUNT OF FINES) | | GC | CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES |
| MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE | SAND AND SANDY SOILS | CLEAN SANDS | | SW | WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| | | (LITTLE OR NO FINES) | | SP | POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES |
| | MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE | SANDS WITH FINES | | SM | SILTY SANDS, SAND - SILT MIXTURES |
| | | (APPRECIABLE AMOUNT OF FINES) | | SC | CLAYEY SANDS, SAND - CLAY MIXTURES |
| FINE GRAINED SOILS | SILTS AND CLAYS | LIQUID LIMIT LESS THAN 50 | | ML | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY |
| | | | | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | | | OL | ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY |
| MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE | SILTS AND CLAYS | LIQUID LIMIT GREATER THAN 50 | | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS |
| | | | | CH | INORGANIC CLAYS OF HIGH PLASTICITY |
| | | | | OH | ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS |
| HIGHLY ORGANIC SOILS | | | | PT | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS |

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# BORING NO. I-1

JOB NO.: 20G180-2 | DRILLING DATE: 10/7/20 | WATER DEPTH: ---
PROJECT: Proposed Redlands East Development | DRILLING METHOD: Hollow Stem Auger | CAVE DEPTH: ---
LOCATION: Perris, California | LOGGED BY: Jose Zuniga | READING TAKEN: ---

| DEPTH (FEET) | SAMPLE | BLOW COUNT | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION<br>SURFACE ELEVATION: --- MSL | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | LIQUID LIMIT | PLASTIC LIMIT | PASSING #200 SIEVE (%) | ORGANIC CONTENT (%) | COMMENTS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ALLUVIUM: Brown Silty fine to medium Sand, loose - dry to damp | | | | | | | |
| | X | 8 | | | | | 4 | | | | | |
| | X | 16 | | | @ 3.5 feet, trace coarse Sand, medium dense | | 4 | | | | | |
| 5 | | | | | | | | | | | | |
| | | | | | Brown Silty fine to medium Sand, trace coarse Sand, loose - dry | | | | | | | |
| | X | 8 | | | | | 2 | | | | | |
| | X | 14 | | | @ 8.5 feet, medium dense - dry to damp | | 5 | | | 16 | | |
| 10 | | | | | Boring Terminated at 10' | | | | | | | |

TBL 20G180-2.GPJ SOCALGEO.GDT 11/2/20

SOUTHERN CALIFORNIA GEOTECHNICAL

SoCalGeo

A California Corporation

# BORING NO. I-2

JOB NO.: 20G180-2
PROJECT: Proposed Redlands East Development
LOCATION: Perris, California

DRILLING DATE: 10/7/20
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jose Zuniga

WATER DEPTH: ---
CAVE DEPTH: ---
READING TAKEN: ---

SURFACE ELEVATION: --- MSL

| FIELD RESULTS | | | | | | LABORATORY RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | BLOW COUNT | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | LIQUID LIMIT | PLASTIC LIMIT | PASSING #200 SIEVE (%) | ORGANIC CONTENT (%) | COMMENTS |
| | | | | | ALLUVIUM: Brown Silty fine to medium Sand, medium dense - dry to damp | | | | | | | |
| | X | 17 | | | | | 4 | | | | | |
| | X | 21 | | | @ 3.5 feet, cementation | | 5 | | | | | |
| 5 | | | | | | | | | | | | |
| | | | | | Brown fine Sandy Silt, little Clay, trace medium Sand, medium dense - damp | | | | | | | |
| | X | 15 | | | | | 10 | | | | | |
| | X | 18 | | | @ 8.5 feet, moist | | 16 | | | 66 | | |
| 10 | | | | | Boring Terminated at 10' | | | | | | | |

TBL 20G180-2.GPJ SOCALGEO.GDT 11/2/20

**TEST BORING LOG**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# BORING NO. I-3

JOB NO.: 20G180-2
PROJECT: Proposed Redlands East Development
LOCATION: Perris, California

DRILLING DATE: 10/7/20
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jose Zuniga

WATER DEPTH: ---
CAVE DEPTH: ---
READING TAKEN: ---

| FIELD RESULTS | | | | | | LABORATORY RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | BLOW COUNT | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION<br>SURFACE ELEVATION: --- MSL | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | LIQUID LIMIT | PLASTIC LIMIT | PASSING #200 SIEVE (%) | ORGANIC CONTENT (%) | COMMENTS |
| | | | | | ALLUVIUM: Brown Silty fine to medium Sand, trace coarse Sand, medium dense - dry to damp | | | | | | | |
| | X | 21 | | | | | 5 | | | | | |
| | X | 29 | | | | | 6 | | | | | |
| 5 | | | | | | | | | | | | |
| | | | | | Brown fine to coarse Sand, loose - dry | | | | | | | |
| | X | 7 | | | | | 2 | | | | | |
| | | | | | Brown Silty fine to medium Sand, trace coarse Sand, loose - damp | | | | | | | |
| | X | 9 | | | | | 9 | | | 33 | | |
| 10 | | | | | Boring Terminated at 10' | | | | | | | |

TBL 20G180-2.GPJ SOCALGEO.GDT 11/2/20

TEST BORING LOG

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# BORING NO. I-4

JOB NO.: 20G180-2
PROJECT: Proposed Redlands East Development
LOCATION: Perris, California

DRILLING DATE: 10/7/20
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jose Zuniga

WATER DEPTH: ---
CAVE DEPTH: ---
READING TAKEN: ---

| FIELD RESULTS | | | | | DESCRIPTION | LABORATORY RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | BLOW COUNT | POCKET PEN. (TSF) | GRAPHIC LOG | SURFACE ELEVATION: --- MSL | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | LIQUID LIMIT | PLASTIC LIMIT | PASSING #200 SIEVE (%) | ORGANIC CONTENT (%) | COMMENTS |
| | | | | | ALLUVIUM: Brown Silty fine to medium Sand, loose to medium dense - dry to damp | | | | | | | |
| | X | 10 | | | | | 6 | | | | | |
| | X | 12 | | | @ 3.5 feet, damp | | 11 | | | | | |
| 5 | | | | | | | | | | | | |
| | | | | | Brown Silty fine to coarse Sand, medium dense - damp | | | | | | | |
| | X | 12 | | | | | 10 | | | | | |
| | X | 13 | | | | | 13 | | | 32 | | |
| 10 | | | | | Boring Terminated at 10' | | | | | | | |

TBL 20G180-2.GPJ SOCALGEO.GDT 11/2/20

SoCalGeo SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# BORING NO. I-5

JOB NO.: 20G180-2
PROJECT: Proposed Redlands East Development
LOCATION: Perris, California

DRILLING DATE: 10/7/20
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jose Zuniga

WATER DEPTH: ---
CAVE DEPTH: ---
READING TAKEN: ---

| FIELD RESULTS | | | | | | LABORATORY RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | BLOW COUNT | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION<br>SURFACE ELEVATION: --- MSL | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | LIQUID LIMIT | PLASTIC LIMIT | PASSING #200 SIEVE (%) | ORGANIC CONTENT (%) | COMMENTS |
| | X | 6 | | | ALLUVIUM: Brown Silty fine Sand, loose - damp | | 8 | | | | | |
| | X | 9 | | | Gray Brown fine to coarse Sand, trace fine to coarse Gravel, trace Silt, loose - dry to damp | | 6 | | | | | |
| 5 | | | | | | | | | | | | |
| | X | 6 | | | Brown fine to medium Sand, trace Silt, loose - damp | | 8 | | | | | |
| | X | 13 | | | Brown fine Sandy Silt, trace medium Sand, medium dense - damp | | 10 | | | 78 | | |
| 10 | | | | | Boring Terminated at 10' | | | | | | | |

TBL 20G180-2.GPJ SOCALGEO.GDT 11/2/20

# BORING NO. I-6

JOB NO.: 20G180-2
PROJECT: Proposed Redlands East Development
LOCATION: Perris, California
DRILLING DATE: 10/7/20
DRILLING METHOD: Hollow Stem Auger
LOGGED BY: Jose Zuniga
WATER DEPTH: ---
CAVE DEPTH: ---
READING TAKEN: ---

| FIELD RESULTS | | | | | | LABORATORY RESULTS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (FEET) | SAMPLE | BLOW COUNT | POCKET PEN. (TSF) | GRAPHIC LOG | DESCRIPTION<br>SURFACE ELEVATION: --- MSL | DRY DENSITY (PCF) | MOISTURE CONTENT (%) | LIQUID LIMIT | PLASTIC LIMIT | PASSING #200 SIEVE (%) | ORGANIC CONTENT (%) | COMMENTS |
| | X | 14 | | | ALLUVIUM: Brown fine to medium Sandy Silt, medium dense - dry to damp | | 5 | | | | | |
| 5 | X | 14 | | | Brown Silty fine to medium Sand, medium dense - dry to damp | | 4 | | | | | |
| | X | 20 | | | Brown fine to medium Sand, little to some coarse Sand, medium dense - dry to damp | | 4 | | | | | |
| 10 | X | 16 | | | Brown Silty fine to medium Sand, trace coarse Sand, medium dense - dry to damp | | 6 | | | 40 | | |
| | | | | | Boring Terminated at 10' | | | | | | | |

TBL 20G180-2.GPJ SOCALGEO.GDT 11/2/20

**INFILTRATION CALCULATIONS**

| | |
|---|---|
| Project Name | Proposed Redlands East Development |
| Project Location | Perris, California |
| Project Number | 20G180-2 |
| Engineer | Jose Zuniga |

| | | |
|---|---|---|
| Test Hole Radius | 4 | (in) |
| Test Depth | 10 | (ft) |

| | |
|---|---|
| Infiltration Test Hole | I-1 |

| Interval Number | | Time | Time Interval (min) | Water Depth (ft) | Change in Water Level (ft) | Average Head Height (ft) | Infiltration Rate Q (in/hr) | |
|---|---|---|---|---|---|---|---|---|
| P1 | Initial | 6:56 AM | 25.0 | 8.19 | 0.51 | 1.56 | 1.42 | Pre-Soak |
| | Final | 7:21 AM | | 8.70 | | | | |
| P2 | Initial | 7:23 AM | 25.0 | 8.74 | 0.32 | 1.10 | 1.21 | |
| | Final | 7:48 AM | | 9.06 | | | | |
| 1 | Initial | 8:43 AM | 10.0 | 8.35 | 0.45 | 1.43 | 3.39 | Infiltration Testing |
| | Final | 8:53 AM | | 8.80 | | | | |
| 2 | Initial | 8:54 AM | 10.0 | 8.21 | 0.42 | 1.58 | 2.89 | |
| | Final | 9:04 AM | | 8.63 | | | | |
| 3 | Initial | 9:06 AM | 10.0 | 8.26 | 0.40 | 1.54 | 2.81 | |
| | Final | 9:16 AM | | 8.66 | | | | |
| 4 | Initial | 9:17 AM | 10.0 | 8.66 | 0.32 | 1.18 | 2.85 | |
| | Final | 9:27 AM | | 8.98 | | | | |
| 5 | Initial | 9:37 AM | 10.0 | 8.44 | 0.39 | 1.37 | 3.06 | |
| | Final | 9:47 AM | | 8.83 | | | | |
| 6 | Initial | 9:48 AM | 10.0 | 8.16 | 0.38 | 1.65 | 2.51 | |
| | Final | 9:58 AM | | 8.54 | | | | |

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where:
- Q = Infiltration Rate (in inches per hour)
- $\Delta H$ = Change in Height (Water Level) over the time interval
- r = Test Hole (Borehole) Radius
- $\Delta t$ = Time Interval
- $H_{avg}$ = Average Head Height over the time interval

**INFILTRATION CALCULATIONS**

| | |
|---|---|
| Project Name | Proposed Redlands East Development |
| Project Location | Perris, California |
| Project Number | 20G180-2 |
| Engineer | Jose Zuniga |

| | | |
|---|---|---|
| Test Hole Radius | 4 | (in) |
| Test Depth | 10 | (ft) |

| | |
|---|---|
| Infiltration Test Hole | I-2 |

| Interval Number | | Time | Time Interval (min) | Water Depth (ft) | Change in Water Level (ft) | Average Head Height (ft) | Infiltration Rate Q (in/hr) | |
|---|---|---|---|---|---|---|---|---|
| P1 | Initial | 6:59 AM | 25.0 | 7.69 | 0.05 | 2.29 | 0.10 | Pre-Soak |
| | Final | 7:24 AM | | 7.74 | | | | |
| P2 | Initial | 7:26 AM | 25.0 | 7.50 | 0.03 | 2.49 | 0.05 | |
| | Final | 7:51 AM | | 7.53 | | | | |
| 1 | Initial | 8:38 AM | 30.0 | 7.50 | 0.02 | 2.49 | 0.03 | Infiltration Testing |
| | Final | 9:08 AM | | 7.52 | | | | |
| 2 | Initial | 9:29 AM | 30.0 | 7.50 | 0.03 | 2.49 | 0.05 | |
| | Final | 9:59 AM | | 7.53 | | | | |
| 3 | Initial | 10:01 AM | 30.0 | 7.43 | 0.01 | 2.57 | 0.01 | |
| | Final | 10:31 AM | | 7.44 | | | | |
| 4 | Initial | 10:32 AM | 30.0 | 7.44 | 0.03 | 2.55 | 0.04 | |
| | Final | 11:02 AM | | 7.47 | | | | |
| 5 | Initial | 11:03 AM | 30.0 | 7.47 | 0.03 | 2.52 | 0.04 | |
| | Final | 11:33 AM | | 7.50 | | | | |
| 6 | Initial | 11:34 AM | 30.0 | 7.50 | 0.04 | 2.48 | 0.06 | |
| | Final | 12:04 PM | | 7.54 | | | | |
| 7 | Initial | 12:06 PM | 30.0 | 7.46 | 0.03 | 2.53 | 0.04 | |
| | Final | 12:36 PM | | 7.49 | | | | |
| 8 | Initial | 12:37 PM | 30.0 | 7.49 | 0.05 | 2.49 | 0.08 | |
| | Final | 1:07 PM | | 7.54 | | | | |
| 9 | Initial | 1:10 PM | 30.0 | 7.20 | 0.03 | 2.79 | 0.04 | |
| | Final | 1:40 PM | | 7.23 | | | | |
| 10 | Initial | 1:41 PM | 30.0 | 7.23 | 0.04 | 2.75 | 0.05 | |
| | Final | 2:11 PM | | 7.27 | | | | |
| 11 | Initial | 2:12 PM | 30.0 | 7.24 | 0.05 | 2.74 | 0.07 | |
| | Final | 2:42 PM | | 7.29 | | | | |
| 12 | Initial | 2:44 PM | 30.0 | 7.20 | 0.05 | 2.78 | 0.07 | |
| | Final | 3:14 PM | | 7.25 | | | | |

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where:
- Q = Infiltration Rate (in inches per hour)
- $\Delta H$ = Change in Height (Water Level) over the time interval
- r = Test Hole (Borehole) Radius
- $\Delta t$ = Time Interval
- $H_{avg}$ = Average Head Height over the time interval

## INFILTRATION CALCULATIONS

| | |
|---|---|
| Project Name | Proposed Redlands East Development |
| Project Location | Perris, California |
| Project Number | 20G180-2 |
| Engineer | Jose Zuniga |

| | | |
|---|---|---|
| Test Hole Radius | 4 | (in) |
| Test Depth | 10 | (ft) |

| | |
|---|---|
| Infiltration Test Hole | I-3 |

| Interval Number | | Time | Time Interval (min) | Water Depth (ft) | Change in Water Level (ft) | Average Head Height (ft) | Infiltration Rate Q (in/hr) | |
|---|---|---|---|---|---|---|---|---|
| P1 | Initial | 7:02 AM | 25.0 | 8.16 | 0.33 | 1.68 | 0.86 | Pre-Soak |
| | Final | 7:27 AM | | 8.49 | | | | |
| P2 | Initial | 7:29 AM | 25.0 | 8.24 | 0.25 | 1.64 | 0.67 | |
| | Final | 7:54 AM | | 8.49 | | | | |
| 1 | Initial | 8:31 AM | 30.0 | 8.20 | 0.33 | 1.64 | 0.73 | Infiltration Testing |
| | Final | 9:01 AM | | 8.53 | | | | |
| 2 | Initial | 9:03 AM | 30.0 | 8.20 | 0.30 | 1.65 | 0.66 | |
| | Final | 9:33 AM | | 8.50 | | | | |
| 3 | Initial | 9:34 AM | 30.0 | 8.17 | 0.33 | 1.67 | 0.72 | |
| | Final | 10:04 AM | | 8.50 | | | | |
| 4 | Initial | 10:05 AM | 30.0 | 8.17 | 0.34 | 1.66 | 0.74 | |
| | Final | 10:35 AM | | 8.51 | | | | |
| 5 | Initial | 10:37 AM | 30.0 | 8.21 | 0.33 | 1.63 | 0.74 | |
| | Final | 11:07 AM | | 8.54 | | | | |
| 6 | Initial | 11:08 AM | 30.0 | 8.13 | 0.37 | 1.69 | 0.80 | |
| | Final | 11:38 AM | | 8.50 | | | | |
| 7 | Initial | 11:41 AM | 30.0 | 8.16 | 0.36 | 1.66 | 0.79 | |
| | Final | 12:11 PM | | 8.52 | | | | |
| 8 | Initial | 12:15 PM | 30.0 | 8.16 | 0.37 | 1.66 | 0.81 | |
| | Final | 12:45 PM | | 8.53 | | | | |
| 9 | Initial | 12:49 PM | 30.0 | 8.14 | 0.37 | 1.68 | 0.80 | |
| | Final | 1:19 PM | | 8.51 | | | | |
| 10 | Initial | 1:20 PM | 30.0 | 7.95 | 0.51 | 1.80 | 1.04 | |
| | Final | 1:50 PM | | 8.46 | | | | |
| 11 | Initial | 1:51 PM | 30.0 | 8.14 | 0.31 | 1.71 | 0.66 | |
| | Final | 2:21 PM | | 8.45 | | | | |
| 12 | Initial | 2:22 PM | 30.0 | 8.15 | 0.32 | 1.69 | 0.69 | |
| | Final | 2:52 PM | | 8.47 | | | | |

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where:
- $Q$ = Infiltration Rate (in inches per hour)
- $\Delta H$ = Change in Height (Water Level) over the time interval
- $r$ = Test Hole (Borehole) Radius
- $\Delta t$ = Time Interval
- $H_{avg}$ = Average Head Height over the time interval

**INFILTRATION CALCULATIONS**

| | |
|---|---|
| Project Name | Proposed Redlands East Development |
| Project Location | Perris, California |
| Project Number | 20G180-2 |
| Engineer | Jose Zuniga |

| | | |
|---|---|---|
| Test Hole Radius | 4 | (in) |
| Test Depth | 10 | (ft) |

| | |
|---|---|
| Infiltration Test Hole | I-4 |

| Interval Number | | Time | Time Interval (min) | Water Depth (ft) | Change in Water Level (ft) | Average Head Height (ft) | Infiltration Rate Q (in/hr) | |
|---|---|---|---|---|---|---|---|---|
| P1 | Initial | 7:06 AM | 25.0 | 8.00 | 0.68 | 1.66 | 1.79 | Pre-Soak |
| | Final | 7:31 AM | | 8.68 | | | | |
| P2 | Initial | 7:32 AM | 25.0 | 7.85 | 0.60 | 1.85 | 1.43 | |
| | Final | 7:57 AM | | 8.45 | | | | |
| 1 | Initial | 8:46 AM | 10.0 | 8.26 | 0.20 | 1.64 | 1.33 | Infiltration Testing |
| | Final | 8:56 AM | | 8.46 | | | | |
| 2 | Initial | 8:57 AM | 10.0 | 7.96 | 0.24 | 1.92 | 1.38 | |
| | Final | 9:07 AM | | 8.20 | | | | |
| 3 | Initial | 10:16 AM | 10.0 | 8.33 | 0.20 | 1.57 | 1.38 | |
| | Final | 10:26 AM | | 8.53 | | | | |
| 4 | Initial | 10:28 AM | 10.0 | 7.91 | 0.25 | 1.97 | 1.41 | |
| | Final | 10:38 AM | | 8.16 | | | | |
| 5 | Initial | 10:39 AM | 10.0 | 7.84 | 0.25 | 2.04 | 1.36 | |
| | Final | 10:49 AM | | 8.09 | | | | |
| 6 | Initial | 11:12 AM | 10.0 | 7.54 | 0.28 | 2.32 | 1.35 | |
| | Final | 11:22 AM | | 7.82 | | | | |

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where: Q = Infiltration Rate (in inches per hour)
$\Delta H$ = Change in Height (Water Level) over the time interval
r = Test Hole (Borehole) Radius
$\Delta t$ = Time Interval
$H_{avg}$ = Average Head Height over the time interval

**INFILTRATION CALCULATIONS**

| | |
|---|---|
| Project Name | Proposed Redlands East Development |
| Project Location | Perris, California |
| Project Number | 20G180-2 |
| Engineer | Jose Zuniga |

| | | |
|---|---|---|
| Test Hole Radius | 4 | (in) |
| Test Depth | 10 | (ft) |

| | |
|---|---|
| Infiltration Test Hole | I-5 |

| Interval Number | | Time | Time Interval (min) | Water Depth (ft) | Change in Water Level (ft) | Average Head Height (ft) | Infiltration Rate Q (in/hr) | |
|---|---|---|---|---|---|---|---|---|
| P1 | Initial | 7:09 AM | 25.0 | 8.51 | 0.63 | 1.18 | 2.25 | Pre-Soak |
| | Final | 7:34 AM | | 9.14 | | | | |
| P2 | Initial | 7:35 AM | 25.0 | 8.35 | 0.71 | 1.30 | 2.33 | |
| | Final | 8:00 AM | | 9.06 | | | | |
| 1 | Initial | 8:50 AM | 10.0 | 8.20 | 0.50 | 1.55 | 3.50 | Infiltration Testing |
| | Final | 9:00 AM | | 8.70 | | | | |
| 2 | Initial | 9:00 AM | 10.0 | 8.11 | 0.55 | 1.62 | 3.70 | |
| | Final | 9:10 AM | | 8.66 | | | | |
| 3 | Initial | 10:44 AM | 10.0 | 8.11 | 0.50 | 1.64 | 3.32 | |
| | Final | 10:54 AM | | 8.61 | | | | |
| 4 | Initial | 11:14 AM | 10.0 | 8.09 | 0.48 | 1.67 | 3.14 | |
| | Final | 11:24 AM | | 8.57 | | | | |
| 5 | Initial | 11:49 AM | 10.0 | 8.30 | 0.35 | 1.53 | 2.48 | |
| | Final | 11:59 AM | | 8.65 | | | | |
| 6 | Initial | 12:01 PM | 10.0 | 7.80 | 0.40 | 2.00 | 2.22 | |
| | Final | 12:11 PM | | 8.20 | | | | |

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where: Q = Infiltration Rate (in inches per hour)
$\Delta H$ = Change in Height (Water Level) over the time interval
r = Test Hole (Borehole) Radius
$\Delta t$ = Time Interval
$H_{avg}$ = Average Head Height over the time interval

**INFILTRATION CALCULATIONS**

| | |
|---|---|
| Project Name | Proposed Redlands East Development |
| Project Location | Perris, California |
| Project Number | 20G180-2 |
| Engineer | Jose Zuniga |

| | | |
|---|---|---|
| Test Hole Radius | 4 | (in) |
| Test Depth | 10 | (ft) |

Infiltration Test Hole: I-6

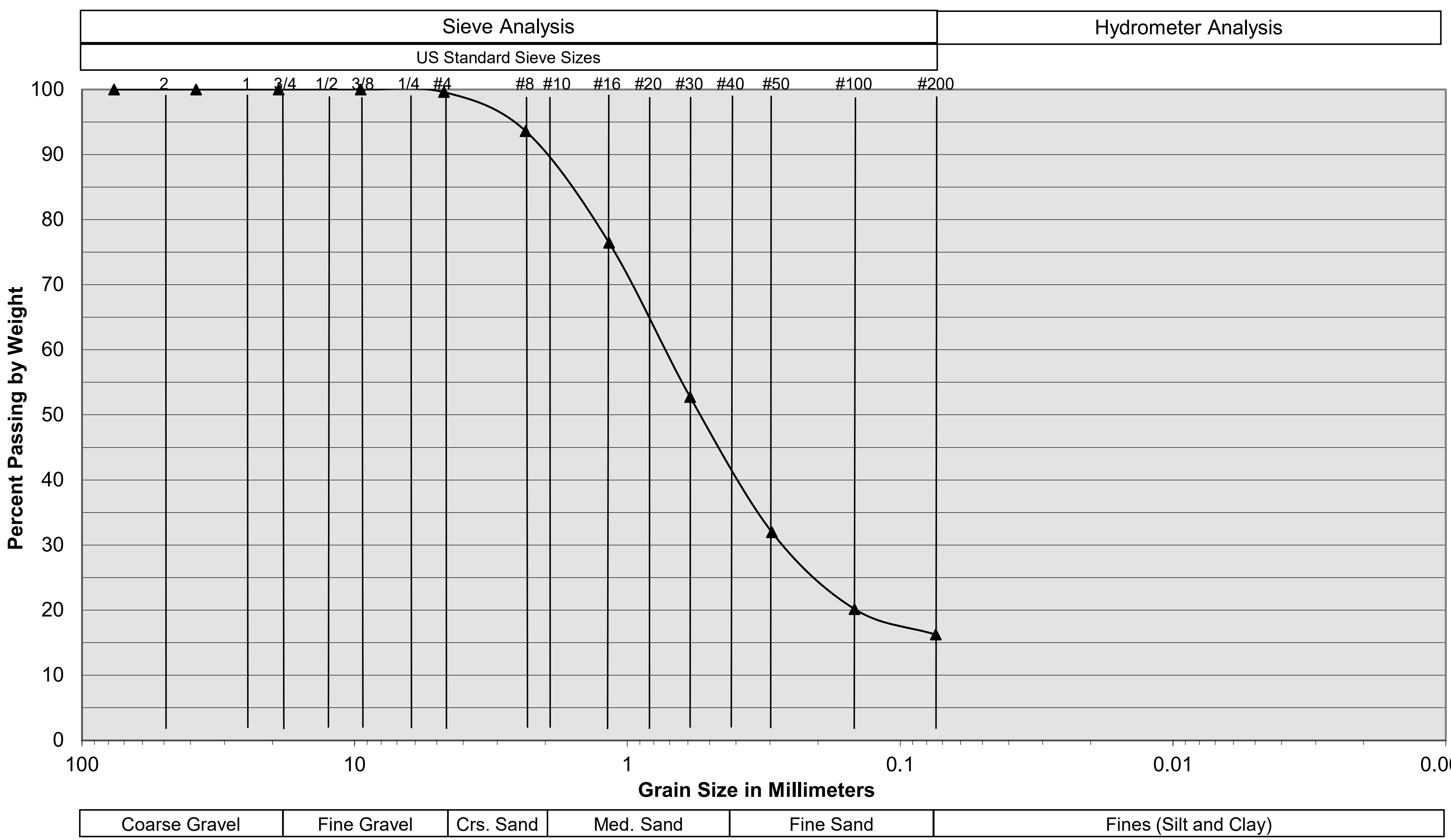
| Interval Number | | Time | Time Interval (min) | Water Depth (ft) | Change in Water Level (ft) | Average Head Height (ft) | Infiltration Rate Q (in/hr) | |
|---|---|---|---|---|---|---|---|---|
| P1 | Initial | 7:13 AM | 25.0 | 7.95 | 0.66 | 1.72 | 1.68 | Pre-Soak |
| | Final | 7:38 AM | | 8.61 | | | | |
| P2 | Initial | 7:39 AM | 25.0 | 7.84 | 0.59 | 1.87 | 1.39 | |
| | Final | 8:04 AM | | 8.43 | | | | |
| 1 | Initial | 12:31 PM | 10.0 | 7.90 | 0.32 | 1.94 | 1.82 | Infiltration Testing |
| | Final | 12:41 PM | | 8.22 | | | | |
| 2 | Initial | 12:43 PM | 10.0 | 7.68 | 0.36 | 2.14 | 1.87 | |
| | Final | 12:53 PM | | 8.04 | | | | |
| 3 | Initial | 12:55 PM | 10.0 | 7.39 | 0.47 | 2.38 | 2.22 | |
| | Final | 1:05 PM | | 7.86 | | | | |
| 4 | Initial | 1:23 PM | 10.0 | 7.70 | 0.30 | 2.15 | 1.55 | |
| | Final | 1:33 PM | | 8.00 | | | | |
| 5 | Initial | 1:46 PM | 10.0 | 7.80 | 0.28 | 2.06 | 1.51 | |
| | Final | 1:56 PM | | 8.08 | | | | |
| 6 | Initial | 2:00 PM | 10.0 | 7.63 | 0.29 | 2.23 | 1.46 | |
| | Final | 2:10 PM | | 7.92 | | | | |

Per County Standards, Infiltration Rate calculated as follows:

$$Q = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

Where:
- $Q$ = Infiltration Rate (in inches per hour)
- $\Delta H$ = Change in Height (Water Level) over the time interval
- $r$ = Test Hole (Borehole) Radius
- $\Delta t$ = Time Interval
- $H_{avg}$ = Average Head Height over the time interval

# Grain Size Distribution

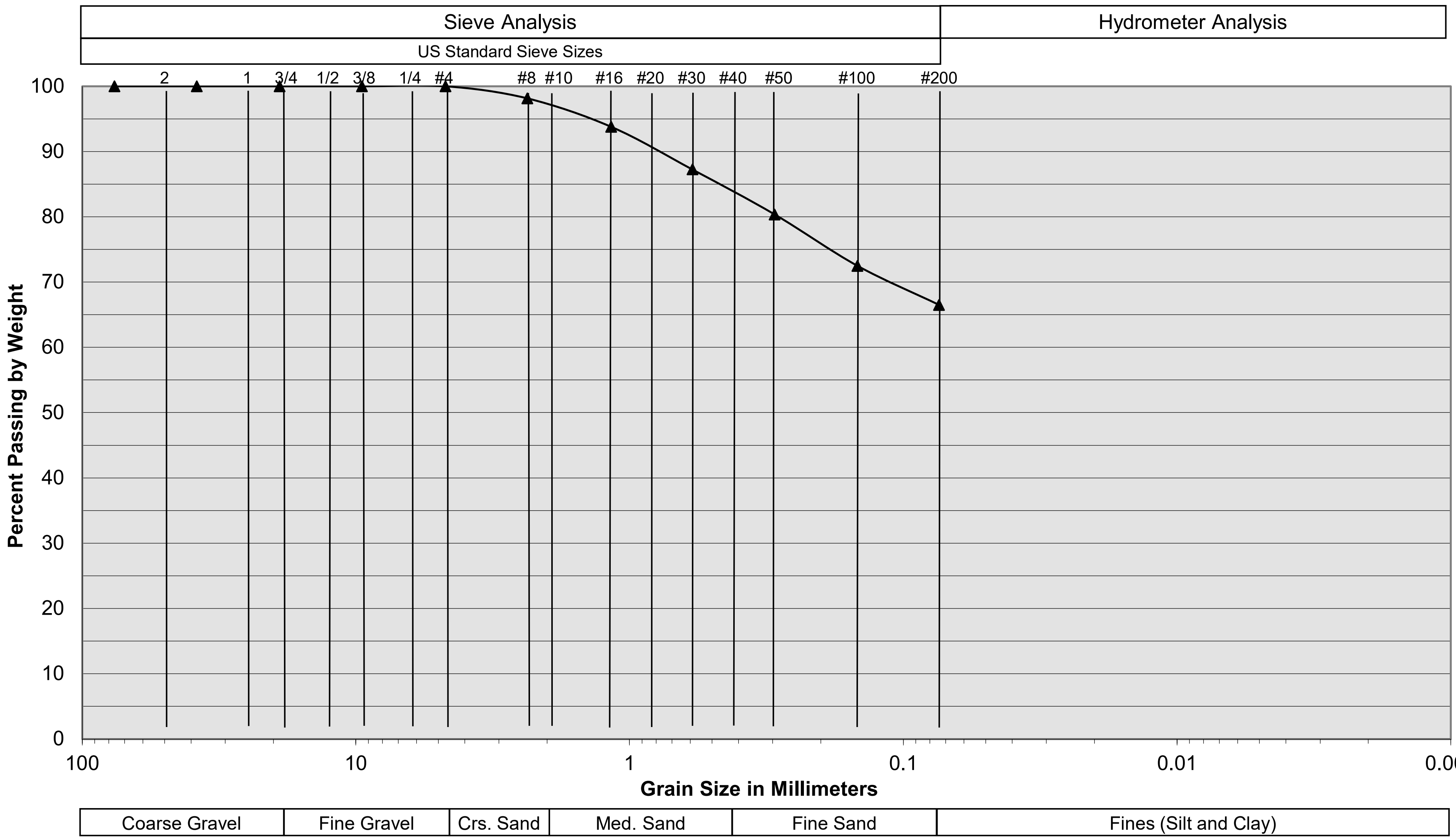



| | |
|---|---|
| Sample Description | I-1 @ 8½ feet |
| Soil Classification | Brown Silty fine to medium Sand, trace coarse Sand |

Proposed Redlands East Development
Perris, CA
Project No. 20G180-2
**PLATE C-1**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# Grain Size Distribution

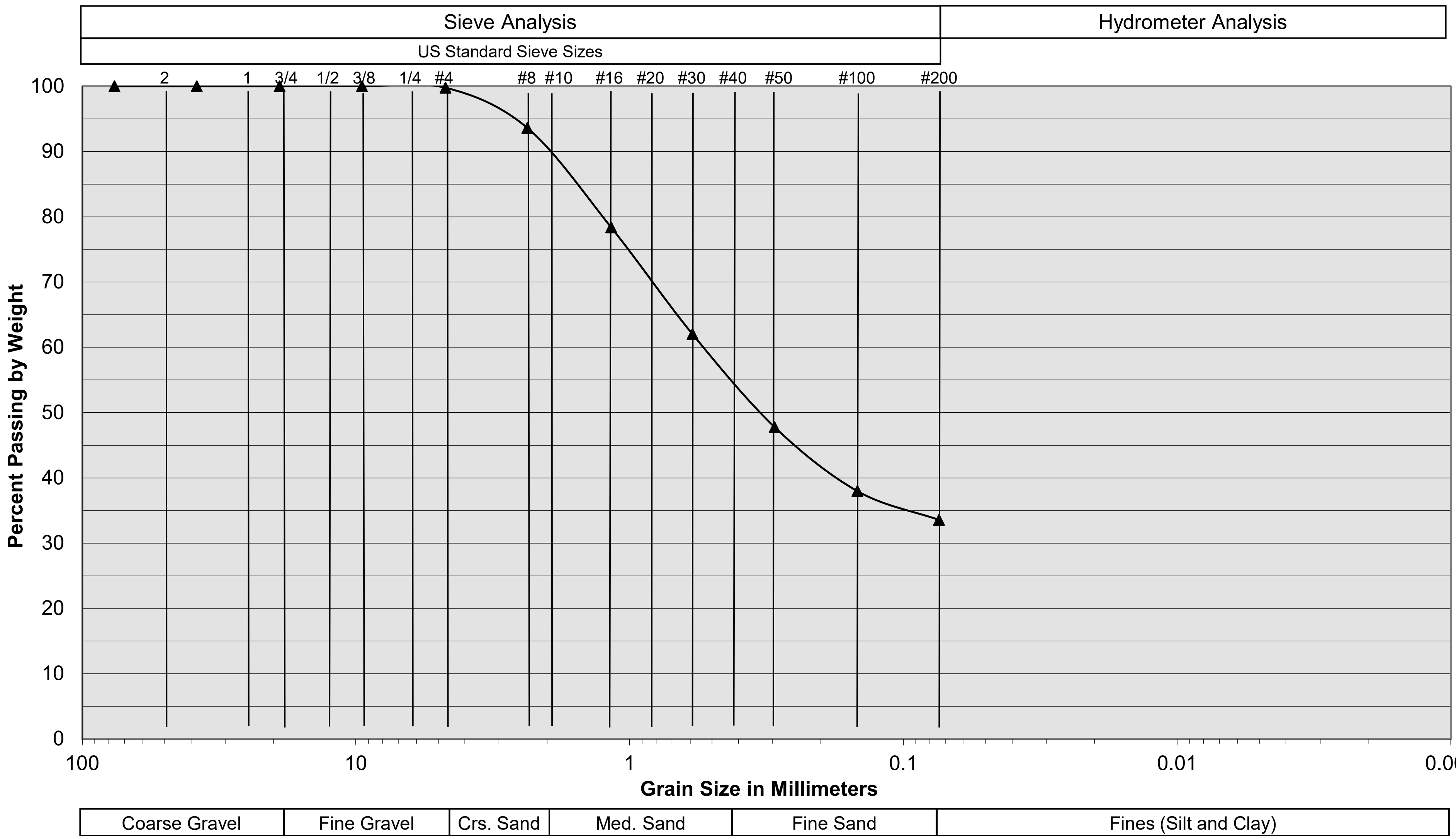



| | |
|---|---|
| Sample Description | I-2 @ 8½ feet |
| Soil Classification | Brown fine Sandy Silt, little to some Clay, trace medium Sand |

Proposed Redlands East Development
Perris, CA
Project No. 20G180-2
**PLATE C-2**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# Grain Size Distribution

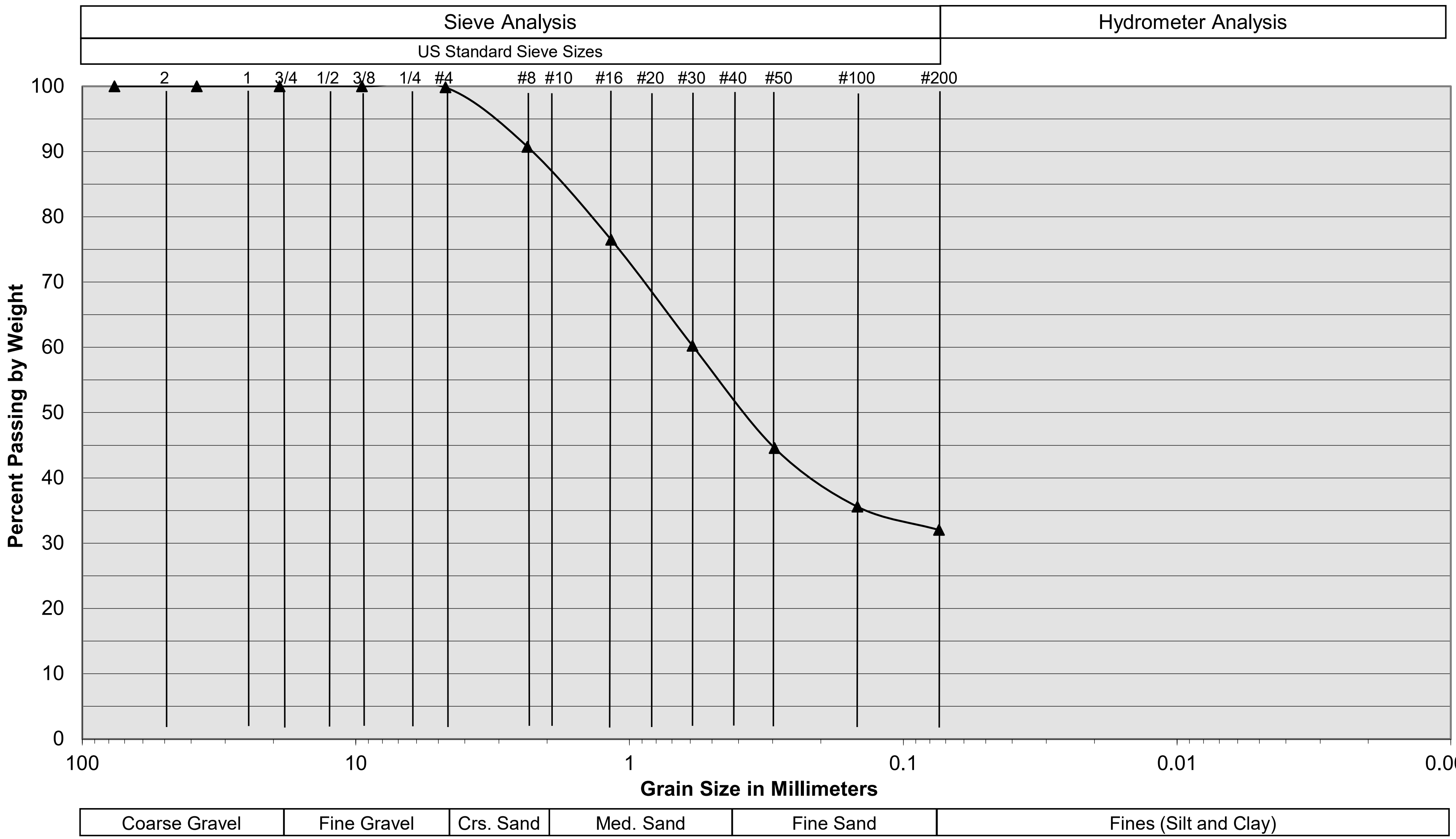



| | |
|---|---|
| Sample Description | I-3 @ 8½ feet |
| Soil Classification | Brown Silty fine to medium Sand, trace coarse Sand |

Proposed Redlands East Development
Perris, CA
Project No. 20G180-2
**PLATE C-3**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# Grain Size Distribution

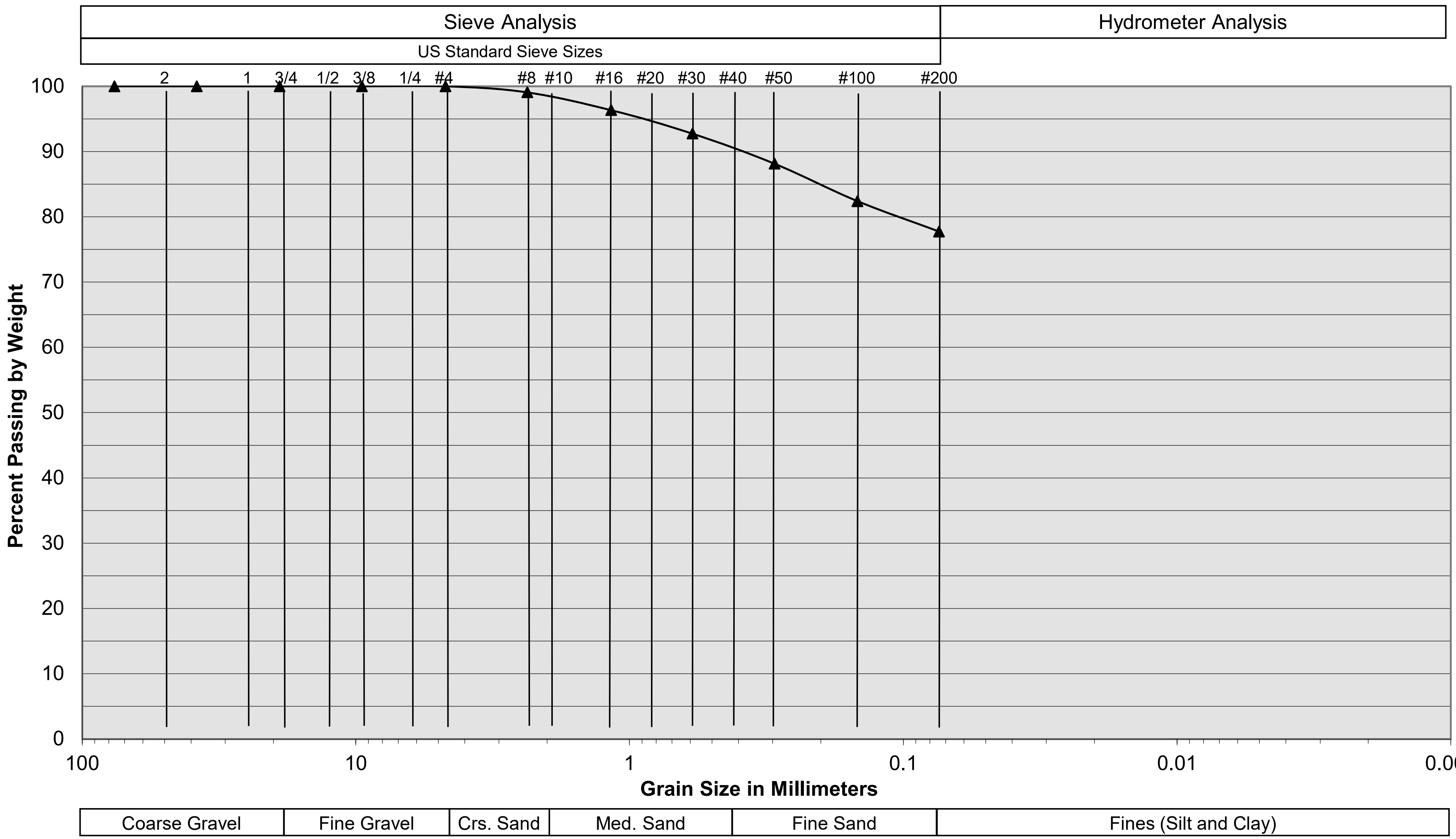



| | |
|---|---|
| Sample Description | I-4 @ 8½ feet |
| Soil Classification | Brown Silty fine to coarse Sand |

Proposed Redlands East Development
Perris, CA
Project No. 20G180-2
**PLATE C-4**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# Grain Size Distribution

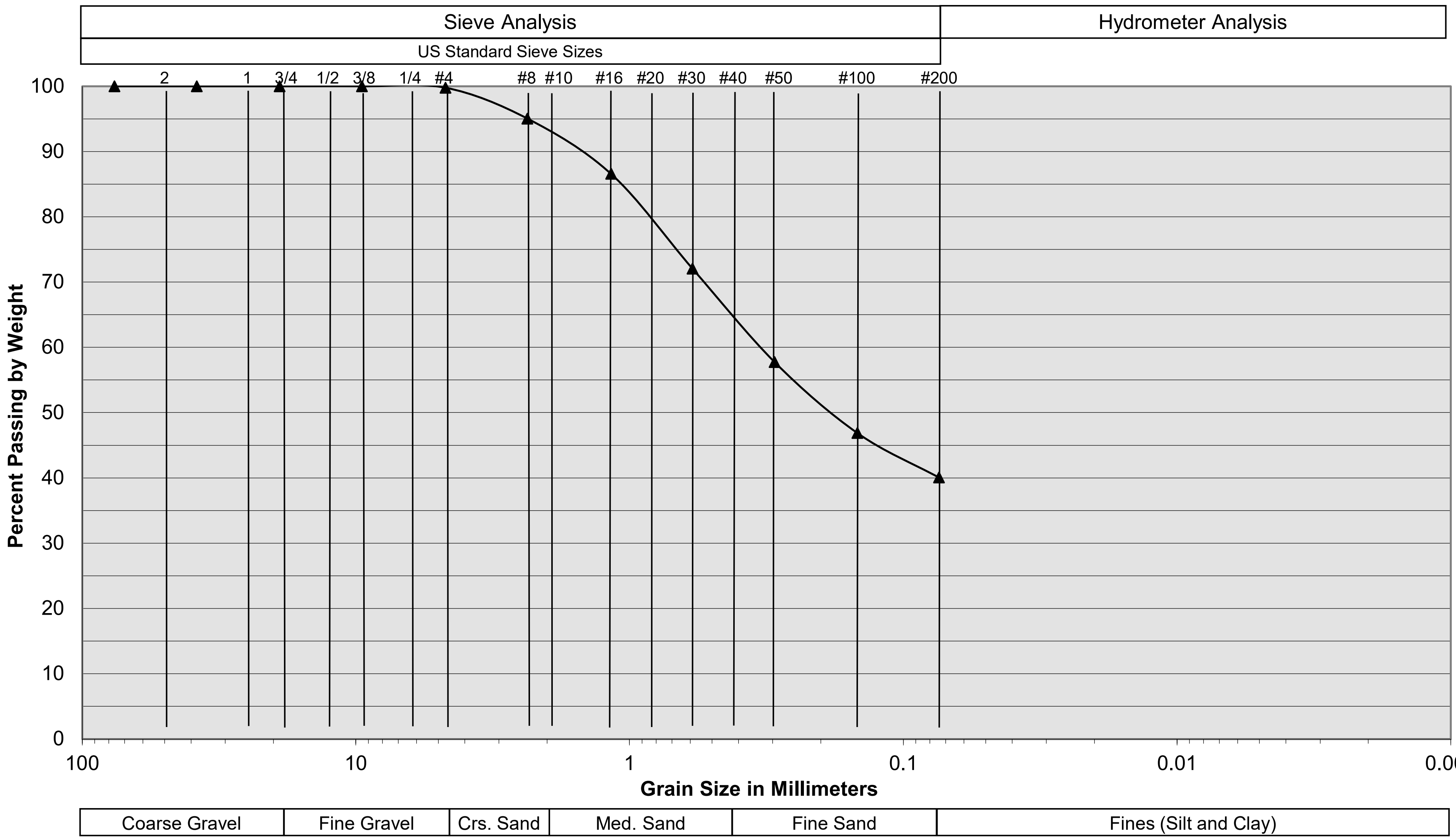



| | |
|---|---|
| Sample Description | I-5 @ 8½ feet |
| Soil Classification | Brown fine Sandy Silt, trace medium Sand |

Proposed Redlands East Development
Perris, CA
Project No. 20G180-2
**PLATE C-5**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# Grain Size Distribution




| | |
|---|---|
| Sample Description | I-6 @ 8½ feet |
| Soil Classification | Brown Silty fine to mediun Sand, trace coarse Sand |

Proposed Redlands East Development
Perris, CA
Project No. 20G180-2
**PLATE C-6**

SOUTHERN CALIFORNIA GEOTECHNICAL
A California Corporation

# Appendix 4: Historical Site Conditions

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

*N/A*

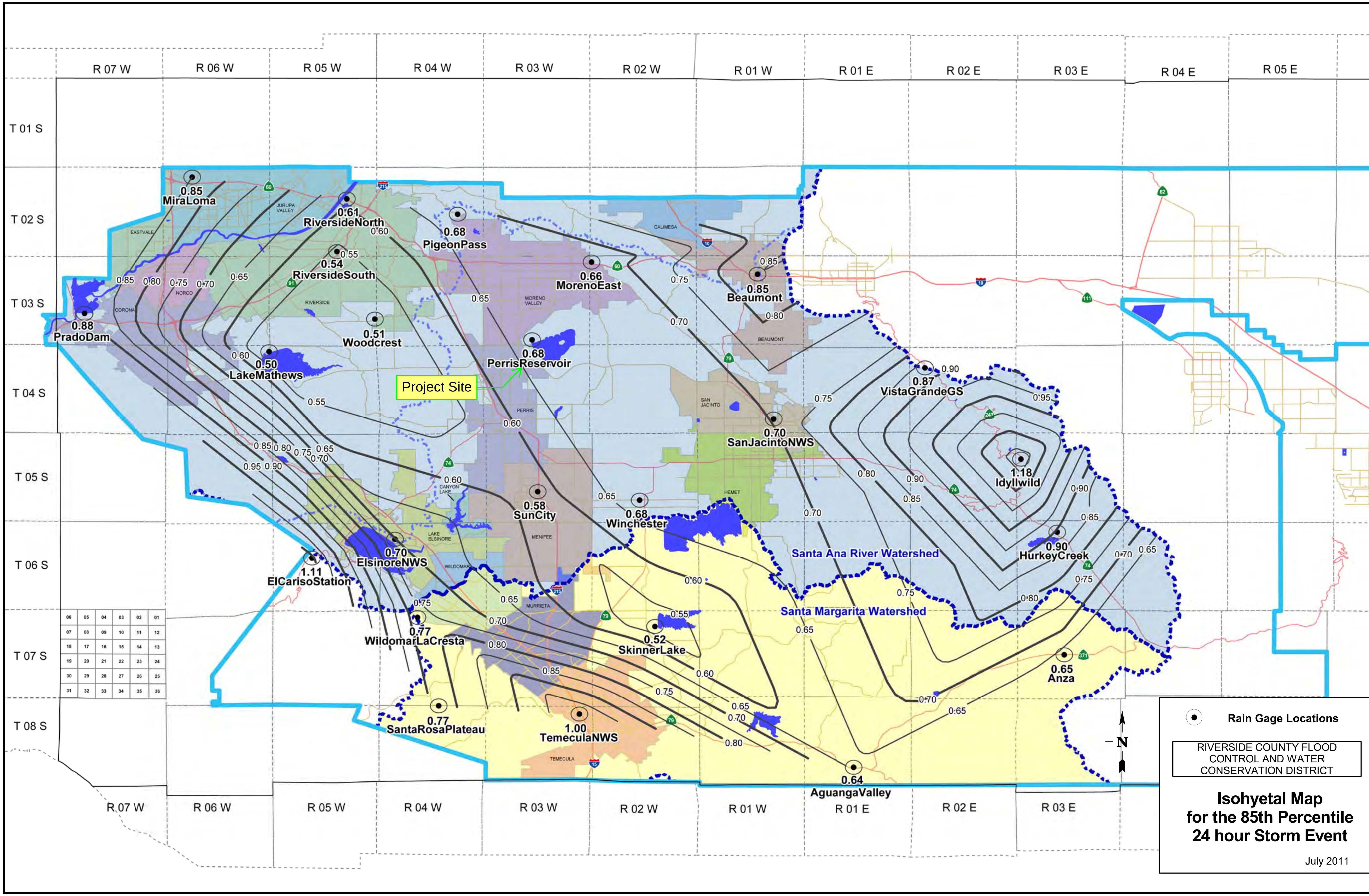
# Appendix 5:  LID Infeasibility

*LID Technical Infeasibility Analysis*

*N/A*

# Appendix 6:  BMP Design Details

*BMP Sizing, Design Details and other Supporting Documentation*



Isohyetal Map
for the 85th Percentile
24 hour Storm Event
July 2011
RIVERSIDE COUNTY FLOOD
CONTROL AND WATER
CONSERVATION DISTRICT
Rain Gage Locations
N
Project Site
Santa Ana River Watershed
Santa Margarita Watershed
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
0.68
PerrisReservoir
0.50
LakeMathews
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

## **Santa Ana Watershed** - BMP Design Flow Rate, $Q_{BMP}$

(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: Albert A. Webb Associates — Date: 12/1/2021

Designed by: EA — Case No:

Company Project Number/Name: 20-0181 Redlands East

### BMP Identification

BMP NAME / ID: DMA 1

*Must match Name/ID used on BMP Design Calculation Sheet*

### Design Rainfall Depth

Design Rainfall Intensity: I = 0.20 in/hr

### 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 (use pull-down menu) | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | *Design Rainfall Intensity (in/hr)* | *Design Flow Rate (cfs)* | *Proposed Flow Rate (cfs)* |
|---|---|---|---|---|---|---|---|---|---|
| DMAs | *DMA 1 - Concrete / Asphalt* | *45,817* | *Concrete or Asphalt* | *1* | *0.89* | *40868.8* | | | |
| | *DMA 1 - Landscape* | *15,231* | *Ornamental Landscaping* | *0.1* | *0.110458* | *1682.4* | | | |
| | *DMA 1 - Roofs* | *117,135* | *Roofs* | *1* | *0.892* | *104484.4* | | | |
| | *DMA 1 - Self-Retaining* | *6,308* | *Ornamental Landscaping* | *0.1* | *0.110458* | *696.8* | | | |
| | | **184491** | ***Total*** | | | **147732.4** | **0.20** | ***0.7*** | ***0.7*** |

Notes:

## **Santa Ana Watershed** - BMP Design Flow Rate, $Q_{BMP}$

(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: Albert A. Webb Associates — Date: 12/1/2021

Designed by: EA — Case No:

Company Project Number/Name: 20-0181 Redlands East

### BMP Identification

BMP NAME / ID: DMA 2

*Must match Name/ID used on BMP Design Calculation Sheet*

### Design Rainfall Depth

Design Rainfall Intensity — I = 0.20 in/hr

### 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 (use pull-down menu) | Effective Imperivous Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | *Design Rainfall Intensity (in/hr)* | *Design Flow Rate (cfs)* | *Proposed Flow Rate (cfs)* |
|---|---|---|---|---|---|---|---|---|
| *DMA 2 - Concrete / Asphalt* | *148,486* | *Concrete or Asphalt* | *1* | *0.89* | *132449.5* | | | |
| *DMA 2 - Landscape* | *27,572* | *Ornamental Landscaping* | *0.1* | *0.110458* | *3045.5* | | | |
| *DMA 2 - Self-Retaining* | *12,049* | *Ornamental Landscaping* | *0.1* | *0.110458* | *1330.9* | | | |
| | ***188107*** | ***Total*** | | | **136825.9** | **0.20** | ***0.6*** | ***0.6*** |

DMAs

Notes:

## **Santa Ana Watershed** - BMP Design Flow Rate, $Q_{BMP}$

(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: Albert A. Webb Associates — Date: 12/1/2021

Designed by: EA — Case No:

Company Project Number/Name: 20-0181 Redlands East

### BMP Identification

BMP NAME / ID: DMA 3

*Must match Name/ID used on BMP Design Calculation Sheet*

### Design Rainfall Depth

Design Rainfall Intensity — I = 0.20 in/hr

### Drainage Management Area Tabulation

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

DMAs

| DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type (use pull-down menu) | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | Design Rainfall Intensity (in/hr) | Design Flow Rate (cfs) | Proposed Flow Rate (cfs) |
|---|---|---|---|---|---|---|---|---|
| *DMA 3 - Roofs* | *133,283* | *Roofs* | *1* | *0.89* | *118888.4* | | | |
| | ***133283*** | ***Total*** | | | **118888.4** | **0.20** | ***0.5*** | ***0.6*** |

Notes:

## **Santa Ana Watershed** - BMP Design Flow Rate, $Q_{BMP}$

(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: Albert A. Webb Associates | Date: 12/1/2021
Designed by: EA | Case No:
Company Project Number/Name: 20-0181 Redlands East

### BMP Identification

BMP NAME / ID: DMA 4

*Must match Name/ID used on BMP Design Calculation Sheet*

### Design Rainfall Depth

Design Rainfall Intensity: I = 0.20 in/hr

### Drainage Management Area Tabulation

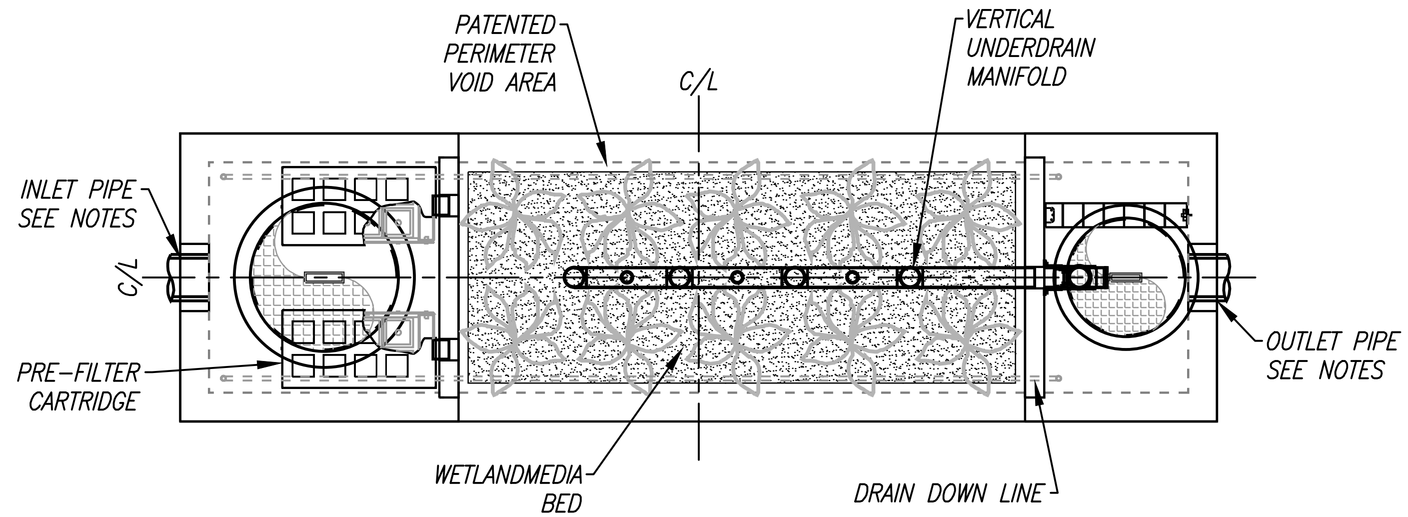
*Insert additional rows if needed to accommodate all DMAs draining to the BMP*

| | DMA Type/ID | DMA Area (square feet) | Post-Project Surface Type (use pull-down menu) | Effective Impervious Fraction, $I_f$ | DMA Runoff Factor | DMA Areas x Runoff Factor | *Design Rainfall Intensity (in/hr)* | *Design Flow Rate (cfs)* | *Proposed Flow Rate (cfs)* |
|---|---|---|---|---|---|---|---|---|---|
| DMAs | *DMA 4 - Concrete / Asphalt* | *37,068* | *Concrete or Asphalt* | *1* | *0.89* | *33064.7* | | | |
| | *DMA 4 - Landscape* | *5,251* | *Ornamental Landscaping* | *0.1* | *0.110458* | *580* | | | |
| | | **42319** | ***Total*** | | | **33644.7** | **0.20** | **0.2** | **0.2** |

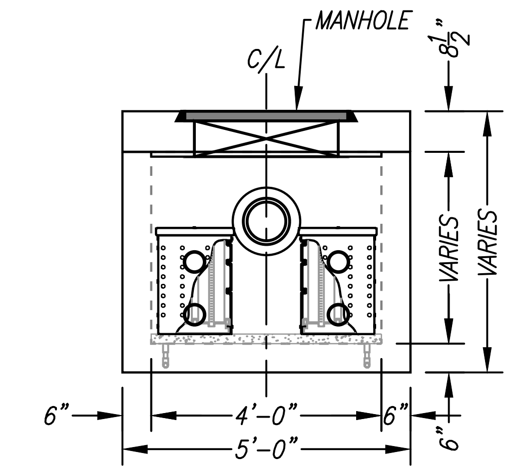
Notes:

| SITE SPECIFIC DATA | | | |
|---|---|---|---|
| PROJECT NUMBER | | | |
| PROJECT NAME | | | |
| PROJECT LOCATION | | | |
| STRUCTURE ID | | | |
| TREATMENT REQUIRED | | | |
| VOLUME BASED (CF) | | FLOW BASED (CFS) | |
| N/A | | 0.206 | |
| PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE | | | OFFLINE |
| PIPE DATA | I.E. | MATERIAL | DIAMETER |
| INLET PIPE 1 | | | |
| INLET PIPE 2 | N/A | N/A | N/A |
| OUTLET PIPE | | | |
| | PRETREATMENT | BIOFILTRATION | DISCHARGE |
| RIM ELEVATION | | | |
| SURFACE LOAD | PEDESTRIAN | | |
| FRAME & COVER | ø30" | OPEN PLANTER | ø24" |
| NOTES: | | | |

* PRELIMINARY NOT FOR CONSTRUCTION



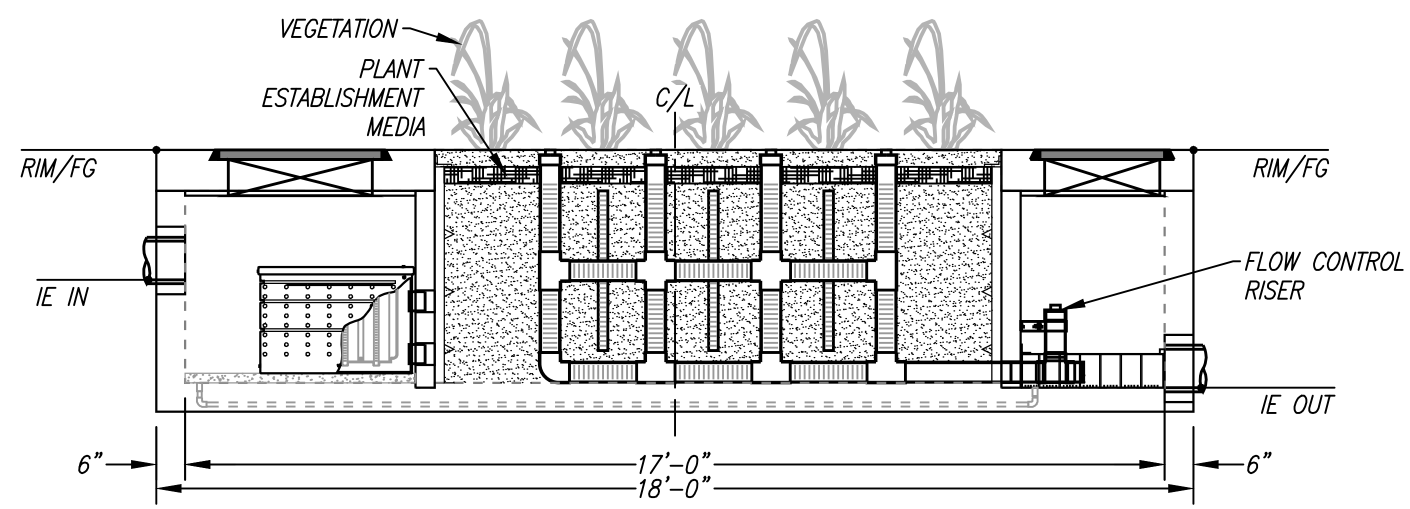

**PLAN VIEW**



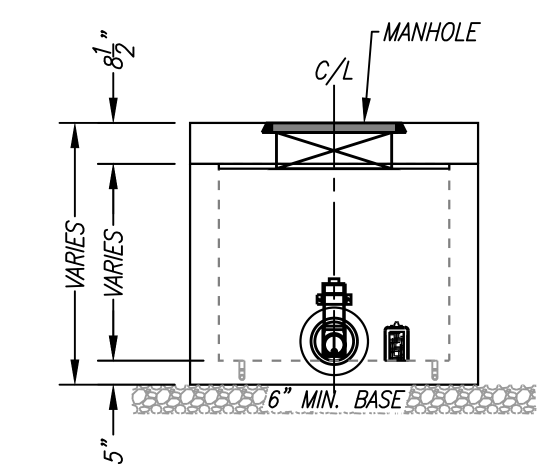

**LEFT END VIEW**

## INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATER TIGHT PER MANUFACTURERS STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURERS WARRANTY IS VOID WITH OUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.




**ELEVATION VIEW**




**RIGHT END VIEW**

| | |
|---|---|
| TREATMENT FLOW (CFS) | 0.206 |
| OPERATING HEAD (FT) | 3.4 |
| PRETREATMENT LOADING RATE (GPM/SF) | 1.8 |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0 |

## GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.

MODULAR WETLANDS

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING



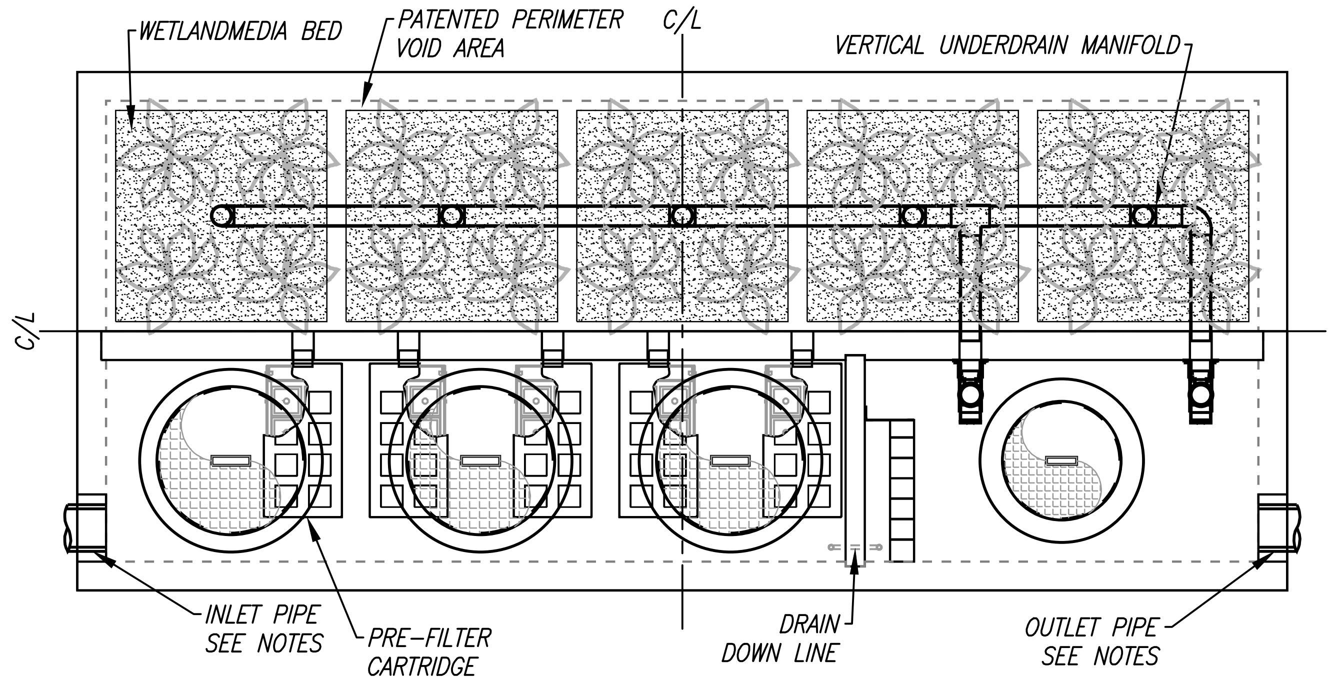
Bio Clean
A Forterra Company

# MWS-L-4-17-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

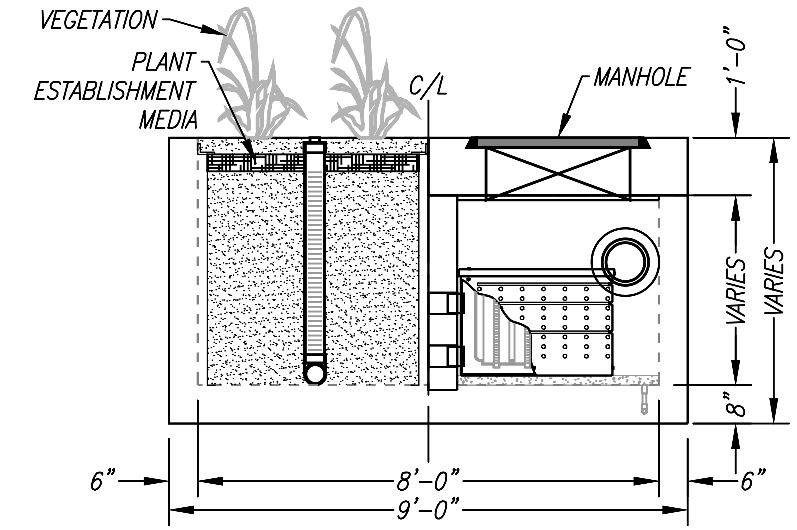
5/23/19TOLFF

| SITE SPECIFIC DATA | | | |
|---|---|---|---|
| PROJECT NUMBER | | | |
| PROJECT NAME | | | |
| PROJECT LOCATION | | | |
| STRUCTURE ID | | | |
| TREATMENT REQUIRED | | | |
| VOLUME BASED (CF) | | FLOW BASED (CFS) | |
| N/A | | 0.577 | |
| PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE | | | OFFLINE |
| PIPE DATA | I.E. | MATERIAL | DIAMETER |
| INLET PIPE 1 | | | |
| INLET PIPE 2 | N/A | N/A | N/A |
| OUTLET PIPE | | | |
| | PRETREATMENT | BIOFILTRATION | DISCHARGE |
| RIM ELEVATION | | | |
| SURFACE LOAD | PEDESTRIAN | | |
| FRAME & COVER | 3EA ø30" | OPEN PLANTER | ø24" |
| NOTES: | | | |

* PRELIMINARY NOT FOR CONSTRUCTION



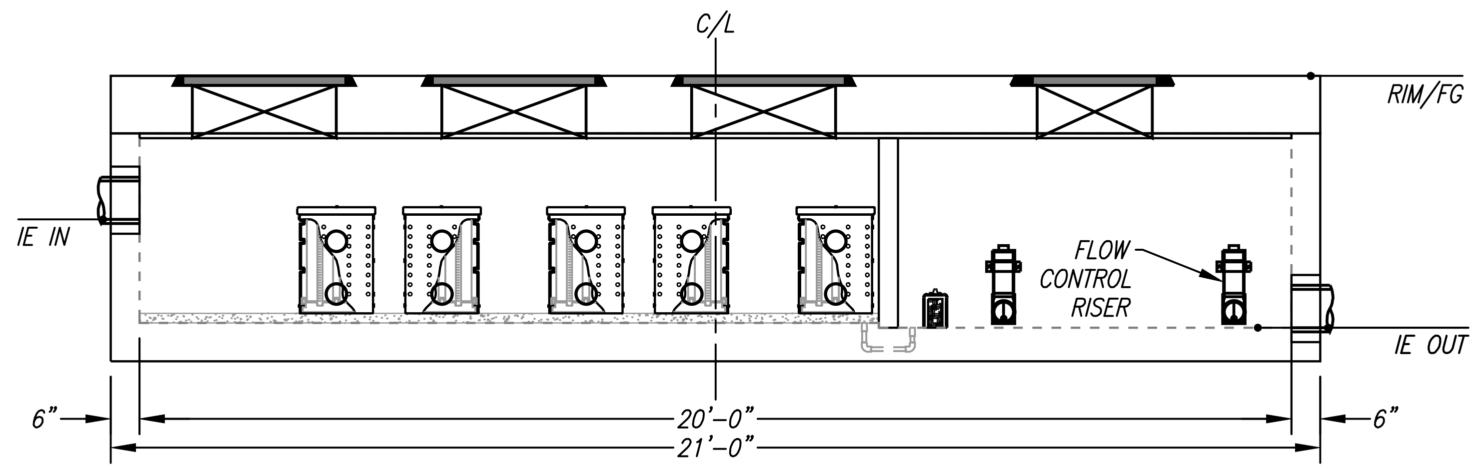

**PLAN VIEW**



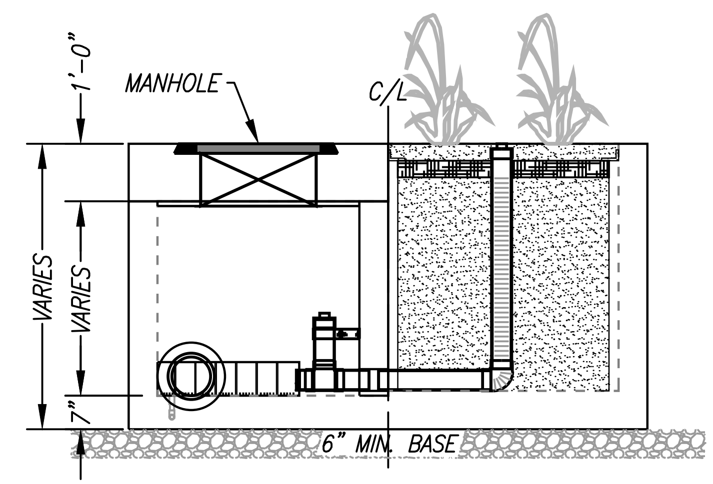

**LEFT END VIEW**

## INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATER TIGHT PER MANUFACTURERS STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURERS WARRANTY IS VOID WITH OUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.




**ELEVATION VIEW**




**RIGHT END VIEW**

| | |
|---|---|
| TREATMENT FLOW (CFS) | 0.577 |
| OPERATING HEAD (FT) | 3.4 |
| PRETREATMENT LOADING RATE (GPM/SF) | 2.0 |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0 |

## GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.

MODULAR WETLANDS

THIS PRODUCT MAY BE PROTECTED BY ONE OR MORE OF THE FOLLOWING US PATENTS: 7,425,262; 7,470,362; 7,674,378; 8,303,816; RELATED FOREIGN PATENTS OR OTHER PATENTS PENDING



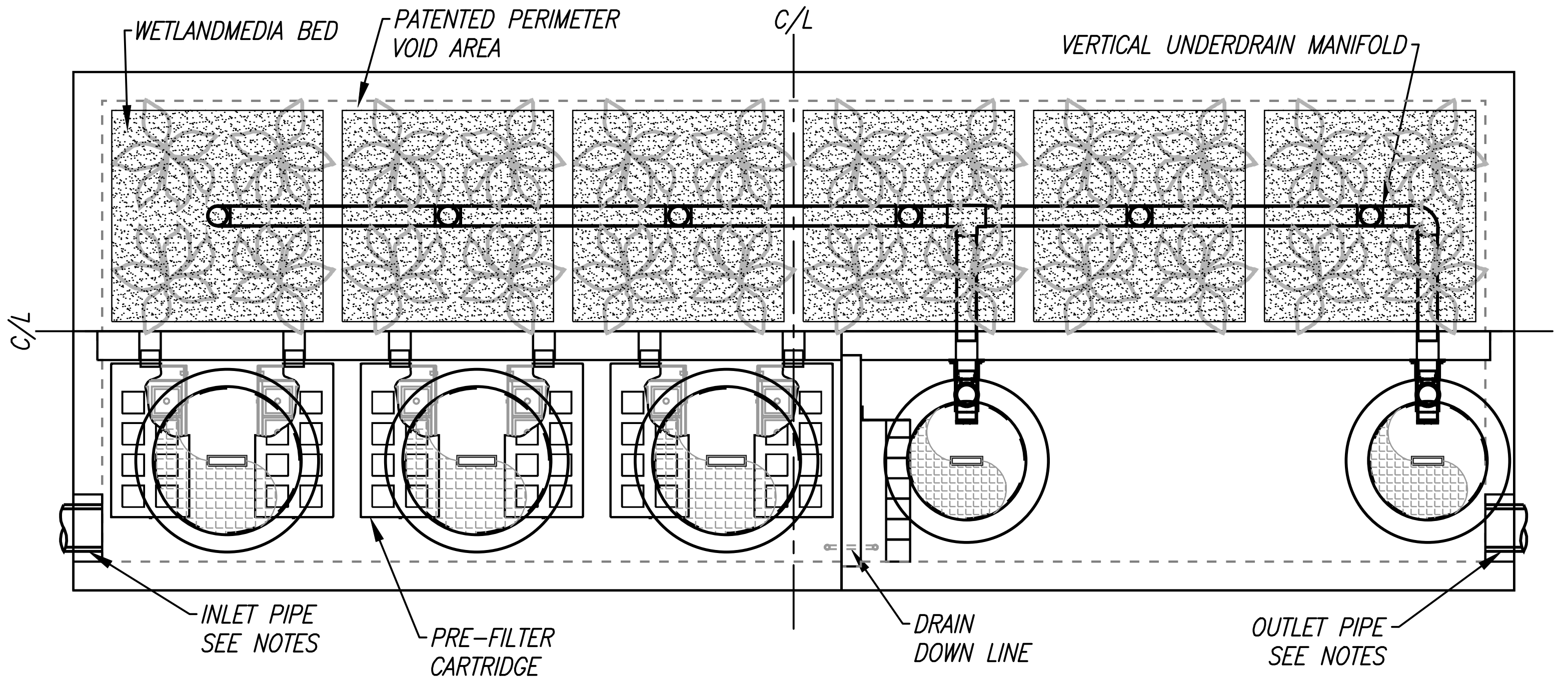
Bio Clean
A Forterra Company

# MWS-L-8-20-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

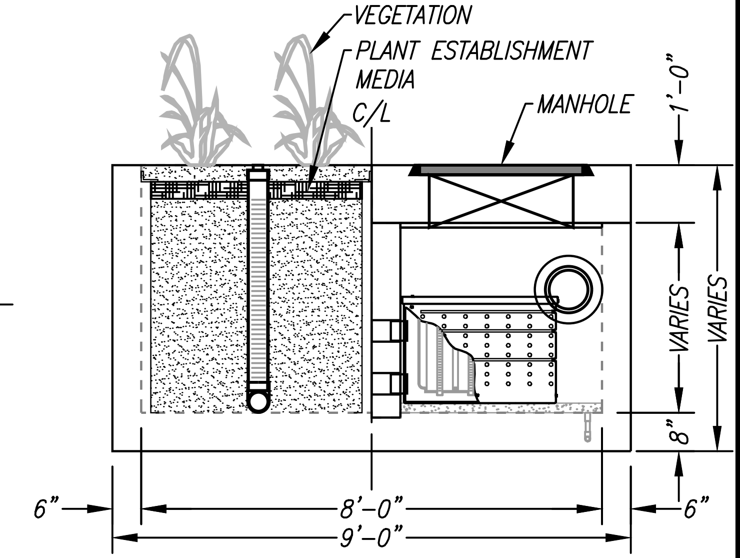
5/23/19TOLFE

| SITE SPECIFIC DATA | | | |
|---|---|---|---|
| PROJECT NUMBER | | | |
| PROJECT NAME | | | |
| PROJECT LOCATION | | | |
| STRUCTURE ID | | | |
| TREATMENT REQUIRED | | | |
| VOLUME BASED (CF) | | FLOW BASED (CFS) | |
| N/A | | 0.693 | |
| PEAK BYPASS REQUIRED (CFS) – IF APPLICABLE | | | OFFLINE |
| PIPE DATA | I.E. | MATERIAL | DIAMETER |
| INLET PIPE 1 | | | |
| INLET PIPE 2 | N/A | N/A | N/A |
| OUTLET PIPE | | | |
| | PRETREATMENT | BIOFILTRATION | DISCHARGE |
| RIM ELEVATION | | | |
| SURFACE LOAD | PEDESTRIAN | | |
| FRAME & COVER | 3EA ø30" | OPEN PLANTER | 2EA ø24" |
| NOTES: | | | |

* PRELIMINARY NOT FOR CONSTRUCTION



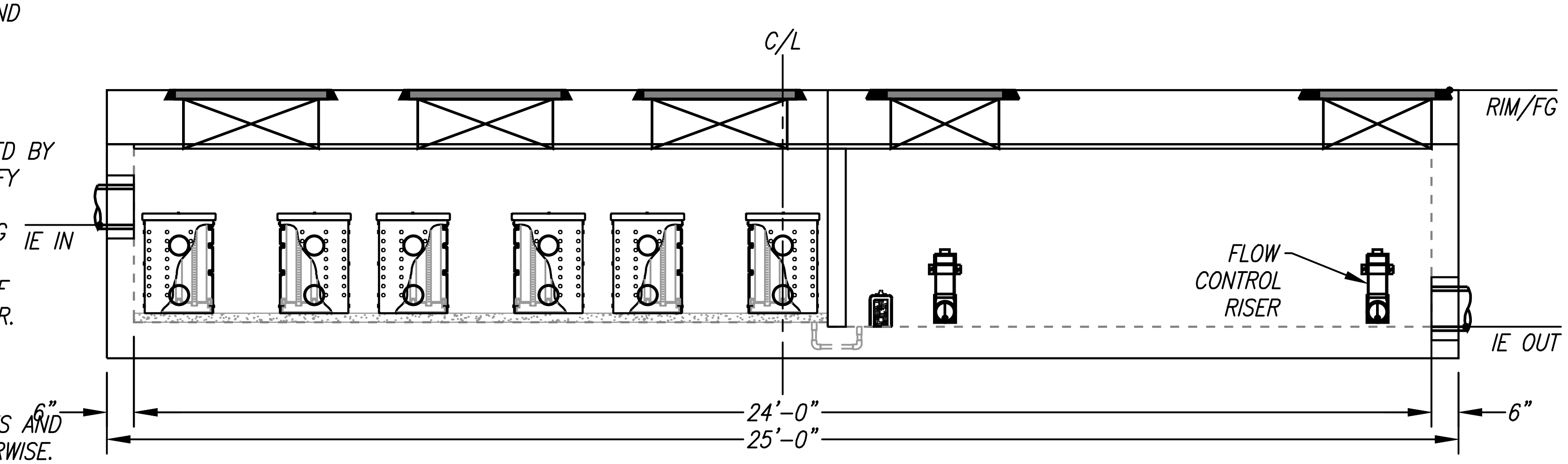

**PLAN VIEW**



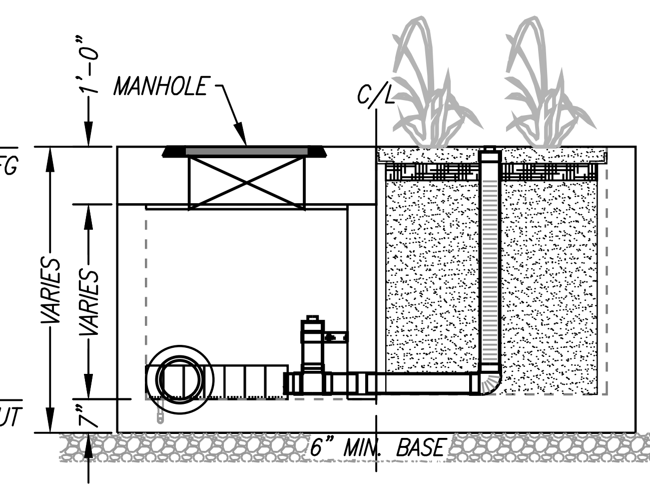

**LEFT END VIEW**

## INSTALLATION NOTES

1. CONTRACTOR TO PROVIDE ALL LABOR, EQUIPMENT, MATERIALS AND INCIDENTALS REQUIRED TO OFFLOAD AND INSTALL THE SYSTEM AND APPURTENANCES IN ACCORDANCE WITH THIS DRAWING AND THE MANUFACTURERS SPECIFICATIONS, UNLESS OTHERWISE STATED IN MANUFACTURERS CONTRACT.
2. UNIT MUST BE INSTALLED ON LEVEL BASE. MANUFACTURER RECOMMENDS A MINIMUM 6" LEVEL ROCK BASE UNLESS SPECIFIED BY THE PROJECT ENGINEER. CONTRACTOR IS RESPONSIBLE TO VERIFY PROJECT ENGINEERS RECOMMENDED BASE SPECIFICATIONS.
4. CONTRACTOR TO SUPPLY AND INSTALL ALL EXTERNAL CONNECTING PIPES. ALL PIPES MUST BE FLUSH WITH INSIDE SURFACE OF CONCRETE. (PIPES CANNOT INTRUDE BEYOND FLUSH). INVERT OF OUTFLOW PIPE MUST BE FLUSH WITH DISCHARGE CHAMBER FLOOR. ALL PIPES SHALL BE SEALED WATER TIGHT PER MANUFACTURERS STANDARD CONNECTION DETAIL.
5. CONTRACTOR RESPONSIBLE FOR INSTALLATION OF ALL RISERS, MANHOLES, AND HATCHES. CONTRACTOR TO GROUT ALL MANHOLES AND HATCHES TO MATCH FINISHED SURFACE UNLESS SPECIFIED OTHERWISE.
6. VEGETATION SUPPLIED AND INSTALLED BY OTHERS. ALL UNITS WITH VEGETATION MUST HAVE DRIP OR SPRAY IRRIGATION SUPPLIED AND INSTALLED BY OTHERS.
7. CONTRACTOR RESPONSIBLE FOR CONTACTING BIO CLEAN FOR ACTIVATION OF UNIT. MANUFACTURERS WARRANTY IS VOID WITH OUT PROPER ACTIVATION BY A BIO CLEAN REPRESENTATIVE.




**ELEVATION VIEW**




**RIGHT END VIEW**

| | |
|---|---|
| TREATMENT FLOW (CFS) | 0.693 |
| OPERATING HEAD (FT) | 3.4 |
| PRETREATMENT LOADING RATE (GPM/SF) | 2.0 |
| WETLAND MEDIA LOADING RATE (GPM/SF) | 1.0 |

## GENERAL NOTES

1. MANUFACTURER TO PROVIDE ALL MATERIALS UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS, ELEVATIONS, SPECIFICATIONS AND CAPACITIES ARE SUBJECT TO CHANGE. FOR PROJECT SPECIFIC DRAWINGS DETAILING EXACT DIMENSIONS, WEIGHTS AND ACCESSORIES PLEASE CONTACT BIO CLEAN.

MODULAR WETLANDS

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Bio Clean
A Forterra Company

MWS-L-8-24-V
STORMWATER BIOFILTRATION SYSTEM
STANDARD DETAIL

5/23/19TOLFE

Bio Clean
A Forterra Company

# Modular Wetlands® Linear

## A Stormwater Biofiltration Solution

# OVERVIEW

The Modular Wetlands® Linear (MWS Linear*) represents a pioneering breakthrough in stormwater technology as the only biofiltration system to utilize patented horizontal flow, allowing for a smaller footprint, higher treatment capacity, and a wide range of versatility. While most biofilters use little or no pretreatment, the Modular Wetlands Linear incorporates an advanced pretreatment chamber that includes separation and pre-filter boxes. In this chamber, sediment and hydrocarbons are removed from runoff before entering the biofiltration chamber, reducing maintenance costs and improving performance.

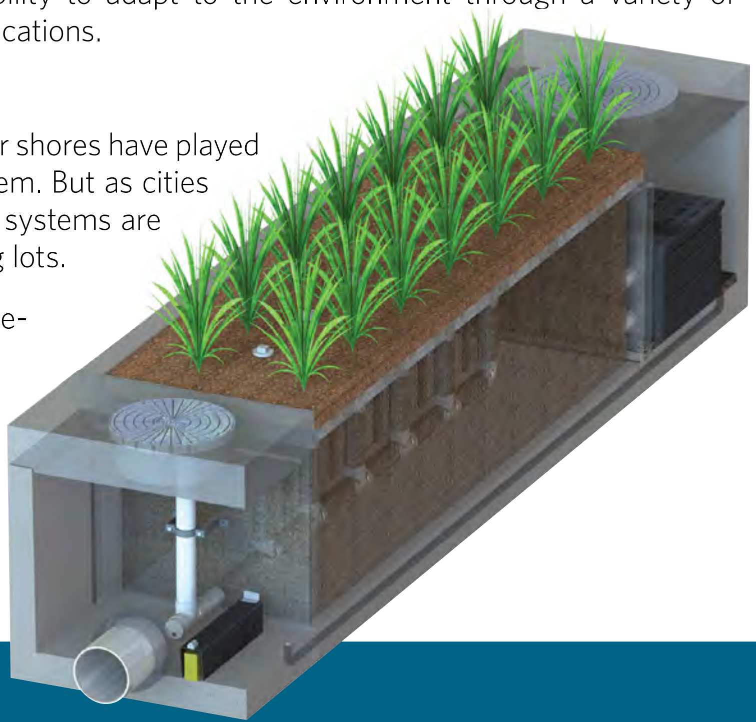
Horizontal flow also gives the system the unique ability to adapt to the environment through a variety of configurations, bypass orientations, and diversion applications.

### The Urban Impact

For hundreds of years, natural wetlands surrounding our shores have played an integral role as nature's stormwater treatment system. But as cities grow and develop, our environment's natural filtration systems are blanketed with impervious roads, rooftops, and parking lots.

Bio Clean understands this loss and has spent years re-establishing nature's presence in urban areas, and rejuvenating waterways with the Modular Wetlands Linear.

*Also known as: Modular Wetlands®, Modular Wetlands® System Linear, Modwet™, or MWS Linear™.



## PERFORMANCE

The Modular Wetlands® Linear continues to outperform other treatment methods with superior pollutant removal for TSS, heavy metals, nutrients, hydrocarbons, and bacteria. Since 2007 the Modular Wetlands Linear has been field tested on numerous sites across the country and is proven to effectively remove pollutants through a combination of physical, chemical, and biological filtration processes. In fact, the Modular Wetlands Linear harnesses some of the same biological processes found in natural wetlands in order to collect, transform, and remove even the most harmful pollutants.

| | | | | |
|---|---|---|---|---|
| 66% REMOVAL OF DISSOLVED ZINC | 69% REMOVAL OF TOTAL ZINC | 38% REMOVAL OF DISSOLVED COPPER | 85% REMOVAL OF TSS | 100% REMOVAL OF TRASH |
| 45% REMOVAL OF NITROGEN | 50% REMOVAL OF TOTAL COPPER | 95% REMOVAL OF MOTOR OIL | 67% REMOVAL OF ORTHO PHOSPHORUS | 64% REMOVAL OF TOTAL PHOSPHORUS |

# APPROVALS

The Modular Wetlands® Linear (MWS Linear) has successfully met years of challenging technical reviews and testing from some of the most prestigious and demanding agencies in the nation and perhaps the world. Here is a list of some of the most high-profile approvals, certifications, and verifications from around the country.

### Washington State Department of Ecology TAPE Approved

The MWS Linear is approved for General Use Level Designation (GULD) for Basic, Enhanced, and Phosphorus treatment at 1 gpm/$ft^2$ loading rate. The highest performing BMP on the market for all main pollutant categories.

### California Water Resources Control Board, Full Capture Certification

The Modular Wetlands® Linear is the first biofiltration system to receive certification as a full capture trash treatment control device.

### Virginia Department of Environmental Quality, Assignment

The Virginia Department of Environmental Quality assigned the MWS Linear the highest phosphorus removal rating for manufactured treatment devices to meet the new Virginia Stormwater Management Program (VSMP) regulation technical criteria.

### Maryland Department of the Environment, Approved ESD

Granted Environmental Site Design (ESD) status for new construction, redevelopment, and retrofitting when designed in accordance with the design manual.

### MASTEP Evaluation

The University of Massachusetts at Amherst – Water Resources Research Center issued a technical evaluation report noting removal rates up to 84% TSS, 70% total phosphorus, 68.5% total zinc, and more.

### Rhode Island Department of Environmental Management, Approved BMP

Approved as an authorized BMP and noted to achieve the following minimum removal efficiencies: 85% TSS, 60% pathogens, 30% total phosphorus, and 30% total nitrogen.

## ADVANTAGES

- HORIZONTAL FLOW BIOFILTRATION
- GREATER FILTER SURFACE AREA
- PRETREATMENT CHAMBER
- PATENTED PERIMETER VOID AREA
- FLOW CONTROL
- NO DEPRESSED PLANTER AREA
- AUTO DRAINDOWN MEANS NO MOSQUITO VECTOR

# OPERATION

The Modular Wetlands® Linear is the most efficient and versatile biofiltration system on the market, and it is the only system with horizontal flow which:

- Improves performance
- Reduces footprint
- Minimizes maintenance

Figure 1 & Figure 2 illustrate the invaluable benefits of horizontal flow and the multiple treatment stages.

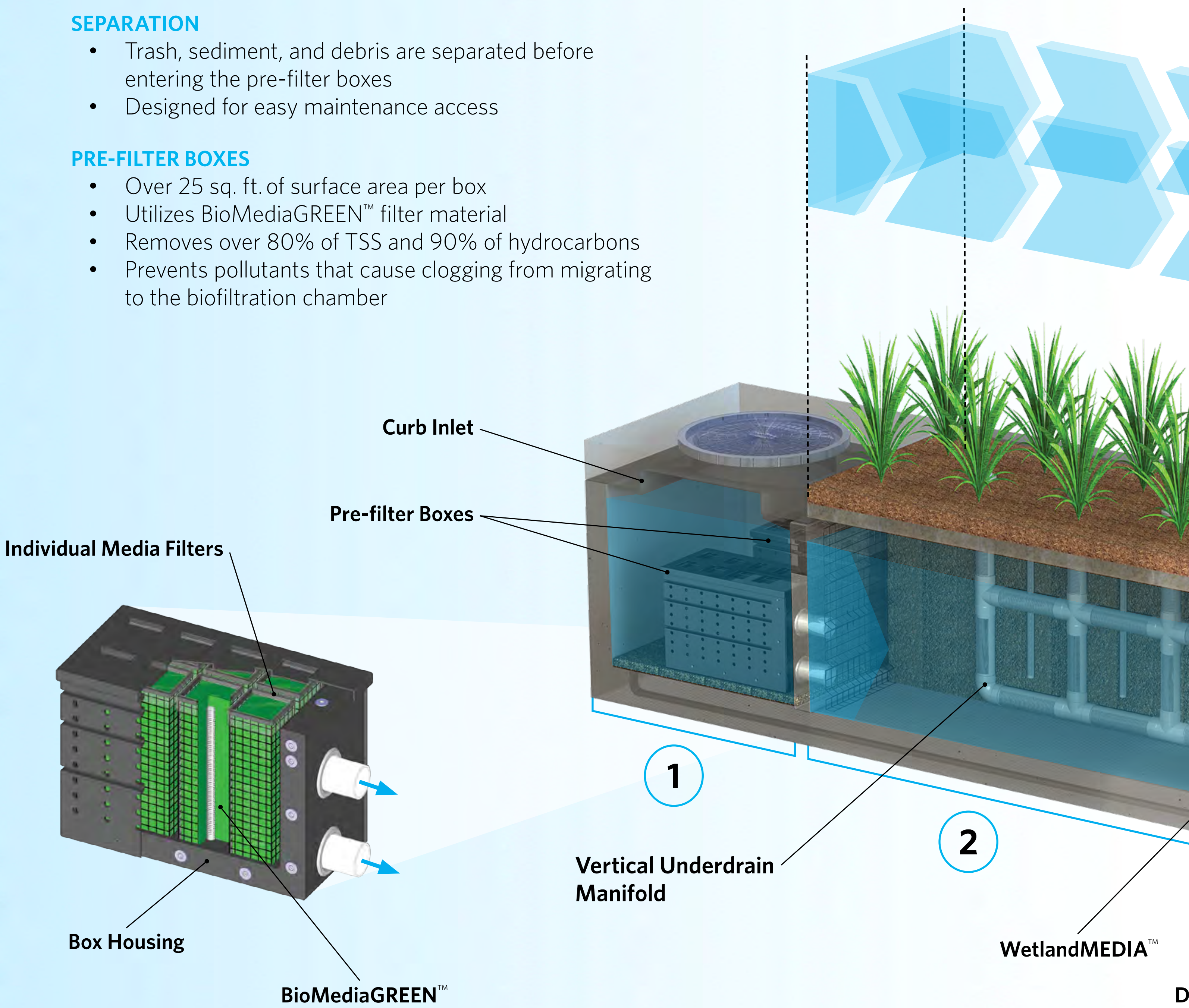
## 1 PRETREATMENT

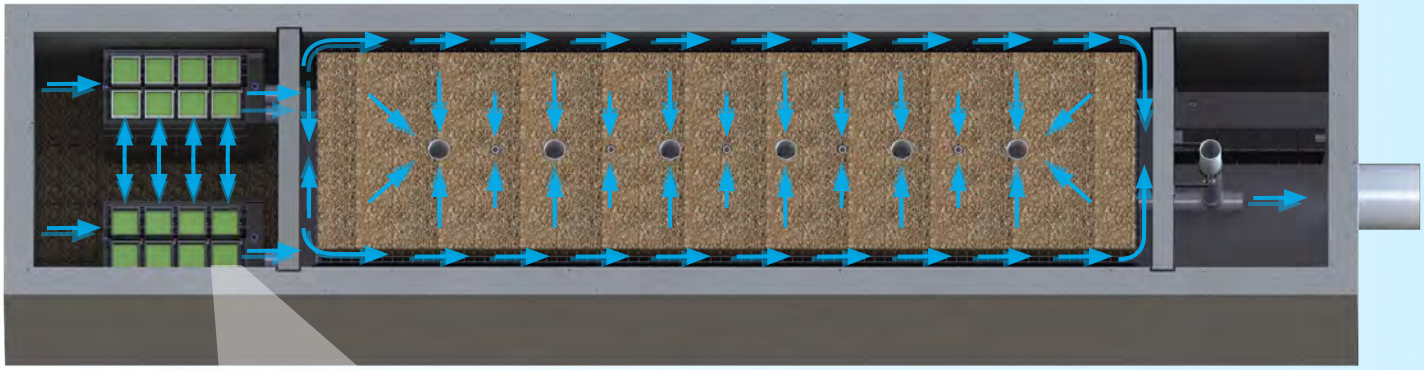
### SEPARATION

- Trash, sediment, and debris are separated before entering the pre-filter boxes
- Designed for easy maintenance access

### PRE-FILTER BOXES

- Over 25 sq. ft. of surface area per box
- Utilizes BioMediaGREEN™ filter material
- Removes over 80% of TSS and 90% of hydrocarbons
- Prevents pollutants that cause clogging from migrating to the biofiltration chamber





2x to 3x more surface area than traditional downward flow bioretention systems.

**Figure 2, Top View**

## 2 BIOFILTRATION

### HORIZONTAL FLOW

- Less clogging than downward flow biofilters
- Water flow is subsurface
- Improves biological filtration

### PATENTED PERIMETER VOID AREA

- Vertically extends void area between the walls and the WetlandMEDIA™ on all four sides
- Maximizes surface area of the media for higher treatment capacity

### WETLANDMEDIA

- Contains no organics and removes phosphorus
- Greater surface area and 48% void space
- Maximum evapotranspiration
- High ion exchange capacity and lightweight

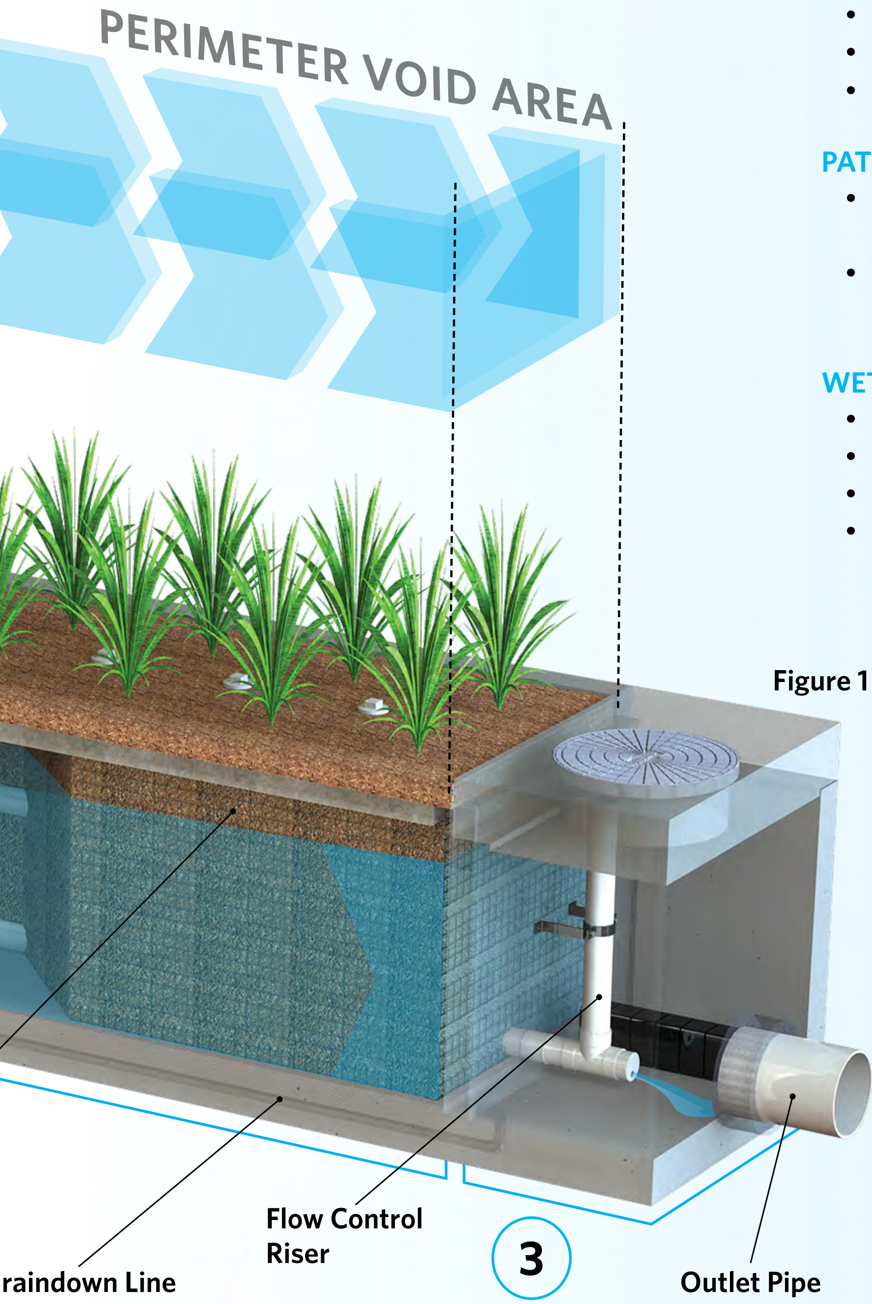



**Figure 1**

## 3 DISCHARGE

### FLOW CONTROL

- Orifice plate controls flow of water through WetlandMEDIA™ to a level lower than the media's capacity
- Extends the life of the media and improves performance

### DRAINDOWN FILTER

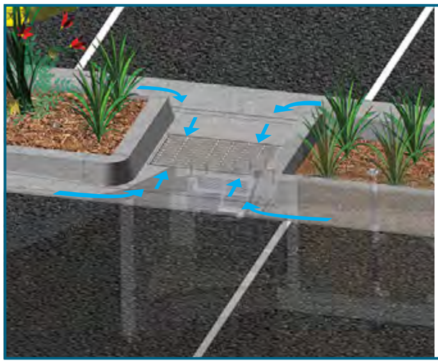
- The draindown is an optional feature that completely drains the pretreatment chamber
- Water that drains from the pretreatment chamber between storm events will be treated

# CONFIGURATIONS

The Modular Wetlands® Linear is the preferred biofiltration system of civil engineers across the country due to its versatile design. This highly versatile system has available "pipe-in" options on most models, along with built-in curb or grated inlets for simple integration into your storm drain design.

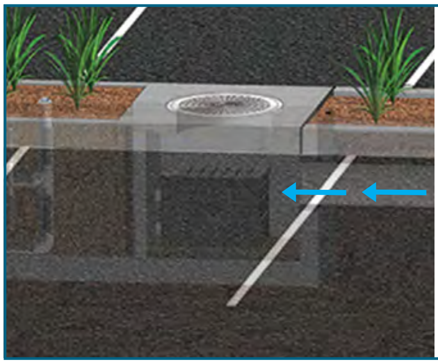
## CURB TYPE

The Curb Type configuration accepts sheet flow through a curb opening and is commonly used along roadways and parking lots. It can be used in sump or flow-by conditions. Length of curb opening varies based on model and size.



## GRATE TYPE

The Grate Type configuration offers the same features and benefits as the Curb Type but with a grated/drop inlet above the systems pretreatment chamber. It has the added benefit of allowing pedestrian access over the inlet. ADA-compliant grates are available to assure easy and safe access. The Grate Type can also be used in scenarios where runoff needs to be intercepted on both sides of landscape islands.



## VAULT TYPE

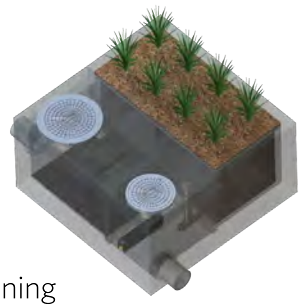
The system's patented horizontal flow biofilter is able to accept inflow pipes directly into the pretreatment chamber, meaning the Modular Wetlands® can be used in end-of-the-line installations. This greatly improves feasibility over typical decentralized designs that are required with other biofiltration/ bioretention systems. Another benefit of the "pipe-in" design is the ability to install the system downstream of underground detention systems to meet water quality volume requirements.

## DOWNSPOUT TYPE

The Downspout Type is a variation of the Vault Type and is designed to accept a vertical downspout pipe from rooftop and podium areas. Some models have the option of utilizing an internal bypass, simplifying the overall design. The system can be installed as a raised planter, and the exterior can be stuccoed or covered with other finishes to match the look of adjacent buildings.

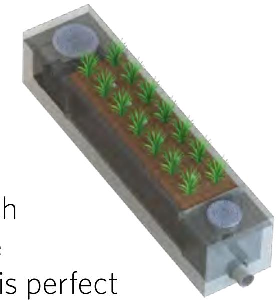
# ORIENTATIONS

## SIDE-BY-SIDE



The Side-By-Side orientation places the pretreatment and discharge chamber adjacent to one another with the biofiltration chamber running parallel on either side. This minimizes the system length, providing a highly compact footprint. It has been proven useful in situations such as streets with directly adjacent sidewalks, as half of the system can be placed under that sidewalk. This orientation also offers internal bypass options as discussed below.

## END-TO-END



The End-To-End orientation places the pretreatment and discharge chambers on opposite ends of the biofiltration chamber, therefore minimizing the width of the system to 5 ft. (outside dimension). This orientation is perfect for linear projects and street retrofits where existing utilities and sidewalks limit the amount of space available for installation. One limitation of this orientation is that bypass must be external.

# BYPASS

## INTERNAL BYPASS WEIR (SIDE-BY-SIDE ONLY)

The Side-By-Side orientation places the pretreatment and discharge chambers adjacent to one another allowing for integration of internal bypass. The wall between these chambers can act as a bypass weir when flows exceed the system's treatment capacity, thus allowing bypass from the pretreatment chamber directly to the discharge chamber.

## EXTERNAL DIVERSION WEIR STRUCTURE

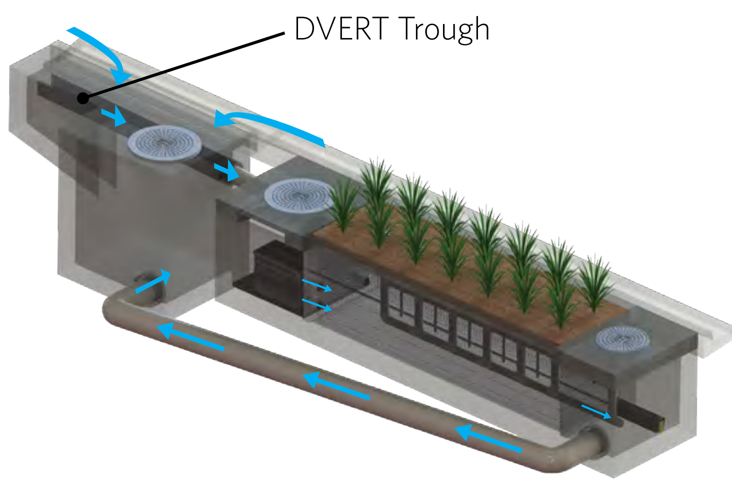
This traditional offline diversion method can be used with the Modular Wetlands® Linear in scenarios where runoff is being piped to the system. These simple and effective structures are generally configured with two outflow pipes. The first is a smaller pipe on the upstream side of the diversion weir - to divert low flows over to the MWS Linear for treatment. The second is the main pipe that receives water once the system has exceeded treatment capacity and water flows over the weir.

## FLOW-BY-DESIGN

This method is one in which the system is placed just upstream of a standard curb or grate inlet to intercept the first flush. Higher flows simply pass by the MWS Linear and into the standard inlet downstream.

## DVERT LOW FLOW DIVERSION

This simple yet innovative diversion trough can be installed in existing or new curb and grate inlets to divert the first flush to the Modular Wetlands® Linear via pipe. It works similar to a rain gutter and is installed just below the opening into the inlet. It captures the low flows and channels them over to a connecting pipe exiting out the wall of the inlet and leading to the MWS Linear. The DVERT is perfect for retrofit and green street applications that allow the system to be installed anywhere space is available.



# SPECIFICATIONS

## FLOW-BASED DESIGNS

The Modular Wetlands® System Linear can be used in stand-alone applications to meet treatment flow requirements, and since it is the only biofiltration system that can accept inflow pipes several feet below the surface, it can be used not only in decentralized design applications but also as a large central end-of-the-line application for maximum feasibility.

| MODEL # | DIMENSIONS | WETLANDMEDIA SURFACE AREA (sq. ft.) | TREATMENT FLOW RATE (cfs) |
|---|---|---|---|
| MWS-L-4-4 | 4′ x 4′ | 23 | 0.052 |
| MWS-L-4-6 | 4′ x 6′ | 32 | 0.073 |
| MWS-L-4-8 | 4′ x 8′ | 50 | 0.115 |
| MWS-L-4-13 | 4′ x 13′ | 63 | 0.144 |
| MWS-L-4-15 | 4′ x 15′ | 76 | 0.175 |
| MWS-L-4-17 | 4′ x 17′ | 90 | 0.206 |
| MWS-L-4-19 | 4′ x 19′ | 103 | 0.237 |
| MWS-L-4-21 | 4′ x 21′ | 117 | 0.268 |
| MWS-L-6-8 | 7′ x 9′ | 64 | 0.147 |
| MWS-L-8-8 | 8′ x 8′ | 100 | 0.230 |
| MWS-L-8-12 | 8′ x 12′ | 151 | 0.346 |
| MWS-L-8-16 | 8′ x 16′ | 201 | 0.462 |
| MWS-L-8-20 | 9′ x 21′ | 252 | 0.577 |
| MWS-L-8-24 | 9′ x 25′ | 302 | 0.693 |
| MWS-L-10-20 | 10' x 20' | 302 | 0.693 |

# VOLUME-BASED DESIGNS

## HORIZONTAL FLOW BIOFILTRATION ADVANTAGE


### MODULAR WETLANDS® SYSTEM LINEAR WITH URBANPOND™ PRESTORAGE

In the example above, the Modular Wetlands® System Linear is installed downstream of the UrbanPond storage system. The MWS Linear is designed for the water quality volume and will treat and discharge the required volume within local draindown time requirements. The MWS Linear's unique horizontal flow design, gives it benefits no other biofilter has - the ability to be placed downstream of detention ponds, extended dry detention basins, underground storage systems and permeable paver reservoirs. The system's horizontal flow configuration and built-in orifice control allows it to be installed with just 6" of fall between inlet and outlet pipe for a simple connection to projects with shallow downstream tie-in points.

UrbanPond
Single and Double Modules

### DESIGN SUPPORT

Bio Clean engineers are trained to provide you with superior support for all volume sizing configurations throughout the country. Our vast knowledge of state and local regulations allow us to quickly and efficiently size a system to maximize feasibility. Volume control and hydromodification regulations are expanding the need to decrease the cost and size of your biofiltration system. Bio Clean will help you realize these cost savings with the MWS Linear, the only biofilter than can be used downstream of storage BMPs.

## ADVANTAGES

- LOWER COST THAN FLOW-BASED DESIGN
- MEETS LID REQUIREMENTS
- BUILT-IN ORIFICE CONTROL STRUCTURE
- WORKS WITH DEEP INSTALLATIONS

# APPLICATIONS

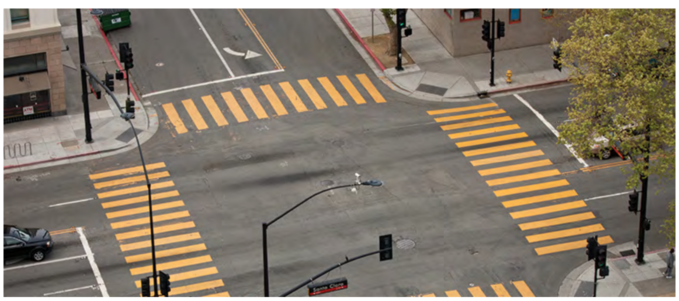
The Modular Wetlands® System Linear has been successfully used on numerous new construction and retrofit projects. The system's superior versatility makes it beneficial for a wide range of stormwater and waste water applications - treating rooftops, streetscapes, parking lots, and industrial sites.

### INDUSTRIAL

Many states enforce strict regulations for discharges from industrial sites. The Modular Wetlands® has helped various sites meet difficult EPA-mandated effluent limits for dissolved metals and other pollutants.

### RESIDENTIAL

Low to high density developments can benefit from the versatile design of the Modular Wetlands®. The system can be used in both decentralized LID design and cost-effective end-of-the-line configurations.

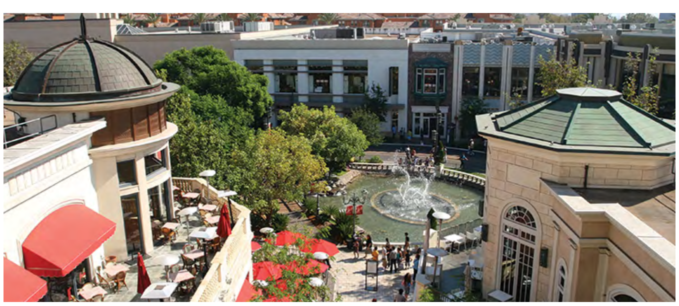


### STREETS

Street applications can be challenging due to limited space. The Modular Wetlands® is very adaptable, and it offers the smallest footprint to work around the constraints of existing utilities on retrofit projects.

### PARKING LOTS

Parking lots are designed to maximize space and the Modular Wetlands'® 4 ft. standard planter width allows for easy integration into parking lot islands and other landscape medians.



### COMMERCIAL

Compared to bioretention systems, the Modular Wetlands® can treat far more area in less space, meeting treatment and volume control requirements.

### MIXED USE

The Modular Wetlands® can be installed as a raised planter to treat runoff from rooftops or patios, making it perfect for sustainable "live-work" spaces.

**More applications include:**

• Agriculture • Reuse • Low Impact Development • Waste Water

# PLANT SELECTION

Abundant plants, trees, and grasses bring value and an aesthetic benefit to any urban setting, but those in the Modular Wetlands® System Linear do even more - they increase pollutant removal. What's not seen, but very important, is that below grade, the stormwater runoff/flow is being subjected to nature's secret weapon: a dynamic physical, chemical, and biological process working to break down and remove non-point source pollutants. The flow rate is controlled in the Modular Wetlands®, giving the plants more contact time so that pollutants are more successfully decomposed, volatilized, and incorporated into the biomass of the Modular Wetlands'® micro/macro flora and fauna.

A wide range of plants are suitable for use in the Modular Wetlands®, but selections vary by location and climate. View suitable plants by visiting biocleanenvironmental.com/plants.

# INSTALLATION

The Modular Wetlands® is simple, easy to install, and has a space-efficient design that offers lower excavation and installation costs compared to traditional tree-box type systems. The structure of the system resembles precast catch basin or utility vaults and is installed in a similar fashion.

The system is delivered fully assembled for quick installation. Generally, the structure can be unloaded and set in place in 15 minutes. Our experienced team of field technicians is available to supervise installations and provide technical support.

# MAINTENANCE

Reduce your maintenance costs, man hours, and materials with the Modular Wetlands®. Unlike other biofiltration systems that provide no pretreatment, the Modular Wetlands® is a self-contained treatment train which incorporates simple and effective pretreatment.

Maintenance requirements for the biofilter itself are almost completely eliminated, as the pretreatment chamber removes and isolates trash, sediments, and hydrocarbons. What's left is the simple maintenance of an easily accessible pretreatment chamber that can be cleaned by hand or with a standard vac truck. Only periodic replacement of low-cost media in the pre-filter cartridges is required for long-term operation, and there is absolutely no need to replace expensive biofiltration media.


Bio Clean
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biocleanenvironmental.com


11192020v2

# STORMTECH MC-3500 CHAMBER

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots, thus maximizing land usage for private (commercial) and public applications. StormTech chambers can also be used in conjunction with Green Infrastructure, thus enhancing the performance and extending the service life of these practices.

## STORMTECH MC-3500 CHAMBER
(not to scale)

**Nominal Chamber Specifications**

**Size (L x W x H)**
90" x 77" x 45"
2,286 mm x 1,956 mm x 1,143 mm

**Chamber Storage**
109.9 $ft^3$ (3.11 $m^3$)

**Min. Installed Storage***
175.0 $ft^3$ (4.96 $m^3$)

**Weight**
134 lbs (60.8 kg)

**Shipping**
15 chambers/pallet
7 end caps/pallet
7 pallets/truck

*Assumes a minimum of 12" (300 mm) of stone above, 9" (230 mm) of stone below chambers, 6" (150 mm) of stone between chambers/end caps and 40% stone porosity.

## STORMTECH MC-3500 END CAP
(not to scale)

**Nominal End Cap Specifications**

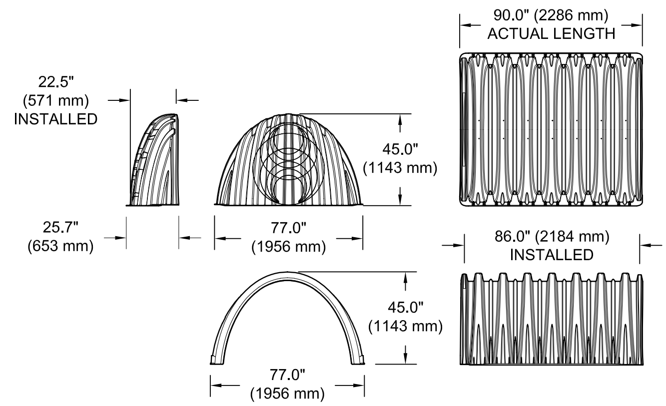
**Size (L x W x H)**
26.5" x 71" x 45.1"
673 mm x 1,803 mm x 1,145 mm

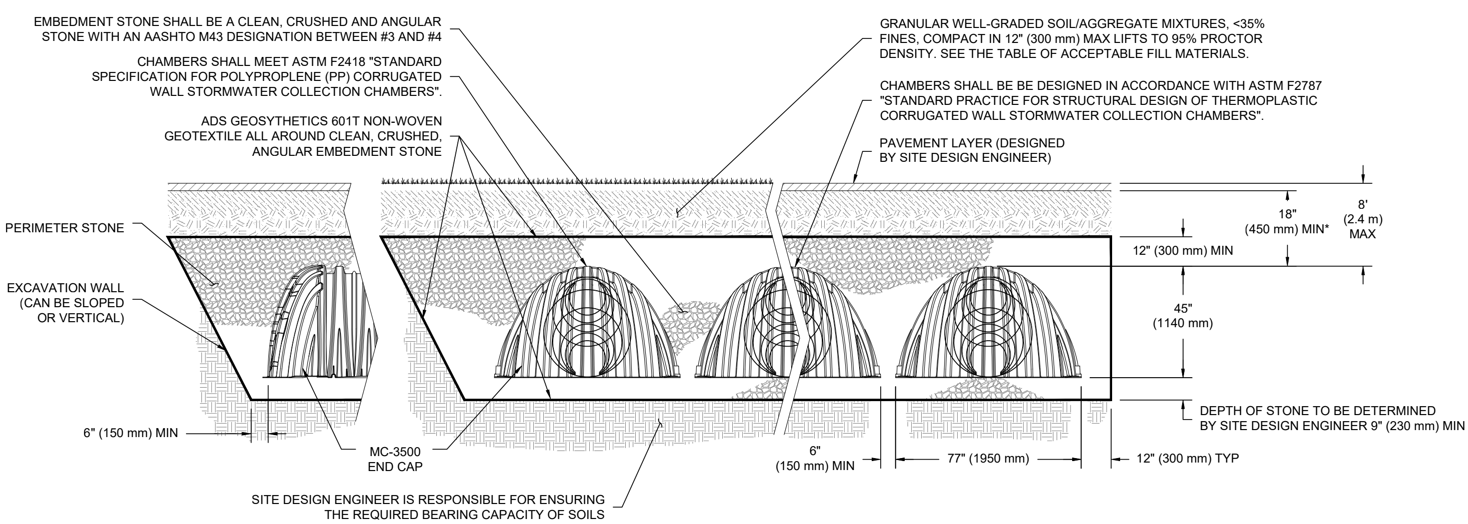
**End Cap Storage**
14.9 $ft^3$ (0.42 $m^3$)

**Min. Installed Storage***
45.1 $ft^3$ (1.28 $m^3$)

**Weight**
49 lbs (22.2 kg)

*Assumes a minimum of 12" (300 mm) of stone above, 9" (230 mm) of stone below, 6" (150 mm) of stone perimeter, 6" (150 mm) of stone between chambers/end caps and 40% stone porosity.




*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 24" (600 mm).

StormTech®

ADS®

# MC-3500 CHAMBER SPECIFICATION

## STORAGE VOLUME PER CHAMBER FT³ (M³)

| | Bare Chamber Storage ft³ (m³) | Chamber and Stone Foundation Depth in. (mm) | | | |
|---|---|---|---|---|---|
| | | 9” (230 mm) | 12” (300 mm) | 15” (375 mm) | 18” (450 mm) |
| MC-3500 Chamber | 109.9 (3.11) | 175.0 (4.96) | 179.9 (5.09) | 184.9 (5.24) | 189.9 (5.38) |
| MC-3500 End Cap | 14.9 (.42) | 45.1 (1.28) | 46.6 (1.32) | 48.3 (1.37) | 49.9 (1.41) |

**Note:** Assumes 6” (150 mm) row spacing, 40% stone porosity, 12” (300 mm) stone above and includes the bare chamber/end cap volume.

## AMOUNT OF STONE PER CHAMBER

| ENGLISH TONS (yds³) | Stone Foundation Depth | | | |
|---|---|---|---|---|
| | 9” | 12” | 15” | 18” |
| MC-3500 Chamber | 8.5 (6.0) | 9.1 (6.5) | 9.7 (6.9) | 10.4 (7.4) |
| MC-3500 End Cap | 3.9 (2.8) | 4.1 (2.9) | 4.3 (3.1) | 4.5 (3.2) |
| METRIC KILOGRAMS (m³) | 230 mm | 300 mm | 375 mm | 450 mm |
| MC-3500 Chamber | 7711 (4.6) | 8255 (5.0) | 8800 (5.3) | 9435 (5.7) |
| MC-3500 End Cap | 3538 (2.1) | 3719 (2.2) | 3901 (2.4) | 4082 (2.5) |

**Note:** Assumes 12” (300 mm) of stone above and 6” (150 mm) row spacing and 6” (150 mm) of perimeter stone in front of end caps.

## VOLUME EXCAVATION PER CHAMBER YD³ (M³)

| | Stone Foundation Depth | | | |
|---|---|---|---|---|
| | 9” (230 mm) | 12” (300 mm) | 15” (375mm) | 18” (450 mm) |
| MC-3500 Chamber | 11.9 (9.1) | 12.4 (9.5) | 12.8(9.8) | 13.3 (10.2) |
| MC-3500 End Cap | 4.0 (3.1) | 4.1 (3.2) | 4.3 (3.3) | 4.4 (3.4) |

**Note:** Assumes 6” (150 mm) of separation between chamber rows and 24” (600 mm) of cover. The volume of excavation will vary as depth of cover increases.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**Visit us at www.stormtech.com**
**and utilize the StormTech Design Tool**

**For more information on the StormTech MC-3500 Chamber and other ADS products, please contact our Customer Service Representatives at 1-800-821-6710**



**Advanced Drainage Systems, Inc.**
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

Basin 1 - Stage/Storage/Outflow Table

W.O.# 20-0181 Redlands East

Basin Information: UG Chambers

| | |
|---|---|
| Tributary Area: | 12.6 AC |
| DCV= | - |
| Bottom Chamber Elevation: | 1431.00 |
| Bottom Stone Elevation: | 1430.25 |

$Q_{ORIFICE} = Cd*Area*(2*G*H)^{0.5}$

$Q_{WEIR} = C*L*H^{3/2}$

PUMP
Q=5.0 CFS

| # | Elevation (ft) | Depth (ft) | Storage (cf) | Storage (ac-ft) | Total Q (cfs) | Comments |
|---|---|---|---|---|---|---|
| 1 | 1431 | 0 | 0.00 | 0.000 | 5.00 | Bottom of Chamber |
| 2 | 1431.5 | 0.5 | 8035.72 | 0.184 | 5.00 | |
| 3 | 1432 | 1 | 12442.03 | 0.286 | 5.00 | |
| 4 | 1432.5 | 1.5 | 16727.93 | 0.384 | 5.00 | |
| 5 | 1433 | 2 | 20850.27 | 0.479 | 5.00 | |
| 6 | 1433.5 | 2.5 | 24749.60 | 0.568 | 5.00 | |
| 7 | 1434 | 3 | 28332.78 | 0.650 | 5.00 | |
| 8 | 1434.5 | 3.5 | 31347.54 | 0.720 | 5.00 | |
| 9 | 1435 | 4 | 33762.87 | 0.775 | 5.00 | |
| 10 | 1435.5 | 4.5 | 36121.87 | 0.829 | 5.00 | |
| 11 | 1436 | 5 | 38480.87 | 0.883 | 5.00 | Top of Storage |

**Project:** **Redlands East Industrial**

| | | |
|---|---|---|
| Chamber Model - | MC-3500 | |
| Units - | **Imperial** | Click Here for Metric |
| Number of Chambers - | 171 | |
| Number of End Caps - | 8 | |
| Voids in the stone (porosity) - | 40 | % |
| Base of STONE Elevation - | 1430.25 | ft |
| Amount of Stone Above Chambers - | 15 | in |
| Amount of Stone Below Chambers - | 9 | in |
| Area of system - | 11795 | sf Min. Area - 8917 sf min. area |

☑ Include Perimeter Stone in Calculations

| Height of System *(inches)* | Incremental Single Chamber *(cubic feet)* | Incremental Single End Cap *(cubic feet)* | Incremental Chambers *(cubic feet)* | Incremental End Cap *(cubic feet)* | Incremental Stone *(cubic feet)* | Incremental Ch, EC and Stone *(cubic feet)* | Cumulative System (cubic feet) | Elevation (feet) |
|---|---|---|---|---|---|---|---|---|
| 69 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 38480.87 | 1436.00 |
| 68 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 38087.70 | 1435.92 |
| 67 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 37694.54 | 1435.83 |
| 66 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 37301.37 | 1435.75 |
| 65 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 36908.20 | 1435.67 |
| 64 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 36515.04 | 1435.58 |
| 63 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 36121.87 | 1435.50 |
| 62 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 35728.70 | 1435.42 |
| 61 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 35335.54 | 1435.33 |
| 60 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 34942.37 | 1435.25 |
| 59 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 34549.20 | 1435.17 |
| 58 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 34156.04 | 1435.08 |
| 57 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 33762.87 | 1435.00 |
| 56 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 33369.70 | 1434.92 |
| 55 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 32976.54 | 1434.83 |
| 54 | 0.06 | 0.00 | 9.93 | 0.00 | 389.19 | 399.13 | 32583.37 | 1434.75 |
| 53 | 0.19 | 0.02 | 33.19 | 0.19 | 379.81 | 413.20 | 32184.24 | 1434.67 |
| 52 | 0.29 | 0.04 | 50.27 | 0.30 | 372.94 | 423.51 | 31771.05 | 1434.58 |
| 51 | 0.40 | 0.05 | 69.02 | 0.41 | 365.39 | 434.83 | 31347.54 | 1434.50 |
| 50 | 0.69 | 0.07 | 117.51 | 0.54 | 345.95 | 464.00 | 30912.71 | 1434.42 |
| 49 | 1.03 | 0.09 | 175.84 | 0.71 | 322.55 | 499.09 | 30448.72 | 1434.33 |
| 48 | 1.25 | 0.11 | 213.67 | 0.86 | 307.36 | 521.88 | 29949.62 | 1434.25 |
| 47 | 1.42 | 0.13 | 243.20 | 1.01 | 295.48 | 539.69 | 29427.74 | 1434.17 |
| 46 | 1.57 | 0.14 | 269.01 | 1.16 | 285.10 | 555.26 | 28888.05 | 1434.08 |
| 45 | 1.71 | 0.16 | 291.92 | 1.30 | 275.88 | 569.10 | 28332.78 | 1434.00 |
| 44 | 1.83 | 0.18 | 312.67 | 1.45 | 267.52 | 581.64 | 27763.68 | 1433.92 |
| 43 | 1.94 | 0.20 | 331.36 | 1.60 | 259.98 | 592.94 | 27182.04 | 1433.83 |
| 42 | 2.04 | 0.22 | 348.98 | 1.75 | 252.88 | 603.60 | 26589.09 | 1433.75 |
| 41 | 2.13 | 0.23 | 365.03 | 1.88 | 246.40 | 613.31 | 25985.49 | 1433.67 |
| 40 | 2.22 | 0.25 | 380.34 | 2.00 | 240.23 | 622.57 | 25372.18 | 1433.58 |
| 39 | 2.31 | 0.27 | 394.46 | 2.12 | 234.53 | 631.12 | 24749.60 | 1433.50 |
| 38 | 2.38 | 0.28 | 407.80 | 2.24 | 229.15 | 639.19 | 24118.48 | 1433.42 |
| 37 | 2.46 | 0.29 | 420.51 | 2.35 | 224.02 | 646.88 | 23479.30 | 1433.33 |
| 36 | 2.53 | 0.31 | 432.32 | 2.46 | 219.25 | 654.03 | 22832.42 | 1433.25 |
| 35 | 2.59 | 0.32 | 443.53 | 2.57 | 214.73 | 660.83 | 22178.38 | 1433.17 |
| 34 | 2.66 | 0.33 | 454.19 | 2.68 | 210.42 | 667.28 | 21517.55 | 1433.08 |
| 33 | 2.72 | 0.35 | 464.28 | 2.78 | 206.34 | 673.40 | 20850.27 | 1433.00 |
| 32 | 2.77 | 0.36 | 473.89 | 2.88 | 202.46 | 679.23 | 20176.87 | 1432.92 |
| 31 | 2.82 | 0.37 | 483.02 | 2.98 | 198.77 | 684.76 | 19497.64 | 1432.83 |
| 30 | 2.88 | 0.38 | 491.70 | 3.07 | 195.26 | 690.03 | 18812.88 | 1432.75 |
| 29 | 2.92 | 0.40 | 500.03 | 3.17 | 191.89 | 695.08 | 18122.84 | 1432.67 |
| 28 | 2.97 | 0.41 | 507.85 | 3.26 | 188.72 | 699.83 | 17427.76 | 1432.58 |
| 27 | 3.01 | 0.42 | 515.13 | 3.35 | 185.78 | 704.25 | 16727.93 | 1432.50 |
| 26 | 3.05 | 0.43 | 522.11 | 3.44 | 182.95 | 708.49 | 16023.67 | 1432.42 |
| 25 | 3.09 | 0.44 | 529.12 | 3.52 | 180.11 | 712.75 | 15315.18 | 1432.33 |
| 24 | 3.13 | 0.45 | 535.33 | 3.61 | 177.59 | 716.53 | 14602.43 | 1432.25 |
| 23 | 3.17 | 0.46 | 541.33 | 3.69 | 175.16 | 720.18 | 13885.90 | 1432.17 |
| 22 | 3.20 | 0.47 | 547.11 | 3.77 | 172.82 | 723.69 | 13165.72 | 1432.08 |
| 21 | 3.23 | 0.48 | 552.52 | 3.84 | 170.62 | 726.98 | 12442.03 | 1432.00 |
| 20 | 3.26 | 0.49 | 557.70 | 3.91 | 168.52 | 730.14 | 11715.05 | 1431.92 |
| 19 | 3.29 | 0.50 | 562.63 | 3.98 | 166.52 | 733.14 | 10984.92 | 1431.83 |
| 18 | 3.32 | 0.51 | 567.37 | 4.05 | 164.60 | 736.02 | 10251.78 | 1431.75 |
| 17 | 3.34 | 0.51 | 571.85 | 4.12 | 162.78 | 738.74 | 9515.76 | 1431.67 |
| 16 | 3.37 | 0.52 | 576.03 | 4.18 | 161.08 | 741.29 | 8777.01 | 1431.58 |
| 15 | 3.39 | 0.53 | 580.12 | 4.24 | 159.42 | 743.78 | 8035.72 | 1431.50 |
| 14 | 3.41 | 0.54 | 583.89 | 4.29 | 157.90 | 746.07 | 7291.94 | 1431.42 |
| 13 | 3.44 | 0.54 | 587.73 | 4.35 | 156.34 | 748.41 | 6545.87 | 1431.33 |
| 12 | 3.46 | 0.55 | 591.27 | 4.40 | 154.90 | 750.57 | 5797.46 | 1431.25 |
| 11 | 3.48 | 0.56 | 594.86 | 4.44 | 153.45 | 752.75 | 5046.89 | 1431.17 |
| 10 | 3.51 | 0.59 | 599.37 | 4.76 | 151.51 | 755.64 | 4294.14 | 1431.08 |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 3538.50 | 1431.00 |
| 8 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 3145.33 | 1430.92 |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 2752.17 | 1430.83 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 2359.00 | 1430.75 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 1965.83 | 1430.67 |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 1572.67 | 1430.58 |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 1179.50 | 1430.50 |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 786.33 | 1430.42 |
| 1 | 0.00 | 0.00 | 0.00 | 0.00 | 393.17 | 393.17 | 393.17 | 1430.33 |

| PROJECT INFORMATION | |
|---|---|
| ENGINEERED PRODUCT MANAGER | |
| ADS SALES REP | |
| PROJECT NO. | |

ADS
Advanced Drainage Systems, Inc.

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# REDLANDS EAST PRELIM

PERRIS, CA

## MC-3500 STORMTECH CHAMBER SPECIFICATIONS

1. CHAMBERS SHALL BE STORMTECH MC-3500.
2. CHAMBERS SHALL BE ARCH-SHAPED AND SHALL BE MANUFACTURED FROM VIRGIN, IMPACT-MODIFIED POLYPROPYLENE COPOLYMERS.
3. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-16a, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
4. CHAMBER ROWS SHALL PROVIDE CONTINUOUS, UNOBSTRUCTED INTERNAL SPACE WITH NO INTERNAL SUPPORTS THAT WOULD IMPEDE FLOW OR LIMIT ACCESS FOR INSPECTION.
5. 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.
6. CHAMBERS SHALL BE DESIGNED, TESTED AND ALLOWABLE LOAD CONFIGURATIONS DETERMINED IN ACCORDANCE WITH ASTM F2787, "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS". LOAD CONFIGURATIONS SHALL INCLUDE: 1) INSTANTANEOUS (<1 MIN) AASHTO DESIGN TRUCK LIVE LOAD ON MINIMUM COVER 2) MAXIMUM PERMANENT (75-YR) COVER LOAD AND 3) ALLOWABLE COVER WITH PARKED (1-WEEK) AASHTO DESIGN TRUCK.
7. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 500 LBS/IN/IN. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.
8. ONLY CHAMBERS THAT ARE APPROVED BY THE SITE DESIGN ENGINEER WILL BE ALLOWED. UPON REQUEST BY THE SITE DESIGN ENGINEER OR OWNER, THE CHAMBER MANUFACTURER SHALL SUBMIT A STRUCTURAL EVALUATION FOR APPROVAL BEFORE DELIVERING CHAMBERS TO THE PROJECT SITE AS FOLLOWS:
   - THE STRUCTURAL EVALUATION SHALL BE SEALED BY A REGISTERED PROFESSIONAL ENGINEER.
   - THE STRUCTURAL EVALUATION SHALL DEMONSTRATE 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 SECTIONS 3 AND 12.12 OF THE AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS FOR THERMOPLASTIC PIPE.
   - THE TEST DERIVED CREEP MODULUS AS SPECIFIED IN ASTM F2418 SHALL BE USED FOR PERMANENT DEAD LOAD DESIGN EXCEPT THAT IT SHALL BE THE 75-YEAR MODULUS USED FOR DESIGN.
9. 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 - 6" (150 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 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. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE SITE DESIGN ENGINEER.
11. 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 CONSTRUCTION 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.**

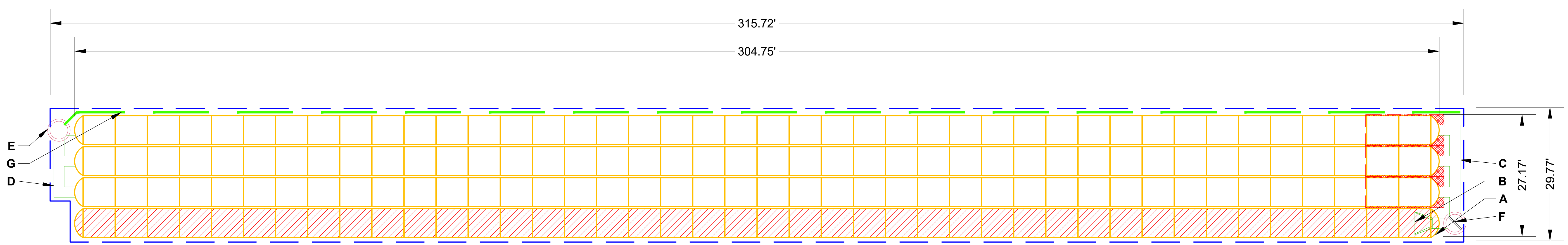
CONTACT STORMTECH AT 1-888-892-2694 WITH ANY QUESTIONS ON INSTALLATION REQUIREMENTS OR WEIGHT LIMITS FOR CONSTRUCTION EQUIPMENT.

| PROPOSED LAYOUT | |
|---|---|
| 168 | STORMTECH MC-3500 CHAMBERS |
| 8 | STORMTECH MC-3500 END CAPS |
| 24 | STONE ABOVE (in) |
| 9 | STONE BELOW (in) |
| 40 | STONE VOID |
| 35483 | INSTALLED SYSTEM VOLUME (CF)<br>(PERIMETER STONE INCLUDED)<br>(COVER STONE INCLUDED)<br>(BASE STONE INCLUDED) |
| 9357 | SYSTEM AREA (SF) |
| 691.0 | SYSTEM PERIMETER (ft) |

| PROPOSED ELEVATIONS | |
|---|---|
| MAXIMUM ALLOWABLE GRADE (TOP OF PAVEMENT/UNPAVED): | 1442.75 |
| TOP OF STONE: | 1436.75 |
| MINIMUM ALLOWABLE GRADE (UNPAVED WITH TRAFFIC): | 1436.75 |
| MINIMUM ALLOWABLE GRADE (UNPAVED NO TRAFFIC): | 1436.25 |
| MINIMUM ALLOWABLE GRADE (TOP OF RIGID CONCRETE PAVEMENT): | 1436.25 |
| MINIMUM ALLOWABLE GRADE (BASE OF FLEXIBLE PAVEMENT): | 1436.25 |
| TOP OF MC-3500 CHAMBER: | 1434.75 |
| 24" x 24" BOTTOM MANIFOLD INVERT: | 1431.17 |
| 24" x 24" BOTTOM MANIFOLD INVERT: | 1431.17 |
| 24" ISOLATOR ROW PLUS INVERT: | 1431.17 |
| 24" BOTTOM CONNECTION INVERT: | 1431.17 |
| BOTTOM OF MC-3500 CHAMBER: | 1431.00 |
| UNDERDRAIN INVERT: | 1430.25 |
| BOTTOM OF STONE: | 1430.25 |

*INVERT ABOVE BASE OF CHAMBER

| PART TYPE | ITEM ON LAYOUT | DESCRIPTION | INVERT* | MAX FLOW |
|---|---|---|---|---|
| PREFABRICATED END CAP | A | 24" BOTTOM CORED END CAP, PART#: MC3500IEPP24BC / TYP OF ALL 24" BOTTOM CONNECTIONS AND ISOLATOR PLUS ROWS | 2.06" | |
| FLAMP | B | INSTALL FLAMP ON 24" ACCESS PIPE / PART#: MC350024RAMP | | |
| MANIFOLD | C | 24" x 24" BOTTOM MANIFOLD, ADS N-12 | 2.06" | |
| MANIFOLD | D | 24" x 24" BOTTOM MANIFOLD, ADS N-12 | 2.06" | |
| CONCRETE STRUCTURE | E | OCS (DESIGN BY ENGINEER / PROVIDED BY OTHERS) | | 14.0 CFS OUT |
| CONCRETE STRUCTURE W/WEIR | F | (DESIGN BY ENGINEER / PROVIDED BY OTHERS) | | 25.5 CFS IN |
| UNDERDRAIN | G | 6" ADS N-12 DUAL WALL PERFORATED HDPE UNDERDRAIN | | |




ISOLATOR ROW PLUS (SEE DETAIL)

PLACE MINIMUM 17.50' OF ADSPLUS175 WOVEN GEOTEXTILE OVER BEDDING STONE AND UNDERNEATH CHAMBER FEET FOR SCOUR PROTECTION AT ALL CHAMBER INLET ROWS

BED LIMITS

## NOTES

- MANIFOLD SIZE TO BE DETERMINED BY SITE DESIGN ENGINEER. SEE TECH NOTE #6.32 FOR MANIFOLD SIZING GUIDANCE.
- DUE TO THE ADAPTATION OF THIS CHAMBER SYSTEM TO SPECIFIC SITE AND DESIGN CONSTRAINTS, IT MAY BE NECESSARY TO CUT AND COUPLE ADDITIONAL PIPE TO STANDARD MANIFOLD COMPONENTS IN THE FIELD.
- THE SITE DESIGN ENGINEER MUST REVIEW ELEVATIONS AND IF NECESSARY ADJUST GRADING TO ENSURE THE CHAMBER COVER REQUIREMENTS ARE MET.
- THIS CHAMBER SYSTEM WAS DESIGNED WITHOUT SITE-SPECIFIC INFORMATION ON SOIL CONDITIONS OR BEARING CAPACITY. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR DETERMINING THE SUITABILITY OF THE SOIL AND PROVIDING THE BEARING CAPACITY OF THE INSITU SOILS. THE BASE STONE DEPTH MAY BE INCREASED OR DECREASED ONCE THIS INFORMATION IS PROVIDED.
- **NOT FOR CONSTRUCTION:** THIS LAYOUT IS FOR DIMENSIONAL PURPOSES ONLY TO PROVE CONCEPT & THE REQUIRED STORAGE VOLUME CAN BE ACHIEVED ON SITE.

REDLANDS EAST PRELIM
PERRIS, CA

DRAWN: AS
CHECKED: N/A
DATE:
PROJECT #:

| REV | DRW | CHK | DESCRIPTION |
|---|---|---|---|

StormTech®
Chamber System
888-892-2694 | WWW.STORMTECH.COM

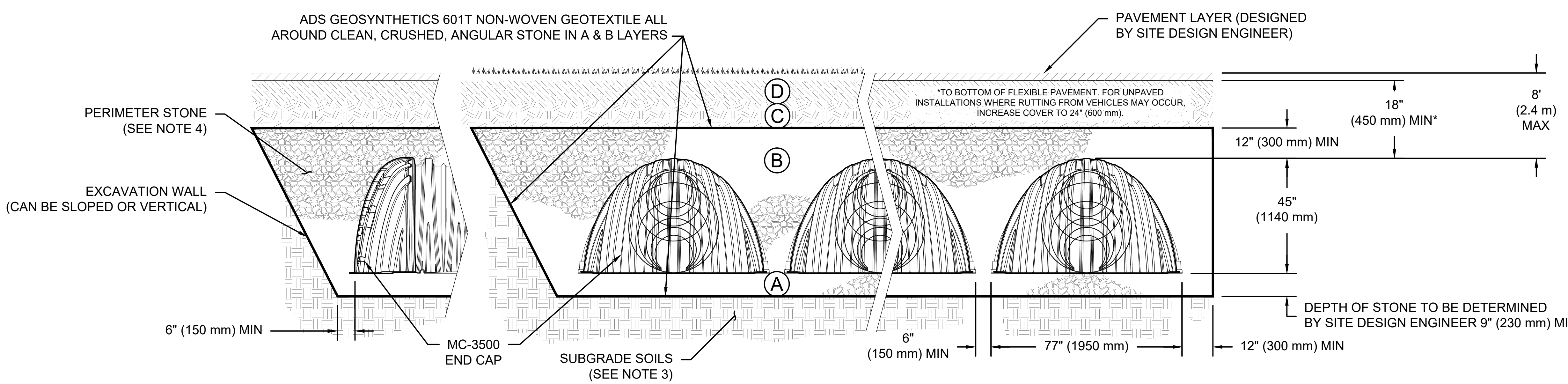
ADS
4640 TRUEMAN BLVD
HILLIARD, OH 43026
1-800-733-7473

0 25' 50'

# 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.<br><br>MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER. | AASHTO M145[1]<br>A-1, A-2-4, A-3<br><br>OR<br><br>AASHTO M43[1]<br>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 | AASHTO M43[1]<br>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 | AASHTO M43[1]<br>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.
4. 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.




## NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-16a, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS" CHAMBER CLASSIFICATION 45x76 DESIGNATION SS.
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. 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.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 3".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 500 LBS/IN/IN. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

REDLANDS EAST PRELIM
PERRIS, CA
DRAWN: AS
CHECKED: N/A
DATE:
PROJECT #:

| REV | DRW | CHK | DESCRIPTION |
|---|---|---|---|
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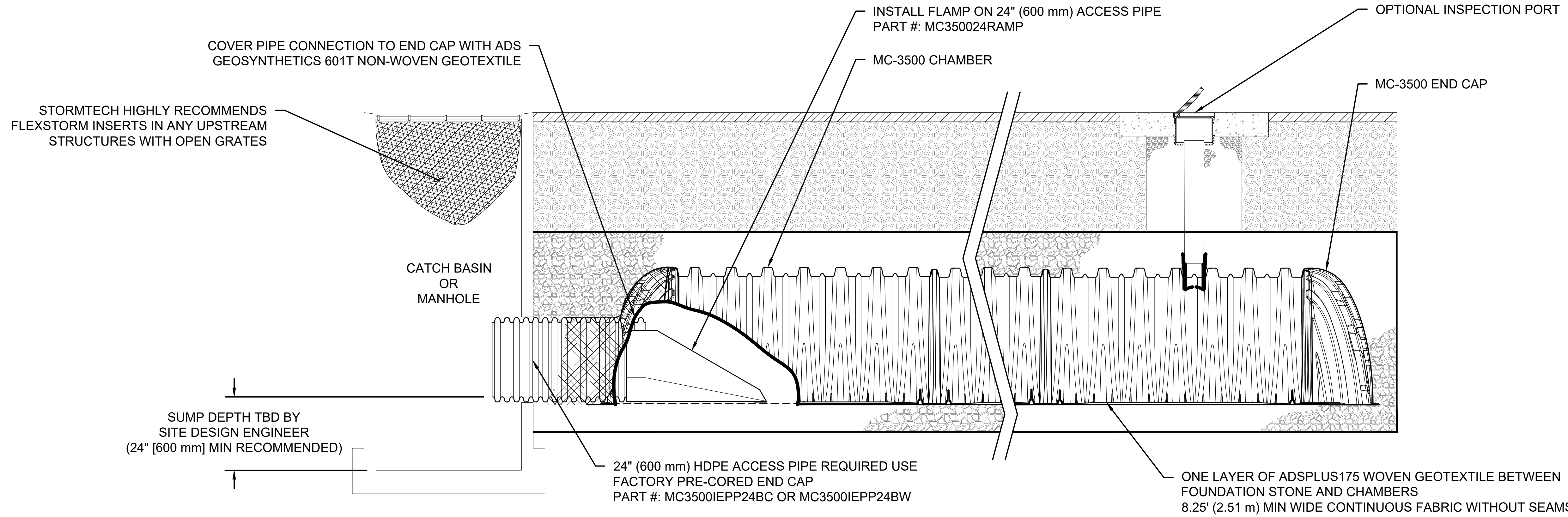


**MC-3500 ISOLATOR ROW PLUS DETAIL**

NTS

## INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS 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 PLUS 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 PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS 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 PLUS 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.

REDLANDS EAST PRELIM
PERRIS, CA

DATE: | DRAWN: AS
PROJECT #: | CHECKED: N/A

| REV | DRW | CHK | DESCRIPTION |
| --- | --- | --- | --- |


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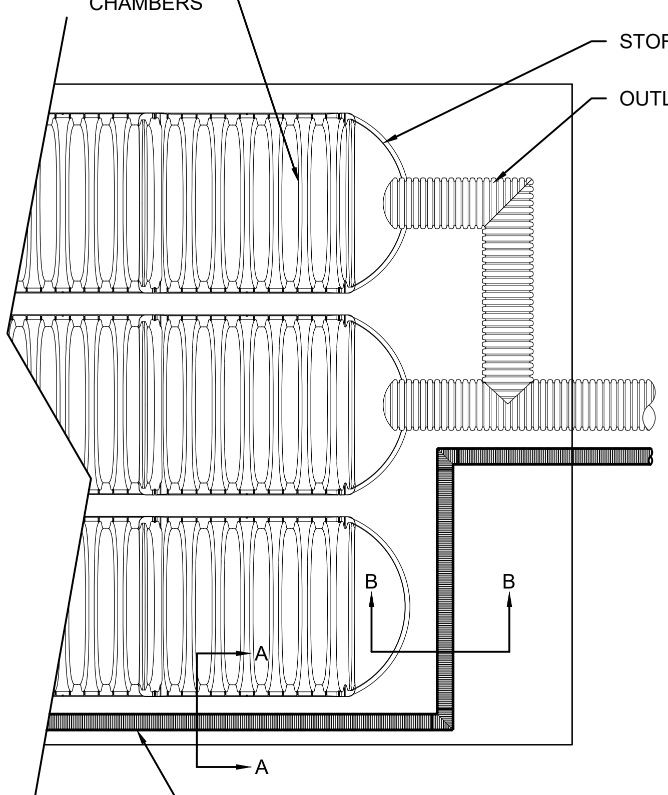
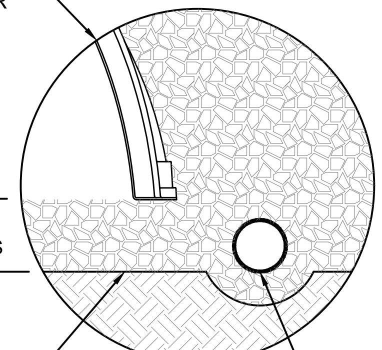
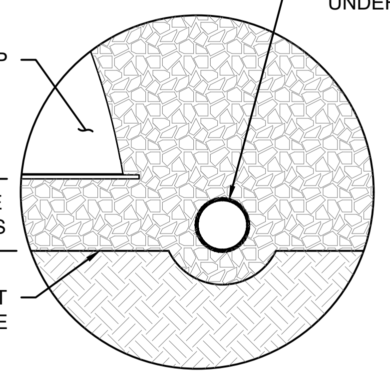
## UNDERDRAIN DETAIL
NTS



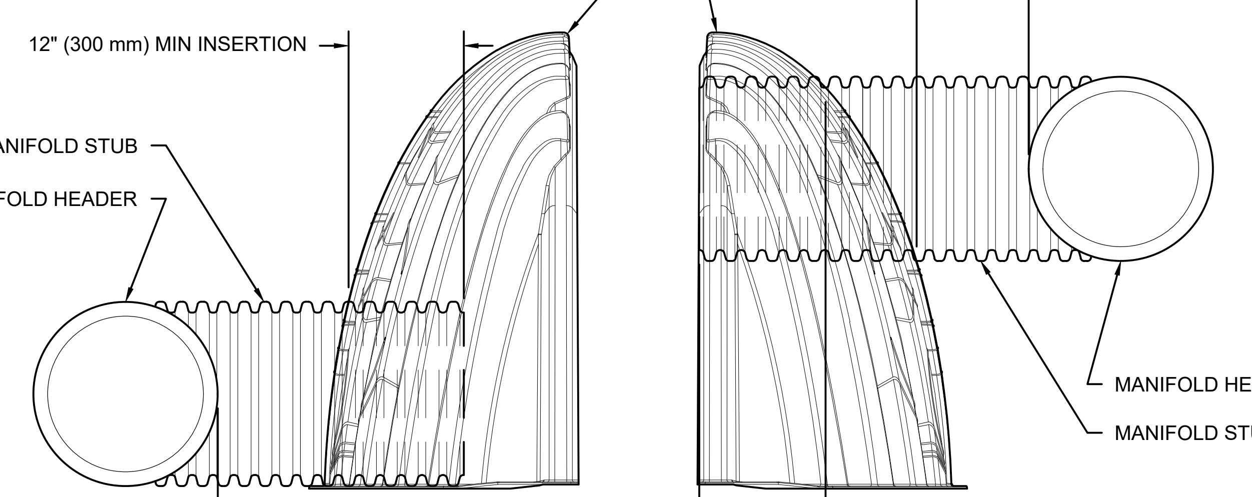

SECTION A-A




SECTION B-B

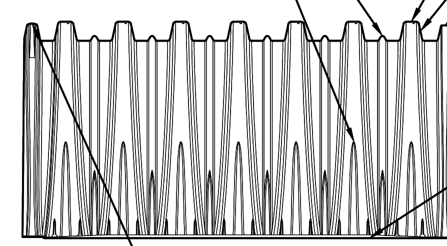
NUMBER AND SIZE OF UNDERDRAINS PER SITE DESIGN ENGINEER
4" (100 mm) TYP FOR SC-310 & SC-160LP SYSTEMS
6" (150 mm) TYP FOR SC-740, DC-780, MC-3500 & MC-4500 SYSTEMS

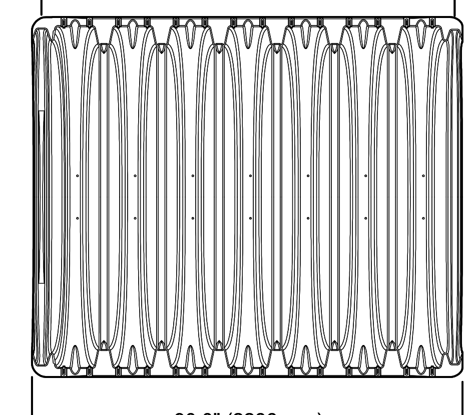
## MC-SERIES END CAP INSERTION DETAIL
NTS

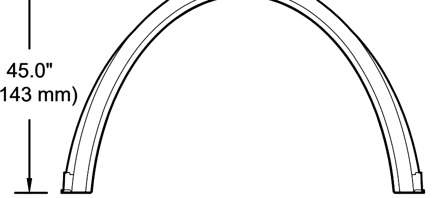


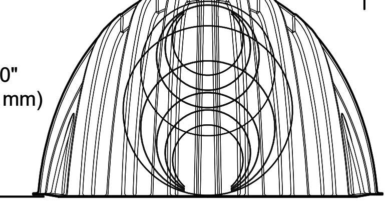

NOTE: MANIFOLD STUB MUST BE LAID HORIZONTAL FOR A PROPER FIT IN END CAP OPENING.

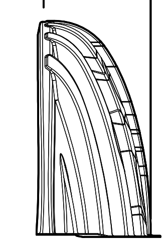
## MC-3500 TECHNICAL SPECIFICATION
NTS




**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* | 175.0 CUBIC FEET | (4.96 m³) |
| WEIGHT | 134 lbs. | (60.8 kg) |

**NOMINAL END CAP SPECIFICATIONS**

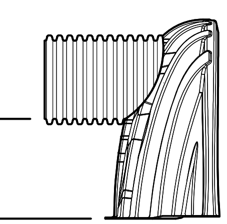
| | | |
|---|---|---|
| SIZE (W X H X INSTALLED LENGTH) | 75.0" X 45.0" X 22.2" | (1905 mm X 1143 mm X 564 mm) |
| END CAP STORAGE | 14.9 CUBIC FEET | (0.42 m³) |
| MINIMUM INSTALLED STORAGE* | 45.1 CUBIC FEET | (1.28 m³) |
| WEIGHT | 49 lbs. | (22.2 kg) |

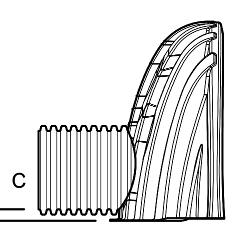
*ASSUMES 12" (305 mm) STONE ABOVE, 9" (229 mm) STONE FOUNDATION, 6" SPACING BETWEEN CHAMBERS, 6" (152 mm) STONE PERIMETER IN FRONT OF END CAPS AND 40% STONE POROSITY

STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"
END CAPS WITH A WELDED CROWN PLATE END WITH "C"
END CAPS WITH A PREFABRICATED WELDED STUB END WITH "W"

| 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) | --- |
| MC3500IEPP18TW | | | |
| MC3500IEPP18BC | | --- | 1.77" (45 mm) |
| MC3500IEPP18BW | | | |
| MC3500IEPP24TC | 24" (600 mm) | 14.48" (368 mm) | --- |
| MC3500IEPP24TW | | | |
| MC3500IEPP24BC | | --- | 2.06" (52 mm) |
| MC3500IEPP24BW | | | |
| MC3500IEPP30BC | 30" (750 mm) | --- | 2.75" (70 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 HIGHEST POSSIBLE FOR THE PIPE SIZE.

REDLANDS EAST PRELIM
PERRIS, CA

DRAWN: AS
CHECKED: N/A
DATE:
PROJECT #:

| REV | DRW | CHK | DESCRIPTION |
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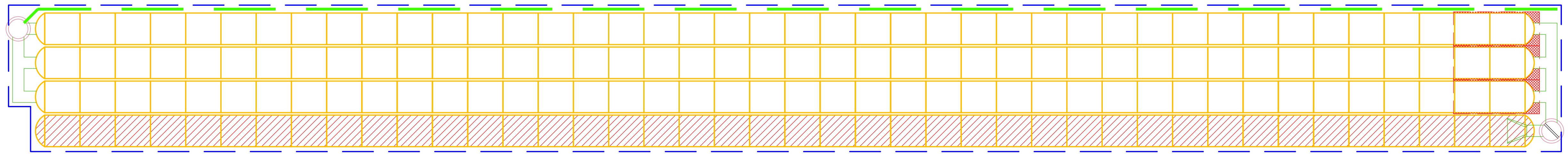
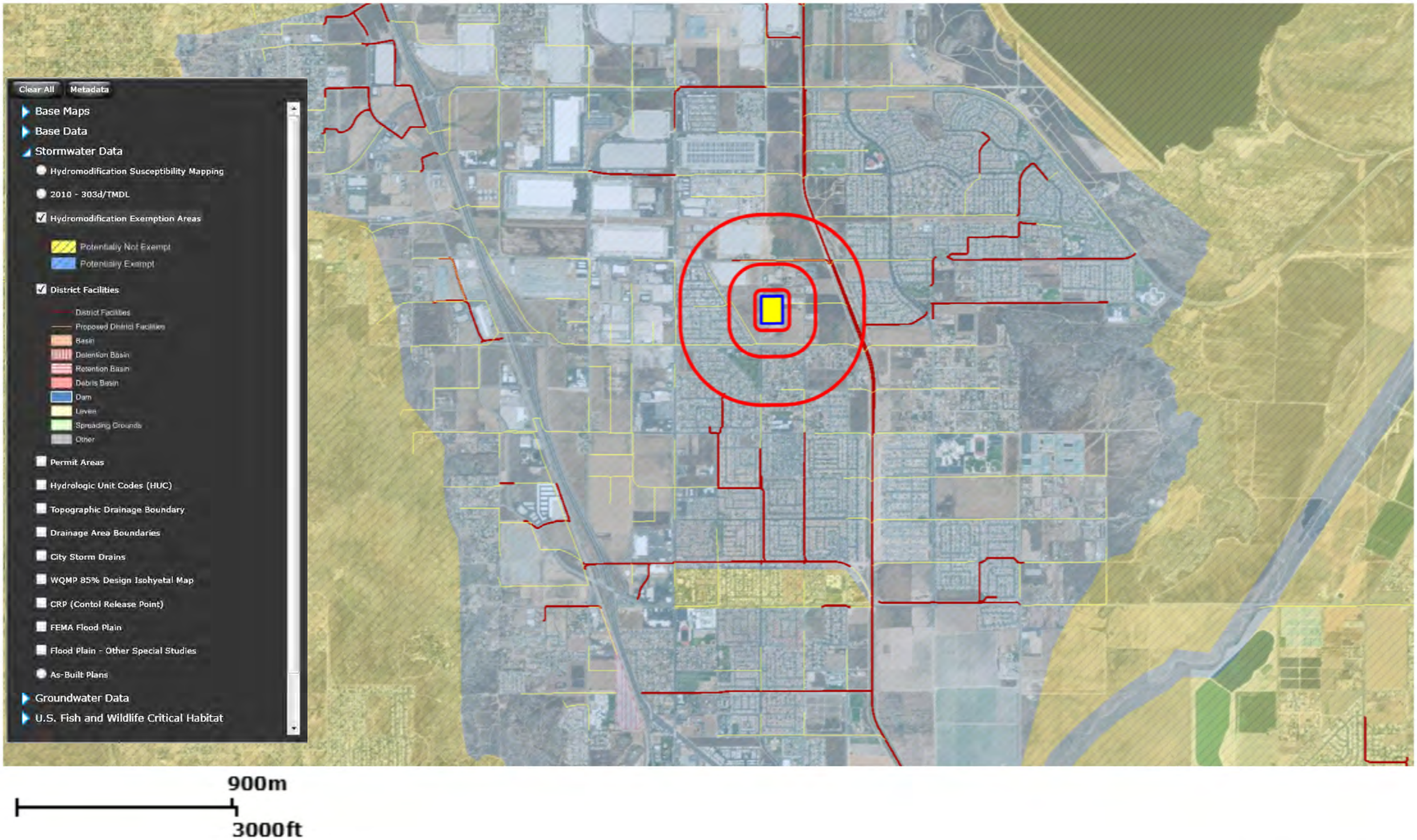


# Appendix 7: Hydromodification

*Supporting Detail Relating to Hydrologic Conditions of Concern*

*The project site drains towards the MDP Line A-B via an extension of the existing lateral Lat A-B-10. The Redlands East Industrial project is allocated 12.5 cfs of flow to discharge into Lat A-B-10. Proposed underground storage chambers are required for the site in order to mitigate the 100-year peak flow rates.*




Riverside County
SWCTT

# Stormwater Map

Site Address: rivco.permitrack.com

**DEVELOPED CONDITION**

| Cover Type | Condition (Poor,Fair,Good) | Soil Type (A,B,C,D) | COVER TYPE | RI | Land Use | % Impervious | Area (SF) | Area (SF) | Impervious Area (SF) |
|---|---|---|---|---|---|---|---|---|---|
| Urban | Good | B | RESIDENTIAL OR COMMERCIAL | 56 | Streets/Conc | 0.9 | 195607 | 4.49 | 176046 |
| Urban | Good | B | RESIDENTIAL OR COMMERCIAL | 56 | Roof | 0.9 | 228213 | 5.24 | 205392 |
| Urban | Good | B | RESIDENTIAL OR COMMERCIAL | 56 | Landscape | 0 | 49462 | 1.14 | 0 |
| Urban | Good | C | RESIDENTIAL OR COMMERCIAL | 69 | Streets/Conc | 0.9 | 37202 | 0.85 | 33482 |
| Urban | Good | C | RESIDENTIAL OR COMMERCIAL | 69 | Roof | 0.9 | 22205 | 0.51 | 19984 |
| Urban | Good | C | RESIDENTIAL OR COMMERCIAL | 69 | Landscape | 0 | 15681 | 0.36 | 0 |
| | | | **AVERAGE WEIGHTED RI VALUE** | **57.8** | | **TOTAL** | 548370 | 12.6 | |
| | | | | | | **TOTAL % IMPERVIOUS** | | **79.3%** | |
| | | | | | | **LOW LOSS RATE** | | **0.266** | |

| DEVELOPED CONDITION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | EAST | | | WEST | | | COMBINED | |
| **RETURN PERIOD** *(yr)* | **EVENT** *(hrs)* | **VOL** *(ac-ft)* | ***PEAK*** *(cfs)* | **EVENT** *(hrs)* | **VOL** *(ac-ft)* | ***PEAK*** *(cfs)* | **VOL** *(ac-ft)* | ***PEAK*** *(cfs)* |
| **100** | 1 | 1.1 | *36.37* | 1 | 1.8 | *50.07* | 2.9 | *86.44* |
| | 3 | 1.6 | *20.47* | 3 | 2.6 | *31.52* | 4.2 | *51.99* |
| | 6 | 2.1 | *17.76* | 6 | 3.3 | *27.41* | 5.4 | *45.17* |
| | 24 | 3.3 | *5.81* | 24 | 5.3 | *9.47* | 8.6 | *15.28* |

*H:\2020\20-0186\Drainage\PWQMP\Appendix 6 - BMP Sizing\[20-0186 Vbmp Calcs.xls]QBMP DMA7*

| | Developed Condition | | Basin Routing Results | | |
|---|---|---|---|---|---|
| **Storm Event** | **Volume (Ac-ft)** | **Peak Flow (cfs)** | **Peak Flow (cfs)** | **Max Basin Depth (feet)** | **Water Surface Elevation (cfs)** |
| **EAST 100-Year, 1-Hour** | 1.1 | 36.4 | 5.0 | 3.98 | 1434.98 |
| **WEST 100-Year, 1-Hour** | 1.8 | 50.1 | 5.0 | 5.38 | 1437.88 |
| **COMBINED 100-Year, 1-Hour** | **2.9** | **86.5** | **10.0** | - | - |
| **EAST 100-Year, 3-Hour** | 1.6 | 20.5 | 5.0 | 3.59 | 1434.59 |
| **WEST 100-Year, 3-Hour** | 2.6 | 31.5 | 11.0 | 6.12 | 1438.62 |
| **COMBINED 100-Year, 3-Hour** | **4.2** | **52.0** | **16.0** | - | - |
| **EAST 100-Year, 6-Hour** | 2.1 | 17.8 | 5.0 | 3.05 | 1434.05 |
| **WEST 100-Year, 6-Hour** | 3.3 | 27.4 | 8.6 | 5.93 | 1438.43 |
| **COMBINED 100-Year, 24-Hour** | **5.4** | **45.2** | **13.6** | - | - |
| **EAST 100-Year, 24-Hour** | 3.3 | 5.8 | 5.0 | 0.55 | 1431.55 |
| **WEST 100-Year, 24-Hour** | 5.3 | 9.5 | 5.0 | 2.30 | 1434.80 |
| **COMBINED 100-Year, 24-Hour** | **8.6** | **15.3** | **10.0** | - | - |

*H:\2020\20-0181\Drainage\PHYD\Hydrology\Unit Hydrograph\[20-0181 East UH Inputs and Stage Storage.xlsx]PUMP REPORT OW*

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

       Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2008, Version 8.1
              Study date  05/12/21 File: PROPEAST1001100.out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------------------------------------------------------------------------

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


Program License Serial Number 4010

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

 English Units used in output format



---------------------------------------------------------------------
REDLANDS EAST - DEVELOPED CONDITION
100-YEAR STORM EVENT
20-0181 EAST INDUSTRIAL PROJECT
05/12/2021   AYS
--------------------------------------------------------------------
Drainage Area =      12.60(Ac.)  =      0.020 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =      12.60(Ac.)  =      0.020 Sq. Mi.
Length along longest watercourse =    1235.00(Ft.)
Length along longest watercourse measured to centroid =     300.00(Ft.)
Length along longest watercourse =      0.234 Mi.
Length along longest watercourse measured to centroid =      0.057 Mi.
Difference in elevation =      15.60(Ft.)
Slope along watercourse =     66.6947 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.031 Hr.
Lag time =     1.88 Min.
25% of lag time =     0.47 Min.
40% of lag time =     0.75 Min.
Unit time =     5.00 Min.
Duration of storm = 1 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
       12.60           0.45                  5.67

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
       12.60           1.20                 15.12

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    0.450(In)
Area Averaged 100-Year Rainfall =    1.200(In)

Point rain (area averaged) =    1.200(In)
Areal adjustment factor =   99.99 %
Adjusted average point rain =    1.200(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
    12.600           57.80         0.793
 Total Area Entered =     12.60(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)     (In/Hr)      (Dec.)    (In/Hr)
```

| | | | | | | |
|---|---|---|---|---|---|---|
| 57.8 | 57.8 | 0.492 | 0.793 | 0.141 | 1.000 | 0.141 |
| | | | | | Sum (F) = | 0.141 |

Area averaged mean soil loss (F) (In/Hr) = 0.141
Minimum soil loss rate ((In/Hr)) = 0.070
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.266

---

Slope of intensity-duration curve for a 1 hour storm =0.5000

---

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 | 265.556 | 52.846 | 6.711 |
| 2 | 0.167 | 531.112 | 39.109 | 4.966 |
| 3 | 0.250 | 796.668 | 6.539 | 0.830 |
| 4 | 0.333 | 1062.223 | 1.506 | 0.191 |
| | | | Sum = 100.000 | Sum= 12.698 |

---

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

| Unit | Time (Hr.) | Pattern Percent | Storm Rain (In/Hr) | Loss rate(In./Hr) Max | Loss rate(In./Hr) Low | Effective (In/Hr) |
|---|---|---|---|---|---|---|
| 1 | 0.08 | 4.20 | 0.605 | 0.141 | ( 0.161) | 0.464 |
| 2 | 0.17 | 4.30 | 0.619 | 0.141 | ( 0.165) | 0.478 |
| 3 | 0.25 | 5.00 | 0.720 | 0.141 | ( 0.191) | 0.579 |
| 4 | 0.33 | 5.00 | 0.720 | 0.141 | ( 0.191) | 0.579 |
| 5 | 0.42 | 5.80 | 0.835 | 0.141 | ( 0.222) | 0.694 |
| 6 | 0.50 | 6.50 | 0.936 | 0.141 | ( 0.249) | 0.795 |
| 7 | 0.58 | 7.40 | 1.065 | 0.141 | ( 0.283) | 0.924 |
| 8 | 0.67 | 8.60 | 1.238 | 0.141 | ( 0.329) | 1.097 |
| 9 | 0.75 | 12.30 | 1.771 | 0.141 | ( 0.471) | 1.630 |
| 10 | 0.83 | 29.10 | 4.190 | 0.141 | ( 1.115) | 4.049 |
| 11 | 0.92 | 6.80 | 0.979 | 0.141 | ( 0.260) | 0.838 |
| 12 | 1.00 | 5.00 | 0.720 | 0.141 | ( 0.191) | 0.579 |
| | | (Loss Rate Not Used) | | | | |
| Sum = | | 100.0 | | | Sum = | 12.7 |

Flood volume = Effective rainfall 1.06(In)
times area 12.6(Ac.)/[(In)/(Ft.)] = 1.1(Ac.Ft)
Total soil loss = 0.14(In)
Total soil loss = 0.148(Ac.Ft)
Total rainfall = 1.20(In)
Flood volume = 48430.9 Cubic Feet
Total soil loss = 6448.4 Cubic Feet

---

Peak flow rate of this hydrograph = 36.373(CFS)

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1 - 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       10.0      20.0      30.0      40.0
-----------------------------------------------------------------------
  0+ 5       0.0214      3.11  V  Q      |         |         |         |
  0+10       0.0594      5.51  | V  Q    |         |         |         |
  0+15       0.1052      6.65  |  V  Q   |         |         |         |
  0+20       0.1551      7.25  |    V Q  |         |         |         |
  0+25       0.2110      8.11  |      VQ |         |         |         |
  0+30       0.2756      9.38  |        Q|         |         |         |
  0+35       0.3503     10.84  |         Q V       |         |         |
  0+40       0.4381     12.75  |         | Q  V    |         |         |
  0+45       0.5574     17.32  |         |      Q  V         |         |
  0+50       0.8079     36.37  |         |         |        V|     Q   |
  0+55       0.9959     27.31  |         |         |      Q  |    V    |
```

```
    1+ 0      1.0767     11.73  |         |Q        |         |       V |
    1+ 5      1.1066      4.35  |   Q     |         |         |        V|
    1+10      1.1111      0.64  Q         |         |         |        V|
    1+15      1.1118      0.11  Q         |         |         |         V
-----------------------------------------------------------------------
```

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

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              Study date  05/12/21 File: PROPEAST1003100.out

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


Program License Serial Number 4010

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

 English Units used in output format



---------------------------------------------------------------------
REDLANDS EAST - DEVELOPED CONDITION
100-YEAR STORM EVENT
20-0181 EAST INDUSTRIAL PROJECT
05/12/2021   AYS
--------------------------------------------------------------------
Drainage Area =      12.60(Ac.)  =      0.020 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =      12.60(Ac.)  =      0.020 Sq. Mi.
Length along longest watercourse =    1235.00(Ft.)
Length along longest watercourse measured to centroid =     300.00(Ft.)
Length along longest watercourse =      0.234 Mi.
Length along longest watercourse measured to centroid =      0.057 Mi.
Difference in elevation =      15.60(Ft.)
Slope along watercourse =     66.6947 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.031 Hr.
Lag time =     1.88 Min.
25% of lag time =     0.47 Min.
40% of lag time =     0.75 Min.
Unit time =     5.00 Min.
Duration of storm = 3 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
       12.60           0.80                 10.08

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
       12.60           1.90                 23.94

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    0.800(In)
Area Averaged 100-Year Rainfall =    1.900(In)

Point rain (area averaged) =    1.900(In)
Areal adjustment factor =   99.99 %
Adjusted average point rain =    1.900(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
    12.600           57.80         0.793
 Total Area Entered =     12.60(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)     (In/Hr)      (Dec.)    (In/Hr)
```

57.8 57.8 0.492 0.793 0.141 1.000 0.141

Sum (F) = 0.141

Area averaged mean soil loss (F) (In/Hr) = 0.141
Minimum soil loss rate ((In/Hr)) = 0.070
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.266

---

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 | 265.556 | 52.846 | 6.711 |
| 2 | 0.167 | 531.112 | 39.109 | 4.966 |
| 3 | 0.250 | 796.668 | 6.539 | 0.830 |
| 4 | 0.333 | 1062.223 | 1.506 | 0.191 |
| | | | Sum = 100.000 | Sum= 12.698 |

---

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 | 1.30 | 0.296 | ( 0.141) | 0.079 | 0.218 |
| 2 | 0.17 | 1.30 | 0.296 | ( 0.141) | 0.079 | 0.218 |
| 3 | 0.25 | 1.10 | 0.251 | ( 0.141) | 0.067 | 0.184 |
| 4 | 0.33 | 1.50 | 0.342 | ( 0.141) | 0.091 | 0.251 |
| 5 | 0.42 | 1.50 | 0.342 | ( 0.141) | 0.091 | 0.251 |
| 6 | 0.50 | 1.80 | 0.410 | ( 0.141) | 0.109 | 0.301 |
| 7 | 0.58 | 1.50 | 0.342 | ( 0.141) | 0.091 | 0.251 |
| 8 | 0.67 | 1.80 | 0.410 | ( 0.141) | 0.109 | 0.301 |
| 9 | 0.75 | 1.80 | 0.410 | ( 0.141) | 0.109 | 0.301 |
| 10 | 0.83 | 1.50 | 0.342 | ( 0.141) | 0.091 | 0.251 |
| 11 | 0.92 | 1.60 | 0.365 | ( 0.141) | 0.097 | 0.268 |
| 12 | 1.00 | 1.80 | 0.410 | ( 0.141) | 0.109 | 0.301 |
| 13 | 1.08 | 2.20 | 0.502 | ( 0.141) | 0.133 | 0.368 |
| 14 | 1.17 | 2.20 | 0.502 | ( 0.141) | 0.133 | 0.368 |
| 15 | 1.25 | 2.20 | 0.502 | ( 0.141) | 0.133 | 0.368 |
| 16 | 1.33 | 2.00 | 0.456 | ( 0.141) | 0.121 | 0.335 |
| 17 | 1.42 | 2.60 | 0.593 | 0.141 | ( 0.158) | 0.452 |
| 18 | 1.50 | 2.70 | 0.616 | 0.141 | ( 0.164) | 0.475 |
| 19 | 1.58 | 2.40 | 0.547 | 0.141 | ( 0.146) | 0.406 |
| 20 | 1.67 | 2.70 | 0.616 | 0.141 | ( 0.164) | 0.475 |
| 21 | 1.75 | 3.30 | 0.752 | 0.141 | ( 0.200) | 0.611 |
| 22 | 1.83 | 3.10 | 0.707 | 0.141 | ( 0.188) | 0.566 |
| 23 | 1.92 | 2.90 | 0.661 | 0.141 | ( 0.176) | 0.520 |
| 24 | 2.00 | 3.00 | 0.684 | 0.141 | ( 0.182) | 0.543 |
| 25 | 2.08 | 3.10 | 0.707 | 0.141 | ( 0.188) | 0.566 |
| 26 | 2.17 | 4.20 | 0.958 | 0.141 | ( 0.255) | 0.817 |
| 27 | 2.25 | 5.00 | 1.140 | 0.141 | ( 0.303) | 0.999 |
| 28 | 2.33 | 3.50 | 0.798 | 0.141 | ( 0.212) | 0.657 |
| 29 | 2.42 | 6.80 | 1.550 | 0.141 | ( 0.412) | 1.409 |
| 30 | 2.50 | 7.30 | 1.664 | 0.141 | ( 0.443) | 1.523 |
| 31 | 2.58 | 8.20 | 1.869 | 0.141 | ( 0.497) | 1.729 |
| 32 | 2.67 | 5.90 | 1.345 | 0.141 | ( 0.358) | 1.204 |
| 33 | 2.75 | 2.00 | 0.456 | ( 0.141) | 0.121 | 0.335 |
| 34 | 2.83 | 1.80 | 0.410 | ( 0.141) | 0.109 | 0.301 |
| 35 | 2.92 | 1.80 | 0.410 | ( 0.141) | 0.109 | 0.301 |
| 36 | 3.00 | 0.60 | 0.137 | ( 0.141) | 0.036 | 0.100 |
| | | (Loss Rate Not Used) | | | | |
| Sum = | | 100.0 | | | Sum = | 18.5 |

Flood volume = Effective rainfall 1.54(In)
times area 12.6(Ac.)/[(In)/(Ft.)] = 1.6(Ac.Ft)
Total soil loss = 0.36(In)
Total soil loss = 0.374(Ac.Ft)
Total rainfall = 1.90(In)
Flood volume = 70602.3 Cubic Feet
Total soil loss = 16295.1 Cubic Feet

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```
      Peak flow rate of this hydrograph =     20.471(CFS)
     ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                    3 - 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         7.5       15.0      22.5      30.0
-----------------------------------------------------------------------
  0+ 5       0.0101      1.46  VQ        |         |         |         |
  0+10       0.0276      2.54  V  Q      |         |         |         |
  0+15       0.0448      2.50  |V Q      |         |         |         |
  0+20       0.0642      2.82  |V Q      |         |         |         |
  0+25       0.0857      3.13  | V Q     |         |         |         |
  0+30       0.1099      3.51  | V Q     |         |         |         |
  0+35       0.1336      3.44  |  VQ     |         |         |         |
  0+40       0.1582      3.57  |  VQ     |         |         |         |
  0+45       0.1843      3.79  |   VQ    |         |         |         |
  0+50       0.2082      3.48  |   QV    |         |         |         |
  0+55       0.2313      3.35  |   QV    |         |         |         |
  1+ 0       0.2562      3.62  |   Q V   |         |         |         |
  1+ 5       0.2854      4.24  |    Q V  |         |         |         |
  1+10       0.3171      4.60  |     QV  |         |         |         |
  1+15       0.3493      4.66  |     Q V |         |         |         |
  1+20       0.3799      4.45  |    Q   V|         |         |         |
  1+25       0.4149      5.07  |     Q   V         |         |         |
  1+30       0.4547      5.78  |      Q  |V        |         |         |
  1+35       0.4927      5.52  |      Q  | V       |         |         |
  1+40       0.5319      5.69  |      Q  |  V      |         |         |
  1+45       0.5793      6.89  |        Q|   V     |         |         |
  1+50       0.6297      7.31  |        Q|    V    |         |         |
  1+55       0.6772      6.90  |        Q|     V   |         |         |
  2+ 0       0.7242      6.82  |        Q|      V  |         |         |
  2+ 5       0.7726      7.04  |        Q|        V|         |         |
  2+10       0.8335      8.84  |         |Q        V         |         |
  2+15       0.9116     11.34  |         |    Q    | V       |         |
  2+20       0.9816     10.16  |         |  Q      |   V     |         |
  2+25       1.0760     13.71  |         |       Q |     V   |         |
  2+30       1.1998     17.97  |         |         |  Q     V|         |
  2+35       1.3408     20.47  |         |         |      Q  |  V      |
  2+40       1.4662     18.21  |         |         |   Q     |     V   |
  2+45       1.5347      9.96  |         |  Q      |         |      V  |
  2+50       1.5693      5.02  |     Q   |         |         |       V |
  2+55       1.5970      4.03  |    Q    |         |         |        V|
  3+ 0       1.6141      2.49  |  Q      |         |         |        V|
  3+ 5       1.6197      0.81  |Q        |         |         |        V|
  3+10       1.6207      0.14  Q         |         |         |        V|
  3+15       1.6208      0.02  Q         |         |         |        V|
-----------------------------------------------------------------------
```

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

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              Study date  05/12/21 File: PROPEAST1006100.out


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


Program License Serial Number 4010

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

 English Units used in output format



---------------------------------------------------------------------
REDLANDS EAST - DEVELOPED CONDITION
100-YEAR STORM EVENT
20-0181 EAST INDUSTRIAL PROJECT
05/12/2021   AYS
--------------------------------------------------------------------
Drainage Area =      12.60(Ac.)  =      0.020 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =      12.60(Ac.)  =      0.020 Sq. Mi.
Length along longest watercourse =    1235.00(Ft.)
Length along longest watercourse measured to centroid =     300.00(Ft.)
Length along longest watercourse =      0.234 Mi.
Length along longest watercourse measured to centroid =      0.057 Mi.
Difference in elevation =      15.60(Ft.)
Slope along watercourse =     66.6947 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.031 Hr.
Lag time =     1.88 Min.
25% of lag time =     0.47 Min.
40% of lag time =     0.75 Min.
Unit time =     5.00 Min.
Duration of storm = 6 Hour(s)
User Entered Base Flow =     0.00(CFS)

2 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
       12.60           1.00                 12.60

100 YEAR Area rainfall data:


Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
       12.60           2.50                 31.50

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    1.000(In)
Area Averaged 100-Year Rainfall =    2.500(In)

Point rain (area averaged) =    2.500(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    2.500(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
    12.600           57.80         0.793
 Total Area Entered =     12.60(Ac.)


RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)     (In/Hr)      (Dec.)    (In/Hr)
```

57.8  57.8      0.492     0.793       0.141      1.000      0.141
Sum (F) =   0.141

Area averaged mean soil loss (F) (In/Hr) =  0.141
Minimum soil loss rate ((In/Hr)) =  0.070
(for 24 hour storm duration)
Soil low loss rate (decimal) =   0.266

---

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 | 265.556 | 52.846 | 6.711 |
| 2 | 0.167 | 531.112 | 39.109 | 4.966 |
| 3 | 0.250 | 796.668 | 6.539 | 0.830 |
| 4 | 0.333 | 1062.223 | 1.506 | 0.191 |
| | | | Sum = 100.000 | Sum= 12.698 |

---

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

| Unit | Time (Hr.) | Pattern Percent | Storm Rain (In/Hr) | Loss rate(In./Hr) Max | Loss rate(In./Hr) Low | Effective (In/Hr) |
|---|---|---|---|---|---|---|
| 1 | 0.08 | 0.50 | 0.150 | ( 0.141) | 0.040 | 0.110 |
| 2 | 0.17 | 0.60 | 0.180 | ( 0.141) | 0.048 | 0.132 |
| 3 | 0.25 | 0.60 | 0.180 | ( 0.141) | 0.048 | 0.132 |
| 4 | 0.33 | 0.60 | 0.180 | ( 0.141) | 0.048 | 0.132 |
| 5 | 0.42 | 0.60 | 0.180 | ( 0.141) | 0.048 | 0.132 |
| 6 | 0.50 | 0.70 | 0.210 | ( 0.141) | 0.056 | 0.154 |
| 7 | 0.58 | 0.70 | 0.210 | ( 0.141) | 0.056 | 0.154 |
| 8 | 0.67 | 0.70 | 0.210 | ( 0.141) | 0.056 | 0.154 |
| 9 | 0.75 | 0.70 | 0.210 | ( 0.141) | 0.056 | 0.154 |
| 10 | 0.83 | 0.70 | 0.210 | ( 0.141) | 0.056 | 0.154 |
| 11 | 0.92 | 0.70 | 0.210 | ( 0.141) | 0.056 | 0.154 |
| 12 | 1.00 | 0.80 | 0.240 | ( 0.141) | 0.064 | 0.176 |
| 13 | 1.08 | 0.80 | 0.240 | ( 0.141) | 0.064 | 0.176 |
| 14 | 1.17 | 0.80 | 0.240 | ( 0.141) | 0.064 | 0.176 |
| 15 | 1.25 | 0.80 | 0.240 | ( 0.141) | 0.064 | 0.176 |
| 16 | 1.33 | 0.80 | 0.240 | ( 0.141) | 0.064 | 0.176 |
| 17 | 1.42 | 0.80 | 0.240 | ( 0.141) | 0.064 | 0.176 |
| 18 | 1.50 | 0.80 | 0.240 | ( 0.141) | 0.064 | 0.176 |
| 19 | 1.58 | 0.80 | 0.240 | ( 0.141) | 0.064 | 0.176 |
| 20 | 1.67 | 0.80 | 0.240 | ( 0.141) | 0.064 | 0.176 |
| 21 | 1.75 | 0.80 | 0.240 | ( 0.141) | 0.064 | 0.176 |
| 22 | 1.83 | 0.80 | 0.240 | ( 0.141) | 0.064 | 0.176 |
| 23 | 1.92 | 0.80 | 0.240 | ( 0.141) | 0.064 | 0.176 |
| 24 | 2.00 | 0.90 | 0.270 | ( 0.141) | 0.072 | 0.198 |
| 25 | 2.08 | 0.80 | 0.240 | ( 0.141) | 0.064 | 0.176 |
| 26 | 2.17 | 0.90 | 0.270 | ( 0.141) | 0.072 | 0.198 |
| 27 | 2.25 | 0.90 | 0.270 | ( 0.141) | 0.072 | 0.198 |
| 28 | 2.33 | 0.90 | 0.270 | ( 0.141) | 0.072 | 0.198 |
| 29 | 2.42 | 0.90 | 0.270 | ( 0.141) | 0.072 | 0.198 |
| 30 | 2.50 | 0.90 | 0.270 | ( 0.141) | 0.072 | 0.198 |
| 31 | 2.58 | 0.90 | 0.270 | ( 0.141) | 0.072 | 0.198 |
| 32 | 2.67 | 0.90 | 0.270 | ( 0.141) | 0.072 | 0.198 |
| 33 | 2.75 | 1.00 | 0.300 | ( 0.141) | 0.080 | 0.220 |
| 34 | 2.83 | 1.00 | 0.300 | ( 0.141) | 0.080 | 0.220 |
| 35 | 2.92 | 1.00 | 0.300 | ( 0.141) | 0.080 | 0.220 |
| 36 | 3.00 | 1.00 | 0.300 | ( 0.141) | 0.080 | 0.220 |
| 37 | 3.08 | 1.00 | 0.300 | ( 0.141) | 0.080 | 0.220 |
| 38 | 3.17 | 1.10 | 0.330 | ( 0.141) | 0.088 | 0.242 |
| 39 | 3.25 | 1.10 | 0.330 | ( 0.141) | 0.088 | 0.242 |
| 40 | 3.33 | 1.10 | 0.330 | ( 0.141) | 0.088 | 0.242 |
| 41 | 3.42 | 1.20 | 0.360 | ( 0.141) | 0.096 | 0.264 |
| 42 | 3.50 | 1.30 | 0.390 | ( 0.141) | 0.104 | 0.286 |
| 43 | 3.58 | 1.40 | 0.420 | ( 0.141) | 0.112 | 0.308 |
| 44 | 3.67 | 1.40 | 0.420 | ( 0.141) | 0.112 | 0.308 |
| 45 | 3.75 | 1.50 | 0.450 | ( 0.141) | 0.120 | 0.330 |
| 46 | 3.83 | 1.50 | 0.450 | ( 0.141) | 0.120 | 0.330 |

```
47   3.92     1.60      0.480       (  0.141)       0.128        0.352
48   4.00     1.60      0.480       (  0.141)       0.128        0.352
49   4.08     1.70      0.510       (  0.141)       0.136        0.374
50   4.17     1.80      0.540          0.141    (  0.144)        0.399
51   4.25     1.90      0.570          0.141    (  0.152)        0.429
52   4.33     2.00      0.600          0.141    (  0.160)        0.459
53   4.42     2.10      0.630          0.141    (  0.168)        0.489
54   4.50     2.10      0.630          0.141    (  0.168)        0.489
55   4.58     2.20      0.660          0.141    (  0.176)        0.519
56   4.67     2.30      0.690          0.141    (  0.184)        0.549
57   4.75     2.40      0.720          0.141    (  0.192)        0.579
58   4.83     2.40      0.720          0.141    (  0.192)        0.579
59   4.92     2.50      0.750          0.141    (  0.199)        0.609
60   5.00     2.60      0.780          0.141    (  0.207)        0.639
61   5.08     3.10      0.930          0.141    (  0.247)        0.789
62   5.17     3.60      1.080          0.141    (  0.287)        0.939
63   5.25     3.90      1.170          0.141    (  0.311)        1.029
64   5.33     4.20      1.260          0.141    (  0.335)        1.119
65   5.42     4.70      1.410          0.141    (  0.375)        1.269
66   5.50     5.60      1.680          0.141    (  0.447)        1.539
67   5.58     1.90      0.570          0.141    (  0.152)        0.429
68   5.67     0.90      0.270       (  0.141)       0.072        0.198
69   5.75     0.60      0.180       (  0.141)       0.048        0.132
70   5.83     0.50      0.150       (  0.141)       0.040        0.110
71   5.92     0.30      0.090       (  0.141)       0.024        0.066
72   6.00     0.20      0.060       (  0.141)       0.016        0.044
              (Loss Rate Not Used)
   Sum =     100.0                                   Sum =    23.6
      Flood volume = Effective rainfall      1.96(In)
       times area      12.6(Ac.)/[(In)/(Ft.)] =       2.1(Ac.Ft)
      Total soil loss =      0.54(In)
      Total soil loss =     0.562(Ac.Ft)
      Total rainfall =      2.50(In)
      Flood volume =       89855.6 Cubic Feet
      Total soil loss =       24484.4 Cubic Feet
      --------------------------------------------------------------------
       Peak flow rate of this hydrograph =     17.764(CFS)
      --------------------------------------------------------------------
      ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                          6 - 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        5.0      10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5       0.0051      0.74  VQ        |         |         |         |
  0+10       0.0150      1.43  V Q       |         |         |         |
  0+15       0.0262      1.63  V  Q      |         |         |         |
  0+20       0.0378      1.67  V  Q      |         |         |         |
  0+25       0.0493      1.68  V  Q      |         |         |         |
  0+30       0.0619      1.83  |V Q      |         |         |         |
  0+35       0.0752      1.94  |V Q      |         |         |         |
  0+40       0.0887      1.95  |V Q      |         |         |         |
  0+45       0.1022      1.96  |V Q      |         |         |         |
  0+50       0.1157      1.96  | VQ      |         |         |         |
  0+55       0.1291      1.96  | VQ      |         |         |         |
  1+ 0       0.1437      2.11  | V Q     |         |         |         |
  1+ 5       0.1589      2.22  |  VQ     |         |         |         |
  1+10       0.1743      2.23  |  VQ     |         |         |         |
  1+15       0.1897      2.24  |  VQ     |         |         |         |
  1+20       0.2051      2.24  |  VQ     |         |         |         |
  1+25       0.2205      2.24  |   Q     |         |         |         |
  1+30       0.2359      2.24  |   Q     |         |         |         |
  1+35       0.2514      2.24  |   Q     |         |         |         |
  1+40       0.2668      2.24  |   QV    |         |         |         |
  1+45       0.2822      2.24  |   QV    |         |         |         |
  1+50       0.2976      2.24  |   QV    |         |         |         |
  1+55       0.3130      2.24  |   Q V   |         |         |         |
  2+ 0       0.3294      2.39  |   Q V   |         |         |         |
  2+ 5       0.3456      2.35  |   Q V   |         |         |         |
  2+10       0.3622      2.40  |   Q  V  |         |         |         |
  2+15       0.3794      2.50  |   Q  V  |         |         |         |
  2+20       0.3967      2.51  |    Q V  |         |         |         |
```

```
    2+25       0.4140      2.52  |    Q  V |         |         |         |
    2+30       0.4314      2.52  |    Q  V |         |         |         |
    2+35       0.4487      2.52  |    Q  V |         |         |         |
    2+40       0.4661      2.52  |    Q   V|         |         |         |
    2+45       0.4844      2.67  |    Q   V|         |         |         |
    2+50       0.5035      2.78  |    Q   V|         |         |         |
    2+55       0.5228      2.79  |    Q    V         |         |         |
    3+ 0       0.5420      2.80  |    Q    V         |         |         |
    3+ 5       0.5613      2.80  |    Q    V         |         |         |
    3+10       0.5816      2.95  |    Q    |V        |         |         |
    3+15       0.6026      3.05  |     Q   |V        |         |         |
    3+20       0.6238      3.07  |     Q   | V       |         |         |
    3+25       0.6460      3.23  |     Q   | V       |         |         |
    3+30       0.6700      3.48  |     Q   | V       |         |         |
    3+35       0.6959      3.76  |      Q  |  V      |         |         |
    3+40       0.7226      3.89  |      Q  |   V     |         |         |
    3+45       0.7506      4.06  |       Q |   V     |         |         |
    3+50       0.7794      4.17  |       Q |    V    |         |         |
    3+55       0.8092      4.34  |       Q |    V    |         |         |
    4+ 0       0.8399      4.45  |       Q |     V   |         |         |
    4+ 5       0.8717      4.62  |        Q|     V   |         |         |
    4+10       0.9055      4.90  |        Q|      V  |         |         |
    4+15       0.9416      5.24  |         Q       V |         |         |
    4+20       0.9802      5.62  |         |Q       V|         |         |
    4+25       1.0215      6.00  |         |Q       V|         |         |
    4+30       1.0641      6.18  |         | Q       V         |         |
    4+35       1.1082      6.41  |         | Q       |V        |         |
    4+40       1.1548      6.76  |         |  Q      | V       |         |
    4+45       1.2040      7.14  |         |   Q     |  V      |         |
    4+50       1.2544      7.32  |         |   Q     |   V     |         |
    4+55       1.3064      7.55  |         |    Q    |    V    |         |
    5+ 0       1.3609      7.91  |         |    Q    |     V   |         |
    5+ 5       1.4235      9.09  |         |       Q |      V  |         |
    5+10       1.4983     10.87  |         |         |Q       V|         |
    5+15       1.5834     12.35  |         |         |   Q     V         |
    5+20       1.6768     13.56  |         |         |      Q  | V       |
    5+25       1.7809     15.11  |         |         |         Q   V     |
    5+30       1.9032     17.76  |         |         |         |    QV   |
    5+35       1.9844     11.80  |         |         |  Q      |       V |
    5+40       2.0187      4.98  |        Q|         |         |        V|
    5+45       2.0361      2.52  |    Q    |         |         |        V|
    5+50       2.0474      1.64  |  Q      |         |         |        V|
    5+55       2.0553      1.14  | Q       |         |         |        V|
    6+ 0       2.0604      0.74  |Q        |         |         |        V|
    6+ 5       2.0624      0.29  Q         |         |         |        V|
    6+10       2.0627      0.05  Q         |         |         |        V|
    6+15       2.0628      0.01  Q         |         |         |         V
-----------------------------------------------------------------------
```

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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  05/12/21 File: PROPEAST10024100.out

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

Program License Serial Number 4010

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

 English Units used in output format

---------------------------------------------------------------------
REDLANDS EAST - DEVELOPED CONDITION
100-YEAR STORM EVENT
20-0181 EAST INDUSTRIAL PROJECT
05/12/2021   AYS
--------------------------------------------------------------------
Drainage Area =      12.60(Ac.)  =      0.020 Sq. Mi.
Drainage Area for Depth-Area Areal Adjustment =      12.60(Ac.)  =      0.020 Sq. Mi.
Length along longest watercourse =    1235.00(Ft.)
Length along longest watercourse measured to centroid =     300.00(Ft.)
Length along longest watercourse =      0.234 Mi.
Length along longest watercourse measured to centroid =      0.057 Mi.
Difference in elevation =      15.60(Ft.)
Slope along watercourse =     66.6947 Ft./Mi.
Average Manning's 'N' = 0.015
Lag time =    0.031 Hr.
Lag time =     1.88 Min.
25% of lag time =     0.47 Min.
40% of lag time =     0.75 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]
       12.60           1.70                 21.42

100 YEAR Area rainfall data:

Area(Ac.)[1]       Rainfall(In)[2]      Weighting[1*2]
       12.60           4.25                 53.55

STORM EVENT (YEAR) =  100.00
Area Averaged 2-Year Rainfall =    1.700(In)
Area Averaged 100-Year Rainfall =    4.250(In)

Point rain (area averaged) =    4.250(In)
Areal adjustment factor =  100.00 %
Adjusted average point rain =    4.250(In)

Sub-Area Data:
Area(Ac.)         Runoff Index   Impervious %
    12.600           57.80         0.793
 Total Area Entered =     12.60(Ac.)

RI    RI   Infil. Rate Impervious   Adj. Infil. Rate  Area%     F
AMC2 AMC-2     (In/Hr)    (Dec.%)     (In/Hr)      (Dec.)    (In/Hr)
```

| | | | | | | |
|---|---|---|---|---|---|---|
| 57.8 | 57.8 | 0.492 | 0.793 | 0.141 | 1.000 | 0.141 |
| | | | | | Sum (F) = | 0.141 |

Area averaged mean soil loss (F) (In/Hr) = 0.141
Minimum soil loss rate ((In/Hr)) = 0.070
(for 24 hour storm duration)
Soil low loss rate (decimal) = 0.266

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

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Unit Hydrograph Data

| Unit time period (hrs) | | Time % of lag | Distribution Graph % | Unit Hydrograph (CFS) |
|---|---|---|---|---|
| 1 | 0.083 | 265.556 | 52.846 | 6.711 |
| 2 | 0.167 | 531.112 | 39.109 | 4.966 |
| 3 | 0.250 | 796.668 | 6.539 | 0.830 |
| 4 | 0.333 | 1062.223 | 1.506 | 0.191 |
| | | | Sum = 100.000 | Sum= 12.698 |

---

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

| Unit | Time (Hr.) | Pattern Percent | Storm Rain (In/Hr) | Loss rate(In./Hr) Max | Loss rate(In./Hr) Low | Effective (In/Hr) |
|---|---|---|---|---|---|---|
| 1 | 0.08 | 0.07 | 0.034 | ( 0.250) | 0.009 | 0.025 |
| 2 | 0.17 | 0.07 | 0.034 | ( 0.249) | 0.009 | 0.025 |
| 3 | 0.25 | 0.07 | 0.034 | ( 0.248) | 0.009 | 0.025 |
| 4 | 0.33 | 0.10 | 0.051 | ( 0.247) | 0.014 | 0.037 |
| 5 | 0.42 | 0.10 | 0.051 | ( 0.246) | 0.014 | 0.037 |
| 6 | 0.50 | 0.10 | 0.051 | ( 0.245) | 0.014 | 0.037 |
| 7 | 0.58 | 0.10 | 0.051 | ( 0.244) | 0.014 | 0.037 |
| 8 | 0.67 | 0.10 | 0.051 | ( 0.243) | 0.014 | 0.037 |
| 9 | 0.75 | 0.10 | 0.051 | ( 0.242) | 0.014 | 0.037 |
| 10 | 0.83 | 0.13 | 0.068 | ( 0.241) | 0.018 | 0.050 |
| 11 | 0.92 | 0.13 | 0.068 | ( 0.240) | 0.018 | 0.050 |
| 12 | 1.00 | 0.13 | 0.068 | ( 0.239) | 0.018 | 0.050 |
| 13 | 1.08 | 0.10 | 0.051 | ( 0.238) | 0.014 | 0.037 |
| 14 | 1.17 | 0.10 | 0.051 | ( 0.238) | 0.014 | 0.037 |
| 15 | 1.25 | 0.10 | 0.051 | ( 0.237) | 0.014 | 0.037 |
| 16 | 1.33 | 0.10 | 0.051 | ( 0.236) | 0.014 | 0.037 |
| 17 | 1.42 | 0.10 | 0.051 | ( 0.235) | 0.014 | 0.037 |
| 18 | 1.50 | 0.10 | 0.051 | ( 0.234) | 0.014 | 0.037 |
| 19 | 1.58 | 0.10 | 0.051 | ( 0.233) | 0.014 | 0.037 |
| 20 | 1.67 | 0.10 | 0.051 | ( 0.232) | 0.014 | 0.037 |
| 21 | 1.75 | 0.10 | 0.051 | ( 0.231) | 0.014 | 0.037 |
| 22 | 1.83 | 0.13 | 0.068 | ( 0.230) | 0.018 | 0.050 |
| 23 | 1.92 | 0.13 | 0.068 | ( 0.229) | 0.018 | 0.050 |
| 24 | 2.00 | 0.13 | 0.068 | ( 0.228) | 0.018 | 0.050 |
| 25 | 2.08 | 0.13 | 0.068 | ( 0.227) | 0.018 | 0.050 |
| 26 | 2.17 | 0.13 | 0.068 | ( 0.226) | 0.018 | 0.050 |
| 27 | 2.25 | 0.13 | 0.068 | ( 0.225) | 0.018 | 0.050 |
| 28 | 2.33 | 0.13 | 0.068 | ( 0.224) | 0.018 | 0.050 |
| 29 | 2.42 | 0.13 | 0.068 | ( 0.224) | 0.018 | 0.050 |
| 30 | 2.50 | 0.13 | 0.068 | ( 0.223) | 0.018 | 0.050 |
| 31 | 2.58 | 0.17 | 0.085 | ( 0.222) | 0.023 | 0.062 |
| 32 | 2.67 | 0.17 | 0.085 | ( 0.221) | 0.023 | 0.062 |
| 33 | 2.75 | 0.17 | 0.085 | ( 0.220) | 0.023 | 0.062 |
| 34 | 2.83 | 0.17 | 0.085 | ( 0.219) | 0.023 | 0.062 |
| 35 | 2.92 | 0.17 | 0.085 | ( 0.218) | 0.023 | 0.062 |
| 36 | 3.00 | 0.17 | 0.085 | ( 0.217) | 0.023 | 0.062 |
| 37 | 3.08 | 0.17 | 0.085 | ( 0.216) | 0.023 | 0.062 |
| 38 | 3.17 | 0.17 | 0.085 | ( 0.215) | 0.023 | 0.062 |
| 39 | 3.25 | 0.17 | 0.085 | ( 0.215) | 0.023 | 0.062 |
| 40 | 3.33 | 0.17 | 0.085 | ( 0.214) | 0.023 | 0.062 |
| 41 | 3.42 | 0.17 | 0.085 | ( 0.213) | 0.023 | 0.062 |
| 42 | 3.50 | 0.17 | 0.085 | ( 0.212) | 0.023 | 0.062 |
| 43 | 3.58 | 0.17 | 0.085 | ( 0.211) | 0.023 | 0.062 |
| 44 | 3.67 | 0.17 | 0.085 | ( 0.210) | 0.023 | 0.062 |
| 45 | 3.75 | 0.17 | 0.085 | ( 0.209) | 0.023 | 0.062 |
| 46 | 3.83 | 0.20 | 0.102 | ( 0.208) | 0.027 | 0.075 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 47 | 3.92 | 0.20 | 0.102 | ( 0.207) | 0.027 | 0.075 |
| 48 | 4.00 | 0.20 | 0.102 | ( 0.207) | 0.027 | 0.075 |
| 49 | 4.08 | 0.20 | 0.102 | ( 0.206) | 0.027 | 0.075 |
| 50 | 4.17 | 0.20 | 0.102 | ( 0.205) | 0.027 | 0.075 |
| 51 | 4.25 | 0.20 | 0.102 | ( 0.204) | 0.027 | 0.075 |
| 52 | 4.33 | 0.23 | 0.119 | ( 0.203) | 0.032 | 0.087 |
| 53 | 4.42 | 0.23 | 0.119 | ( 0.202) | 0.032 | 0.087 |
| 54 | 4.50 | 0.23 | 0.119 | ( 0.201) | 0.032 | 0.087 |
| 55 | 4.58 | 0.23 | 0.119 | ( 0.200) | 0.032 | 0.087 |
| 56 | 4.67 | 0.23 | 0.119 | ( 0.200) | 0.032 | 0.087 |
| 57 | 4.75 | 0.23 | 0.119 | ( 0.199) | 0.032 | 0.087 |
| 58 | 4.83 | 0.27 | 0.136 | ( 0.198) | 0.036 | 0.100 |
| 59 | 4.92 | 0.27 | 0.136 | ( 0.197) | 0.036 | 0.100 |
| 60 | 5.00 | 0.27 | 0.136 | ( 0.196) | 0.036 | 0.100 |
| 61 | 5.08 | 0.20 | 0.102 | ( 0.195) | 0.027 | 0.075 |
| 62 | 5.17 | 0.20 | 0.102 | ( 0.194) | 0.027 | 0.075 |
| 63 | 5.25 | 0.20 | 0.102 | ( 0.194) | 0.027 | 0.075 |
| 64 | 5.33 | 0.23 | 0.119 | ( 0.193) | 0.032 | 0.087 |
| 65 | 5.42 | 0.23 | 0.119 | ( 0.192) | 0.032 | 0.087 |
| 66 | 5.50 | 0.23 | 0.119 | ( 0.191) | 0.032 | 0.087 |
| 67 | 5.58 | 0.27 | 0.136 | ( 0.190) | 0.036 | 0.100 |
| 68 | 5.67 | 0.27 | 0.136 | ( 0.189) | 0.036 | 0.100 |
| 69 | 5.75 | 0.27 | 0.136 | ( 0.189) | 0.036 | 0.100 |
| 70 | 5.83 | 0.27 | 0.136 | ( 0.188) | 0.036 | 0.100 |
| 71 | 5.92 | 0.27 | 0.136 | ( 0.187) | 0.036 | 0.100 |
| 72 | 6.00 | 0.27 | 0.136 | ( 0.186) | 0.036 | 0.100 |
| 73 | 6.08 | 0.30 | 0.153 | ( 0.185) | 0.041 | 0.112 |
| 74 | 6.17 | 0.30 | 0.153 | ( 0.184) | 0.041 | 0.112 |
| 75 | 6.25 | 0.30 | 0.153 | ( 0.184) | 0.041 | 0.112 |
| 76 | 6.33 | 0.30 | 0.153 | ( 0.183) | 0.041 | 0.112 |
| 77 | 6.42 | 0.30 | 0.153 | ( 0.182) | 0.041 | 0.112 |
| 78 | 6.50 | 0.30 | 0.153 | ( 0.181) | 0.041 | 0.112 |
| 79 | 6.58 | 0.33 | 0.170 | ( 0.180) | 0.045 | 0.125 |
| 80 | 6.67 | 0.33 | 0.170 | ( 0.180) | 0.045 | 0.125 |
| 81 | 6.75 | 0.33 | 0.170 | ( 0.179) | 0.045 | 0.125 |
| 82 | 6.83 | 0.33 | 0.170 | ( 0.178) | 0.045 | 0.125 |
| 83 | 6.92 | 0.33 | 0.170 | ( 0.177) | 0.045 | 0.125 |
| 84 | 7.00 | 0.33 | 0.170 | ( 0.176) | 0.045 | 0.125 |
| 85 | 7.08 | 0.33 | 0.170 | ( 0.176) | 0.045 | 0.125 |
| 86 | 7.17 | 0.33 | 0.170 | ( 0.175) | 0.045 | 0.125 |
| 87 | 7.25 | 0.33 | 0.170 | ( 0.174) | 0.045 | 0.125 |
| 88 | 7.33 | 0.37 | 0.187 | ( 0.173) | 0.050 | 0.137 |
| 89 | 7.42 | 0.37 | 0.187 | ( 0.172) | 0.050 | 0.137 |
| 90 | 7.50 | 0.37 | 0.187 | ( 0.172) | 0.050 | 0.137 |
| 91 | 7.58 | 0.40 | 0.204 | ( 0.171) | 0.054 | 0.150 |
| 92 | 7.67 | 0.40 | 0.204 | ( 0.170) | 0.054 | 0.150 |
| 93 | 7.75 | 0.40 | 0.204 | ( 0.169) | 0.054 | 0.150 |
| 94 | 7.83 | 0.43 | 0.221 | ( 0.168) | 0.059 | 0.162 |
| 95 | 7.92 | 0.43 | 0.221 | ( 0.168) | 0.059 | 0.162 |
| 96 | 8.00 | 0.43 | 0.221 | ( 0.167) | 0.059 | 0.162 |
| 97 | 8.08 | 0.50 | 0.255 | ( 0.166) | 0.068 | 0.187 |
| 98 | 8.17 | 0.50 | 0.255 | ( 0.165) | 0.068 | 0.187 |
| 99 | 8.25 | 0.50 | 0.255 | ( 0.165) | 0.068 | 0.187 |
| 100 | 8.33 | 0.50 | 0.255 | ( 0.164) | 0.068 | 0.187 |
| 101 | 8.42 | 0.50 | 0.255 | ( 0.163) | 0.068 | 0.187 |
| 102 | 8.50 | 0.50 | 0.255 | ( 0.162) | 0.068 | 0.187 |
| 103 | 8.58 | 0.53 | 0.272 | ( 0.161) | 0.072 | 0.200 |
| 104 | 8.67 | 0.53 | 0.272 | ( 0.161) | 0.072 | 0.200 |
| 105 | 8.75 | 0.53 | 0.272 | ( 0.160) | 0.072 | 0.200 |
| 106 | 8.83 | 0.57 | 0.289 | ( 0.159) | 0.077 | 0.212 |
| 107 | 8.92 | 0.57 | 0.289 | ( 0.158) | 0.077 | 0.212 |
| 108 | 9.00 | 0.57 | 0.289 | ( 0.158) | 0.077 | 0.212 |
| 109 | 9.08 | 0.63 | 0.323 | ( 0.157) | 0.086 | 0.237 |
| 110 | 9.17 | 0.63 | 0.323 | ( 0.156) | 0.086 | 0.237 |
| 111 | 9.25 | 0.63 | 0.323 | ( 0.155) | 0.086 | 0.237 |
| 112 | 9.33 | 0.67 | 0.340 | ( 0.155) | 0.090 | 0.250 |
| 113 | 9.42 | 0.67 | 0.340 | ( 0.154) | 0.090 | 0.250 |
| 114 | 9.50 | 0.67 | 0.340 | ( 0.153) | 0.090 | 0.250 |
| 115 | 9.58 | 0.70 | 0.357 | ( 0.153) | 0.095 | 0.262 |
| 116 | 9.67 | 0.70 | 0.357 | ( 0.152) | 0.095 | 0.262 |
| 117 | 9.75 | 0.70 | 0.357 | ( 0.151) | 0.095 | 0.262 |
| 118 | 9.83 | 0.73 | 0.374 | ( 0.150) | 0.099 | 0.275 |
| 119 | 9.92 | 0.73 | 0.374 | ( 0.150) | 0.099 | 0.275 |
| 120 | 10.00 | 0.73 | 0.374 | ( 0.149) | 0.099 | 0.275 |
| 121 | 10.08 | 0.50 | 0.255 | ( 0.148) | 0.068 | 0.187 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 122 | 10.17 | 0.50 | 0.255 | ( 0.147) | 0.068 | 0.187 |
| 123 | 10.25 | 0.50 | 0.255 | ( 0.147) | 0.068 | 0.187 |
| 124 | 10.33 | 0.50 | 0.255 | ( 0.146) | 0.068 | 0.187 |
| 125 | 10.42 | 0.50 | 0.255 | ( 0.145) | 0.068 | 0.187 |
| 126 | 10.50 | 0.50 | 0.255 | ( 0.145) | 0.068 | 0.187 |
| 127 | 10.58 | 0.67 | 0.340 | ( 0.144) | 0.090 | 0.250 |
| 128 | 10.67 | 0.67 | 0.340 | ( 0.143) | 0.090 | 0.250 |
| 129 | 10.75 | 0.67 | 0.340 | ( 0.142) | 0.090 | 0.250 |
| 130 | 10.83 | 0.67 | 0.340 | ( 0.142) | 0.090 | 0.250 |
| 131 | 10.92 | 0.67 | 0.340 | ( 0.141) | 0.090 | 0.250 |
| 132 | 11.00 | 0.67 | 0.340 | ( 0.140) | 0.090 | 0.250 |
| 133 | 11.08 | 0.63 | 0.323 | ( 0.140) | 0.086 | 0.237 |
| 134 | 11.17 | 0.63 | 0.323 | ( 0.139) | 0.086 | 0.237 |
| 135 | 11.25 | 0.63 | 0.323 | ( 0.138) | 0.086 | 0.237 |
| 136 | 11.33 | 0.63 | 0.323 | ( 0.138) | 0.086 | 0.237 |
| 137 | 11.42 | 0.63 | 0.323 | ( 0.137) | 0.086 | 0.237 |
| 138 | 11.50 | 0.63 | 0.323 | ( 0.136) | 0.086 | 0.237 |
| 139 | 11.58 | 0.57 | 0.289 | ( 0.136) | 0.077 | 0.212 |
| 140 | 11.67 | 0.57 | 0.289 | ( 0.135) | 0.077 | 0.212 |
| 141 | 11.75 | 0.57 | 0.289 | ( 0.134) | 0.077 | 0.212 |
| 142 | 11.83 | 0.60 | 0.306 | ( 0.134) | 0.081 | 0.225 |
| 143 | 11.92 | 0.60 | 0.306 | ( 0.133) | 0.081 | 0.225 |
| 144 | 12.00 | 0.60 | 0.306 | ( 0.132) | 0.081 | 0.225 |
| 145 | 12.08 | 0.83 | 0.425 | ( 0.132) | 0.113 | 0.312 |
| 146 | 12.17 | 0.83 | 0.425 | ( 0.131) | 0.113 | 0.312 |
| 147 | 12.25 | 0.83 | 0.425 | ( 0.130) | 0.113 | 0.312 |
| 148 | 12.33 | 0.87 | 0.442 | ( 0.130) | 0.118 | 0.324 |
| 149 | 12.42 | 0.87 | 0.442 | ( 0.129) | 0.118 | 0.324 |
| 150 | 12.50 | 0.87 | 0.442 | ( 0.128) | 0.118 | 0.324 |
| 151 | 12.58 | 0.93 | 0.476 | ( 0.128) | 0.127 | 0.349 |
| 152 | 12.67 | 0.93 | 0.476 | ( 0.127) | 0.127 | 0.349 |
| 153 | 12.75 | 0.93 | 0.476 | 0.126 | ( 0.127) | 0.350 |
| 154 | 12.83 | 0.97 | 0.493 | 0.126 | ( 0.131) | 0.367 |
| 155 | 12.92 | 0.97 | 0.493 | 0.125 | ( 0.131) | 0.368 |
| 156 | 13.00 | 0.97 | 0.493 | 0.125 | ( 0.131) | 0.368 |
| 157 | 13.08 | 1.13 | 0.578 | 0.124 | ( 0.154) | 0.454 |
| 158 | 13.17 | 1.13 | 0.578 | 0.123 | ( 0.154) | 0.455 |
| 159 | 13.25 | 1.13 | 0.578 | 0.123 | ( 0.154) | 0.455 |
| 160 | 13.33 | 1.13 | 0.578 | 0.122 | ( 0.154) | 0.456 |
| 161 | 13.42 | 1.13 | 0.578 | 0.121 | ( 0.154) | 0.457 |
| 162 | 13.50 | 1.13 | 0.578 | 0.121 | ( 0.154) | 0.457 |
| 163 | 13.58 | 0.77 | 0.391 | ( 0.120) | 0.104 | 0.287 |
| 164 | 13.67 | 0.77 | 0.391 | ( 0.120) | 0.104 | 0.287 |
| 165 | 13.75 | 0.77 | 0.391 | ( 0.119) | 0.104 | 0.287 |
| 166 | 13.83 | 0.77 | 0.391 | ( 0.118) | 0.104 | 0.287 |
| 167 | 13.92 | 0.77 | 0.391 | ( 0.118) | 0.104 | 0.287 |
| 168 | 14.00 | 0.77 | 0.391 | ( 0.117) | 0.104 | 0.287 |
| 169 | 14.08 | 0.90 | 0.459 | 0.117 | ( 0.122) | 0.342 |
| 170 | 14.17 | 0.90 | 0.459 | 0.116 | ( 0.122) | 0.343 |
| 171 | 14.25 | 0.90 | 0.459 | 0.115 | ( 0.122) | 0.344 |
| 172 | 14.33 | 0.87 | 0.442 | 0.115 | ( 0.118) | 0.327 |
| 173 | 14.42 | 0.87 | 0.442 | 0.114 | ( 0.118) | 0.328 |
| 174 | 14.50 | 0.87 | 0.442 | 0.114 | ( 0.118) | 0.328 |
| 175 | 14.58 | 0.87 | 0.442 | 0.113 | ( 0.118) | 0.329 |
| 176 | 14.67 | 0.87 | 0.442 | 0.112 | ( 0.118) | 0.330 |
| 177 | 14.75 | 0.87 | 0.442 | 0.112 | ( 0.118) | 0.330 |
| 178 | 14.83 | 0.83 | 0.425 | 0.111 | ( 0.113) | 0.314 |
| 179 | 14.92 | 0.83 | 0.425 | 0.111 | ( 0.113) | 0.314 |
| 180 | 15.00 | 0.83 | 0.425 | 0.110 | ( 0.113) | 0.315 |
| 181 | 15.08 | 0.80 | 0.408 | ( 0.110) | 0.109 | 0.299 |
| 182 | 15.17 | 0.80 | 0.408 | ( 0.109) | 0.109 | 0.299 |
| 183 | 15.25 | 0.80 | 0.408 | 0.108 | ( 0.109) | 0.300 |
| 184 | 15.33 | 0.77 | 0.391 | ( 0.108) | 0.104 | 0.287 |
| 185 | 15.42 | 0.77 | 0.391 | ( 0.107) | 0.104 | 0.287 |
| 186 | 15.50 | 0.77 | 0.391 | ( 0.107) | 0.104 | 0.287 |
| 187 | 15.58 | 0.63 | 0.323 | ( 0.106) | 0.086 | 0.237 |
| 188 | 15.67 | 0.63 | 0.323 | ( 0.106) | 0.086 | 0.237 |
| 189 | 15.75 | 0.63 | 0.323 | ( 0.105) | 0.086 | 0.237 |
| 190 | 15.83 | 0.63 | 0.323 | ( 0.105) | 0.086 | 0.237 |
| 191 | 15.92 | 0.63 | 0.323 | ( 0.104) | 0.086 | 0.237 |
| 192 | 16.00 | 0.63 | 0.323 | ( 0.104) | 0.086 | 0.237 |
| 193 | 16.08 | 0.13 | 0.068 | ( 0.103) | 0.018 | 0.050 |
| 194 | 16.17 | 0.13 | 0.068 | ( 0.102) | 0.018 | 0.050 |
| 195 | 16.25 | 0.13 | 0.068 | ( 0.102) | 0.018 | 0.050 |
| 196 | 16.33 | 0.13 | 0.068 | ( 0.101) | 0.018 | 0.050 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 197 | 16.42 | 0.13 | 0.068 | ( 0.101) | 0.018 | 0.050 |
| 198 | 16.50 | 0.13 | 0.068 | ( 0.100) | 0.018 | 0.050 |
| 199 | 16.58 | 0.10 | 0.051 | ( 0.100) | 0.014 | 0.037 |
| 200 | 16.67 | 0.10 | 0.051 | ( 0.099) | 0.014 | 0.037 |
| 201 | 16.75 | 0.10 | 0.051 | ( 0.099) | 0.014 | 0.037 |
| 202 | 16.83 | 0.10 | 0.051 | ( 0.098) | 0.014 | 0.037 |
| 203 | 16.92 | 0.10 | 0.051 | ( 0.098) | 0.014 | 0.037 |
| 204 | 17.00 | 0.10 | 0.051 | ( 0.097) | 0.014 | 0.037 |
| 205 | 17.08 | 0.17 | 0.085 | ( 0.097) | 0.023 | 0.062 |
| 206 | 17.17 | 0.17 | 0.085 | ( 0.096) | 0.023 | 0.062 |
| 207 | 17.25 | 0.17 | 0.085 | ( 0.096) | 0.023 | 0.062 |
| 208 | 17.33 | 0.17 | 0.085 | ( 0.095) | 0.023 | 0.062 |
| 209 | 17.42 | 0.17 | 0.085 | ( 0.095) | 0.023 | 0.062 |
| 210 | 17.50 | 0.17 | 0.085 | ( 0.094) | 0.023 | 0.062 |
| 211 | 17.58 | 0.17 | 0.085 | ( 0.094) | 0.023 | 0.062 |
| 212 | 17.67 | 0.17 | 0.085 | ( 0.094) | 0.023 | 0.062 |
| 213 | 17.75 | 0.17 | 0.085 | ( 0.093) | 0.023 | 0.062 |
| 214 | 17.83 | 0.13 | 0.068 | ( 0.093) | 0.018 | 0.050 |
| 215 | 17.92 | 0.13 | 0.068 | ( 0.092) | 0.018 | 0.050 |
| 216 | 18.00 | 0.13 | 0.068 | ( 0.092) | 0.018 | 0.050 |
| 217 | 18.08 | 0.13 | 0.068 | ( 0.091) | 0.018 | 0.050 |
| 218 | 18.17 | 0.13 | 0.068 | ( 0.091) | 0.018 | 0.050 |
| 219 | 18.25 | 0.13 | 0.068 | ( 0.090) | 0.018 | 0.050 |
| 220 | 18.33 | 0.13 | 0.068 | ( 0.090) | 0.018 | 0.050 |
| 221 | 18.42 | 0.13 | 0.068 | ( 0.089) | 0.018 | 0.050 |
| 222 | 18.50 | 0.13 | 0.068 | ( 0.089) | 0.018 | 0.050 |
| 223 | 18.58 | 0.10 | 0.051 | ( 0.089) | 0.014 | 0.037 |
| 224 | 18.67 | 0.10 | 0.051 | ( 0.088) | 0.014 | 0.037 |
| 225 | 18.75 | 0.10 | 0.051 | ( 0.088) | 0.014 | 0.037 |
| 226 | 18.83 | 0.07 | 0.034 | ( 0.087) | 0.009 | 0.025 |
| 227 | 18.92 | 0.07 | 0.034 | ( 0.087) | 0.009 | 0.025 |
| 228 | 19.00 | 0.07 | 0.034 | ( 0.087) | 0.009 | 0.025 |
| 229 | 19.08 | 0.10 | 0.051 | ( 0.086) | 0.014 | 0.037 |
| 230 | 19.17 | 0.10 | 0.051 | ( 0.086) | 0.014 | 0.037 |
| 231 | 19.25 | 0.10 | 0.051 | ( 0.085) | 0.014 | 0.037 |
| 232 | 19.33 | 0.13 | 0.068 | ( 0.085) | 0.018 | 0.050 |
| 233 | 19.42 | 0.13 | 0.068 | ( 0.085) | 0.018 | 0.050 |
| 234 | 19.50 | 0.13 | 0.068 | ( 0.084) | 0.018 | 0.050 |
| 235 | 19.58 | 0.10 | 0.051 | ( 0.084) | 0.014 | 0.037 |
| 236 | 19.67 | 0.10 | 0.051 | ( 0.083) | 0.014 | 0.037 |
| 237 | 19.75 | 0.10 | 0.051 | ( 0.083) | 0.014 | 0.037 |
| 238 | 19.83 | 0.07 | 0.034 | ( 0.083) | 0.009 | 0.025 |
| 239 | 19.92 | 0.07 | 0.034 | ( 0.082) | 0.009 | 0.025 |
| 240 | 20.00 | 0.07 | 0.034 | ( 0.082) | 0.009 | 0.025 |
| 241 | 20.08 | 0.10 | 0.051 | ( 0.082) | 0.014 | 0.037 |
| 242 | 20.17 | 0.10 | 0.051 | ( 0.081) | 0.014 | 0.037 |
| 243 | 20.25 | 0.10 | 0.051 | ( 0.081) | 0.014 | 0.037 |
| 244 | 20.33 | 0.10 | 0.051 | ( 0.080) | 0.014 | 0.037 |
| 245 | 20.42 | 0.10 | 0.051 | ( 0.080) | 0.014 | 0.037 |
| 246 | 20.50 | 0.10 | 0.051 | ( 0.080) | 0.014 | 0.037 |
| 247 | 20.58 | 0.10 | 0.051 | ( 0.079) | 0.014 | 0.037 |
| 248 | 20.67 | 0.10 | 0.051 | ( 0.079) | 0.014 | 0.037 |
| 249 | 20.75 | 0.10 | 0.051 | ( 0.079) | 0.014 | 0.037 |
| 250 | 20.83 | 0.07 | 0.034 | ( 0.078) | 0.009 | 0.025 |
| 251 | 20.92 | 0.07 | 0.034 | ( 0.078) | 0.009 | 0.025 |
| 252 | 21.00 | 0.07 | 0.034 | ( 0.078) | 0.009 | 0.025 |
| 253 | 21.08 | 0.10 | 0.051 | ( 0.078) | 0.014 | 0.037 |
| 254 | 21.17 | 0.10 | 0.051 | ( 0.077) | 0.014 | 0.037 |
| 255 | 21.25 | 0.10 | 0.051 | ( 0.077) | 0.014 | 0.037 |
| 256 | 21.33 | 0.07 | 0.034 | ( 0.077) | 0.009 | 0.025 |
| 257 | 21.42 | 0.07 | 0.034 | ( 0.076) | 0.009 | 0.025 |
| 258 | 21.50 | 0.07 | 0.034 | ( 0.076) | 0.009 | 0.025 |
| 259 | 21.58 | 0.10 | 0.051 | ( 0.076) | 0.014 | 0.037 |
| 260 | 21.67 | 0.10 | 0.051 | ( 0.075) | 0.014 | 0.037 |
| 261 | 21.75 | 0.10 | 0.051 | ( 0.075) | 0.014 | 0.037 |
| 262 | 21.83 | 0.07 | 0.034 | ( 0.075) | 0.009 | 0.025 |
| 263 | 21.92 | 0.07 | 0.034 | ( 0.075) | 0.009 | 0.025 |
| 264 | 22.00 | 0.07 | 0.034 | ( 0.074) | 0.009 | 0.025 |
| 265 | 22.08 | 0.10 | 0.051 | ( 0.074) | 0.014 | 0.037 |
| 266 | 22.17 | 0.10 | 0.051 | ( 0.074) | 0.014 | 0.037 |
| 267 | 22.25 | 0.10 | 0.051 | ( 0.074) | 0.014 | 0.037 |
| 268 | 22.33 | 0.07 | 0.034 | ( 0.073) | 0.009 | 0.025 |
| 269 | 22.42 | 0.07 | 0.034 | ( 0.073) | 0.009 | 0.025 |
| 270 | 22.50 | 0.07 | 0.034 | ( 0.073) | 0.009 | 0.025 |
| 271 | 22.58 | 0.07 | 0.034 | ( 0.073) | 0.009 | 0.025 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 272 | 22.67 | 0.07 | 0.034 | ( 0.073) | 0.009 | 0.025 |
| 273 | 22.75 | 0.07 | 0.034 | ( 0.072) | 0.009 | 0.025 |
| 274 | 22.83 | 0.07 | 0.034 | ( 0.072) | 0.009 | 0.025 |
| 275 | 22.92 | 0.07 | 0.034 | ( 0.072) | 0.009 | 0.025 |
| 276 | 23.00 | 0.07 | 0.034 | ( 0.072) | 0.009 | 0.025 |
| 277 | 23.08 | 0.07 | 0.034 | ( 0.072) | 0.009 | 0.025 |
| 278 | 23.17 | 0.07 | 0.034 | ( 0.072) | 0.009 | 0.025 |
| 279 | 23.25 | 0.07 | 0.034 | ( 0.071) | 0.009 | 0.025 |
| 280 | 23.33 | 0.07 | 0.034 | ( 0.071) | 0.009 | 0.025 |
| 281 | 23.42 | 0.07 | 0.034 | ( 0.071) | 0.009 | 0.025 |
| 282 | 23.50 | 0.07 | 0.034 | ( 0.071) | 0.009 | 0.025 |
| 283 | 23.58 | 0.07 | 0.034 | ( 0.071) | 0.009 | 0.025 |
| 284 | 23.67 | 0.07 | 0.034 | ( 0.071) | 0.009 | 0.025 |
| 285 | 23.75 | 0.07 | 0.034 | ( 0.071) | 0.009 | 0.025 |
| 286 | 23.83 | 0.07 | 0.034 | ( 0.071) | 0.009 | 0.025 |
| 287 | 23.92 | 0.07 | 0.034 | ( 0.071) | 0.009 | 0.025 |
| 288 | 24.00 | 0.07 | 0.034 | ( 0.071) | 0.009 | 0.025 |

```
              (Loss Rate Not Used)
    Sum =     100.0                                  Sum =    37.7
      Flood volume = Effective rainfall      3.14(In)
       times area      12.6(Ac.)/[(In)/(Ft.)] =       3.3(Ac.Ft)
      Total soil loss =      1.11(In)
      Total soil loss =     1.164(Ac.Ft)
      Total rainfall =      4.25(In)
      Flood volume =     143660.7 Cubic Feet
      Total soil loss =      50721.1 Cubic Feet
      --------------------------------------------------------------------
       Peak flow rate of this hydrograph =      5.805(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      0.0012      0.17  Q          |         |         |         |
   0+10      0.0032      0.29  VQ         |         |         |         |
   0+15      0.0053      0.31  VQ         |         |         |         |
   0+20      0.0081      0.40  VQ         |         |         |         |
   0+25      0.0113      0.46  VQ         |         |         |         |
   0+30      0.0145      0.47  VQ         |         |         |         |
   0+35      0.0178      0.48  VQ         |         |         |         |
   0+40      0.0211      0.48  VQ         |         |         |         |
   0+45      0.0243      0.48  VQ         |         |         |         |
   0+50      0.0282      0.56  V Q        |         |         |         |
   0+55      0.0325      0.62  V Q        |         |         |         |
   1+ 0      0.0368      0.63  V Q        |         |         |         |
   1+ 5      0.0406      0.55  V Q        |         |         |         |
   1+10      0.0440      0.49  VQ         |         |         |         |
   1+15      0.0473      0.48  VQ         |         |         |         |
   1+20      0.0505      0.48  VQ         |         |         |         |
   1+25      0.0538      0.48  VQ         |         |         |         |
   1+30      0.0571      0.48  VQ         |         |         |         |
   1+35      0.0604      0.48  VQ         |         |         |         |
   1+40      0.0637      0.48  VQ         |         |         |         |
   1+45      0.0669      0.48  VQ         |         |         |         |
   1+50      0.0708      0.56  V Q        |         |         |         |
   1+55      0.0751      0.62  V Q        |         |         |         |
   2+ 0      0.0794      0.63  V Q        |         |         |         |
   2+ 5      0.0838      0.63  |VQ        |         |         |         |
   2+10      0.0881      0.63  |VQ        |         |         |         |
   2+15      0.0925      0.63  |VQ        |         |         |         |
   2+20      0.0969      0.63  |VQ        |         |         |         |
   2+25      0.1012      0.63  |VQ        |         |         |         |
   2+30      0.1056      0.63  |VQ        |         |         |         |
   2+35      0.1106      0.72  |VQ        |         |         |         |
   2+40      0.1159      0.78  |V Q       |         |         |         |
   2+45      0.1214      0.79  |V Q       |         |         |         |
   2+50      0.1268      0.79  |V Q       |         |         |         |
   2+55      0.1323      0.79  |V Q       |         |         |         |
   3+ 0      0.1377      0.79  |V Q       |         |         |         |
   3+ 5      0.1432      0.79  |V Q       |         |         |         |
```

```
3+10       0.1487      0.79  |V Q      |         |         |         |
3+15       0.1541      0.79  |V Q      |         |         |         |
3+20       0.1596      0.79  |V Q      |         |         |         |
3+25       0.1650      0.79  | VQ      |         |         |         |
3+30       0.1705      0.79  | VQ      |         |         |         |
3+35       0.1760      0.79  | VQ      |         |         |         |
3+40       0.1814      0.79  | VQ      |         |         |         |
3+45       0.1869      0.79  | VQ      |         |         |         |
3+50       0.1929      0.88  | VQ      |         |         |         |
3+55       0.1994      0.94  | VQ      |         |         |         |
4+ 0       0.2059      0.95  | VQ      |         |         |         |
4+ 5       0.2125      0.95  | VQ      |         |         |         |
4+10       0.2190      0.95  | VQ      |         |         |         |
4+15       0.2256      0.95  | VQ      |         |         |         |
4+20       0.2327      1.03  | V Q     |         |         |         |
4+25       0.2402      1.10  | V Q     |         |         |         |
4+30       0.2479      1.11  |  VQ     |         |         |         |
4+35       0.2555      1.11  |  VQ     |         |         |         |
4+40       0.2632      1.11  |  VQ     |         |         |         |
4+45       0.2708      1.11  |  VQ     |         |         |         |
4+50       0.2790      1.19  |  VQ     |         |         |         |
4+55       0.2877      1.26  |  V Q    |         |         |         |
5+ 0       0.2964      1.27  |  V Q    |         |         |         |
5+ 5       0.3040      1.10  |  VQ     |         |         |         |
5+10       0.3107      0.98  |  Q      |         |         |         |
5+15       0.3173      0.96  |  Q      |         |         |         |
5+20       0.3244      1.03  |  VQ     |         |         |         |
5+25       0.3320      1.10  |   Q     |         |         |         |
5+30       0.3396      1.11  |   Q     |         |         |         |
5+35       0.3478      1.19  |   Q     |         |         |         |
5+40       0.3564      1.26  |   VQ    |         |         |         |
5+45       0.3652      1.27  |   VQ    |         |         |         |
5+50       0.3739      1.27  |   VQ    |         |         |         |
5+55       0.3826      1.27  |   VQ    |         |         |         |
6+ 0       0.3914      1.27  |   VQ    |         |         |         |
6+ 5       0.4007      1.35  |   VQ    |         |         |         |
6+10       0.4104      1.41  |   VQ    |         |         |         |
6+15       0.4202      1.42  |    Q    |         |         |         |
6+20       0.4301      1.43  |    Q    |         |         |         |
6+25       0.4399      1.43  |    Q    |         |         |         |
6+30       0.4497      1.43  |    Q    |         |         |         |
6+35       0.4601      1.51  |    VQ   |         |         |         |
6+40       0.4709      1.57  |    VQ   |         |         |         |
6+45       0.4818      1.58  |    VQ   |         |         |         |
6+50       0.4928      1.59  |    VQ   |         |         |         |
6+55       0.5037      1.59  |     Q   |         |         |         |
7+ 0       0.5146      1.59  |     Q   |         |         |         |
7+ 5       0.5255      1.59  |     Q   |         |         |         |
7+10       0.5364      1.59  |     Q   |         |         |         |
7+15       0.5474      1.59  |     Q   |         |         |         |
7+20       0.5588      1.67  |     Q   |         |         |         |
7+25       0.5708      1.73  |     Q   |         |         |         |
7+30       0.5828      1.74  |     QV  |         |         |         |
7+35       0.5953      1.83  |      Q  |         |         |         |
7+40       0.6084      1.89  |      Q  |         |         |         |
7+45       0.6214      1.90  |      Q  |         |         |         |
7+50       0.6351      1.99  |      Q  |         |         |         |
7+55       0.6492      2.05  |      VQ |         |         |         |
8+ 0       0.6634      2.06  |       Q |         |         |         |
8+ 5       0.6788      2.23  |       Q |         |         |         |
8+10       0.6950      2.35  |       VQ|         |         |         |
8+15       0.7113      2.37  |       VQ|         |         |         |
8+20       0.7277      2.38  |       VQ|         |         |         |
8+25       0.7441      2.38  |        Q|         |         |         |
8+30       0.7604      2.38  |        Q|         |         |         |
8+35       0.7774      2.46  |        Q|         |         |         |
8+40       0.7948      2.52  |        VQ         |         |         |
8+45       0.8122      2.53  |        VQ         |         |         |
8+50       0.8303      2.62  |         Q         |         |         |
8+55       0.8487      2.68  |         Q         |         |         |
9+ 0       0.8673      2.69  |         Q         |         |         |
9+ 5       0.8870      2.86  |         VQ        |         |         |
9+10       0.9076      2.99  |         |Q        |         |         |
9+15       0.9283      3.01  |         |VQ       |         |         |
9+20       0.9496      3.10  |         |VQ       |         |         |
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 9+25        0.9713        3.16  |         |VQ       |         |         |
 9+30        0.9932        3.17  |         | Q       |         |         |
 9+35        1.0156        3.25  |         | VQ      |         |         |
 9+40        1.0384        3.32  |         | VQ      |         |         |
 9+45        1.0613        3.33  |         | VQ      |         |         |
 9+50        1.0848        3.41  |         |  Q      |         |         |
 9+55        1.1088        3.47  |         |  Q      |         |         |
10+ 0        1.1328        3.49  |         |  Q      |         |         |
10+ 5        1.1527        2.90  |         |Q V      |         |         |
10+10        1.1697        2.47  |        Q|   V     |         |         |
10+15        1.1862        2.39  |        Q|   V     |         |         |
10+20        1.2026        2.38  |        Q|   V     |         |         |
10+25        1.2190        2.38  |        Q|   V     |         |         |
10+30        1.2354        2.38  |        Q|   V     |         |         |
10+35        1.2546        2.80  |         |Q   V    |         |         |
10+40        1.2760        3.11  |         | Q  V    |         |         |
10+45        1.2978        3.16  |         | Q  V    |         |         |
10+50        1.3196        3.17  |         | Q   V   |         |         |
10+55        1.3414        3.17  |         | Q   V   |         |         |
11+ 0        1.3633        3.17  |         | Q   V   |         |         |
11+ 5        1.3845        3.09  |         | Q   V   |         |         |
11+10        1.4054        3.02  |         | Q    V  |         |         |
11+15        1.4261        3.01  |         | Q    V  |         |         |
11+20        1.4469        3.01  |         | Q    V  |         |         |
11+25        1.4676        3.01  |         | Q    V  |         |         |
11+30        1.4884        3.01  |         | Q     V |         |         |
11+35        1.5080        2.84  |         |Q      V |         |         |
11+40        1.5267        2.72  |         Q       V |         |         |
11+45        1.5453        2.70  |         Q       V |         |         |
11+50        1.5644        2.78  |         |Q      V |         |         |
11+55        1.5840        2.84  |         |Q       V|         |         |
12+ 0        1.6036        2.85  |         |Q       V|         |         |
12+ 5        1.6273        3.44  |         |  Q     V|         |         |
12+10        1.6540        3.87  |         |    Q    V         |         |
12+15        1.6812        3.95  |         |    Q    V         |         |
12+20        1.7090        4.05  |         |     Q   V         |         |
12+25        1.7373        4.11  |         |     Q   |V        |         |
12+30        1.7657        4.12  |         |     Q   |V        |         |
12+35        1.7953        4.29  |         |      Q  |V        |         |
12+40        1.8257        4.41  |         |      Q  | V       |         |
12+45        1.8562        4.44  |         |      Q  | V       |         |
12+50        1.8876        4.56  |         |       Q | V       |         |
12+55        1.9196        4.65  |         |       Q |  V      |         |
13+ 0        1.9518        4.67  |         |       Q |  V      |         |
13+ 5        1.9880        5.26  |         |         |Q  V     |         |
13+10        2.0272        5.69  |         |         | Q V     |         |
13+15        2.0669        5.76  |         |         |  Q V    |         |
13+20        2.1068        5.79  |         |         |  Q V    |         |
13+25        2.1467        5.80  |         |         |  Q  V   |         |
13+30        2.1867        5.80  |         |         |  Q  V   |         |
13+35        2.2188        4.67  |         |       Q |     V   |         |
13+40        2.2451        3.82  |         |    Q    |      V  |         |
13+45        2.2704        3.68  |         |   Q     |      V  |         |
13+50        2.2955        3.65  |         |   Q     |      V  |         |
13+55        2.3207        3.65  |         |   Q     |       V |         |
14+ 0        2.3458        3.65  |         |   Q     |       V |         |
14+ 5        2.3734        4.02  |         |     Q   |       V |         |
14+10        2.4030        4.30  |         |      Q  |        V|         |
14+15        2.4330        4.35  |         |      Q  |        V|         |
14+20        2.4623        4.26  |         |      Q  |        V|         |
14+25        2.4911        4.18  |         |     Q   |         V         |
14+30        2.5198        4.17  |         |     Q   |         V         |
14+35        2.5486        4.18  |         |     Q   |         V         |
14+40        2.5774        4.18  |         |     Q   |         |V        |
14+45        2.6063        4.19  |         |     Q   |         |V        |
14+50        2.6344        4.08  |         |     Q   |         |V        |
14+55        2.6620        4.01  |         |     Q   |         | V       |
15+ 0        2.6895        4.00  |         |    Q    |         | V       |
15+ 5        2.7164        3.90  |         |    Q    |         | V       |
15+10        2.7427        3.82  |         |    Q    |         |  V      |
15+15        2.7689        3.81  |         |    Q    |         |  V      |
15+20        2.7945        3.72  |         |   Q     |         |  V      |
15+25        2.8197        3.66  |         |   Q     |         |   V     |
15+30        2.8449        3.65  |         |   Q     |         |   V     |
15+35        2.8677        3.31  |         |  Q      |         |   V     |
```

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15+40       2.8888      3.06  |         | Q       |         |    V    |
15+45       2.9096      3.02  |         | Q       |         |    V    |
15+50       2.9303      3.01  |         | Q       |         |    V    |
15+55       2.9510      3.01  |         | Q       |         |    V    |
16+ 0       2.9718      3.01  |         | Q       |         |     V   |
16+ 5       2.9839      1.76  |      Q  |         |         |     V   |
16+10       2.9896      0.83  |  Q      |         |         |     V   |
16+15       2.9942      0.67  | Q       |         |         |     V   |
16+20       2.9985      0.63  | Q       |         |         |     V   |
16+25       3.0029      0.63  | Q       |         |         |     V   |
16+30       3.0073      0.63  | Q       |         |         |     V   |
16+35       3.0111      0.55  | Q       |         |         |     V   |
16+40       3.0144      0.49  |Q        |         |         |     V   |
16+45       3.0177      0.48  |Q        |         |         |     V   |
16+50       3.0210      0.48  |Q        |         |         |     V   |
16+55       3.0243      0.48  |Q        |         |         |     V   |
17+ 0       3.0276      0.48  |Q        |         |         |     V   |
17+ 5       3.0320      0.64  | Q       |         |         |     V   |
17+10       3.0373      0.77  |  Q      |         |         |     V   |
17+15       3.0427      0.79  |  Q      |         |         |     V   |
17+20       3.0482      0.79  |  Q      |         |         |     V   |
17+25       3.0536      0.79  |  Q      |         |         |      V  |
17+30       3.0591      0.79  |  Q      |         |         |      V  |
17+35       3.0645      0.79  |  Q      |         |         |      V  |
17+40       3.0700      0.79  |  Q      |         |         |      V  |
17+45       3.0754      0.79  |  Q      |         |         |      V  |
17+50       3.0803      0.71  | Q       |         |         |      V  |
17+55       3.0848      0.65  | Q       |         |         |      V  |
18+ 0       3.0892      0.64  | Q       |         |         |      V  |
18+ 5       3.0935      0.63  | Q       |         |         |      V  |
18+10       3.0979      0.63  | Q       |         |         |      V  |
18+15       3.1023      0.63  | Q       |         |         |      V  |
18+20       3.1066      0.63  | Q       |         |         |      V  |
18+25       3.1110      0.63  | Q       |         |         |      V  |
18+30       3.1154      0.63  | Q       |         |         |      V  |
18+35       3.1192      0.55  | Q       |         |         |      V  |
18+40       3.1225      0.49  |Q        |         |         |      V  |
18+45       3.1258      0.48  |Q        |         |         |      V  |
18+50       3.1285      0.39  |Q        |         |         |      V  |
18+55       3.1308      0.33  |Q        |         |         |      V  |
19+ 0       3.1330      0.32  |Q        |         |         |      V  |
19+ 5       3.1357      0.40  |Q        |         |         |       V |
19+10       3.1389      0.46  |Q        |         |         |       V |
19+15       3.1422      0.47  |Q        |         |         |       V |
19+20       3.1460      0.56  | Q       |         |         |       V |
19+25       3.1503      0.62  | Q       |         |         |       V |
19+30       3.1547      0.63  | Q       |         |         |       V |
19+35       3.1585      0.55  | Q       |         |         |       V |
19+40       3.1618      0.49  |Q        |         |         |       V |
19+45       3.1651      0.48  |Q        |         |         |       V |
19+50       3.1678      0.39  |Q        |         |         |       V |
19+55       3.1701      0.33  |Q        |         |         |       V |
20+ 0       3.1723      0.32  |Q        |         |         |       V |
20+ 5       3.1751      0.40  |Q        |         |         |       V |
20+10       3.1782      0.46  |Q        |         |         |       V |
20+15       3.1815      0.47  |Q        |         |         |       V |
20+20       3.1848      0.48  |Q        |         |         |       V |
20+25       3.1880      0.48  |Q        |         |         |       V |
20+30       3.1913      0.48  |Q        |         |         |       V |
20+35       3.1946      0.48  |Q        |         |         |       V |
20+40       3.1979      0.48  |Q        |         |         |       V |
20+45       3.2012      0.48  |Q        |         |         |       V |
20+50       3.2038      0.39  |Q        |         |         |       V |
20+55       3.2061      0.33  |Q        |         |         |       V |
21+ 0       3.2083      0.32  |Q        |         |         |       V |
21+ 5       3.2111      0.40  |Q        |         |         |       V |
21+10       3.2143      0.46  |Q        |         |         |       V |
21+15       3.2175      0.47  |Q        |         |         |        V|
21+20       3.2202      0.39  |Q        |         |         |        V|
21+25       3.2225      0.33  |Q        |         |         |        V|
21+30       3.2247      0.32  |Q        |         |         |        V|
21+35       3.2275      0.40  |Q        |         |         |        V|
21+40       3.2306      0.46  |Q        |         |         |        V|
21+45       3.2339      0.47  |Q        |         |         |        V|
21+50       3.2366      0.39  |Q        |         |         |        V|
```

```
   21+55       3.2389      0.33  |Q         |         |         |        V|
   22+ 0       3.2411      0.32  |Q         |         |         |        V|
   22+ 5       3.2438      0.40  |Q         |         |         |        V|
   22+10       3.2470      0.46  |Q         |         |         |        V|
   22+15       3.2503      0.47  |Q         |         |         |        V|
   22+20       3.2530      0.39  |Q         |         |         |        V|
   22+25       3.2553      0.33  |Q         |         |         |        V|
   22+30       3.2575      0.32  |Q         |         |         |        V|
   22+35       3.2596      0.32  |Q         |         |         |        V|
   22+40       3.2618      0.32  |Q         |         |         |        V|
   22+45       3.2640      0.32  |Q         |         |         |        V|
   22+50       3.2662      0.32  |Q         |         |         |        V|
   22+55       3.2684      0.32  |Q         |         |         |        V|
   23+ 0       3.2706      0.32  |Q         |         |         |        V|
   23+ 5       3.2727      0.32  |Q         |         |         |        V|
   23+10       3.2749      0.32  |Q         |         |         |        V|
   23+15       3.2771      0.32  |Q         |         |         |        V|
   23+20       3.2793      0.32  |Q         |         |         |        V|
   23+25       3.2815      0.32  |Q         |         |         |        V|
   23+30       3.2837      0.32  |Q         |         |         |        V|
   23+35       3.2858      0.32  |Q         |         |         |        V|
   23+40       3.2880      0.32  |Q         |         |         |        V|
   23+45       3.2902      0.32  |Q         |         |         |        V|
   23+50       3.2924      0.32  |Q         |         |         |        V|
   23+55       3.2946      0.32  |Q         |         |         |        V|
   24+ 0       3.2968      0.32  |Q         |         |         |        V|
   24+ 5       3.2978      0.15  Q          |         |         |        V|
   24+10       3.2980      0.03  Q          |         |         |        V|
   24+15       3.2980      0.00  Q          |         |         |         V
-----------------------------------------------------------------------
```

FLOOD HYDROGRAPH ROUTING PROGRAM
Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2005
Study date: 05/12/21

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PROPOSED 100-YR, 1-HOUR STORM EVENT
REDLANDS EAST - ROUTING
20-0181 UG CHAMBER STORAGE PUMP 5.0 CFS
05/12/2021   AYS

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Program License Serial Number 4010

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```
******************** HYDROGRAPH INFORMATION *********************

               From study/file name: PROPEAST1001100.rte
***************************HYDROGRAPH DATA***************************
               Number of intervals =    15
               Time interval =    5.0 (Min.)
               Maximum/Peak flow rate =       36.373 (CFS)
               Total volume =       1.112 (Ac.Ft)
       Status of hydrographs being held in storage
                  Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
       Peak (CFS)      0.000     0.000     0.000     0.000     0.000
       Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
*********************************************************************
```

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      200.000 to Point/Station      201.000
**** RETARDING BASIN ROUTING ****
```

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User entry of depth-outflow-storage data

---

Total number of inflow hydrograph intervals = 15
Hydrograph time unit =  5.000 (Min.)
Initial depth in storage basin =   0.00(Ft.)

---

Initial basin depth =   0.00 (Ft.)
Initial basin storage =      0.00 (Ac.Ft)
Initial basin outflow =   0.00 (CFS)

---

Depth vs. Storage and Depth vs. Discharge data:

| Basin Depth (Ft.) | Storage (Ac.Ft) | Outflow (CFS) | (S-O*dt/2) (Ac.Ft) | (S+O*dt/2) (Ac.Ft) |
|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.500 | 0.184 | 5.000 | 0.167 | 0.201 |
| 1.000 | 0.286 | 5.000 | 0.269 | 0.303 |
| 1.500 | 0.384 | 5.000 | 0.367 | 0.401 |
| 2.000 | 0.479 | 5.000 | 0.462 | 0.496 |
| 2.500 | 0.568 | 5.000 | 0.551 | 0.585 |
| 3.000 | 0.650 | 5.000 | 0.633 | 0.667 |
| 3.500 | 0.720 | 5.000 | 0.703 | 0.737 |
| 4.000 | 0.775 | 5.000 | 0.758 | 0.792 |
| 4.500 | 0.829 | 5.000 | 0.812 | 0.846 |
| 5.000 | 0.883 | 5.000 | 0.866 | 0.900 |

---

Hydrograph Detention Basin Routing

---

Graph values: 'I'= unit inflow; 'O'=outflow at time shown

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```
 Time    Inflow  Outflow    Storage                                    Depth
(Hours)  (CFS)   (CFS)     (Ac.Ft) .0       9.1   18.19   27.28   36.37 (Ft.)
```

```
0.083    3.11    0.27      0.010  O I     |       |       |       |     0.03
0.167    5.51    0.96      0.035  O   I   |       |       |       |     0.10
0.250    6.65    1.84      0.068  |O   I  |       |       |       |     0.18
0.333    7.25    2.71      0.100  | O   I |       |       |       |     0.27
0.417    8.11    3.56      0.131  |  O   I|       |       |       |     0.36
0.500    9.38    4.45      0.164  |  O    I       |       |       |     0.44
0.583   10.84    5.00      0.201  |   O   |I      |       |       |     0.58
0.667   12.75    5.00      0.248  |   O   |  I    |       |       |     0.81
0.750   17.32    5.00      0.317  |   O   |      I|       |       |     1.16
0.833   36.37    5.00      0.467  |   O   |       |       |       I     1.94
0.917   27.31    5.00      0.652  |   O   |       |       I       |     3.01
1.000   11.73    5.00      0.752  |   O   | I     |       |       |     3.79
1.083    4.35    5.00      0.773  |  IO   |       |       |       |     3.98
1.167    0.64    5.00      0.756  I   O   |       |       |       |     3.82
1.250    0.11    5.00      0.724  I   O   |       |       |       |     3.53
1.333    0.00    5.00      0.690  I   O   |       |       |       |     3.28
1.417    0.00    5.00      0.655  I   O   |       |       |       |     3.04
1.500    0.00    5.00      0.621  I   O   |       |       |       |     2.82
1.583    0.00    5.00      0.586  I   O   |       |       |       |     2.61
1.667    0.00    5.00      0.552  I   O   |       |       |       |     2.41
1.750    0.00    5.00      0.518  I   O   |       |       |       |     2.22
1.833    0.00    5.00      0.483  I   O   |       |       |       |     2.02
1.917    0.00    5.00      0.449  I   O   |       |       |       |     1.84
2.000    0.00    5.00      0.414  I   O   |       |       |       |     1.66
2.083    0.00    5.00      0.380  I   O   |       |       |       |     1.48
2.167    0.00    5.00      0.345  I   O   |       |       |       |     1.30
2.250    0.00    5.00      0.311  I   O   |       |       |       |     1.13
2.333    0.00    5.00      0.277  I   O   |       |       |       |     0.95
2.417    0.00    5.00      0.242  I   O   |       |       |       |     0.78
2.500    0.00    5.00      0.208  I   O   |       |       |       |     0.62
2.583    0.00    4.73      0.174  I   O   |       |       |       |     0.47
2.667    0.00    3.92      0.144  I  O    |       |       |       |     0.39
2.750    0.00    3.25      0.120  I O     |       |       |       |     0.33
2.833    0.00    2.70      0.099  I O     |       |       |       |     0.27
2.917    0.00    2.23      0.082  IO      |       |       |       |     0.22
3.000    0.00    1.85      0.068  IO      |       |       |       |     0.19
3.083    0.00    1.53      0.056  IO      |       |       |       |     0.15
3.167    0.00    1.27      0.047  IO      |       |       |       |     0.13
3.250    0.00    1.05      0.039  O       |       |       |       |     0.11
3.333    0.00    0.87      0.032  O       |       |       |       |     0.09
3.417    0.00    0.72      0.027  O       |       |       |       |     0.07
3.500    0.00    0.60      0.022  O       |       |       |       |     0.06
3.583    0.00    0.50      0.018  O       |       |       |       |     0.05
3.667    0.00    0.41      0.015  O       |       |       |       |     0.04
3.750    0.00    0.34      0.013  O       |       |       |       |     0.03
3.833    0.00    0.28      0.010  O       |       |       |       |     0.03
3.917    0.00    0.23      0.009  O       |       |       |       |     0.02
4.000    0.00    0.19      0.007  O       |       |       |       |     0.02
4.083    0.00    0.16      0.006  O       |       |       |       |     0.02
4.167    0.00    0.13      0.005  O       |       |       |       |     0.01
4.250    0.00    0.11      0.004  O       |       |       |       |     0.01
4.333    0.00    0.09      0.003  O       |       |       |       |     0.01
4.417    0.00    0.08      0.003  O       |       |       |       |     0.01
4.500    0.00    0.06      0.002  O       |       |       |       |     0.01
4.583    0.00    0.05      0.002  O       |       |       |       |     0.01
4.667    0.00    0.04      0.002  O       |       |       |       |     0.00
4.750    0.00    0.04      0.001  O       |       |       |       |     0.00
4.833    0.00    0.03      0.001  O       |       |       |       |     0.00
4.917    0.00    0.02      0.001  O       |       |       |       |     0.00
5.000    0.00    0.02      0.001  O       |       |       |       |     0.00
5.083    0.00    0.02      0.001  O       |       |       |       |     0.00
5.167    0.00    0.01      0.001  O       |       |       |       |     0.00
5.250    0.00    0.01      0.000  O       |       |       |       |     0.00
5.333    0.00    0.01      0.000  O       |       |       |       |     0.00

     ****************************HYDROGRAPH DATA***************************
                  Number of intervals =    64
                  Time interval =    5.0 (Min.)
                  Maximum/Peak flow rate =        5.000 (CFS)
                  Total volume =       1.111 (Ac.Ft)
          Status of hydrographs being held in storage
                     Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
          Peak (CFS)      0.000     0.000     0.000     0.000     0.000
          Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
     **********************************************************************
```

FLOOD HYDROGRAPH ROUTING PROGRAM



Study date: 05/12/21

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PROPOSED 100-YR, 3-HOUR STORM EVENT
REDLANDS EAST - ROUTING
20-0181 UG CHAMBER STORAGE PUMP 5.0 CFS
05/12/2021   AYS

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Program License Serial Number 4010

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******************** HYDROGRAPH INFORMATION *********************

From study/file name: PROPEAST1003100.rte

****************************HYDROGRAPH DATA****************************

Number of intervals = 39
Time interval = 5.0 (Min.)
Maximum/Peak flow rate = 20.471 (CFS)
Total volume = 1.621 (Ac.Ft)

Status of hydrographs being held in storage

| | Stream 1 | Stream 2 | Stream 3 | Stream 4 | Stream 5 |
|---|---|---|---|---|---|
| Peak (CFS) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Vol (Ac.Ft) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

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Process from Point/Station 200.000 to Point/Station 201.000

**** RETARDING BASIN ROUTING ****

---

User entry of depth-outflow-storage data

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Total number of inflow hydrograph intervals = 39
Hydrograph time unit = 5.000 (Min.)
Initial depth in storage basin = 0.00(Ft.)

---

Initial basin depth = 0.00 (Ft.)
Initial basin storage = 0.00 (Ac.Ft)
Initial basin outflow = 0.00 (CFS)

---

Depth vs. Storage and Depth vs. Discharge data:

| Basin Depth (Ft.) | Storage (Ac.Ft) | Outflow (CFS) | (S-O*dt/2) (Ac.Ft) | (S+O*dt/2) (Ac.Ft) |
|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.500 | 0.184 | 5.000 | 0.167 | 0.201 |
| 1.000 | 0.286 | 5.000 | 0.269 | 0.303 |
| 1.500 | 0.384 | 5.000 | 0.367 | 0.401 |
| 2.000 | 0.479 | 5.000 | 0.462 | 0.496 |
| 2.500 | 0.568 | 5.000 | 0.551 | 0.585 |
| 3.000 | 0.650 | 5.000 | 0.633 | 0.667 |
| 3.500 | 0.720 | 5.000 | 0.703 | 0.737 |
| 4.000 | 0.775 | 5.000 | 0.758 | 0.792 |
| 4.500 | 0.829 | 5.000 | 0.812 | 0.846 |
| 5.000 | 0.883 | 5.000 | 0.866 | 0.900 |

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Hydrograph Detention Basin Routing

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Graph values: 'I'= unit inflow; 'O'=outflow at time shown

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| Time (Hours) | Inflow (CFS) | Outflow (CFS) | Storage (Ac.Ft) | .0 | 5.1 | 10.24 | 15.35 | 20.47 | Depth (Ft.) |
|---|---|---|---|---|---|---|---|---|---|

```
0.083    1.46    0.12      0.005  O I     |       |       |       |     0.01
0.167    2.54    0.45      0.016  O  I    |       |       |       |     0.04
0.250    2.50    0.80      0.029  |O I    |       |       |       |     0.08
0.333    2.82    1.12      0.041  |O  I   |       |       |       |     0.11
0.417    3.13    1.44      0.053  | O I   |       |       |       |     0.14
0.500    3.51    1.76      0.065  | O  I  |       |       |       |     0.18
0.583    3.44    2.05      0.076  |  O I  |       |       |       |     0.21
0.667    3.57    2.30      0.085  |  O I  |       |       |       |     0.23
0.750    3.79    2.54      0.093  |  O I  |       |       |       |     0.25
0.833    3.48    2.72      0.100  |   OI  |       |       |       |     0.27
0.917    3.35    2.84      0.105  |   OI  |       |       |       |     0.28
1.000    3.62    2.95      0.109  |   OI  |       |       |       |     0.30
1.083    4.24    3.12      0.115  |   O I |       |       |       |     0.31
1.167    4.60    3.34      0.123  |    O I|       |       |       |     0.33
1.250    4.66    3.56      0.131  |    O I|       |       |       |     0.36
1.333    4.45    3.73      0.137  |    OI |       |       |       |     0.37
1.417    5.07    3.91      0.144  |     OI|       |       |       |     0.39
1.500    5.78    4.17      0.153  |     O |I      |       |       |     0.42
1.583    5.52    4.42      0.163  |     O I       |       |       |     0.44
1.667    5.69    4.63      0.170  |      OI       |       |       |     0.46
1.750    6.89    4.91      0.181  |      O| I     |       |       |     0.49
1.833    7.31    5.00      0.195  |      O|  I    |       |       |     0.56
1.917    6.90    5.00      0.210  |      O| I     |       |       |     0.63
2.000    6.82    5.00      0.223  |      O| I     |       |       |     0.69
2.083    7.04    5.00      0.236  |      O|  I    |       |       |     0.76
2.167    8.84    5.00      0.256  |      O|    I  |       |       |     0.85
2.250   11.34    5.00      0.291  |      O|       |I      |       |     1.03
2.333   10.16    5.00      0.331  |      O|      I|       |       |     1.23
2.417   13.71    5.00      0.379  |      O|       |    I  |       |     1.47
2.500   17.97    5.00      0.453  |      O|       |       |   I   |     1.87
2.583   20.47    5.00      0.551  |      O|       |       |       I     2.41
2.667   18.21    5.00      0.650  |      O|       |       |   I   |     3.00
2.750    9.96    5.00      0.713  |      O|      I|       |       |     3.45
2.833    5.02    5.00      0.730  |      O|       |       |       |     3.59
2.917    4.03    5.00      0.726  |     IO|       |       |       |     3.56
3.000    2.49    5.00      0.714  |  I   O|       |       |       |     3.46
3.083    0.81    5.00      0.691  |I     O|       |       |       |     3.30
3.167    0.14    5.00      0.660  I      O|       |       |       |     3.07
3.250    0.02    5.00      0.626  I      O|       |       |       |     2.86
3.333    0.00    5.00      0.592  I      O|       |       |       |     2.65
3.417    0.00    5.00      0.557  I      O|       |       |       |     2.44
3.500    0.00    5.00      0.523  I      O|       |       |       |     2.25
3.583    0.00    5.00      0.489  I      O|       |       |       |     2.05
3.667    0.00    5.00      0.454  I      O|       |       |       |     1.87
3.750    0.00    5.00      0.420  I      O|       |       |       |     1.69
3.833    0.00    5.00      0.385  I      O|       |       |       |     1.51
3.917    0.00    5.00      0.351  I      O|       |       |       |     1.33
4.000    0.00    5.00      0.316  I      O|       |       |       |     1.16
4.083    0.00    5.00      0.282  I      O|       |       |       |     0.98
4.167    0.00    5.00      0.248  I      O|       |       |       |     0.81
4.250    0.00    5.00      0.213  I      O|       |       |       |     0.64
4.333    0.00    4.87      0.179  I      O|       |       |       |     0.49
4.417    0.00    4.04      0.149  I     O |       |       |       |     0.40
4.500    0.00    3.34      0.123  I    O  |       |       |       |     0.33
4.583    0.00    2.77      0.102  I   O   |       |       |       |     0.28
4.667    0.00    2.30      0.085  I  O    |       |       |       |     0.23
4.750    0.00    1.90      0.070  I O     |       |       |       |     0.19
4.833    0.00    1.58      0.058  I O     |       |       |       |     0.16
4.917    0.00    1.31      0.048  I O     |       |       |       |     0.13
5.000    0.00    1.08      0.040  IO      |       |       |       |     0.11
5.083    0.00    0.90      0.033  IO      |       |       |       |     0.09
5.167    0.00    0.75      0.027  IO      |       |       |       |     0.07
5.250    0.00    0.62      0.023  O       |       |       |       |     0.06
5.333    0.00    0.51      0.019  O       |       |       |       |     0.05
5.417    0.00    0.42      0.016  O       |       |       |       |     0.04
5.500    0.00    0.35      0.013  O       |       |       |       |     0.04
5.583    0.00    0.29      0.011  O       |       |       |       |     0.03
5.667    0.00    0.24      0.009  O       |       |       |       |     0.02
5.750    0.00    0.20      0.007  O       |       |       |       |     0.02
5.833    0.00    0.17      0.006  O       |       |       |       |     0.02
5.917    0.00    0.14      0.005  O       |       |       |       |     0.01
6.000    0.00    0.11      0.004  O       |       |       |       |     0.01
6.083    0.00    0.09      0.003  O       |       |       |       |     0.01
6.167    0.00    0.08      0.003  O       |       |       |       |     0.01
6.250    0.00    0.06      0.002  O       |       |       |       |     0.01
```

```
6.333    0.00    0.05      0.002  O        |        |        |        |      0.01
6.417    0.00    0.04      0.002  O        |        |        |        |      0.00
6.500    0.00    0.04      0.001  O        |        |        |        |      0.00
6.583    0.00    0.03      0.001  O        |        |        |        |      0.00
6.667    0.00    0.03      0.001  O        |        |        |        |      0.00
6.750    0.00    0.02      0.001  O        |        |        |        |      0.00
6.833    0.00    0.02      0.001  O        |        |        |        |      0.00
6.917    0.00    0.01      0.001  O        |        |        |        |      0.00
7.000    0.00    0.01      0.000  O        |        |        |        |      0.00
7.083    0.00    0.01      0.000  O        |        |        |        |      0.00

     ****************************HYDROGRAPH DATA****************************
                Number of intervals =    85
                Time interval =    5.0 (Min.)
                Maximum/Peak flow rate =        5.000 (CFS)
                Total volume =       1.620 (Ac.Ft)
        Status of hydrographs being held in storage
                   Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
        Peak (CFS)      0.000     0.000     0.000     0.000     0.000
        Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
     ***********************************************************************

     --------------------------------------------------------------------
```

```
                    FLOOD HYDROGRAPH ROUTING PROGRAM
           Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2005
                       Study date: 05/12/21

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 PROPOSED 100-YR, 6-HOUR STORM EVENT
 REDLANDS EAST - ROUTING
 20-0181 UG CHAMBER STORAGE PUMP 5.0 CFS
 05/12/2021   AYS
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 Program License Serial Number 4010

 --------------------------------------------------------------------
 ********************* HYDROGRAPH INFORMATION **********************

               From study/file name: PROPEAST1006100.rte
 ****************************HYDROGRAPH DATA****************************
               Number of intervals =    75
               Time interval =    5.0 (Min.)
               Maximum/Peak flow rate =       17.764 (CFS)
               Total volume =       2.063 (Ac.Ft)
        Status of hydrographs being held in storage
                   Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
        Peak (CFS)      0.000     0.000     0.000     0.000     0.000
        Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
 **********************************************************************



 ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
 Process from Point/Station      200.000 to Point/Station      201.000
 **** RETARDING BASIN ROUTING ****
 ______________________________________________________________________

 User entry of depth-outflow-storage data
 --------------------------------------------------------------------
 Total number of inflow hydrograph intervals = 75
 Hydrograph time unit =  5.000 (Min.)
 Initial depth in storage basin =   0.00(Ft.)
 --------------------------------------------------------------------
 --------------------------------------------------------------------
 Initial basin depth =   0.00 (Ft.)
 Initial basin storage =      0.00 (Ac.Ft)
 Initial basin outflow =   0.00 (CFS)
 ---------------------------------------------------------------------
 --------------------------------------------------------------------
 Depth vs. Storage and Depth vs. Discharge data:
  Basin Depth  Storage    Outflow   (S-O*dt/2)   (S+O*dt/2)
      (Ft.)    (Ac.Ft)    (CFS)     (Ac.Ft)    (Ac.Ft)
 ---------------------------------------------------------------------
    0.000      0.000      0.000      0.000        0.000
    0.500      0.184      5.000      0.167        0.201
    1.000      0.286      5.000      0.269        0.303
    1.500      0.384      5.000      0.367        0.401
    2.000      0.479      5.000      0.462        0.496
    2.500      0.568      5.000      0.551        0.585
    3.000      0.650      5.000      0.633        0.667
    3.500      0.720      5.000      0.703        0.737
    4.000      0.775      5.000      0.758        0.792
    4.500      0.829      5.000      0.812        0.846
    5.000      0.883      5.000      0.866        0.900
 --------------------------------------------------------------------
               Hydrograph Detention Basin Routing
 ---------------------------------------------------------------------

 Graph values: 'I'= unit inflow; 'O'=outflow at time shown
 ---------------------------------------------------------------------
 Time   Inflow  Outflow    Storage                                   Depth
(Hours)  (CFS)   (CFS)     (Ac.Ft) .0       4.4    8.88   13.32   17.76 (Ft.)
```

```
0.083    0.74    0.06      0.002  OI      |       |       |       |     0.01
0.167    1.43    0.24      0.009  O I     |       |       |       |     0.02
0.250    1.63    0.46      0.017  O I     |       |       |       |     0.05
0.333    1.67    0.66      0.024  |O I    |       |       |       |     0.07
0.417    1.68    0.84      0.031  |O I    |       |       |       |     0.08
0.500    1.83    0.99      0.037  |O I    |       |       |       |     0.10
0.583    1.94    1.15      0.042  | OI    |       |       |       |     0.11
0.667    1.95    1.28      0.047  | OI    |       |       |       |     0.13
0.750    1.96    1.40      0.051  | OI    |       |       |       |     0.14
0.833    1.96    1.49      0.055  | OI    |       |       |       |     0.15
0.917    1.96    1.57      0.058  | OI    |       |       |       |     0.16
1.000    2.11    1.65      0.061  | OI    |       |       |       |     0.17
1.083    2.22    1.74      0.064  |  O    |       |       |       |     0.17
1.167    2.23    1.82      0.067  |  OI   |       |       |       |     0.18
1.250    2.24    1.89      0.070  |  OI   |       |       |       |     0.19
1.333    2.24    1.95      0.072  |  OI   |       |       |       |     0.20
1.417    2.24    2.00      0.074  |  OI   |       |       |       |     0.20
1.500    2.24    2.04      0.075  |  OI   |       |       |       |     0.20
1.583    2.24    2.08      0.076  |  OI   |       |       |       |     0.21
1.667    2.24    2.10      0.077  |  OI   |       |       |       |     0.21
1.750    2.24    2.13      0.078  |  OI   |       |       |       |     0.21
1.833    2.24    2.15      0.079  |  OI   |       |       |       |     0.21
1.917    2.24    2.16      0.080  |  OI   |       |       |       |     0.22
2.000    2.39    2.19      0.080  |  OI   |       |       |       |     0.22
2.083    2.35    2.22      0.082  |  OI   |       |       |       |     0.22
2.167    2.40    2.24      0.083  |   O   |       |       |       |     0.22
2.250    2.50    2.28      0.084  |   O   |       |       |       |     0.23
2.333    2.51    2.32      0.085  |   O   |       |       |       |     0.23
2.417    2.52    2.35      0.087  |   O   |       |       |       |     0.24
2.500    2.52    2.38      0.088  |   O   |       |       |       |     0.24
2.583    2.52    2.40      0.088  |   O   |       |       |       |     0.24
2.667    2.52    2.42      0.089  |   O   |       |       |       |     0.24
2.750    2.67    2.45      0.090  |   O   |       |       |       |     0.25
2.833    2.78    2.50      0.092  |   O   |       |       |       |     0.25
2.917    2.79    2.55      0.094  |   OI  |       |       |       |     0.25
3.000    2.80    2.59      0.095  |   OI  |       |       |       |     0.26
3.083    2.80    2.63      0.097  |   OI  |       |       |       |     0.26
3.167    2.95    2.67      0.098  |   OI  |       |       |       |     0.27
3.250    3.05    2.72      0.100  |   OI  |       |       |       |     0.27
3.333    3.07    2.78      0.102  |    O  |       |       |       |     0.28
3.417    3.23    2.85      0.105  |    O  |       |       |       |     0.28
3.500    3.48    2.93      0.108  |    OI |       |       |       |     0.29
3.583    3.76    3.05      0.112  |    OI |       |       |       |     0.30
3.667    3.89    3.18      0.117  |    O I|       |       |       |     0.32
3.750    4.06    3.32      0.122  |    O I|       |       |       |     0.33
3.833    4.17    3.45      0.127  |     OI|       |       |       |     0.35
3.917    4.34    3.59      0.132  |     OI|       |       |       |     0.36
4.000    4.45    3.73      0.137  |     O I       |       |       |     0.37
4.083    4.62    3.87      0.142  |     O I       |       |       |     0.39
4.167    4.90    4.02      0.148  |      OI       |       |       |     0.40
4.250    5.24    4.20      0.155  |      O|I      |       |       |     0.42
4.333    5.62    4.41      0.162  |      O| I     |       |       |     0.44
4.417    6.00    4.65      0.171  |       O I     |       |       |     0.46
4.500    6.18    4.90      0.180  |       O  I    |       |       |     0.49
4.583    6.41    5.00      0.189  |       |O I    |       |       |     0.53
4.667    6.76    5.00      0.200  |       |O  I   |       |       |     0.58
4.750    7.14    5.00      0.214  |       |O  I   |       |       |     0.65
4.833    7.32    5.00      0.229  |       |O   I  |       |       |     0.72
4.917    7.55    5.00      0.246  |       |O   I  |       |       |     0.80
5.000    7.91    5.00      0.265  |       |O    I |       |       |     0.90
5.083    9.09    5.00      0.289  |       |O      I       |       |     1.01
5.167   10.87    5.00      0.323  |       |O      |  I    |       |     1.19
5.250   12.35    5.00      0.369  |       |O      |     I |       |     1.42
5.333   13.56    5.00      0.423  |       |O      |       I       |     1.71
5.417   15.11    5.00      0.488  |       |O      |       |  I    |     2.05
5.500   17.76    5.00      0.566  |       |O      |       |       I     2.49
5.583   11.80    5.00      0.634  |       |O      |    I  |       |     2.90
5.667    4.98    5.00      0.657  |       IO      |       |       |     3.05
5.750    2.52    5.00      0.649  |   I   |O      |       |       |     2.99
5.833    1.64    5.00      0.629  | I     |O      |       |       |     2.87
5.917    1.14    5.00      0.604  | I     |O      |       |       |     2.72
6.000    0.74    5.00      0.576  |I      |O      |       |       |     2.55
6.083    0.29    5.00      0.545  I       |O      |       |       |     2.37
6.167    0.05    5.00      0.512  I       |O      |       |       |     2.18
6.250    0.01    5.00      0.477  I       |O      |       |       |     1.99
```

```
6.333    0.00    5.00      0.443  I       |O      |       |       |     1.81
6.417    0.00    5.00      0.408  I       |O      |       |       |     1.63
6.500    0.00    5.00      0.374  I       |O      |       |       |     1.45
6.583    0.00    5.00      0.340  I       |O      |       |       |     1.27
6.667    0.00    5.00      0.305  I       |O      |       |       |     1.10
6.750    0.00    5.00      0.271  I       |O      |       |       |     0.93
6.833    0.00    5.00      0.236  I       |O      |       |       |     0.76
6.917    0.00    5.00      0.202  I       |O      |       |       |     0.59
7.000    0.00    4.59      0.169  I       O       |       |       |     0.46
7.083    0.00    3.80      0.140  I     O |       |       |       |     0.38
7.167    0.00    3.15      0.116  I    O  |       |       |       |     0.32
7.250    0.00    2.61      0.096  I   O   |       |       |       |     0.26
7.333    0.00    2.17      0.080  I  O    |       |       |       |     0.22
7.417    0.00    1.80      0.066  I  O    |       |       |       |     0.18
7.500    0.00    1.49      0.055  I O     |       |       |       |     0.15
7.583    0.00    1.23      0.045  I O     |       |       |       |     0.12
7.667    0.00    1.02      0.038  IO      |       |       |       |     0.10
7.750    0.00    0.85      0.031  IO      |       |       |       |     0.08
7.833    0.00    0.70      0.026  IO      |       |       |       |     0.07
7.917    0.00    0.58      0.021  IO      |       |       |       |     0.06
8.000    0.00    0.48      0.018  O       |       |       |       |     0.05
8.083    0.00    0.40      0.015  O       |       |       |       |     0.04
8.167    0.00    0.33      0.012  O       |       |       |       |     0.03
8.250    0.00    0.27      0.010  O       |       |       |       |     0.03
8.333    0.00    0.23      0.008  O       |       |       |       |     0.02
8.417    0.00    0.19      0.007  O       |       |       |       |     0.02
8.500    0.00    0.16      0.006  O       |       |       |       |     0.02
8.583    0.00    0.13      0.005  O       |       |       |       |     0.01
8.667    0.00    0.11      0.004  O       |       |       |       |     0.01
8.750    0.00    0.09      0.003  O       |       |       |       |     0.01
8.833    0.00    0.07      0.003  O       |       |       |       |     0.01
8.917    0.00    0.06      0.002  O       |       |       |       |     0.01
9.000    0.00    0.05      0.002  O       |       |       |       |     0.01
9.083    0.00    0.04      0.002  O       |       |       |       |     0.00
9.167    0.00    0.03      0.001  O       |       |       |       |     0.00
9.250    0.00    0.03      0.001  O       |       |       |       |     0.00
9.333    0.00    0.02      0.001  O       |       |       |       |     0.00
9.417    0.00    0.02      0.001  O       |       |       |       |     0.00
9.500    0.00    0.02      0.001  O       |       |       |       |     0.00
9.583    0.00    0.01      0.001  O       |       |       |       |     0.00
9.667    0.00    0.01      0.000  O       |       |       |       |     0.00
9.750    0.00    0.01      0.000  O       |       |       |       |     0.00

     ***************************HYDROGRAPH DATA***************************
                Number of intervals =    117
                Time interval =    5.0 (Min.)
                Maximum/Peak flow rate =        5.000 (CFS)
                Total volume =       2.062 (Ac.Ft)
         Status of hydrographs being held in storage
                   Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
         Peak (CFS)      0.000     0.000     0.000     0.000     0.000
         Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
     ***********************************************************************

     --------------------------------------------------------------------
```

FLOOD HYDROGRAPH ROUTING PROGRAM
Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2005
Study date: 05/12/21

----------------------------------------------------------------------

PROPOSED 100-YR, 24-HOUR STORM EVENT
REDLANDS EAST - ROUTING
20-0181 UG CHAMBER STORAGE PUMP 5.0 CFS
05/12/2021 AYS

----------------------------------------------------------------------

Program License Serial Number 4010

----------------------------------------------------------------------

******************** HYDROGRAPH INFORMATION ********************

From study/file name: PROPEAST10024100.rte

*************************HYDROGRAPH DATA*************************

Number of intervals = 291
Time interval = 5.0 (Min.)
Maximum/Peak flow rate = 5.805 (CFS)
Total volume = 3.298 (Ac.Ft)

Status of hydrographs being held in storage

| | Stream 1 | Stream 2 | Stream 3 | Stream 4 | Stream 5 |
|---|---|---|---|---|---|
| Peak (CFS) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| Vol (Ac.Ft) | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

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Process from Point/Station 200.000 to Point/Station 201.000

**** RETARDING BASIN ROUTING ****

User entry of depth-outflow-storage data

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Total number of inflow hydrograph intervals = 291
Hydrograph time unit = 5.000 (Min.)
Initial depth in storage basin = 0.00(Ft.)

----------------------------------------------------------------------

Initial basin depth = 0.00 (Ft.)
Initial basin storage = 0.00 (Ac.Ft)
Initial basin outflow = 0.00 (CFS)

----------------------------------------------------------------------

Depth vs. Storage and Depth vs. Discharge data:

| Basin Depth (Ft.) | Storage (Ac.Ft) | Outflow (CFS) | (S-O*dt/2) (Ac.Ft) | (S+O*dt/2) (Ac.Ft) |
|---|---|---|---|---|
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.500 | 0.184 | 5.000 | 0.167 | 0.201 |
| 1.000 | 0.286 | 5.000 | 0.269 | 0.303 |
| 1.500 | 0.384 | 5.000 | 0.367 | 0.401 |
| 2.000 | 0.479 | 5.000 | 0.462 | 0.496 |
| 2.500 | 0.568 | 5.000 | 0.551 | 0.585 |
| 3.000 | 0.650 | 5.000 | 0.633 | 0.667 |
| 3.500 | 0.720 | 5.000 | 0.703 | 0.737 |
| 4.000 | 0.775 | 5.000 | 0.758 | 0.792 |
| 4.500 | 0.829 | 5.000 | 0.812 | 0.846 |
| 5.000 | 0.883 | 5.000 | 0.866 | 0.900 |

----------------------------------------------------------------------

Hydrograph Detention Basin Routing

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Graph values: 'I'= unit inflow; 'O'=outflow at time shown

----------------------------------------------------------------------

| Time (Hours) | Inflow (CFS) | Outflow (CFS) | Storage (Ac.Ft) | .0 | 1.5 | 2.90 | 4.35 | 5.80 | Depth (Ft.) |
|---|---|---|---|---|---|---|---|---|---|

```
0.083    0.17    0.01      0.001  o       |       |       |       |     0.00
0.167    0.29    0.05      0.002  oI      |       |       |       |     0.01
0.250    0.31    0.09      0.003  oI      |       |       |       |     0.01
0.333    0.40    0.14      0.005  o I     |       |       |       |     0.01
0.417    0.46    0.19      0.007  |oI     |       |       |       |     0.02
0.500    0.47    0.24      0.009  |oI     |       |       |       |     0.02
0.583    0.48    0.28      0.010  |oI     |       |       |       |     0.03
0.667    0.48    0.31      0.011  |oI     |       |       |       |     0.03
0.750    0.48    0.34      0.012  |oI     |       |       |       |     0.03
0.833    0.56    0.37      0.014  | oI    |       |       |       |     0.04
0.917    0.62    0.41      0.015  | oI    |       |       |       |     0.04
1.000    0.63    0.45      0.016  | oI    |       |       |       |     0.04
1.083    0.55    0.47      0.017  | oI    |       |       |       |     0.05
1.167    0.49    0.48      0.018  | o     |       |       |       |     0.05
1.250    0.48    0.48      0.018  | o     |       |       |       |     0.05
1.333    0.48    0.48      0.018  | o     |       |       |       |     0.05
1.417    0.48    0.48      0.018  | o     |       |       |       |     0.05
1.500    0.48    0.48      0.018  | o     |       |       |       |     0.05
1.583    0.48    0.48      0.018  | o     |       |       |       |     0.05
1.667    0.48    0.48      0.018  | o     |       |       |       |     0.05
1.750    0.48    0.48      0.018  | o     |       |       |       |     0.05
1.833    0.56    0.48      0.018  | oI    |       |       |       |     0.05
1.917    0.62    0.50      0.018  | oI    |       |       |       |     0.05
2.000    0.63    0.52      0.019  | oI    |       |       |       |     0.05
2.083    0.63    0.54      0.020  | oI    |       |       |       |     0.05
2.167    0.63    0.56      0.021  |  o    |       |       |       |     0.06
2.250    0.63    0.57      0.021  |  o    |       |       |       |     0.06
2.333    0.63    0.58      0.021  |  o    |       |       |       |     0.06
2.417    0.63    0.59      0.022  |  o    |       |       |       |     0.06
2.500    0.63    0.60      0.022  |  o    |       |       |       |     0.06
2.583    0.72    0.61      0.023  |  o    |       |       |       |     0.06
2.667    0.78    0.63      0.023  |  oI   |       |       |       |     0.06
2.750    0.79    0.66      0.024  |  oI   |       |       |       |     0.07
2.833    0.79    0.68      0.025  |  oI   |       |       |       |     0.07
2.917    0.79    0.70      0.026  |  oI   |       |       |       |     0.07
3.000    0.79    0.72      0.026  |  oI   |       |       |       |     0.07
3.083    0.79    0.73      0.027  |   o   |       |       |       |     0.07
3.167    0.79    0.74      0.027  |   o   |       |       |       |     0.07
3.250    0.79    0.75      0.028  |   o   |       |       |       |     0.07
3.333    0.79    0.76      0.028  |   o   |       |       |       |     0.08
3.417    0.79    0.76      0.028  |   o   |       |       |       |     0.08
3.500    0.79    0.77      0.028  |   o   |       |       |       |     0.08
3.583    0.79    0.77      0.028  |   o   |       |       |       |     0.08
3.667    0.79    0.78      0.029  |   o   |       |       |       |     0.08
3.750    0.79    0.78      0.029  |   o   |       |       |       |     0.08
3.833    0.88    0.79      0.029  |   o   |       |       |       |     0.08
3.917    0.94    0.81      0.030  |   oI  |       |       |       |     0.08
4.000    0.95    0.83      0.031  |   oI  |       |       |       |     0.08
4.083    0.95    0.85      0.031  |   oI  |       |       |       |     0.09
4.167    0.95    0.87      0.032  |   oI  |       |       |       |     0.09
4.250    0.95    0.88      0.032  |   oI  |       |       |       |     0.09
4.333    1.03    0.90      0.033  |   oI  |       |       |       |     0.09
4.417    1.10    0.93      0.034  |    oI |       |       |       |     0.09
4.500    1.11    0.96      0.035  |    oI |       |       |       |     0.10
4.583    1.11    0.98      0.036  |    oI |       |       |       |     0.10
4.667    1.11    1.01      0.037  |    oI |       |       |       |     0.10
4.750    1.11    1.02      0.038  |    oI |       |       |       |     0.10
4.833    1.19    1.05      0.038  |    oI |       |       |       |     0.10
4.917    1.26    1.08      0.040  |    oI |       |       |       |     0.11
5.000    1.27    1.11      0.041  |     o |       |       |       |     0.11
5.083    1.10    1.12      0.041  |     o |       |       |       |     0.11
5.167    0.98    1.11      0.041  |    Io |       |       |       |     0.11
5.250    0.96    1.08      0.040  |    o  |       |       |       |     0.11
5.333    1.03    1.07      0.039  |    o  |       |       |       |     0.11
5.417    1.10    1.07      0.039  |    oI |       |       |       |     0.11
5.500    1.11    1.07      0.040  |    oI |       |       |       |     0.11
5.583    1.19    1.09      0.040  |    oI |       |       |       |     0.11
5.667    1.26    1.11      0.041  |     o |       |       |       |     0.11
5.750    1.27    1.14      0.042  |     o |       |       |       |     0.11
5.833    1.27    1.16      0.043  |     o |       |       |       |     0.12
5.917    1.27    1.18      0.043  |     o |       |       |       |     0.12
6.000    1.27    1.19      0.044  |     o |       |       |       |     0.12
6.083    1.35    1.21      0.045  |     oI|       |       |       |     0.12
6.167    1.41    1.24      0.046  |     oI|       |       |       |     0.12
6.250    1.42    1.27      0.047  |      o|       |       |       |     0.13
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 6.333    1.43    1.30      0.048  |      O|       |       |       |     0.13
 6.417    1.43    1.32      0.049  |      O|       |       |       |     0.13
 6.500    1.43    1.34      0.049  |      O|       |       |       |     0.13
 6.583    1.51    1.36      0.050  |      OI       |       |       |     0.14
 6.667    1.57    1.39      0.051  |      OI       |       |       |     0.14
 6.750    1.58    1.42      0.052  |      OI       |       |       |     0.14
 6.833    1.59    1.45      0.053  |      OI       |       |       |     0.15
 6.917    1.59    1.47      0.054  |       O       |       |       |     0.15
 7.000    1.59    1.49      0.055  |       O       |       |       |     0.15
 7.083    1.59    1.51      0.056  |       O       |       |       |     0.15
 7.167    1.59    1.52      0.056  |       O       |       |       |     0.15
 7.250    1.59    1.53      0.056  |       O       |       |       |     0.15
 7.333    1.67    1.55      0.057  |       OI      |       |       |     0.15
 7.417    1.73    1.57      0.058  |       OI      |       |       |     0.16
 7.500    1.74    1.60      0.059  |       OI      |       |       |     0.16
 7.583    1.83    1.63      0.060  |       |OI     |       |       |     0.16
 7.667    1.89    1.67      0.062  |       |OI     |       |       |     0.17
 7.750    1.90    1.71      0.063  |       |OI     |       |       |     0.17
 7.833    1.99    1.75      0.064  |       |OI     |       |       |     0.18
 7.917    2.05    1.80      0.066  |       |O I    |       |       |     0.18
 8.000    2.06    1.84      0.068  |       | OI    |       |       |     0.18
 8.083    2.23    1.89      0.070  |       | O I   |       |       |     0.19
 8.167    2.35    1.96      0.072  |       | O I   |       |       |     0.20
 8.250    2.37    2.03      0.075  |       |  O I  |       |       |     0.20
 8.333    2.38    2.09      0.077  |       |  O I  |       |       |     0.21
 8.417    2.38    2.14      0.079  |       |  O I  |       |       |     0.21
 8.500    2.38    2.18      0.080  |       |   OI  |       |       |     0.22
 8.583    2.46    2.22      0.082  |       |   OI  |       |       |     0.22
 8.667    2.52    2.27      0.083  |       |   OI  |       |       |     0.23
 8.750    2.53    2.31      0.085  |       |   OI  |       |       |     0.23
 8.833    2.62    2.36      0.087  |       |   O I |       |       |     0.24
 8.917    2.68    2.41      0.089  |       |    OI |       |       |     0.24
 9.000    2.69    2.46      0.090  |       |    OI |       |       |     0.25
 9.083    2.86    2.51      0.092  |       |    O I|       |       |     0.25
 9.167    2.99    2.58      0.095  |       |     O I       |       |     0.26
 9.250    3.01    2.65      0.098  |       |     O I       |       |     0.27
 9.333    3.10    2.72      0.100  |       |     O |I      |       |     0.27
 9.417    3.16    2.79      0.103  |       |      O|I      |       |     0.28
 9.500    3.17    2.85      0.105  |       |      O|I      |       |     0.29
 9.583    3.25    2.92      0.107  |       |       OI      |       |     0.29
 9.667    3.32    2.98      0.110  |       |       O I     |       |     0.30
 9.750    3.33    3.04      0.112  |       |       O I     |       |     0.30
 9.833    3.41    3.09      0.114  |       |       |OI     |       |     0.31
 9.917    3.47    3.15      0.116  |       |       |O I    |       |     0.32
10.000    3.49    3.21      0.118  |       |       |O I    |       |     0.32
10.083    2.90    3.21      0.118  |       |      I|O      |       |     0.32
10.167    2.47    3.12      0.115  |       |    I  |O      |       |     0.31
10.250    2.39    3.00      0.110  |       |    I  O       |       |     0.30
10.333    2.38    2.89      0.107  |       |    I O|       |       |     0.29
10.417    2.38    2.81      0.103  |       |    I O|       |       |     0.28
10.500    2.38    2.73      0.101  |       |    I O|       |       |     0.27
10.583    2.80    2.71      0.100  |       |     OI|       |       |     0.27
10.667    3.11    2.75      0.101  |       |      O|I      |       |     0.27
10.750    3.16    2.82      0.104  |       |      O|I      |       |     0.28
10.833    3.17    2.88      0.106  |       |      O|I      |       |     0.29
10.917    3.17    2.93      0.108  |       |       OI      |       |     0.29
11.000    3.17    2.97      0.109  |       |       OI      |       |     0.30
11.083    3.09    3.00      0.110  |       |       OI      |       |     0.30
11.167    3.02    3.01      0.111  |       |       O       |       |     0.30
11.250    3.01    3.01      0.111  |       |       O       |       |     0.30
11.333    3.01    3.01      0.111  |       |       O       |       |     0.30
11.417    3.01    3.01      0.111  |       |       O       |       |     0.30
11.500    3.01    3.01      0.111  |       |       O       |       |     0.30
11.583    2.84    3.00      0.110  |       |      IO       |       |     0.30
11.667    2.72    2.96      0.109  |       |     I O       |       |     0.30
11.750    2.70    2.92      0.107  |       |     I O       |       |     0.29
11.833    2.78    2.89      0.106  |       |      O|       |       |     0.29
11.917    2.84    2.87      0.106  |       |      O|       |       |     0.29
12.000    2.85    2.87      0.106  |       |      O|       |       |     0.29
12.083    3.44    2.92      0.107  |       |       O I     |       |     0.29
12.167    3.87    3.04      0.112  |       |       O    I  |       |     0.30
12.250    3.95    3.19      0.117  |       |       |O   I  |       |     0.32
12.333    4.05    3.33      0.123  |       |       | O   I |       |     0.33
12.417    4.11    3.46      0.127  |       |       |  O  I |       |     0.35
12.500    4.12    3.57      0.131  |       |       |  O  I |       |     0.36
```

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12.583    4.29    3.68      0.135  |       |       |   O  I|       |     0.37
12.667    4.41    3.79      0.140  |       |       |   O   I       |     0.38
12.750    4.44    3.90      0.144  |       |       |    O  I       |     0.39
12.833    4.56    4.00      0.147  |       |       |     O |I      |     0.40
12.917    4.65    4.11      0.151  |       |       |     O |I      |     0.41
13.000    4.67    4.20      0.155  |       |       |      O|I      |     0.42
13.083    5.26    4.33      0.159  |       |       |      O|   I   |     0.43
13.167    5.69    4.53      0.167  |       |       |       O      I|     0.45
13.250    5.76    4.73      0.174  |       |       |       | O    I|     0.47
13.333    5.79    4.91      0.181  |       |       |       |  O   I|     0.49
13.417    5.80    5.00      0.186  |       |       |       |  O   I|     0.51
13.500    5.80    5.00      0.192  |       |       |       |  O    I     0.54
13.583    4.67    5.00      0.194  |       |       |       |I O    |     0.55
13.667    3.82    5.00      0.188  |       |       |    I  |  O    |     0.52
13.750    3.68    4.90      0.180  |       |       |   I   | O     |     0.49
13.833    3.65    4.68      0.172  |       |       |   I   |O      |     0.47
13.917    3.65    4.51      0.166  |       |       |   I   O       |     0.45
14.000    3.65    4.36      0.160  |       |       |   I   O       |     0.44
14.083    4.02    4.27      0.157  |       |       |     IO|       |     0.43
14.167    4.30    4.25      0.156  |       |       |      O|       |     0.43
14.250    4.35    4.26      0.157  |       |       |      O|       |     0.43
14.333    4.26    4.27      0.157  |       |       |      O|       |     0.43
14.417    4.18    4.26      0.157  |       |       |      O|       |     0.43
14.500    4.17    4.25      0.156  |       |       |     IO|       |     0.42
14.583    4.18    4.23      0.156  |       |       |      O|       |     0.42
14.667    4.18    4.22      0.155  |       |       |      O|       |     0.42
14.750    4.19    4.22      0.155  |       |       |      O|       |     0.42
14.833    4.08    4.20      0.155  |       |       |     IO|       |     0.42
14.917    4.01    4.18      0.154  |       |       |     IO|       |     0.42
15.000    4.00    4.15      0.153  |       |       |     O |       |     0.41
15.083    3.90    4.11      0.151  |       |       |    IO |       |     0.41
15.167    3.82    4.07      0.150  |       |       |    IO |       |     0.41
15.250    3.81    4.03      0.148  |       |       |   I O |       |     0.40
15.333    3.72    3.98      0.147  |       |       |   IO  |       |     0.40
15.417    3.66    3.93      0.145  |       |       |   IO  |       |     0.39
15.500    3.65    3.88      0.143  |       |       |   IO  |       |     0.39
15.583    3.31    3.81      0.140  |       |       | I  O  |       |     0.38
15.667    3.06    3.71      0.136  |       |       I   O   |       |     0.37
15.750    3.02    3.59      0.132  |       |       I  O    |       |     0.36
15.833    3.01    3.49      0.129  |       |       I  O    |       |     0.35
15.917    3.01    3.41      0.126  |       |       I O     |       |     0.34
16.000    3.01    3.34      0.123  |       |       I O     |       |     0.33
16.083    1.76    3.18      0.117  |       |I      |O      |       |     0.32
16.167    0.83    2.86      0.105  |   I   |      O|       |       |     0.29
16.250    0.67    2.50      0.092  |  I    |    O  |       |       |     0.25
16.333    0.63    2.18      0.080  |  I    |   O   |       |       |     0.22
16.417    0.63    1.92      0.070  |  I    | O     |       |       |     0.19
16.500    0.63    1.70      0.062  |  I    |O      |       |       |     0.17
16.583    0.55    1.51      0.055  |  I    O       |       |       |     0.15
16.667    0.49    1.34      0.049  | I    O|       |       |       |     0.13
16.750    0.48    1.19      0.044  | I   O |       |       |       |     0.12
16.833    0.48    1.07      0.039  | I  O  |       |       |       |     0.11
16.917    0.48    0.97      0.036  | I  O  |       |       |       |     0.10
17.000    0.48    0.88      0.033  | I O   |       |       |       |     0.09
17.083    0.64    0.83      0.030  |  IO   |       |       |       |     0.08
17.167    0.77    0.81      0.030  |   O   |       |       |       |     0.08
17.250    0.79    0.80      0.030  |   O   |       |       |       |     0.08
17.333    0.79    0.80      0.029  |   O   |       |       |       |     0.08
17.417    0.79    0.80      0.029  |   O   |       |       |       |     0.08
17.500    0.79    0.80      0.029  |   O   |       |       |       |     0.08
17.583    0.79    0.80      0.029  |   O   |       |       |       |     0.08
17.667    0.79    0.80      0.029  |   O   |       |       |       |     0.08
17.750    0.79    0.80      0.029  |   O   |       |       |       |     0.08
17.833    0.71    0.79      0.029  |  IO   |       |       |       |     0.08
17.917    0.65    0.77      0.028  |  IO   |       |       |       |     0.08
18.000    0.64    0.75      0.027  |  IO   |       |       |       |     0.07
18.083    0.63    0.73      0.027  |  IO   |       |       |       |     0.07
18.167    0.63    0.71      0.026  |  O    |       |       |       |     0.07
18.250    0.63    0.70      0.026  |  O    |       |       |       |     0.07
18.333    0.63    0.69      0.025  |  O    |       |       |       |     0.07
18.417    0.63    0.68      0.025  |  O    |       |       |       |     0.07
18.500    0.63    0.67      0.025  |  O    |       |       |       |     0.07
18.583    0.55    0.66      0.024  |  O    |       |       |       |     0.07
18.667    0.49    0.63      0.023  | IO    |       |       |       |     0.06
18.750    0.48    0.61      0.022  | IO    |       |       |       |     0.06
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```
18.833    0.39    0.58     0.021  | IO    |       |       |       |     0.06
18.917    0.33    0.54     0.020  |IO     |       |       |       |     0.05
19.000    0.32    0.50     0.019  |IO     |       |       |       |     0.05
19.083    0.40    0.48     0.018  | O     |       |       |       |     0.05
19.167    0.46    0.47     0.017  | O     |       |       |       |     0.05
19.250    0.47    0.47     0.017  | O     |       |       |       |     0.05
19.333    0.56    0.48     0.018  | OI    |       |       |       |     0.05
19.417    0.62    0.50     0.018  | OI    |       |       |       |     0.05
19.500    0.63    0.52     0.019  | OI    |       |       |       |     0.05
19.583    0.55    0.53     0.020  | OI    |       |       |       |     0.05
19.667    0.49    0.53     0.019  | O     |       |       |       |     0.05
19.750    0.48    0.52     0.019  | O     |       |       |       |     0.05
19.833    0.39    0.51     0.019  | O     |       |       |       |     0.05
19.917    0.33    0.48     0.018  |IO     |       |       |       |     0.05
20.000    0.32    0.46     0.017  |IO     |       |       |       |     0.05
20.083    0.40    0.44     0.016  | O     |       |       |       |     0.04
20.167    0.46    0.44     0.016  | O     |       |       |       |     0.04
20.250    0.47    0.44     0.016  | O     |       |       |       |     0.04
20.333    0.48    0.45     0.016  | O     |       |       |       |     0.04
20.417    0.48    0.45     0.017  | O     |       |       |       |     0.05
20.500    0.48    0.46     0.017  | O     |       |       |       |     0.05
20.583    0.48    0.46     0.017  | O     |       |       |       |     0.05
20.667    0.48    0.46     0.017  | O     |       |       |       |     0.05
20.750    0.48    0.46     0.017  | O     |       |       |       |     0.05
20.833    0.39    0.46     0.017  | O     |       |       |       |     0.05
20.917    0.33    0.44     0.016  |IO     |       |       |       |     0.04
21.000    0.32    0.42     0.016  |IO     |       |       |       |     0.04
21.083    0.40    0.41     0.015  | O     |       |       |       |     0.04
21.167    0.46    0.42     0.015  | O     |       |       |       |     0.04
21.250    0.47    0.42     0.016  | O     |       |       |       |     0.04
21.333    0.39    0.43     0.016  | O     |       |       |       |     0.04
21.417    0.33    0.41     0.015  |IO     |       |       |       |     0.04
21.500    0.32    0.40     0.015  |IO     |       |       |       |     0.04
21.583    0.40    0.39     0.014  | O     |       |       |       |     0.04
21.667    0.46    0.40     0.015  | O     |       |       |       |     0.04
21.750    0.47    0.41     0.015  | O     |       |       |       |     0.04
21.833    0.39    0.41     0.015  | O     |       |       |       |     0.04
21.917    0.33    0.41     0.015  |IO     |       |       |       |     0.04
22.000    0.32    0.39     0.014  |IO     |       |       |       |     0.04
22.083    0.40    0.39     0.014  | O     |       |       |       |     0.04
22.167    0.46    0.39     0.015  | O     |       |       |       |     0.04
22.250    0.47    0.41     0.015  | O     |       |       |       |     0.04
22.333    0.39    0.41     0.015  | O     |       |       |       |     0.04
22.417    0.33    0.40     0.015  |IO     |       |       |       |     0.04
22.500    0.32    0.39     0.014  |IO     |       |       |       |     0.04
22.583    0.32    0.38     0.014  |IO     |       |       |       |     0.04
22.667    0.32    0.37     0.013  |IO     |       |       |       |     0.04
22.750    0.32    0.36     0.013  |O      |       |       |       |     0.04
22.833    0.32    0.35     0.013  |O      |       |       |       |     0.04
22.917    0.32    0.35     0.013  |O      |       |       |       |     0.03
23.000    0.32    0.34     0.013  |O      |       |       |       |     0.03
23.083    0.32    0.34     0.012  |O      |       |       |       |     0.03
23.167    0.32    0.33     0.012  |O      |       |       |       |     0.03
23.250    0.32    0.33     0.012  |O      |       |       |       |     0.03
23.333    0.32    0.33     0.012  |O      |       |       |       |     0.03
23.417    0.32    0.33     0.012  |O      |       |       |       |     0.03
23.500    0.32    0.32     0.012  |O      |       |       |       |     0.03
23.583    0.32    0.32     0.012  |O      |       |       |       |     0.03
23.667    0.32    0.32     0.012  |O      |       |       |       |     0.03
23.750    0.32    0.32     0.012  |O      |       |       |       |     0.03
23.833    0.32    0.32     0.012  |O      |       |       |       |     0.03
23.917    0.32    0.32     0.012  |O      |       |       |       |     0.03
24.000    0.32    0.32     0.012  |O      |       |       |       |     0.03
24.083    0.15    0.30     0.011  IO      |       |       |       |     0.03
24.167    0.03    0.27     0.010  IO      |       |       |       |     0.03
24.250    0.00    0.22     0.008  IO      |       |       |       |     0.02
24.333    0.00    0.19     0.007  IO      |       |       |       |     0.02
24.417    0.00    0.15     0.006  O       |       |       |       |     0.02
24.500    0.00    0.13     0.005  O       |       |       |       |     0.01
24.583    0.00    0.11     0.004  O       |       |       |       |     0.01
24.667    0.00    0.09     0.003  O       |       |       |       |     0.01
24.750    0.00    0.07     0.003  O       |       |       |       |     0.01
24.833    0.00    0.06     0.002  O       |       |       |       |     0.01
24.917    0.00    0.05     0.002  O       |       |       |       |     0.01
25.000    0.00    0.04     0.002  O       |       |       |       |     0.00
```

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25.083    0.00    0.03      0.001  O        |       |       |       |      0.00
25.167    0.00    0.03      0.001  O        |       |       |       |      0.00
25.250    0.00    0.02      0.001  O        |       |       |       |      0.00
25.333    0.00    0.02      0.001  O        |       |       |       |      0.00
25.417    0.00    0.02      0.001  O        |       |       |       |      0.00
25.500    0.00    0.01      0.000  O        |       |       |       |      0.00
25.583    0.00    0.01      0.000  O        |       |       |       |      0.00
25.667    0.00    0.01      0.000  O        |       |       |       |      0.00

      ****************************HYDROGRAPH DATA****************************
                     Number of intervals =   308
                     Time interval =    5.0 (Min.)
                     Maximum/Peak flow rate =        5.000 (CFS)
                     Total volume =       3.298 (Ac.Ft)
              Status of hydrographs being held in storage
                         Stream 1  Stream 2  Stream 3  Stream 4  Stream 5
              Peak (CFS)      0.000     0.000     0.000     0.000     0.000
              Vol (Ac.Ft)      0.000     0.000     0.000     0.000     0.000
      ***********************************************************************

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# Appendix 8:  Source Control

*Pollutant Sources/Source Control Checklist*

**To be provided during final engineering.*

# Appendix 9: O&M

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

**To be provided during final engineering.*

# Appendix 10: Educational Materials

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

**To be provided during final engineering.*

## LINE A-B, LINE A-C FLOW REALLOCATION MEMO

# CITY OF PERRIS

**STUART E. MCKIBBIN, CITY ENGINEER**

P8-000

*MEMORANDUM*

| | |
|---|---|
| TO: | Tyler Webb and DJ Arellano<br>Webb and Associates |
| FROM: | Stuart E. McKibbin, City Engineer |
| DATE: | April 8, 2020 |
| RE: | Perris Valley MDP; Line A-B and A-C<br>Tributary Watershed Modification |

The submitted technical memorandum explains the modification to the tributary watershed for the Perris Valley MDP facilities Line A-B and A-C. This change is being made to take advantage of excess capacity in Line A-B and establishing drainage boundaries to account for future Mid-County Parkway.

The following items were submitted to the City of Perris for review:

1. Technical Memorandum dated February 12, 2020

After reviewing the technical memorandum entitled, Perris Valley MDP: Line A-B and Line A-C Tributary Watershed Modification, in concept, the revisions of the master drainage plan lines do not exceed the existing capacities and appear to satisfactorily account for upcoming Mid-County Parkway, see attached exhibit. This memorandum may be used for the initial design of affected developments within the drainage study boundaries.

Should you have any questions, please contact Cassandra Sanchez via email at Cassandra@trilakeconsultants.com or by phone at (951) 963-9952.

**DEPARTMENT OF ENGINEERING**
24 SOUTH D ST., SUITE 100, PERRIS, CA 92570-2200
TEL.: (951) 943-6504

ALBERT A. WEBB ASSOCIATES

# Technical Memorandum

To: Stuart E. McKibbin, P.E. (City of Perris)

From: Tyler Webb, E.I.T. (Webb)

DJ Arellano, P.E. (Webb)

Date: February 12, 2020

Re: Perris Valley MDP: Line A-B and Line A-C Tributary Watershed Modification

This technical memorandum has been prepared to document to the City of Perris and Riverside County Flood Control that the modification of tributary watersheds for Perris Valley MDP facilities Line A-B and Line A-C will not significantly impact the existing design of Line A-B or the design flow rate for the Perris Valley Storm Drain (PVSD). Master Drainage Plans are prepared based on the best data available at the time, and they provide guidance on how drainage in a particular area can be handled. It is often the case that development patterns required the modification of MDPs. Perris Valley Line A-B was designed by Thienes Engineering in conjunction with the development of an industrial building that is located on the southwesterly side of the intersection of Rider Street and Redlands Avenue. The design was sized based on assumed land uses and drainage strategies for the tributary watershed. Subsequent to the construction of Line A-B, several additional industrial buildings have either been constructed, or are planned to be constructed. The drainage design for these sites, coupled with site specific drainage strategies, has resulted in reduced flow rates for Line A-B compared to the original design assumptions. This memo documents the changes from the original design assumptions and proposes to introduce additional tributary area into Line A-B to take advantage of the unused capacity in the facility. This is done in such a manner that the peak design flows of PVSD are not changed and the tributary area for Line A-C can be reduced. This change in the MDP will accommodate the forthcoming construction of RCTC's Mid-County Parkway as well.

## Section 1-A: Line A-B Capacity

Line A-B is located in Rider Street and has been constructed to accommodate the peak flowrates determined by Thienes Engineering when they designed the facility. As-built plans, to the intersection of Rider Street and Perris Boulevard, are included as part of this memorandum as reference. The facility is designed to accommodate runoff as depicted in the line A-B rational method map and analysis completed by Thienes Engineering (see Appendix A).

The proposed modification of tributary watershed areas, and the corresponding peak flow rates were determined using an area-yield analysis. The yield is based on the Line A-B rational method map and analysis stated above. The average yield was rounded up to the nearest whole number of 2.0 cfs/acre to conservatively calculate the peak flow rates (see Appendix A for modified drainage areas).

Hydraulic models were developed, based on the as-built plans for Line A-B. One model used the modified flow rates (revised model) determined using the methodology outlined above. The revised model was compared to a model using the original tributary flowrates (original model) to determine if Line A-B has adequate capacity. The hydraulic models were only completed to just before Lateral AB-11; this is because the tributary flowrates upstream of Lateral AB-10 remained unchanged. It should be noted that the revised model shows an increase in total flowrate for Line A-B; the area-yield method does not utilize confluences between the laterals and Line A-B which can lower the total flowrate by considering the time of concentration. The initial HGL for this model was taken from the ultimate Perris Valley Storm Drain Channel plans and double checked with the initial HGL in the Line A-B as-built plans, which both match and use the NGVD29 datum. The hydraulic analyses of Line A-B, even the one initially conducted by Thienes Engineering, assume ultimate improvements of the Channel have been completed. Capacity will be limited until the ultimate Channel improvements have been made.

The following are brief descriptions of the revised laterals for reference: **Lateral AB-1** is unchanged, **Lateral AB-2** is the single discharge point for the Rider II Distribution Center (DPR No. 19-00004) and removes flow from laterals AB-3 and AB-6, **Lateral AB-4** is the single discharge point for the Core 5 Rider Industrial project (DPR No. 19-05267) and removes flow from laterals AB-5 and AB-7, **Lateral AB-7.5** is the single discharge point for the FIR Rider Industrial project (DPR No. 19-05161) and removes flow from Lateral AB-8, **Lateral AB-9** is the single discharge point for the constructed Rider III Distribution Center which will discharge via pump at a constant 8 cfs instead of the original gravity flow of 61 cfs, **Lateral AB-10** will not remove flow from any laterals and be extended further south to add an additional 33 cfs.

Table 1 shows the HGL's (NGVD29) and total tributary flowrates at significant points for the original and revised Line A-B hydraulic models. For reference, Line A-B is an 8'x7' RCB from STA. 9+97.60 (outlet) to STA. 17+77.51 (Lateral AB-4), an 8'x6' RCB from STA. 17+77.51 (Lateral AB-4) to STA. 30+93.93 (Lateral AB-9), and a 7'x5' RCB from STA. 30+93.93 (Lateral AB-9) to the end of the model.

**Table 1 – Line A-B hydraulics**

| Station and Lateral | Lateral Q's Original/Revised (cfs) | Line A-B Original Model HGL/Q* (ft/cfs) | Line A-B Revised Model HGL/Q* (ft/cfs) | Line A-B Revised minus Original ΔHGL/ΔQ (ft/cfs) |
|---|---|---|---|---|
| 9+97.60 (Outlet) | -- | 1433.0/483.0 | 1433.0/506.1 | 0.0/23.1 |
| 12+63.33 (Lat AB-1) | 21.1/21.1 | 1433.9/461.9 | 1434.0/485.0 | 0.1/23.1 |
| 12+75.33 (Lat AB-2) | 15.9/87.0 | 1434.2/446.0 | 1434.7/398.0 | 0.5/-48.0 |
| 17+71.51 (Lat AB-4) | 12.8/25.0 | 1435.0/413.0 | 1434.9/373.0 | -0.1/-40.0 |
| 25+00.00 (Lat AB-7.5) | 0.0/35.0 | **1437.5/367.0 | 1437.4/338.0 | -0.1/-29.0 |
| 30+83.49 (Lat AB-9) | 61.0/8.0 | 1439.1/295.0 | 1438.1/330.0 | ***-1.0/35.0 |
| 31+16.47 (Lat AB-10) | 13.0/48.0 | 1439.4/282.0 | 1439.2/282.0 | -0.2/0.0 |

*Q is the flowrate in Line A-B directly upstream of the lateral junction
**Approximate HGL for proposed Lat AB-7.5 in the original model
***HGL is lower with higher Q because of downstream hydraulic jump, flow at Lat AB-9 is super critical

Per the results above, the flow reallocation will not significantly impact the hydraulics in Line A-B. The greatest HGL increase of 0.5-feet was located at Lateral AB-2 (Rider II Distribution Center outlet); all other HGL changes either decreased or were insignificant. This means the Line A-B HGL will not rise above the Rider Street pavement surface as previously designed. It should be mentioned that the revised lateral hydraulics will need to be analyzed separately with the construction of the proposed projects, and they might need to be upsized given the onsite designs.

See Appendix B for the Line A-B hydraulic calculations and plan and profile.

See Appendix D for the Line A-B as-built plans for reference.

See Appendix E for Ultimate Perris Valley Storm Drain Channel plans for reference.

## Section 1-B: Line A-C Capacity

Line A-C is a proposed storm drain line whose MDP alignment is disrupted by the Mid County Parkway. As stated above, the tributary areas for Line A-C and Line A-B will be reduced because of this. The modified area for Line A-C was roughly cut in half from the original MDP area; it is our understanding through preliminary correspondence with Mark Lancaster at Riverside County Transportation Commission (RCTC), that the Mid County Parkway will address its own generated runoff by constructing and draining to MDP facility Line H. The proposed tributary flowrate to Line A-C was calculated using area-yield method of 2.0 cfs/acre which yields a total flowrate of 72.6 cfs (see Appendix A for reallocated drainage areas).

A preliminary hydraulic model, in NAVD88, was developed to analyze the proposed alignment and profile of Line A-C. The initial HGL for this model was taken from the ultimate Perris Valley Storm Drain Channel plans, which use the NGVD29 datum and were converted to NAVD88 (NAVD88 = NGVD29 + 2.6'). The hydraulic analysis of Line A-C assumes ultimate improvements of the PVSD have been completed. Capacity will be limited, just like other Channel connections, until the ultimate PVSD improvements have been completed. Based upon our analysis a 42-inch storm drain downstream and 36-inch storm drain upstream will adequately convey the modified flow; the HGL will be below the street and ground surface, and the facilities should provide backbone drainage for the tributary area.

See Appendix C for Line A-C hydraulic calculations and plan and profile.

See Appendix E for Ultimate Perris Valley Storm Drain Channel plans for reference.

## Section 2: Impacts to the Perris Valley Storm Drain Channel

Per the area-yield flow analysis, an additional 23.1 cfs will be added upstream to the Perris Valley Storm Drain Channel via Line A-B. This change is insignificant – roughly 0.17% of the peak design flow of the Perris Valley Storm Drain Channel. This is especially inconsequential since variations in the peak flow timing were not considered.

## Section 3: Conclusions

Per the hydrologic and hydraulic analyses listed above, we conclude that the revised MDP tributary areas and updated flowrates will not significantly impact the hydraulics of Line A-B. The greatest increase in HGL is only 6-inches, which remains well under the Rider Street pavement surface. The change in HGL at other stations was either negligible or decreased. Also, the proposed alignment and profile of Line A-C will work hydraulically with the updated flow rates.

The Perris Valley Storm Drain Channel will not be impacted hydraulically since the increase in tributary flow reallocated upstream is one-one thousandth of a percent of the 100-year design flow per the MDP. Finally, this update is consistent with the forthcoming impacts of RCTC's Mid County Parkway to the original MDP drainage areas. It is our understanding through preliminary correspondence with Mark Lancaster at RCTC, that Mid County Parkway will accommodate their own generated runoff by constructing and draining to MDP facility Line H.

Should you have any questions regarding this analysis, please give me a call at (951) 320-6039 or email me at tyler.webb@webbassociates.com

# Appendix A: Original and Revised Hydrology