Preliminary Water Quality Management Plan

For:

Vesting Tentative Tract No. 20394

APN 1013-211-21 and 1013-211-22

County of San Bernardino, CA

Prepared for:
Yorba Villas, LLC
c/o Borstein Enterprises
11766 Wilshire Boulevard, Suite 820
Los Angeles, CA 90025
(310) 582-1991 x203

Prepared by:
MDS Consulting
17320 Redhill Avenue, Suite 350
Irvine, CA 92614
(949) 251-8821
Stanley C. Morse P.E., L.S.

WQMP Preparation Date

January 2021

WQMP Revision Date

1st: August 2021

2nd: November 2021

Approval Date:_____________

Project Owner's Certification

This Water Quality Management Plan (WQMP) has been prepared for Yorba Villas, LLC c/o Borstein Enterprises by MDS Consulting. The WQMP is intended to comply with the requirements of the County of San Bernardino and the NPDES Area-wide Stormwater Program requiring the preparation of a WQMP. The undersigned, while it owns the subject property, is responsible for the implementation of the provisions of this plan and will ensure that this plan is amended as appropriate to reflect up-to-date conditions on the site consistent with San Bernardino County's Municipal Storm Water Management Program and the intent of the NPDES Permit for San Bernardino County and the incorporated cities of San Bernardino County within the Santa Ana Region. Once the undersigned transfers its interest in the property, its successors in interest and the city/county shall be notified of the transfer. The new owner will be informed of its responsibility under this WQMP. A copy of the approved WQMP shall be available on the subject site in perpetuity.

"I certify under a penalty of law that the provisions (implementation, operation, maintenance, and funding) of the WQMP have been accepted and that the plan will be transferred to future successors."

Project Data			
Permit/Application Number(s):	PROJ-2021-00008	Grading Permit Number(s):	TBA
Tract/Parcel Map Number(s):	VTTM 20394	Building Permit Number(s):	TBA
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN 1013-211-21 and -22

Owner's Signature			
Owner Name: Erik Pfahler			
Title	Senior Vice President		
Company	Yorba Villas, LLC c/o Borstein Enterprises		
Address	11766 Wilshire Boulevard, Suite 820, Los Angeles, CA 90025		
Email	erik@borsteinenterprises.com		
Telephone #	(310) 582-1991 x203		
Signature		Date	

Preparer's Certification

Project Data			
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"The selection, sizing and design of stormwater treatment and other stormwater quality and quantity control measures in this plan were prepared under my oversight and meet the requirements of Regional Water Quality Control Board Order No. R8-2010-0036."

Engineer: Stanley C. Morse P.E., L.S.		PE Stamp Below
Title	Principal	
Company	MDS Consulting	
Address	17320 Redhill Avenue, Suite 350, Irvine, CA 92614	
Email	smorse@mdsconsulting.net	
Telephone #	(949) 251-8821 x203	
Signature	Stanley Morse	
Date	November 2, 2021	

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Forms

Section 1 Discretionary Permit(s)

<table>
<tr><th colspan="6">Form 1-1 Project Information</th></tr>
<tr><td colspan="2">Project Name</td><td colspan="4">Vesting Tentative Tract No. 20394</td></tr>
<tr><td colspan="2">Project Owner Contact Name:</td><td colspan="4">Erik Pfahler</td></tr>
<tr><td>Mailing Address:</td><td>11766 Wilshire Boulevard, Suite 820
Los Angeles, CA 90025</td><td>E-mail Address:</td><td>erik@borsteinenterprises.com</td><td>Telephone:</td><td>(310) 582-1991 x203</td></tr>
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<tr><td colspan="2">Additional Information/Comments:</td><td colspan="4"></td></tr>
<tr><td colspan="2">Description of Project:</td><td colspan="4">The proposed project is a gated single family detached residential project located on 13.35 acres (gross) and 12.03 acres (net) at the northwest corner of Francis and Yorba Avenues in the unincorporated territory of the County of San Bernardino. The project will have 45 residential lots averaging 8,533 square feet at a gross density of 3.36 dwelling units per acre. The project will also have a combination stormwater detention and water quality basin. The detention basin is required due to the project lying within an area that has a Hydraulic Condition of Concern (HCOC) due to a lack of downstream storm water facilities. The project is also classified as infill project as it is surrounded on all four sides by developed property. In addition to the detention basin, the project has expanded landscape lots along both Francis Avenue (10 feet) and Yorba Avenue (5 feet) providing more landscape areas for infiltration. These landscaped areas will drain off-site and will not enter the proposed infiltration basin. Of particular interest on this project is the large tributary area to the north of the property. This 25 acre tributary area is composed of large lots that have been used for agricultural purposes and large animal corrals. Their lot sizes range from 0.48 acres to 4.81 acres averaging 2 acres.

The project proposes to keep the two drainage area’s storm flows separate from each other. The tributary storm flows will be collected along the northerly boundary of the project conveyed through the project in a separate storm drain pipe system (private) and outletted onto Francis Avenue at the southwest corner of the project. The in-tract storm flows will be collected in a second in-tract storm drain pipe system and conveyed to the detention basin at the southeast corner of the project. The basin is dual purpose; infiltration basin with proposed drywells will treat the “first flush flows”, and the storm water detention basin which is the above ground basin will detain the 100 year storm.

The proposed 2- Maxwell drywell systems will infiltrate both the DCV volume and the 2-year 24-hour storm volume. Since the project site is located within the HCOC conditioned area, 2-year storm flow will need to be mitigated. Storm flows up to 2-year storm will be handled on-site, through infiltration via the proposed Maxwell drywell systems, the detention basin will only then mitigate the increase</td></tr>
</table>

	in 100-year storm.
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	None

Section 2 Project Description

2.1 Project Information

This section of the WQMP should provide the information listed below. The information provided for Conceptual/ Preliminary WQMP should give sufficient detail to identify the major proposed site design and LID BMPs and other anticipated water quality features that impact site planning. Final Project WQMP must specifically identify all BMP incorporated into the final site design and provide other detailed information as described herein.

The purpose of this information is to help determine the applicable development category, pollutants of concern, watershed description, and long term maintenance responsibilities for the project, and any applicable water quality credits. This information will be used in conjunction with the information in Section 3, Site Description, to establish the performance criteria and to select the LID BMP or other BMP for the project or other alternative programs that the project will participate in, which are described in Section 4.

Form 2.1-1 Description of Proposed Project					
1 Development Category (Select all that apply):					
☐ Significant re-development involving the addition or replacement of 5,000 ft² or more of impervious surface on an already developed site	☒ New development involving the creation of 10,000 ft² or more of impervious surface collectively over entire site	☐ Automotive repair shops with standard industrial classification (SIC) codes 5013, 5014, 5541, 7532- 7534, 7536-7539		☐ Restaurants (with SIC code 5812) where the land area of development is 5,000 ft² or more	
☐ Hillside developments of 5,000 ft² or more which are located on areas with known erosive soil conditions or where the natural slope is 25 percent or more	☐ Developments of 2,500 ft² of impervious surface or more adjacent to (within 200 ft) or discharging directly into environmentally sensitive areas or waterbodies listed on the CWA Section 303(d) list of impaired waters.	☐ Parking lots of 5,000 ft² or more exposed to storm water		☐ Retail gasoline outlets that are either 5,000 ft² or more, or have a projected average daily traffic of 100 or more vehicles per day	
☐ Non-Priority / Non-Category Project *May require source control LID BMPs and other LIP requirements. Please consult with local jurisdiction on specific requirements*.					
2 Project Area (ft²): Drainage Area (ft2):	523,909± 518,364 ±	3 Number of Dwelling Units:	45	4 SIC Code:	6514 Single Family Residential
5 Is Project going to be phased? Yes ☐ No ☒ *If yes, ensure that the WQMP evaluates each phase as a distinct DA, requiring LID BMPs to address runoff at time of completion.*					
6 Does Project include roads? Yes ☐ No ☒ *If yes, ensure that applicable requirements for transportation projects are addressed (see Appendix A of TGD for WQMP) Transportation WQMP Template Not applicable to New Projects or Significant Projects required to prepare a WQMP*					

2.2 Property Ownership/Management

Describe the ownership/management of all portions of the project and site. State whether any infrastructure will transfer to public agencies (City, County, Caltrans, etc.) after project completion. State if a homeowners or property owners association will be formed and be responsible for the long-term maintenance of project stormwater facilities. Describe any lot-level stormwater features that will be the responsibility of individual property owners.

Form 2.2-1 Property Ownership/Management

Describe property ownership/management responsible for long-term maintenance of WQMP stormwater facilities:

During construction, developer shall be responsible for installing, inspecting, and maintaining all onsite post-construction BMPs. Yorba Villas, LLC c/o Borstein Enterprises shall also be responsible for the management of the project site plus implementation and maintenance of the BMPs required by this WQMP until such time as these responsibilities are turned over to and accepted for maintenance by the homeowner and the HOA.

Post-construction, the HOA shall be responsible for long-term operation and maintenance, including funding of the project's post-construction BMPs. The HOA shall be responsible for maintaining all common private areas within the site. The HOA will be responsible for the maintenance of Infiltration Basin/Detention Basin with Infiltration Drywell located on Lot "A".

The HOA shall retain all inspection and maintenance records for the project's BMPs for a period of 5 years after the recorded inspection date for the lifetime of the project.

The proposed Infiltration Basin/Detention Basin with Infiltration Drywell will be the maintenance responsibility of the HOA. All on-site storm drain system including the catch basins will be HOA maintained.

<u>Owner and Developer Information:</u>
Yorba Villas, LLC
c/o Borstein Enterprises
11766 Wilshire Boulevard, Suite 820
Los Angeles, CA 90025
(310) 582-1991 x203
Contact: Erik Pfahler

2.3 Potential Stormwater Pollutants

Determine and describe expected stormwater pollutants of concern based on land uses and site activities (refer to Table 3-3 in the TGD for WQMP).

Form 2.3-1 Pollutants of Concern

Pollutant	Please check: E=Expected, N=Not Expected		Additional Information and Comments
Pathogens (Bacterial / Virus)	E ☒	N ☐	Expected pollutant for Residential areas; the project site will implement on-site LID BMPs in order to treat expected pollutants of concern
Phosphorous	E ☒	N ☐	Expected pollutant for Residential area; the project site will implement on-site LID BMPs in order to treat expected pollutants of concern
Nitrogen	E ☒	N ☐	Expected pollutant for Residential area; the project site will implement on-site LID BMPs in order to treat expected pollutants of concern
Noxious Aquatic Plants	E ☐	N ☒	
Sediment	E ☒	N ☐	Expected pollutant for Residential areas; the project site will implement on-site LID BMPs in order to treat expected pollutants of concern
Metals	E ☒	N ☐	Expected pollutant for Residential areas; the project site will implement on-site LID BMPs in order to treat expected pollutants of concern
Oil and Grease	E ☒	N ☐	Expected pollutant for Residential areas; the project site will implement on-site LID BMPs in order to treat expected pollutants of concern
Trash/Debris	E ☒	N ☐	Expected pollutant for Residential areas; the project site will implement on-site LID BMPs in order to treat expected pollutants of concern
Pesticides / Herbicides	E ☒	N ☐	Expected pollutant for Residential areas; the project site will implement on-site LID BMPs in order to treat expected pollutants of concern
Organic Compounds	E ☐	N ☒	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	
Other:	E ☐	N ☐	

2.4 Water Quality Credits

A water quality credit program is applicable for certain types of development projects if it is not feasible to meet the requirements for on-site LID. Proponents for eligible projects, as described below, can apply for water quality credits that would reduce project obligations for selecting and sizing other treatment BMP or participating in other alternative compliance programs. Refer to Section 6.2 in the TGD for WQMP to determine if water quality credits are applicable for the project.

Form 2.4-1 Water Quality Credits

[1] Project Types that Qualify for Water Quality Credits: NONE			
☐ Redevelopment projects that reduce the overall impervious footprint of the project site. [Credit = % impervious reduced]	Higher density development projects ☐Vertical density [20%] ☐7 units/ acre [5%]	☐ Mixed use development, (combination of residential, commercial, industrial, office, institutional, or other land uses which incorporate design principles that demonstrate environmental benefits not realized through single use projects) [20%]	☐Brownfield redevelopment (redevelop real property complicated by presence or potential of hazardous contaminants) [25%]
☐ Redevelopment projects in established historic district, historic preservation area, or similar significant core city center areas [10%]	☐ Transit-oriented developments (mixed use residential or commercial area designed to maximize access to public transportation) [20%]	☐ In-fill projects (conversion of empty lots & other underused spaces < 5 acres, substantially surrounded by urban land uses, into more beneficially used spaces, such as residential or commercial areas) [10%]	☐ Live-Work developments (variety of developments designed to support residential and vocational needs) [20%]
[2] Total Credit *(Total all credit percentages up to a maximum allowable credit of 50 percent)* = **0**			
Description of Water Quality Credit Eligibility (if applicable)	**NONE**		

Section 3 Site and Watershed Description

Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and sub-watershed DMAs) is conveyed to the site outlet(s). Refer to Section 3.2 in the TGD for WQMP. The form below is provided as an example. Then complete Forms 3.2 and 3.3 for each DA on the project site. ***If the project has more than one drainage area for stormwater management, then complete additional versions of these forms for each DA / outlet.***

Form 3-1 Site Location and Hydrologic Features

Site coordinates *take GPS measurement at approximate center of site*	Latitude 34.041742	Longitude -117.703684	Thomas Bros Map page 641 F4
1 San Bernardino County climatic region: ☒ Valley ☐ Mountain			
2 Does the site have more than one drainage area (DA): Yes☐ No☒ *If no, proceed to Form 3-2. If yes, then use this form to show a conceptual schematic describing DMAs and hydrologic feature connecting DMAs to the site outlet(s). An example is provided below that can be modified for proposed project or a drawing clearly showing DMA and flow routing may be attached*			

Conveyance	Briefly describe on-site drainage features to convey runoff that is not retained within a DMA
	Project site has one drainage area only.

Form 3-2 Existing Hydrologic Characteristics for Drainage Area 1				
	E-1	E-2		
1 DMA drainage area (ac)	3.3	8.7		
2 Existing site impervious area (ft^2)	28,750	189,486		
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	II	II		
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	A	A		
5 Longest flowpath length (ft)	616	998		
6 Longest flowpath slope (ft/ft)	0.1230	0.0080		
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	Barren and Residential	Barren and Commercial		
8 Pre-developed pervious area condition: *Based on the extent of wet season vegetated cover good >75%; Fair 50-75%; Poor <50% Attach photos of site to support rating*	Good	Fair		

Form 3-3 Watershed Description for Drainage Area	
Receiving waters *Refer to Watershed Mapping Tool - http://sbcounty.permitrack.com/WAP* *See 'Drainage Facilities" link at this website*	San Antonio Channel , Chino Creek Reach 2, Chino Creek Rach 1B, Prado Dam, Santa Ana River Reach 2, 1, Newport Slough, Pacific Ocean
Applicable TMDLs *Refer to Local Implementation Plan*	
303(d) listed impairments *Refer to Local Implementation Plan and Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP and State Water Resources Control Board website – http://www.waterboards.ca.gov/santaana/water_issues/programs/tmdl/index.shtml*	San Antonio Creek: pH Chino Creek Reach 2: Indicator Bacteria, pH Chino Creek Reach 1B: COD, Indicator Bacteria, Nutrients Prado Flood Control Basin, pH
Environmentally Sensitive Areas (ESA) *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	None
Unlined Downstream Water Bodies *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	San Antonio Channel, Chino Creek Reach 1B
Hydrologic Conditions of Concern	☒ Yes *Complete Hydrologic Conditions of Concern (HCOC) Assessment. Include Forms 4.2-2 through Form 4.2-5 and Hydromodification BMP Form 4.3-10 in submittal* ☐ No
Watershed–based BMP included in a RWQCB approved WAP	☐ Yes *Attach verification of regional BMP evaluation criteria in WAP* • *More Effective than On-site LID* • *Remaining Capacity for Project DCV* • *Upstream of any Water of the US* • *Operational at Project Completion* • *Long-Term Maintenance Plan* ☒ No

Section 4 Best Management Practices (BMP)

4.1 Source Control BMP

4.1.1 Pollution Prevention

Non-structural and structural source control BMP are required to be incorporated into all new development and significant redevelopment projects. Form 4.1-1 and 4.1-2 are used to describe specific source control BMPs used in the WQMP or to explain why a certain BMP is not applicable. Table 7-3 of the TGD for WQMP provides a list of applicable source control BMP for projects with specific types of potential pollutant sources or activities. The source control BMP in this table must be implemented for projects with these specific types of potential pollutant sources or activities.

The preparers of this WQMP have reviewed the source control BMP requirements for new development and significant redevelopment projects. The preparers have also reviewed the specific BMP required for project as specified in Forms 4.1-1 and 4.1-2. All applicable non-structural and structural source control BMP shall be implemented in the project.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One: Included	Check One: Not Applicable	Describe BMP Implementation OR, if not applicable, state reason
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	Educational Materials will be available to homeowners through HOA. HOA will periodically provide tenants with environmental awareness education materials which may include use of household chemicals, discharges of wastes via hosing or other direct discharge to gutters, catch basins and storm drains. See attached Education Materials in section 6.4 of the WQMP report.
N2	Activity Restrictions	☒	☐	Once an owner assigns a HOA, certain restrictions may be enacted thru the formation of conditions, covenants and restrictions (CCRs) to protect surface water runoff. Some of the activity restrictions that would help promote water quality protection for residential areas are: 1. Requirement to keep trash receptacles covered at all times 2. Prohibiting discharges of paint of masonry wastes to streets or storm drains 3. Prohibit connections of pool/spa draining to streets or storm drains 4. Prohibiting blowing or sweeping of debris into streets or storm drains. 5. Keep dumpster lids closed at all times 6. Pesticide application shall be done by a certified applicator.
N3	Landscape Management BMPs	☒	☐	Standard landscaping maintenance activities, including trash removal, proper replacement of landscaping as needed and regular trimming should be followed at all times, See attached CASQA SD-12 in section 6.4 of the WQMP Report. 1. Proper irrigation practices should also be observed to prevent over-spraying. 2. Verify that runoff minimizing landscape design continues to function by checking that water sensors are functioning properly 3. Adjust irrigation heads to eliminate overspray to hardscape areas 4. Verify irrigation timing and cycle lengths in accordance to water demands given time of the year, weather and day or night time temperatures. 5. Plants with similar water requirements will be grouped together in order to reduce excess irrigation runoff and promote surface infiltration. 6. Irrigation systems will be inspected on a monthly basis and maintained as needed. Proper sprinkler maintenance should be incorporated into landscape management. Landscape management shall commence immediately upon installation of landscaping and should be maintained twice a month. The HOA and homeowners will be responsible for landscape maintenance within private lots.

Form 4.1-1 Non-Structural Source Control BMPs

N4	BMP Maintenance	☒	☐	Maintenance of BMPs implemented at the project shall be performed at the frequency prescribed in this WQMP. Records of inspections and maintenance shall be maintained by the HOA and documented with the WQMP, and shall be available for review upon request.
N5	Title 22 CCR Compliance	☒	☐	No significant hazardous wastes will be generated and/or stored for the residential areas. Typical household hazardous products shall be disposed of properly. Motor oils and oil filters from household shall be recycled in a recycling centers or motor oil collection centers. Other household hazardous wastes such as unused, unwanted or expired medications, fertilizers, bug sprays, paint or other paint materials, batteries, household cleaners etc., are to be disposed of in hazardous waste collection centers.
N6	Local Water Quality Ordinances	☒	☐	Comply with Local Water Quality Ordinances through this WQMP.
N7	Spill Contingency Plan	☐	☒	Not applicable to proposed single-family homes. Hazardous material spills are not anticipated on-site. In the event of accidental leaks, dry cleaning of oil and grease will be employed.
N8	Underground Storage Tank Compliance	☐	☒	Not applicable to proposed single-family homes. No underground storage tanks proposed for this project.
N9	Hazardous Materials Disclosure Compliance	☐	☒	Not applicable to proposed single-family homes. Hazardous materials in significant amounts are not anticipated on-site.

Form 4.1-1 Non-Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N10	Uniform Fire Code Implementation	☐	☒	Not applicable Project will not include a hazardous material storage facility or other area regulated by Article 80.

N11	Litter/Debris Control Program	☒	☐	Homeowners shall keep trash receptacles covered at all times and dumpster lids kept closed at all times. HOA will maintain private lots and provide trash receptacles. Common areas and perimeter fences or walls will be patrolled by employees on a weekly basis and litter will be collected as needed. Trash disposal violations by tenants and home owners will be reported to the HOA.
N12	Employee Training	☒	☐	Provide education for HOA employees and contractors on stormwater quality management within the first 3 months of hire and annually after.
N13	Housekeeping of Loading Docks	☐	☒	Not applicable to proposed for single-family homes. Loading docks are not anticipated on-site.
N14	Catch Basin Inspection Program	☒	☐	HOA will maintain and inspect proposed catchbasins. Cleaning shall be done in late summer/early fall prior to the start of the rainy season. Inspection shall also include storm drain pipes, inlets, and other storm drain appurtenances. A record of all employees or facility maintenance shall be logged by HOA and kept to closely monitor the inspection of catch basin and other drainage facilities connected to it. Any BMPs attached to it should also be monitored and inspected by HOA.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	HOA shall be in-charge of sweeping all streets on a bi-monthly schedule based on the Street Sweeping Map prepared by the county. Streets should be inspected and any litter or debris shall be removed. Oil spills shall be dry cleaned.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	None. No other non-structural measures will be included in this project which will be implemented for other Public agency Priority Project.
N17	Comply with all other applicable NPDES permits	☒	☐	The developer shall complete and file a SWPPP to the state regional boards and forward a copy of NOI to the county.

Form 4.1-2 Structural Source Control BMPs				
Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S1	Provide storm drain system stencilling and signage (CASQA New Development BMP Handbook SD-13)	☒	☐	See CASQA Detail SD-13 in Section 6.4 of this WQMP. Storm drain stencils are highly visible source control messages, typically placed directly adjacent to storm drain inlets. The stencils contain a brief statement that prohibits the dumping of improper materials into the municipal storm drain system. Graphical icons, either illustrating anti-dumping symbols or images of receiving water fauna, are effective supplements to the antidumping message. Developer will provide initial stenciling and signage after which HOA shall be in charge of maintaining storm drain stenciling and signage.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	No outdoor material storage proposed for this development
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Trash bins will be kept closed and equipped with water-tight lids.
S4	Use efficient irrigation systems & landscape design, water conservation, smart controllers, and source control (Statewide Model Landscape Ordinance; CASQA New Development BMP Handbook SD-12)	☒	☐	See CASQA Detail SD-12 in Section 6.4 of this WQMP for reference. See hereon for items applicable for proposed development. HOA and homeowner may employ any of the following: 1. Install rain shutoff devices to prevent irrigation after precipitation 2. Maintain and fix broken sprinklers or lines. 3. Implement landscape plan consistent with County Water Conservation Resolution or County Equivalent. 4. Group plants with similar water requirements. 5. Choose drought tolerant plants. 6. Design irrigation systems to each landscape area's specific water requirements. Private lot areas shall be maintained by HOA.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	1" to 2" lip between landscaping and adjacent sidewalk/curb will be provided
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	Disturbed slopes will implement permanent stabilization BMPs as soon as possible by planting slopes with drought tolerant vegetation. Disturbed hillside areas will be planted with deep-rooted, drought tolerant plant species selected for erosion control. Stormwater runoff will be treated in infiltration basins located in landscaped areas. Energy dissipaters will be installed at the outlets of new MS4s,

				culverts, conduits or channels that enter unlined channels to reduce erosion and minimize impacts to Receiving Waters.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	Not proposed for the development
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	Not proposed for the development
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Not proposed for the development
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	Not proposed for the development

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Not proposed for the development
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	Not proposed for the development
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	Not proposed for the development
S14	Wash water control for food preparation areas	☐	☒	Not proposed for the development
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	Not proposed for the development

4.1.2 Preventative LID Site Design Practices

Site design practices associated with new LID requirements in the MS4 Permit should be considered in the earliest phases of a project. Preventative site design practices can result in smaller DCV for LID BMP and hydromodification control BMP by reducing runoff generation. Describe site design and drainage plan including:

- A narrative of site design practices utilized or rationale for not using practices
- A narrative of how site plan incorporates preventive site design practices
- Include an attached Site Plan layout which shows how preventative site design practices are included in WQMP

Refer to Section 5.2 of the TGD for WQMP for more details.

Form 4.1-3 Preventative LID Site Design Practices Checklist
Site Design Practices *If yes, explain how preventative site design practice is addressed in project site plan. If no, other LID BMPs must be selected to meet targets*
Minimize impervious areas: Yes ☒ No ☐ Explanation: Minimum street widths are proposed for this project thus minimizing impervious areas.
Maximize natural infiltration capacity: Yes ☒ No ☐ Explanation: The project site proposes to use Infiltration Basin with Infiltration Drywell thus promoting natural infiltration.
Preserve existing drainage patterns and time of concentration: Yes ☒ No ☐ Explanation: Proposed development will match the existing drainage pattern. The proposed BMPs for the project will aid in longer time of concentration for the post development condition by introducing more pervious areas and natural infiltrating capabilities of the BMPs.
Disconnect impervious areas: Yes ☒ No ☐ Explanation: Runoff from the project site will be conveyed through proposed storm drain pipes on-site. WQMP flows are diverted into the proposed infiltration BMP before exiting the project site.
Protect existing vegetation and sensitive areas: Yes ☐ No ☒ Explanation: The site is proposed to be fully developed.
Re-vegetate disturbed areas: Yes ☒ No ☐ Explanation: Drought tolerant plants are proposed for the landscaped areas.
Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐ Explanation: Proposed Infiltration Basin areas will be staked to prevent compaction during construction.
Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒ Explanation: Project site will be fully developed utilizing street flows to Catch Basins.
Stake off areas that will be used for landscaping to minimize compaction during construction : Yes ☒ No ☐ Explanation: Areas where infiltration basin is proposed will be staked.

4.2 Project Performance Criteria

The purpose of this section of the Project WQMP is to establish targets for post-development hydrology based on performance criteria specified in the MS4 Permit. These targets include runoff volume for water quality control (referred to as LID design capture volume), and runoff volume, time of concentration, and peak runoff for protection of any downstream waterbody segments with a HCOC. ***If the project has more than one outlet for stormwater runoff, then complete additional versions of these forms for each DA / outlet.***

Methods applied in the following forms include:

- For LID BMP Design Capture Volume (DCV), the San Bernardino County Stormwater Program requires use of the P_6 method (MS4 Permit Section XI.D.6a.ii) – Form 4.2-1
- For HCOC pre- and post-development hydrologic calculation, the San Bernardino County Stormwater Program requires the use of the Rational Method (San Bernardino County Hydrology Manual Section D). Forms 4.2-2 through Form 4.2-5 calculate hydrologic variables including runoff volume, time of concentration, and peak runoff from the project site pre- and post-development using the Hydrology Manual Rational Method approach. For projects greater than 640 acres (1.0 mi^2), the Rational Method and these forms should not be used. For such projects, the Unit Hydrograph Method (San Bernardino County Hydrology Manual Section E) shall be applied for hydrologic calculations for HCOC performance criteria.

Refer to Section 4 in the TGD for WQMP for detailed guidance and instructions.

Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume (DA-1)		
1 Project area DA-1 (ft^2): **518,364 ±**	2 *Imperviousness after applying preventative site design practices (Imp%):* **45%**	3 Runoff Coefficient (Rc): **0.31** *R_c = 0.858(Imp%)^3-0.78(Imp%)^2+0.774(Imp%)+0.04*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): **0.601** http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html		
5 Compute P_6, Mean 6-hr Precipitation (inches): **0.89** *P_6 = Item 4 *C_1, where C_1 is a function of site climatic region specified in Form 3-1 Item 1 (**Valley = 1.4807**; Mountain = 1.909; Desert = 1.2371)*		
6 Drawdown Rate *Use 48 hours as the default condition. Selection and use of the 24 hour drawdown time condition is subject to approval by the local jurisdiction. The necessary BMP footprint is a function of drawdown time. While shorter drawdown times reduce the performance criteria for LID BMP design capture volume, the depth of water that can be stored is also reduced.*		24-hrs ☐ 48-hrs ☒
7 Compute design capture volume, DCV (ft^3): **23,282 ±** *DCV = 1/12 * [Item 1* Item 3 *Item 5 * C_2], where C_2 is a function of drawdown rate (24-hr = 1.582; 48-hr = 1.963) Compute separate DCV for each outlet from the project site per schematic drawn in Form 3-1 Item 2*		

Form 4.2-2 Summary of HCOC Assessment (DA 1)

Does project have the potential to cause or contribute to an HCOC in a downstream channel: Yes ☒ No ☐

Go to: http://sbcounty.permitrack.com/WAP

If "Yes", then complete HCOC assessment of site hydrology for 2yr storm event using Forms 4.2-3 through 4.2-5 and insert results below

(Forms 4.2-3 through 4.2-5 may be replaced by computer software analysis based on the San Bernardino County Hydrology Manual)

If "No," then proceed to Section 4.3 Project Conformance Analysis

Condition	Runoff Volume (ft^3)	Time of Concentration (min)	Peak Runoff (cfs)
Pre-developed	**1** 44,592 *Form 4.2-3 Item 12*	**2** 28.38 *Form 4.2-4 Item 13*	**3** 9.69 *Form 4.2-5 Item 10*
Post-developed	**4** 46,687 *Form 4.2-3 Item 13*	**5** 31.21 *Form 4.2-4 Item 14*	**6** 11.92 *Form 4.2-5 Item 14*
Difference	**7** 2096 *Item 4 – Item 1*	**8** 2.83 *Item 5 – Item 2*	**9** *2.23* *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** 4.7% *Item 7 / Item 1*	**11** 10.0% *Item 8 / Item 2*	**12** 23.0% *Item 9 / Item 3*

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
         (c) Copyright 1983-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1269

                           Analysis prepared by:

                               MDS Consulting
             17320 Redhill Avenue, Suite 350, Irvine, CA 92614
                           Phone: (949) 251-8821
                     Email: mdsirvine@mdsconsulting.net

 ************************* DESCRIPTION OF STUDY *************************
* Existing Condition                                                       *
* 2-Year Storm                                                             *
*                                                                          *
 **************************************************************************

  FILE NAME: C:\AES2016\HYDROSFT\RATSCX\89704\X.DAT
  TIME/DATE OF STUDY: 10:08 11/05/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 0.6000

  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE     10.00 TO NODE     11.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   525.00
  ELEVATION DATA: UPSTREAM(FEET) =    866.70  DOWNSTREAM(FEET) =    860.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.742
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.453
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "1 DWELLING/ACRE"           A        1.80      0.98     0.800    32   13.74
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
  SUBAREA RUNOFF(CFS) =      1.09
  TOTAL AREA(ACRES) =      1.80   PEAK FLOW RATE(CFS) =      1.09

****************************************************************************
  FLOW PROCESS FROM NODE     11.00 TO NODE     12.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    860.00  DOWNSTREAM(FEET) =    847.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   994.00   CHANNEL SLOPE =  0.0131
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.09
  FLOW VELOCITY(FEET/SEC) =   1.74 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   9.50   Tc(MIN.) =   23.24
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     12.00 =    1519.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     12.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   23.24
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.060
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "1 DWELLING/ACRE"           A        5.90      0.98     0.800    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
  SUBAREA AREA(ACRES) =    5.90      SUBAREA RUNOFF(CFS) =    1.49
  EFFECTIVE AREA(ACRES) =      7.70   AREA-AVERAGED Fm(INCH/HR) =  0.78
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.80
  TOTAL AREA(ACRES) =        7.7       PEAK FLOW RATE(CFS) =       1.94

****************************************************************************
  FLOW PROCESS FROM NODE     12.00 TO NODE     22.00 IS CODE =  52
```

```
--------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
==========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    847.00  DOWNSTREAM(FEET) =    837.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   606.00   CHANNEL SLOPE =  0.0165
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.94
  FLOW VELOCITY(FEET/SEC) =   2.20 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   4.60   Tc(MIN.) =   27.84
  LONGEST FLOWPATH FROM NODE     10.00 TO NODE     22.00 =    2125.00 FEET.

**************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     22.00 IS CODE =  81
--------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==========================================================================
  MAINLINE Tc(MIN.) =   27.84
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  0.951
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "1 DWELLING/ACRE"          A        4.00      0.98     0.800    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
  * RAINFALL INTENSITY IS LESS THAN AREA-AVERAGED Fp;
  * IMPERVIOUS AREA USED FOR RUNOFF ESTIMATES.
  SUBAREA AREA(ACRES) =    4.00      SUBAREA RUNOFF(CFS) =    0.68
  EFFECTIVE AREA(ACRES) =     11.70   AREA-AVERAGED Fm(INCH/HR) =  0.78
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.80
  * RAINFALL INTENSITY IS LESS THAN AREA-AVERAGED Fp;
  * IMPERVIOUS AREA USED FOR RUNOFF ESTIMATES.
  TOTAL AREA(ACRES) =       11.7       PEAK FLOW RATE(CFS) =       2.00

**************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     22.00 IS CODE =   1
--------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
==========================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   27.84
  RAINFALL INTENSITY(INCH/HR) =   0.95
  AREA-AVERAGED Fm(INCH/HR) =  0.78
  AREA-AVERAGED Fp(INCH/HR) =  0.98
  AREA-AVERAGED Ap =  0.80
  EFFECTIVE STREAM AREA(ACRES) =      11.70
  TOTAL STREAM AREA(ACRES) =      11.70
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.00

**************************************************************************
  FLOW PROCESS FROM NODE     20.00 TO NODE     21.00 IS CODE =  21
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
```

```
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   937.00
  ELEVATION DATA: UPSTREAM(FEET) =    866.50  DOWNSTREAM(FEET) =    855.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   11.318
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.632
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.80      0.98     0.100    32   11.32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.10
  TOTAL AREA(ACRES) =      0.80   PEAK FLOW RATE(CFS) =      1.10

****************************************************************************
  FLOW PROCESS FROM NODE     21.00 TO NODE     22.00 IS CODE =  62
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  855.00  DOWNSTREAM ELEVATION(FEET) =  837.00
  STREET LENGTH(FEET) =  1380.00   CURB HEIGHT(INCHES) =  8.0
  STREET HALFWIDTH(FEET) = 30.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  20.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       1.94
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.31
    HALFSTREET FLOOD WIDTH(FEET) =    8.41
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.36
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.74
  STREET FLOW TRAVEL TIME(MIN.) =   9.75   Tc(MIN.) =   21.07
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.124
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        1.80      0.98     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.80      SUBAREA RUNOFF(CFS) =    1.66
  EFFECTIVE AREA(ACRES) =      2.60    AREA-AVERAGED Fm(INCH/HR) =  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        2.6       PEAK FLOW RATE(CFS) =       2.40
```

```
  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.33   HALFSTREET FLOOD WIDTH(FEET) =   9.41
  FLOW VELOCITY(FEET/SEC.) =  2.44   DEPTH*VELOCITY(FT*FT/SEC.) =   0.81
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     22.00 =    2317.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     22.00 TO NODE     22.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   21.07
  RAINFALL INTENSITY(INCH/HR) =   1.12
  AREA-AVERAGED Fm(INCH/HR) =  0.10
  AREA-AVERAGED Fp(INCH/HR) =  0.98
  AREA-AVERAGED Ap =  0.10
  EFFECTIVE STREAM AREA(ACRES) =       2.60
  TOTAL STREAM AREA(ACRES) =       2.60
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.40

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        2.00   27.84    0.951  0.98( 0.78) 0.80      11.7      10.00
      2        2.40   21.07    1.124  0.98( 0.10) 0.10       2.6      20.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.41   21.07    1.124  0.98( 0.63) 0.64      11.5      20.00
      2        4.01   27.84    0.951  0.98( 0.66) 0.67      14.3      10.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       4.41    Tc(MIN.) =    21.07
  EFFECTIVE AREA(ACRES) =      11.46   AREA-AVERAGED Fm(INCH/HR) =  0.63
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.64
  TOTAL AREA(ACRES) =       14.3
  LONGEST FLOWPATH FROM NODE     20.00 TO NODE     22.00 =    2317.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     30.00 TO NODE     31.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   730.00
  ELEVATION DATA: UPSTREAM(FEET) =    866.70  DOWNSTREAM(FEET) =    857.00
```

```
  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.553
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.349
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "1 DWELLING/ACRE"          A        6.70      0.98     0.800    32   15.55
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
  SUBAREA RUNOFF(CFS) =      3.43
  TOTAL AREA(ACRES) =      6.70   PEAK FLOW RATE(CFS) =      3.43

****************************************************************************
  FLOW PROCESS FROM NODE     31.00 TO NODE     32.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    857.00  DOWNSTREAM(FEET) =    845.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1032.00   CHANNEL SLOPE =  0.0116
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.43
  FLOW VELOCITY(FEET/SEC) =   2.09 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   8.25   Tc(MIN.) =   23.80
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     32.00 =    1762.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     32.00 TO NODE     32.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   23.80
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.045
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "1 DWELLING/ACRE"          A       11.20      0.98     0.800    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
  SUBAREA AREA(ACRES) =   11.20      SUBAREA RUNOFF(CFS) =    2.67
  EFFECTIVE AREA(ACRES) =     17.90   AREA-AVERAGED Fm(INCH/HR) =  0.78
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.80
  TOTAL AREA(ACRES) =       17.9       PEAK FLOW RATE(CFS) =       4.27

****************************************************************************
  FLOW PROCESS FROM NODE     32.00 TO NODE     33.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    845.00  DOWNSTREAM(FEET) =    837.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   630.00   CHANNEL SLOPE =  0.0127
  CHANNEL FLOW THRU SUBAREA(CFS) =       4.27
```

```
  FLOW VELOCITY(FEET/SEC) =   2.29 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   4.58   Tc(MIN.) =   28.38
  LONGEST FLOWPATH FROM NODE     30.00 TO NODE     33.00 =    2392.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     33.00 TO NODE     33.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   28.38
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  0.940
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  NATURAL POOR COVER
  "BARREN"                   A        1.30      0.42     1.000    78
  COMMERCIAL                 A        6.57      0.98     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.60
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.249
  SUBAREA AREA(ACRES) =    7.87      SUBAREA RUNOFF(CFS) =    5.60
  EFFECTIVE AREA(ACRES) =     25.77   AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.93  AREA-AVERAGED Ap =  0.63
  TOTAL AREA(ACRES) =      25.8       PEAK FLOW RATE(CFS) =       8.18
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       25.8  TC(MIN.) =     28.38
  EFFECTIVE AREA(ACRES) =     25.77  AREA-AVERAGED Fm(INCH/HR)=  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.93  AREA-AVERAGED Ap = 0.632
  PEAK FLOW RATE(CFS)   =       8.18
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
****************************************************************************
             RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
          (Reference: 1986 SAN BERNARDINO CO. HYDROLOGY CRITERION)
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                           Analysis prepared by:

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 ************************** DESCRIPTION OF STUDY **************************
* TENTATIVE TRACT 20394                                                    *
* PROPOSED HYDROLOGY                                                       *
* 2-YEAR STORM                                                             *
 **************************************************************************

  FILE NAME: C:\AES2016\HYDROSFT\RATSCX\89704\89704.DAT
  TIME/DATE OF STUDY: 09:58 11/05/2021
============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
============================================================================
                   --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.95
  *USER-DEFINED LOGARITHMIC INTERPOLATION USED FOR RAINFALL*

  SLOPE OF INTENSITY DURATION CURVE(LOG(I;IN/HR) vs. LOG(Tc;MIN)) = 0.6000
  USER SPECIFIED 1-HOUR INTENSITY(INCH/HOUR) = 0.6000

  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

****************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      3.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   703.00
  ELEVATION DATA: UPSTREAM(FEET) =    847.30  DOWNSTREAM(FEET) =    842.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.074
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.374
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       A        4.62      0.98     0.600    32   15.07
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      3.28
  TOTAL AREA(ACRES) =      4.62   PEAK FLOW RATE(CFS) =      3.28

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      6.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   835.00  DOWNSTREAM(FEET) =   833.80
  FLOW LENGTH(FEET) =   218.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   8.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.14
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.28
  PIPE TRAVEL TIME(MIN.) =   0.88    Tc(MIN.) =   15.95
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      6.00 =     921.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   15.95
  RAINFALL INTENSITY(INCH/HR) =   1.33
  AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.98
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       4.62
  TOTAL STREAM AREA(ACRES) =       4.62
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.28

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  21
```

```
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   346.00
  ELEVATION DATA: UPSTREAM(FEET) =    844.10  DOWNSTREAM(FEET) =    840.80

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.830
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.676
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"        A        1.54      0.98     0.600    32   10.83
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      1.51
  TOTAL AREA(ACRES) =      1.54   PEAK FLOW RATE(CFS) =      1.51

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.83
  RAINFALL INTENSITY(INCH/HR) =   1.68
  AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.97
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       1.54
  TOTAL STREAM AREA(ACRES) =       1.54
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.51

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        3.28   15.95    1.328  0.98( 0.59) 0.60       4.6       1.00
      2        1.51   10.83    1.676  0.97( 0.59) 0.60       1.5       5.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.78   10.83    1.676  0.98( 0.59) 0.60       4.7       5.00
      2        4.31   15.95    1.328  0.97( 0.58) 0.60       6.2       1.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       4.78    Tc(MIN.) =    10.83
```

```
  EFFECTIVE AREA(ACRES) =       4.68   AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.60
  TOTAL AREA(ACRES) =        6.2
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      6.00 =     921.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE     15.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   833.80  DOWNSTREAM(FEET) =   833.10
  FLOW LENGTH(FEET) =   182.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.7 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.95
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.78
  PIPE TRAVEL TIME(MIN.) =   0.77    Tc(MIN.) =   11.60
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE     15.00 =    1103.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     15.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.60
  RAINFALL INTENSITY(INCH/HR) =   1.61
  AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.98
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       4.68
  TOTAL STREAM AREA(ACRES) =       6.16
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       4.78

****************************************************************************
  FLOW PROCESS FROM NODE      8.00 TO NODE      9.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =    843.50  DOWNSTREAM(FEET) =    840.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.133
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.744
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       A        1.14      0.98     0.600    32   10.13
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
```

```
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      1.19
  TOTAL AREA(ACRES) =      1.14   PEAK FLOW RATE(CFS) =      1.19

****************************************************************************
  FLOW PROCESS FROM NODE      9.00 TO NODE     15.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   835.00  DOWNSTREAM(FEET) =   833.10
  FLOW LENGTH(FEET) =    82.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   3.4 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.22
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.19
  PIPE TRAVEL TIME(MIN.) =   0.26    Tc(MIN.) =   10.39
  LONGEST FLOWPATH FROM NODE      8.00 TO NODE     15.00 =     382.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     15.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.39
  RAINFALL INTENSITY(INCH/HR) =   1.72
  AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.98
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       1.14
  TOTAL STREAM AREA(ACRES) =       1.14
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.19

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        4.78   11.60    1.608  0.98( 0.59) 0.60       4.7       5.00
      1        4.31   16.74    1.291  0.97( 0.58) 0.60       6.2       1.00
      2        1.19   10.39    1.718  0.98( 0.59) 0.60       1.1       8.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.93   10.39    1.718  0.98( 0.59) 0.60       5.3       8.00
      2        5.86   11.60    1.608  0.98( 0.59) 0.60       5.8       5.00
      3        5.05   16.74    1.291  0.98( 0.59) 0.60       7.3       1.00
```

```
  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       5.93    Tc(MIN.) =    10.39
  EFFECTIVE AREA(ACRES) =       5.33   AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.60
  TOTAL AREA(ACRES) =        7.3
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE     15.00 =    1103.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     15.00 TO NODE     17.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   833.10  DOWNSTREAM(FEET) =   832.50
  FLOW LENGTH(FEET) =   150.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.16
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.93
  PIPE TRAVEL TIME(MIN.) =   0.60    Tc(MIN.) =   11.00
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE     17.00 =    1253.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   11.00
  RAINFALL INTENSITY(INCH/HR) =   1.66
  AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.98
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       5.33
  TOTAL STREAM AREA(ACRES) =       7.30
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       5.93

****************************************************************************
  FLOW PROCESS FROM NODE     16.00 TO NODE     17.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   247.00
  ELEVATION DATA: UPSTREAM(FEET) =    843.60  DOWNSTREAM(FEET) =    840.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.959
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.878
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
```

```
  "3-4 DWELLINGS/ACRE"       A        1.79      0.98     0.600    32    8.96
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      2.08
  TOTAL AREA(ACRES) =      1.79   PEAK FLOW RATE(CFS) =      2.08

****************************************************************************
  FLOW PROCESS FROM NODE     17.00 TO NODE     17.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    8.96
  RAINFALL INTENSITY(INCH/HR) =   1.88
  AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.98
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       1.79
  TOTAL STREAM AREA(ACRES) =       1.79
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       2.08

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.93   11.00    1.661  0.98( 0.59) 0.60       5.3       8.00
      1        5.86   12.20    1.560  0.98( 0.59) 0.60       5.8       5.00
      1        5.05   17.35    1.263  0.98( 0.59) 0.60       7.3       1.00
      2        2.08    8.96    1.878  0.98( 0.59) 0.60       1.8      16.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.89    8.96    1.878  0.98( 0.59) 0.60       6.1      16.00
      2        7.67   11.00    1.661  0.98( 0.59) 0.60       7.1       8.00
      3        7.43   12.20    1.560  0.98( 0.59) 0.60       7.6       5.00
      4        6.15   17.35    1.263  0.98( 0.58) 0.60       9.1       1.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       7.89    Tc(MIN.) =     8.96
  EFFECTIVE AREA(ACRES) =       6.13   AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.60
  TOTAL AREA(ACRES) =        9.1
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE     17.00 =    1253.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     17.00 TO NODE     25.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
```

```
================================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   832.50  DOWNSTREAM(FEET) =   831.60
  FLOW LENGTH(FEET) =   260.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.25
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       7.89
  PIPE TRAVEL TIME(MIN.) =   1.02    Tc(MIN.) =    9.98
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE     25.00 =    1513.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     25.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
================================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.98
  RAINFALL INTENSITY(INCH/HR) =   1.76
  AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.98
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       6.13
  TOTAL STREAM AREA(ACRES) =       9.09
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       7.89

****************************************************************************
  FLOW PROCESS FROM NODE     24.00 TO NODE     25.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
================================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   255.00
  ELEVATION DATA: UPSTREAM(FEET) =    843.50  DOWNSTREAM(FEET) =    840.60

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.254
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.842
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       A        1.47      0.98     0.600    32    9.25
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      1.66
  TOTAL AREA(ACRES) =      1.47   PEAK FLOW RATE(CFS) =      1.66

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     25.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
================================================================================
```

```
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.25
  RAINFALL INTENSITY(INCH/HR) =   1.84
  AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.98
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       1.47
  TOTAL STREAM AREA(ACRES) =       1.47
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.66

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        7.89    9.98    1.760  0.98( 0.59) 0.60       6.1      16.00
      1        7.67   12.02    1.574  0.98( 0.59) 0.60       7.1       8.00
      1        7.43   13.23    1.486  0.98( 0.59) 0.60       7.6       5.00
      1        6.15   18.42    1.219  0.98( 0.58) 0.60       9.1       1.00
      2        1.66    9.25    1.842  0.98( 0.59) 0.60       1.5      24.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        9.49    9.25    1.842  0.98( 0.59) 0.60       7.2      24.00
      2        9.45    9.98    1.760  0.98( 0.59) 0.60       7.6      16.00
      3        8.97   12.02    1.574  0.98( 0.59) 0.60       8.6       8.00
      4        8.62   13.23    1.486  0.98( 0.59) 0.60       9.1       5.00
      5        6.98   18.42    1.219  0.98( 0.58) 0.60      10.6       1.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       9.49    Tc(MIN.) =     9.25
  EFFECTIVE AREA(ACRES) =       7.16   AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.97  AREA-AVERAGED Ap =  0.60
  TOTAL AREA(ACRES) =       10.6
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE     25.00 =    1513.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     25.00 TO NODE     28.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   831.60  DOWNSTREAM(FEET) =   831.20
  FLOW LENGTH(FEET) =    98.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  16.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.67
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       9.49
  PIPE TRAVEL TIME(MIN.) =   0.35    Tc(MIN.) =    9.60
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE     28.00 =    1611.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     28.00 TO NODE     28.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =    9.60
  RAINFALL INTENSITY(INCH/HR) =   1.80
  AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.97
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       7.16
  TOTAL STREAM AREA(ACRES) =      10.56
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       9.49

****************************************************************************
  FLOW PROCESS FROM NODE     26.00 TO NODE     27.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   298.00
  ELEVATION DATA: UPSTREAM(FEET) =    843.60  DOWNSTREAM(FEET) =    840.50

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   10.027
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.755
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "3-4 DWELLINGS/ACRE"       A        0.80      0.98     0.600    32   10.03
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.600
  SUBAREA RUNOFF(CFS) =      0.84
  TOTAL AREA(ACRES) =      0.80   PEAK FLOW RATE(CFS) =      0.84

****************************************************************************
  FLOW PROCESS FROM NODE     27.00 TO NODE     28.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   834.50  DOWNSTREAM(FEET) =   831.20
  FLOW LENGTH(FEET) =   150.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   2.9 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.62
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       0.84
  PIPE TRAVEL TIME(MIN.) =   0.54    Tc(MIN.) =   10.57
  LONGEST FLOWPATH FROM NODE     26.00 TO NODE     28.00 =     448.00 FEET.
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     28.00 TO NODE     28.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   10.57
  RAINFALL INTENSITY(INCH/HR) =   1.70
  AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.98
  AREA-AVERAGED Ap =  0.60
  EFFECTIVE STREAM AREA(ACRES) =       0.80
  TOTAL STREAM AREA(ACRES) =       0.80
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       0.84

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        9.49    9.60    1.801  0.98( 0.59) 0.60       7.2      24.00
      1        9.45   10.33    1.724  0.98( 0.59) 0.60       7.6      16.00
      1        8.97   12.37    1.547  0.98( 0.59) 0.60       8.6       8.00
      1        8.62   13.58    1.463  0.98( 0.59) 0.60       9.1       5.00
      1        6.98   18.79    1.204  0.98( 0.58) 0.60      10.6       1.00
      2        0.84   10.57    1.701  0.98( 0.59) 0.60       0.8      26.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1       10.32    9.60    1.801  0.98( 0.59) 0.60       7.9      24.00
      2       10.29   10.33    1.724  0.98( 0.59) 0.60       8.4      16.00
      3       10.23   10.57    1.701  0.98( 0.59) 0.60       8.5      26.00
      4        9.70   12.37    1.547  0.98( 0.59) 0.60       9.4       8.00
      5        9.28   13.58    1.463  0.98( 0.59) 0.60       9.9       5.00
      6        7.45   18.79    1.204  0.98( 0.58) 0.60      11.4       1.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =      10.32    Tc(MIN.) =     9.60
  EFFECTIVE AREA(ACRES) =       7.89   AREA-AVERAGED Fm(INCH/HR) =  0.59
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.60
  TOTAL AREA(ACRES) =       11.4
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE     28.00 =    1611.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     28.00 TO NODE     29.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   831.20  DOWNSTREAM(FEET) =   831.00
```

```
  FLOW LENGTH(FEET) =    30.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  14.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   5.85
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =      10.32
  PIPE TRAVEL TIME(MIN.) =   0.09    Tc(MIN.) =    9.69
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE     29.00 =    1641.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     29.00 TO NODE     29.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =    9.69
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.792
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  PUBLIC PARK                A        0.50      0.98     0.850    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.850
  SUBAREA AREA(ACRES) =    0.50      SUBAREA RUNOFF(CFS) =    0.43
  EFFECTIVE AREA(ACRES) =      8.39   AREA-AVERAGED Fm(INCH/HR) =  0.60
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.61
  TOTAL AREA(ACRES) =       11.9       PEAK FLOW RATE(CFS) =      10.32
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE

+--------------------------------------------------------------------------+
| Offsite area                                                             |
|                                                                          |
|                                                                          |
+--------------------------------------------------------------------------+

****************************************************************************
  FLOW PROCESS FROM NODE     50.00 TO NODE     51.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   525.00
  ELEVATION DATA: UPSTREAM(FEET) =    866.70  DOWNSTREAM(FEET) =    860.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   13.742
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.453
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "1 DWELLING/ACRE"          A        1.80      0.98     0.800    32   13.74
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
  SUBAREA RUNOFF(CFS) =      1.09
  TOTAL AREA(ACRES) =      1.80   PEAK FLOW RATE(CFS) =      1.09
```

```
****************************************************************************
  FLOW PROCESS FROM NODE     51.00 TO NODE     52.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    860.00  DOWNSTREAM(FEET) =    847.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =   994.00   CHANNEL SLOPE =  0.0131
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.09
  FLOW VELOCITY(FEET/SEC) =   1.74 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   9.50   Tc(MIN.) =   23.24
  LONGEST FLOWPATH FROM NODE     50.00 TO NODE     52.00 =    1519.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     52.00 TO NODE     52.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   23.24
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.060
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
  "1 DWELLING/ACRE"           A        5.90      0.98     0.800    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
  SUBAREA AREA(ACRES) =    5.90      SUBAREA RUNOFF(CFS) =    1.49
  EFFECTIVE AREA(ACRES) =      7.70   AREA-AVERAGED Fm(INCH/HR) =  0.78
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.80
  TOTAL AREA(ACRES) =        7.7       PEAK FLOW RATE(CFS) =       1.94

****************************************************************************
  FLOW PROCESS FROM NODE     52.00 TO NODE     62.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    845.00  DOWNSTREAM(FEET) =    843.50
  CHANNEL LENGTH THRU SUBAREA(FEET) =   500.00   CHANNEL SLOPE =  0.0030
  CHANNEL FLOW THRU SUBAREA(CFS) =       1.94
  FLOW VELOCITY(FEET/SEC) =   0.94 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   8.90   Tc(MIN.) =   32.14
  LONGEST FLOWPATH FROM NODE     50.00 TO NODE     62.00 =    2019.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     62.00 TO NODE     62.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  1 ARE:
  TIME OF CONCENTRATION(MIN.) =   32.14
```

```
  RAINFALL INTENSITY(INCH/HR) =   0.87
  AREA-AVERAGED Fm(INCH/HR) =  0.78
  AREA-AVERAGED Fp(INCH/HR) =  0.98
  AREA-AVERAGED Ap =  0.80
  EFFECTIVE STREAM AREA(ACRES) =       7.70
  TOTAL STREAM AREA(ACRES) =       7.70
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       1.94

****************************************************************************
  FLOW PROCESS FROM NODE     60.00 TO NODE     61.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   730.00
  ELEVATION DATA: UPSTREAM(FEET) =    866.70  DOWNSTREAM(FEET) =    857.00

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =   15.553
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.349
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  RESIDENTIAL
  "1 DWELLING/ACRE"           A        6.70      0.98     0.800    32   15.55
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
  SUBAREA RUNOFF(CFS) =      3.43
  TOTAL AREA(ACRES) =      6.70   PEAK FLOW RATE(CFS) =      3.43

****************************************************************************
  FLOW PROCESS FROM NODE     61.00 TO NODE     62.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    857.00  DOWNSTREAM(FEET) =    846.00
  CHANNEL LENGTH THRU SUBAREA(FEET) =  1070.00   CHANNEL SLOPE =  0.0103
  CHANNEL FLOW THRU SUBAREA(CFS) =       3.43
  FLOW VELOCITY(FEET/SEC) =   1.96 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   9.09   Tc(MIN.) =   24.64
  LONGEST FLOWPATH FROM NODE     60.00 TO NODE     62.00 =    1800.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     62.00 TO NODE     62.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   24.64
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.023
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  RESIDENTIAL
```

```
  "1 DWELLING/ACRE"          A       11.20      0.98     0.800    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.98
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.800
  SUBAREA AREA(ACRES) =   11.20      SUBAREA RUNOFF(CFS) =    2.45
  EFFECTIVE AREA(ACRES) =     17.90   AREA-AVERAGED Fm(INCH/HR) =  0.78
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.80
  TOTAL AREA(ACRES) =       17.9       PEAK FLOW RATE(CFS) =       3.92

****************************************************************************
  FLOW PROCESS FROM NODE     62.00 TO NODE     62.00 IS CODE =   1
----------------------------------------------------------------------------
  >>>>>DESIGNATE INDEPENDENT STREAM FOR CONFLUENCE<<<<<
  >>>>>AND COMPUTE VARIOUS CONFLUENCED STREAM VALUES<<<<<
============================================================================
  TOTAL NUMBER OF STREAMS =  2
  CONFLUENCE VALUES USED FOR INDEPENDENT STREAM  2 ARE:
  TIME OF CONCENTRATION(MIN.) =   24.64
  RAINFALL INTENSITY(INCH/HR) =   1.02
  AREA-AVERAGED Fm(INCH/HR) =  0.78
  AREA-AVERAGED Fp(INCH/HR) =  0.98
  AREA-AVERAGED Ap =  0.80
  EFFECTIVE STREAM AREA(ACRES) =      17.90
  TOTAL STREAM AREA(ACRES) =      17.90
  PEAK FLOW RATE(CFS) AT CONFLUENCE =       3.92

  ** CONFLUENCE DATA **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        1.94   32.14    0.873  0.98( 0.78) 0.80       7.7      50.00
      2        3.92   24.64    1.023  0.98( 0.78) 0.80      17.9      60.00

  RAINFALL INTENSITY AND TIME OF CONCENTRATION RATIO
  CONFLUENCE FORMULA USED FOR  2 STREAMS.

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.86   24.64    1.023  0.98( 0.78) 0.80      23.8      60.00
      2        4.75   32.14    0.873  0.98( 0.78) 0.80      25.6      50.00

  COMPUTED CONFLUENCE ESTIMATES ARE AS FOLLOWS:
  PEAK FLOW RATE(CFS) =       5.86    Tc(MIN.) =    24.64
  EFFECTIVE AREA(ACRES) =      23.80   AREA-AVERAGED Fm(INCH/HR) =  0.78
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.80
  TOTAL AREA(ACRES) =       25.6
  LONGEST FLOWPATH FROM NODE     50.00 TO NODE     62.00 =    2019.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     62.00 TO NODE     64.00 IS CODE =  52
----------------------------------------------------------------------------
  >>>>>COMPUTE NATURAL VALLEY CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    843.50  DOWNSTREAM(FEET) =    842.00
```

```
  CHANNEL LENGTH THRU SUBAREA(FEET) =   340.00   CHANNEL SLOPE =  0.0044
  CHANNEL FLOW THRU SUBAREA(CFS) =       5.86
  FLOW VELOCITY(FEET/SEC) =   1.46 (PER LACFCD/RCFC&WCD HYDROLOGY MANUAL)
  TRAVEL TIME(MIN.) =   3.89   Tc(MIN.) =   28.54
  LONGEST FLOWPATH FROM NODE     50.00 TO NODE     64.00 =    2359.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     64.00 TO NODE     69.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   837.00  DOWNSTREAM(FEET) =   835.30
  FLOW LENGTH(FEET) =   596.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   3.72
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.86
  PIPE TRAVEL TIME(MIN.) =   2.67    Tc(MIN.) =   31.21
  LONGEST FLOWPATH FROM NODE     50.00 TO NODE     69.00 =    2955.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE     69.00 TO NODE     69.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   31.21
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  0.888
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.20      0.98     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.97
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  * RAINFALL INTENSITY IS LESS THAN AREA-AVERAGED Fp;
  * IMPERVIOUS AREA USED FOR RUNOFF ESTIMATES.
  SUBAREA AREA(ACRES) =    0.20      SUBAREA RUNOFF(CFS) =    0.14
  EFFECTIVE AREA(ACRES) =     24.00   AREA-AVERAGED Fm(INCH/HR) =  0.77
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap =  0.79
  * RAINFALL INTENSITY IS LESS THAN AREA-AVERAGED Fp;
  * IMPERVIOUS AREA USED FOR RUNOFF ESTIMATES.
  TOTAL AREA(ACRES) =       25.8       PEAK FLOW RATE(CFS) =       5.86
  NOTE: PEAK FLOW RATE DEFAULTED TO UPSTREAM VALUE
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =       25.8  TC(MIN.) =     31.21
  EFFECTIVE AREA(ACRES) =     24.00  AREA-AVERAGED Fm(INCH/HR)=  0.77
  AREA-AVERAGED Fp(INCH/HR) =  0.98  AREA-AVERAGED Ap = 0.794
  PEAK FLOW RATE(CFS)   =       5.86

  ** PEAK FLOW RATE TABLE **
   STREAM       Q      Tc   Intensity   Fp(Fm)     Ap     Ae     HEADWATER
   NUMBER     (CFS)  (MIN.) (INCH/HR) (INCH/HR)         (ACRES)    NODE
      1        5.86   31.21    0.888  0.98( 0.77) 0.79      24.0      60.00
```

```
                                       DEV2
      2        4.75   39.08    0.776  0.98( 0.77) 0.79      25.8      50.00
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
        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  11/05/21


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
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San Bernardino County Synthetic Unit Hydrology Method
                Manual date - August 1986


Program License Serial Number 4027

---------------------------------------------------------------------
Unit Hydrograph
Pre Development
2-year / 24-hour

--------------------------------------------------------------------

        Storm Event Year = 2

        Antecedent Moisture Condition = 2

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

 English Units used in output format



Area averaged rainfall intensity isohyetal data:
        Sub-Area        Duration        Isohyetal
        (Ac.)            (hours)         (In)
Rainfall data for year 2
            11.90            1           0.60
--------------------------------------------------------------------
Rainfall data for year 2
            11.90            6           1.45
--------------------------------------------------------------------
Rainfall data for year 2
            11.90           24           2.50
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

******** Area-averaged max loss rate, Fm ********
```

SCS curve No.(AMCII)	SCS curve NO.(AMC 2)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
32.0	32.0	3.30	0.277	0.978	0.800	0.782
32.0	32.0	8.60	0.723	0.978	0.500	0.489

Area-averaged adjusted loss rate Fm (In/Hr) = 0.570

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
2.64	0.222	32.0	32.0	12.50	0.000
0.66	0.055	98.0	98.0	0.20	0.908
4.30	0.361	32.0	32.0	12.50	0.000
4.30	0.361	98.0	98.0	0.20	0.908

Area-averaged catchment yield fraction, Y = 0.379
Area-averaged low loss fraction, Yb = 0.621
User entry of time of concentration = 0.258 (hours)
++
Watershed area = 11.90(Ac.)
Catchment Lag time = 0.206 hours
Unit interval = 5.000 minutes
Unit interval percentage of lag time = 40.3747
Hydrograph baseflow = 0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.570(In/Hr)
Average low loss rate fraction (Yb) = 0.621 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.222(In)
Computed peak 30-minute rainfall = 0.455(In)
Specified peak 1-hour rainfall = 0.600(In)
Computed peak 3-hour rainfall = 1.031(In)
Specified peak 6-hour rainfall = 1.450(In)
Specified peak 24-hour rainfall = 2.500(In)

Rainfall depth area reduction factors:
Using a total area of 11.90(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999	Adjusted rainfall = 0.222(In)
30-minute factor = 0.999	Adjusted rainfall = 0.454(In)
1-hour factor = 0.999	Adjusted rainfall = 0.600(In)
3-hour factor = 1.000	Adjusted rainfall = 1.031(In)
6-hour factor = 1.000	Adjusted rainfall = 1.450(In)
24-hour factor = 1.000	Adjusted rainfall = 2.500(In)

U n i t H y d r o g r a p h

+++

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))

(K = 143.92 (CFS))

1	3.087	4.442
2	19.928	24.237
3	50.442	43.915
4	78.567	40.476
5	91.525	18.649
6	96.879	7.706
7	98.524	2.367
8	99.251	1.046
9	100.000	0.523

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.2219	0.2219
2	0.2929	0.0709
3	0.3444	0.0516
4	0.3864	0.0420
5	0.4225	0.0361
6	0.4545	0.0320
7	0.4834	0.0289
8	0.5099	0.0265
9	0.5345	0.0246
10	0.5575	0.0230
11	0.5792	0.0217
12	0.5997	0.0205
13	0.6238	0.0241
14	0.6470	0.0232
15	0.6694	0.0224
16	0.6910	0.0216
17	0.7120	0.0210
18	0.7323	0.0203
19	0.7521	0.0198
20	0.7714	0.0193
21	0.7901	0.0188
22	0.8085	0.0183
23	0.8264	0.0179
24	0.8439	0.0175
25	0.8611	0.0172
26	0.8779	0.0168
27	0.8943	0.0165
28	0.9105	0.0162
29	0.9264	0.0159
30	0.9420	0.0156
31	0.9574	0.0153
32	0.9725	0.0151
33	0.9873	0.0149
34	1.0020	0.0146
35	1.0164	0.0144
36	1.0306	0.0142
37	1.0446	0.0140
38	1.0584	0.0138
39	1.0720	0.0136
40	1.0855	0.0135
41	1.0988	0.0133

42	1.1119	0.0131
43	1.1248	0.0130
44	1.1377	0.0128
45	1.1503	0.0127
46	1.1628	0.0125
47	1.1752	0.0124
48	1.1875	0.0122
49	1.1996	0.0121
50	1.2116	0.0120
51	1.2235	0.0119
52	1.2352	0.0118
53	1.2469	0.0116
54	1.2584	0.0115
55	1.2698	0.0114
56	1.2811	0.0113
57	1.2924	0.0112
58	1.3035	0.0111
59	1.3145	0.0110
60	1.3254	0.0109
61	1.3363	0.0108
62	1.3470	0.0107
63	1.3577	0.0107
64	1.3682	0.0106
65	1.3787	0.0105
66	1.3891	0.0104
67	1.3994	0.0103
68	1.4097	0.0102
69	1.4199	0.0102
70	1.4300	0.0101
71	1.4400	0.0100
72	1.4499	0.0100
73	1.4578	0.0079
74	1.4656	0.0078
75	1.4734	0.0078
76	1.4811	0.0077
77	1.4887	0.0076
78	1.4963	0.0076
79	1.5038	0.0075
80	1.5112	0.0075
81	1.5186	0.0074
82	1.5260	0.0073
83	1.5333	0.0073
84	1.5405	0.0072
85	1.5477	0.0072
86	1.5548	0.0071
87	1.5619	0.0071
88	1.5689	0.0070
89	1.5759	0.0070
90	1.5828	0.0069
91	1.5897	0.0069
92	1.5966	0.0068
93	1.6034	0.0068
94	1.6101	0.0068
95	1.6168	0.0067

96	1.6235	0.0067
97	1.6301	0.0066
98	1.6367	0.0066
99	1.6432	0.0065
100	1.6497	0.0065
101	1.6562	0.0065
102	1.6626	0.0064
103	1.6690	0.0064
104	1.6754	0.0063
105	1.6817	0.0063
106	1.6879	0.0063
107	1.6942	0.0062
108	1.7004	0.0062
109	1.7066	0.0062
110	1.7127	0.0061
111	1.7188	0.0061
112	1.7249	0.0061
113	1.7309	0.0060
114	1.7369	0.0060
115	1.7429	0.0060
116	1.7488	0.0059
117	1.7547	0.0059
118	1.7606	0.0059
119	1.7664	0.0058
120	1.7723	0.0058
121	1.7781	0.0058
122	1.7838	0.0058
123	1.7895	0.0057
124	1.7952	0.0057
125	1.8009	0.0057
126	1.8066	0.0056
127	1.8122	0.0056
128	1.8178	0.0056
129	1.8234	0.0056
130	1.8289	0.0055
131	1.8344	0.0055
132	1.8399	0.0055
133	1.8454	0.0055
134	1.8508	0.0054
135	1.8562	0.0054
136	1.8616	0.0054
137	1.8670	0.0054
138	1.8723	0.0053
139	1.8776	0.0053
140	1.8829	0.0053
141	1.8882	0.0053
142	1.8935	0.0053
143	1.8987	0.0052
144	1.9039	0.0052
145	1.9091	0.0052
146	1.9142	0.0052
147	1.9194	0.0051
148	1.9245	0.0051
149	1.9296	0.0051

150	1.9347	0.0051
151	1.9397	0.0051
152	1.9448	0.0050
153	1.9498	0.0050
154	1.9548	0.0050
155	1.9598	0.0050
156	1.9647	0.0050
157	1.9697	0.0049
158	1.9746	0.0049
159	1.9795	0.0049
160	1.9844	0.0049
161	1.9892	0.0049
162	1.9941	0.0048
163	1.9989	0.0048
164	2.0037	0.0048
165	2.0085	0.0048
166	2.0133	0.0048
167	2.0180	0.0048
168	2.0228	0.0047
169	2.0275	0.0047
170	2.0322	0.0047
171	2.0369	0.0047
172	2.0416	0.0047
173	2.0462	0.0047
174	2.0509	0.0046
175	2.0555	0.0046
176	2.0601	0.0046
177	2.0647	0.0046
178	2.0693	0.0046
179	2.0738	0.0046
180	2.0784	0.0045
181	2.0829	0.0045
182	2.0874	0.0045
183	2.0919	0.0045
184	2.0964	0.0045
185	2.1009	0.0045
186	2.1053	0.0045
187	2.1098	0.0044
188	2.1142	0.0044
189	2.1186	0.0044
190	2.1230	0.0044
191	2.1274	0.0044
192	2.1318	0.0044
193	2.1361	0.0044
194	2.1405	0.0043
195	2.1448	0.0043
196	2.1491	0.0043
197	2.1534	0.0043
198	2.1577	0.0043
199	2.1620	0.0043
200	2.1662	0.0043
201	2.1705	0.0042
202	2.1747	0.0042
203	2.1789	0.0042

204	2.1832	0.0042
205	2.1874	0.0042
206	2.1915	0.0042
207	2.1957	0.0042
208	2.1999	0.0042
209	2.2040	0.0041
210	2.2082	0.0041
211	2.2123	0.0041
212	2.2164	0.0041
213	2.2205	0.0041
214	2.2246	0.0041
215	2.2287	0.0041
216	2.2327	0.0041
217	2.2368	0.0041
218	2.2408	0.0040
219	2.2449	0.0040
220	2.2489	0.0040
221	2.2529	0.0040
222	2.2569	0.0040
223	2.2609	0.0040
224	2.2649	0.0040
225	2.2688	0.0040
226	2.2728	0.0040
227	2.2767	0.0039
228	2.2807	0.0039
229	2.2846	0.0039
230	2.2885	0.0039
231	2.2924	0.0039
232	2.2963	0.0039
233	2.3002	0.0039
234	2.3041	0.0039
235	2.3079	0.0039
236	2.3118	0.0039
237	2.3156	0.0038
238	2.3195	0.0038
239	2.3233	0.0038
240	2.3271	0.0038
241	2.3309	0.0038
242	2.3347	0.0038
243	2.3385	0.0038
244	2.3423	0.0038
245	2.3461	0.0038
246	2.3498	0.0038
247	2.3536	0.0037
248	2.3573	0.0037
249	2.3610	0.0037
250	2.3648	0.0037
251	2.3685	0.0037
252	2.3722	0.0037
253	2.3759	0.0037
254	2.3795	0.0037
255	2.3832	0.0037
256	2.3869	0.0037
257	2.3906	0.0037

258	2.3942	0.0037
259	2.3978	0.0036
260	2.4015	0.0036
261	2.4051	0.0036
262	2.4087	0.0036
263	2.4123	0.0036
264	2.4159	0.0036
265	2.4195	0.0036
266	2.4231	0.0036
267	2.4267	0.0036
268	2.4302	0.0036
269	2.4338	0.0036
270	2.4374	0.0036
271	2.4409	0.0035
272	2.4444	0.0035
273	2.4480	0.0035
274	2.4515	0.0035
275	2.4550	0.0035
276	2.4585	0.0035
277	2.4620	0.0035
278	2.4655	0.0035
279	2.4690	0.0035
280	2.4724	0.0035
281	2.4759	0.0035
282	2.4794	0.0035
283	2.4828	0.0035
284	2.4863	0.0034
285	2.4897	0.0034
286	2.4931	0.0034
287	2.4965	0.0034
288	2.5000	0.0034

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0034	0.0021	0.0013
2	0.0034	0.0021	0.0013
3	0.0034	0.0021	0.0013
4	0.0034	0.0021	0.0013
5	0.0035	0.0021	0.0013
6	0.0035	0.0022	0.0013
7	0.0035	0.0022	0.0013
8	0.0035	0.0022	0.0013
9	0.0035	0.0022	0.0013
10	0.0035	0.0022	0.0013
11	0.0035	0.0022	0.0013
12	0.0035	0.0022	0.0013
13	0.0036	0.0022	0.0013
14	0.0036	0.0022	0.0013
15	0.0036	0.0022	0.0014
16	0.0036	0.0022	0.0014
17	0.0036	0.0022	0.0014
18	0.0036	0.0022	0.0014

19	0.0036	0.0023	0.0014
20	0.0036	0.0023	0.0014
21	0.0037	0.0023	0.0014
22	0.0037	0.0023	0.0014
23	0.0037	0.0023	0.0014
24	0.0037	0.0023	0.0014
25	0.0037	0.0023	0.0014
26	0.0037	0.0023	0.0014
27	0.0037	0.0023	0.0014
28	0.0037	0.0023	0.0014
29	0.0038	0.0023	0.0014
30	0.0038	0.0023	0.0014
31	0.0038	0.0024	0.0014
32	0.0038	0.0024	0.0014
33	0.0038	0.0024	0.0014
34	0.0038	0.0024	0.0014
35	0.0038	0.0024	0.0015
36	0.0039	0.0024	0.0015
37	0.0039	0.0024	0.0015
38	0.0039	0.0024	0.0015
39	0.0039	0.0024	0.0015
40	0.0039	0.0024	0.0015
41	0.0039	0.0024	0.0015
42	0.0039	0.0025	0.0015
43	0.0040	0.0025	0.0015
44	0.0040	0.0025	0.0015
45	0.0040	0.0025	0.0015
46	0.0040	0.0025	0.0015
47	0.0040	0.0025	0.0015
48	0.0040	0.0025	0.0015
49	0.0041	0.0025	0.0015
50	0.0041	0.0025	0.0015
51	0.0041	0.0025	0.0016
52	0.0041	0.0026	0.0016
53	0.0041	0.0026	0.0016
54	0.0041	0.0026	0.0016
55	0.0042	0.0026	0.0016
56	0.0042	0.0026	0.0016
57	0.0042	0.0026	0.0016
58	0.0042	0.0026	0.0016
59	0.0042	0.0026	0.0016
60	0.0043	0.0026	0.0016
61	0.0043	0.0027	0.0016
62	0.0043	0.0027	0.0016
63	0.0043	0.0027	0.0016
64	0.0043	0.0027	0.0016
65	0.0044	0.0027	0.0017
66	0.0044	0.0027	0.0017
67	0.0044	0.0027	0.0017
68	0.0044	0.0028	0.0017
69	0.0045	0.0028	0.0017
70	0.0045	0.0028	0.0017
71	0.0045	0.0028	0.0017
72	0.0045	0.0028	0.0017

73	0.0045	0.0028	0.0017
74	0.0046	0.0028	0.0017
75	0.0046	0.0029	0.0017
76	0.0046	0.0029	0.0017
77	0.0046	0.0029	0.0018
78	0.0047	0.0029	0.0018
79	0.0047	0.0029	0.0018
80	0.0047	0.0029	0.0018
81	0.0047	0.0029	0.0018
82	0.0048	0.0030	0.0018
83	0.0048	0.0030	0.0018
84	0.0048	0.0030	0.0018
85	0.0048	0.0030	0.0018
86	0.0049	0.0030	0.0018
87	0.0049	0.0030	0.0019
88	0.0049	0.0031	0.0019
89	0.0050	0.0031	0.0019
90	0.0050	0.0031	0.0019
91	0.0050	0.0031	0.0019
92	0.0050	0.0031	0.0019
93	0.0051	0.0032	0.0019
94	0.0051	0.0032	0.0019
95	0.0051	0.0032	0.0019
96	0.0052	0.0032	0.0020
97	0.0052	0.0032	0.0020
98	0.0052	0.0032	0.0020
99	0.0053	0.0033	0.0020
100	0.0053	0.0033	0.0020
101	0.0053	0.0033	0.0020
102	0.0054	0.0033	0.0020
103	0.0054	0.0034	0.0021
104	0.0054	0.0034	0.0021
105	0.0055	0.0034	0.0021
106	0.0055	0.0034	0.0021
107	0.0056	0.0035	0.0021
108	0.0056	0.0035	0.0021
109	0.0056	0.0035	0.0021
110	0.0057	0.0035	0.0021
111	0.0057	0.0036	0.0022
112	0.0058	0.0036	0.0022
113	0.0058	0.0036	0.0022
114	0.0058	0.0036	0.0022
115	0.0059	0.0037	0.0022
116	0.0059	0.0037	0.0022
117	0.0060	0.0037	0.0023
118	0.0060	0.0038	0.0023
119	0.0061	0.0038	0.0023
120	0.0061	0.0038	0.0023
121	0.0062	0.0039	0.0023
122	0.0062	0.0039	0.0024
123	0.0063	0.0039	0.0024
124	0.0063	0.0039	0.0024
125	0.0064	0.0040	0.0024
126	0.0065	0.0040	0.0024

127	0.0065	0.0041	0.0025
128	0.0066	0.0041	0.0025
129	0.0067	0.0041	0.0025
130	0.0067	0.0042	0.0025
131	0.0068	0.0042	0.0026
132	0.0068	0.0043	0.0026
133	0.0069	0.0043	0.0026
134	0.0070	0.0043	0.0026
135	0.0071	0.0044	0.0027
136	0.0071	0.0044	0.0027
137	0.0072	0.0045	0.0027
138	0.0073	0.0045	0.0028
139	0.0074	0.0046	0.0028
140	0.0075	0.0046	0.0028
141	0.0076	0.0047	0.0029
142	0.0076	0.0047	0.0029
143	0.0078	0.0048	0.0029
144	0.0078	0.0049	0.0030
145	0.0100	0.0062	0.0038
146	0.0100	0.0062	0.0038
147	0.0102	0.0063	0.0039
148	0.0102	0.0064	0.0039
149	0.0104	0.0065	0.0039
150	0.0105	0.0065	0.0040
151	0.0107	0.0066	0.0040
152	0.0107	0.0067	0.0041
153	0.0109	0.0068	0.0041
154	0.0110	0.0068	0.0042
155	0.0112	0.0070	0.0042
156	0.0113	0.0070	0.0043
157	0.0115	0.0072	0.0044
158	0.0116	0.0072	0.0044
159	0.0119	0.0074	0.0045
160	0.0120	0.0075	0.0045
161	0.0122	0.0076	0.0046
162	0.0124	0.0077	0.0047
163	0.0127	0.0079	0.0048
164	0.0128	0.0080	0.0048
165	0.0131	0.0082	0.0050
166	0.0133	0.0083	0.0050
167	0.0136	0.0085	0.0052
168	0.0138	0.0086	0.0052
169	0.0142	0.0088	0.0054
170	0.0144	0.0090	0.0055
171	0.0149	0.0092	0.0056
172	0.0151	0.0094	0.0057
173	0.0156	0.0097	0.0059
174	0.0159	0.0099	0.0060
175	0.0165	0.0102	0.0062
176	0.0168	0.0104	0.0064
177	0.0175	0.0109	0.0066
178	0.0179	0.0111	0.0068
179	0.0188	0.0117	0.0071
180	0.0193	0.0120	0.0073

181	0.0203	0.0126	0.0077
182	0.0210	0.0130	0.0079
183	0.0224	0.0139	0.0085
184	0.0232	0.0144	0.0088
185	0.0205	0.0127	0.0078
186	0.0217	0.0135	0.0082
187	0.0246	0.0153	0.0093
188	0.0265	0.0165	0.0100
189	0.0320	0.0199	0.0121
190	0.0361	0.0224	0.0137
191	0.0516	0.0320	0.0195
192	0.0709	0.0441	0.0268
193	0.2219	0.0475	0.1744
194	0.0420	0.0261	0.0159
195	0.0289	0.0180	0.0109
196	0.0230	0.0143	0.0087
197	0.0241	0.0150	0.0091
198	0.0216	0.0134	0.0082
199	0.0198	0.0123	0.0075
200	0.0183	0.0114	0.0069
201	0.0172	0.0107	0.0065
202	0.0162	0.0101	0.0061
203	0.0153	0.0095	0.0058
204	0.0146	0.0091	0.0055
205	0.0140	0.0087	0.0053
206	0.0135	0.0084	0.0051
207	0.0130	0.0081	0.0049
208	0.0125	0.0078	0.0047
209	0.0121	0.0075	0.0046
210	0.0118	0.0073	0.0045
211	0.0114	0.0071	0.0043
212	0.0111	0.0069	0.0042
213	0.0108	0.0067	0.0041
214	0.0106	0.0066	0.0040
215	0.0103	0.0064	0.0039
216	0.0101	0.0063	0.0038
217	0.0079	0.0049	0.0030
218	0.0077	0.0048	0.0029
219	0.0075	0.0047	0.0028
220	0.0073	0.0046	0.0028
221	0.0072	0.0045	0.0027
222	0.0070	0.0044	0.0027
223	0.0069	0.0043	0.0026
224	0.0068	0.0042	0.0026
225	0.0066	0.0041	0.0025
226	0.0065	0.0040	0.0025
227	0.0064	0.0040	0.0024
228	0.0063	0.0039	0.0024
229	0.0062	0.0038	0.0023
230	0.0061	0.0038	0.0023
231	0.0060	0.0037	0.0023
232	0.0059	0.0037	0.0022
233	0.0058	0.0036	0.0022
234	0.0057	0.0035	0.0022

235	0.0056	0.0035	0.0021
236	0.0055	0.0034	0.0021
237	0.0055	0.0034	0.0021
238	0.0054	0.0034	0.0020
239	0.0053	0.0033	0.0020
240	0.0053	0.0033	0.0020
241	0.0052	0.0032	0.0020
242	0.0051	0.0032	0.0019
243	0.0051	0.0031	0.0019
244	0.0050	0.0031	0.0019
245	0.0049	0.0031	0.0019
246	0.0049	0.0030	0.0018
247	0.0048	0.0030	0.0018
248	0.0048	0.0030	0.0018
249	0.0047	0.0029	0.0018
250	0.0047	0.0029	0.0018
251	0.0046	0.0029	0.0018
252	0.0046	0.0028	0.0017
253	0.0045	0.0028	0.0017
254	0.0045	0.0028	0.0017
255	0.0044	0.0028	0.0017
256	0.0044	0.0027	0.0017
257	0.0044	0.0027	0.0016
258	0.0043	0.0027	0.0016
259	0.0043	0.0027	0.0016
260	0.0042	0.0026	0.0016
261	0.0042	0.0026	0.0016
262	0.0042	0.0026	0.0016
263	0.0041	0.0026	0.0016
264	0.0041	0.0025	0.0015
265	0.0041	0.0025	0.0015
266	0.0040	0.0025	0.0015
267	0.0040	0.0025	0.0015
268	0.0040	0.0025	0.0015
269	0.0039	0.0024	0.0015
270	0.0039	0.0024	0.0015
271	0.0039	0.0024	0.0015
272	0.0038	0.0024	0.0015
273	0.0038	0.0024	0.0014
274	0.0038	0.0023	0.0014
275	0.0037	0.0023	0.0014
276	0.0037	0.0023	0.0014
277	0.0037	0.0023	0.0014
278	0.0037	0.0023	0.0014
279	0.0036	0.0023	0.0014
280	0.0036	0.0022	0.0014
281	0.0036	0.0022	0.0014
282	0.0036	0.0022	0.0014
283	0.0035	0.0022	0.0013
284	0.0035	0.0022	0.0013
285	0.0035	0.0022	0.0013
286	0.0035	0.0022	0.0013
287	0.0035	0.0021	0.0013
288	0.0034	0.0021	0.0013

```
---------------------------------------------------------------------
---------------------------------------------------------------------
Total soil rain loss =      1.46(In)
Total effective rainfall =      1.04(In)
Peak flow rate in flood hydrograph =      9.69(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       0.0000      0.01  Q         |         |         |         |
  0+10       0.0003      0.04  Q         |         |         |         |
  0+15       0.0009      0.09  Q         |         |         |         |
  0+20       0.0020      0.15  Q         |         |         |         |
  0+25       0.0031      0.17  Q         |         |         |         |
  0+30       0.0044      0.18  Q         |         |         |         |
  0+35       0.0057      0.19  Q         |         |         |         |
  0+40       0.0069      0.19  Q         |         |         |         |
  0+45       0.0082      0.19  Q         |         |         |         |
  0+50       0.0095      0.19  Q         |         |         |         |
  0+55       0.0109      0.19  Q         |         |         |         |
  1+ 0       0.0122      0.19  Q         |         |         |         |
  1+ 5       0.0135      0.19  Q         |         |         |         |
  1+10       0.0148      0.19  Q         |         |         |         |
  1+15       0.0161      0.19  Q         |         |         |         |
  1+20       0.0175      0.19  Q         |         |         |         |
  1+25       0.0188      0.19  Q         |         |         |         |
  1+30       0.0201      0.19  Q         |         |         |         |
  1+35       0.0215      0.19  Q         |         |         |         |
  1+40       0.0228      0.20  Q         |         |         |         |
  1+45       0.0242      0.20  Q         |         |         |         |
  1+50       0.0255      0.20  Q         |         |         |         |
  1+55       0.0269      0.20  QV        |         |         |         |
  2+ 0       0.0282      0.20  QV        |         |         |         |
  2+ 5       0.0296      0.20  QV        |         |         |         |
  2+10       0.0310      0.20  QV        |         |         |         |
  2+15       0.0324      0.20  QV        |         |         |         |
  2+20       0.0338      0.20  QV        |         |         |         |
  2+25       0.0351      0.20  QV        |         |         |         |
  2+30       0.0365      0.20  QV        |         |         |         |
  2+35       0.0379      0.20  QV        |         |         |         |
  2+40       0.0393      0.20  QV        |         |         |         |
  2+45       0.0408      0.20  QV        |         |         |         |
  2+50       0.0422      0.21  QV        |         |         |         |
  2+55       0.0436      0.21  QV        |         |         |         |
  3+ 0       0.0450      0.21  QV        |         |         |         |
  3+ 5       0.0465      0.21  QV        |         |         |         |
  3+10       0.0479      0.21  QV        |         |         |         |
  3+15       0.0493      0.21  QV        |         |         |         |
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3+20       0.0508      0.21  QV        |         |         |         |
3+25       0.0522      0.21  Q V       |         |         |         |
3+30       0.0537      0.21  Q V       |         |         |         |
3+35       0.0552      0.21  Q V       |         |         |         |
3+40       0.0566      0.21  Q V       |         |         |         |
3+45       0.0581      0.21  Q V       |         |         |         |
3+50       0.0596      0.22  Q V       |         |         |         |
3+55       0.0611      0.22  Q V       |         |         |         |
4+ 0       0.0626      0.22  Q V       |         |         |         |
4+ 5       0.0641      0.22  Q V       |         |         |         |
4+10       0.0656      0.22  Q V       |         |         |         |
4+15       0.0671      0.22  Q V       |         |         |         |
4+20       0.0686      0.22  Q V       |         |         |         |
4+25       0.0702      0.22  Q V       |         |         |         |
4+30       0.0717      0.22  Q V       |         |         |         |
4+35       0.0733      0.22  Q V       |         |         |         |
4+40       0.0748      0.22  Q V       |         |         |         |
4+45       0.0764      0.23  Q V       |         |         |         |
4+50       0.0779      0.23  Q  V      |         |         |         |
4+55       0.0795      0.23  Q  V      |         |         |         |
5+ 0       0.0811      0.23  Q  V      |         |         |         |
5+ 5       0.0826      0.23  Q  V      |         |         |         |
5+10       0.0842      0.23  Q  V      |         |         |         |
5+15       0.0858      0.23  Q  V      |         |         |         |
5+20       0.0874      0.23  Q  V      |         |         |         |
5+25       0.0891      0.23  Q  V      |         |         |         |
5+30       0.0907      0.24  Q  V      |         |         |         |
5+35       0.0923      0.24  Q  V      |         |         |         |
5+40       0.0939      0.24  Q  V      |         |         |         |
5+45       0.0956      0.24  Q  V      |         |         |         |
5+50       0.0972      0.24  Q  V      |         |         |         |
5+55       0.0989      0.24  Q  V      |         |         |         |
6+ 0       0.1006      0.24  Q  V      |         |         |         |
6+ 5       0.1022      0.24  Q  V      |         |         |         |
6+10       0.1039      0.24  Q   V     |         |         |         |
6+15       0.1056      0.25  Q   V     |         |         |         |
6+20       0.1073      0.25  Q   V     |         |         |         |
6+25       0.1090      0.25  Q   V     |         |         |         |
6+30       0.1107      0.25  Q   V     |         |         |         |
6+35       0.1125      0.25  |Q  V     |         |         |         |
6+40       0.1142      0.25  |Q  V     |         |         |         |
6+45       0.1159      0.25  |Q  V     |         |         |         |
6+50       0.1177      0.25  |Q  V     |         |         |         |
6+55       0.1195      0.26  |Q  V     |         |         |         |
7+ 0       0.1212      0.26  |Q  V     |         |         |         |
7+ 5       0.1230      0.26  |Q  V     |         |         |         |
7+10       0.1248      0.26  |Q  V     |         |         |         |
7+15       0.1266      0.26  |Q  V     |         |         |         |
7+20       0.1284      0.26  |Q   V    |         |         |         |
7+25       0.1303      0.26  |Q   V    |         |         |         |
7+30       0.1321      0.27  |Q   V    |         |         |         |
7+35       0.1339      0.27  |Q   V    |         |         |         |
7+40       0.1358      0.27  |Q   V    |         |         |         |
7+45       0.1377      0.27  |Q   V    |         |         |         |
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 7+50       0.1395      0.27  |Q   V    |         |         |         |
 7+55       0.1414      0.27  |Q   V    |         |         |         |
 8+ 0       0.1433      0.28  |Q   V    |         |         |         |
 8+ 5       0.1452      0.28  |Q   V    |         |         |         |
 8+10       0.1472      0.28  |Q   V    |         |         |         |
 8+15       0.1491      0.28  |Q   V    |         |         |         |
 8+20       0.1511      0.28  |Q   V    |         |         |         |
 8+25       0.1530      0.28  |Q   V    |         |         |         |
 8+30       0.1550      0.29  |Q    V   |         |         |         |
 8+35       0.1570      0.29  |Q    V   |         |         |         |
 8+40       0.1590      0.29  |Q    V   |         |         |         |
 8+45       0.1610      0.29  |Q    V   |         |         |         |
 8+50       0.1630      0.29  |Q    V   |         |         |         |
 8+55       0.1651      0.30  |Q    V   |         |         |         |
 9+ 0       0.1671      0.30  |Q    V   |         |         |         |
 9+ 5       0.1692      0.30  |Q    V   |         |         |         |
 9+10       0.1713      0.30  |Q    V   |         |         |         |
 9+15       0.1734      0.30  |Q    V   |         |         |         |
 9+20       0.1755      0.31  |Q    V   |         |         |         |
 9+25       0.1776      0.31  |Q    V   |         |         |         |
 9+30       0.1798      0.31  |Q     V  |         |         |         |
 9+35       0.1819      0.31  |Q     V  |         |         |         |
 9+40       0.1841      0.32  |Q     V  |         |         |         |
 9+45       0.1863      0.32  |Q     V  |         |         |         |
 9+50       0.1885      0.32  |Q     V  |         |         |         |
 9+55       0.1907      0.32  |Q     V  |         |         |         |
10+ 0       0.1930      0.33  |Q     V  |         |         |         |
10+ 5       0.1953      0.33  |Q     V  |         |         |         |
10+10       0.1975      0.33  |Q     V  |         |         |         |
10+15       0.1999      0.33  |Q     V  |         |         |         |
10+20       0.2022      0.34  |Q     V  |         |         |         |
10+25       0.2045      0.34  |Q     V  |         |         |         |
10+30       0.2069      0.34  |Q      V |         |         |         |
10+35       0.2093      0.35  |Q      V |         |         |         |
10+40       0.2117      0.35  |Q      V |         |         |         |
10+45       0.2141      0.35  |Q      V |         |         |         |
10+50       0.2166      0.36  |Q      V |         |         |         |
10+55       0.2190      0.36  |Q      V |         |         |         |
11+ 0       0.2215      0.36  |Q      V |         |         |         |
11+ 5       0.2241      0.37  |Q      V |         |         |         |
11+10       0.2266      0.37  |Q      V |         |         |         |
11+15       0.2292      0.37  |Q      V |         |         |         |
11+20       0.2318      0.38  |Q       V|         |         |         |
11+25       0.2344      0.38  |Q       V|         |         |         |
11+30       0.2370      0.39  |Q       V|         |         |         |
11+35       0.2397      0.39  |Q       V|         |         |         |
11+40       0.2424      0.39  |Q       V|         |         |         |
11+45       0.2452      0.40  |Q       V|         |         |         |
11+50       0.2480      0.40  |Q       V|         |         |         |
11+55       0.2508      0.41  |Q       V|         |         |         |
12+ 0       0.2536      0.41  |Q       V|         |         |         |
12+ 5       0.2565      0.42  |Q        V         |         |         |
12+10       0.2595      0.44  |Q        V         |         |         |
12+15       0.2629      0.48  |Q        V         |         |         |
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12+20       0.2664      0.52  | Q       V         |         |         |
12+25       0.2702      0.54  | Q       V         |         |         |
12+30       0.2739      0.55  | Q       V         |         |         |
12+35       0.2778      0.56  | Q       V         |         |         |
12+40       0.2817      0.57  | Q       |V        |         |         |
12+45       0.2856      0.57  | Q       |V        |         |         |
12+50       0.2896      0.58  | Q       |V        |         |         |
12+55       0.2937      0.59  | Q       |V        |         |         |
13+ 0       0.2978      0.60  | Q       |V        |         |         |
13+ 5       0.3019      0.60  | Q       |V        |         |         |
13+10       0.3061      0.61  | Q       |V        |         |         |
13+15       0.3104      0.62  | Q       | V       |         |         |
13+20       0.3147      0.63  | Q       | V       |         |         |
13+25       0.3191      0.64  | Q       | V       |         |         |
13+30       0.3236      0.65  | Q       | V       |         |         |
13+35       0.3281      0.66  | Q       | V       |         |         |
13+40       0.3327      0.67  | Q       |  V      |         |         |
13+45       0.3374      0.68  | Q       |  V      |         |         |
13+50       0.3421      0.69  | Q       |  V      |         |         |
13+55       0.3470      0.70  | Q       |  V      |         |         |
14+ 0       0.3519      0.72  | Q       |  V      |         |         |
14+ 5       0.3569      0.73  | Q       |  V      |         |         |
14+10       0.3621      0.74  | Q       |   V     |         |         |
14+15       0.3673      0.76  |  Q      |   V     |         |         |
14+20       0.3726      0.78  |  Q      |   V     |         |         |
14+25       0.3781      0.79  |  Q      |   V     |         |         |
14+30       0.3837      0.81  |  Q      |   V     |         |         |
14+35       0.3894      0.83  |  Q      |    V    |         |         |
14+40       0.3953      0.85  |  Q      |    V    |         |         |
14+45       0.4014      0.88  |  Q      |    V    |         |         |
14+50       0.4076      0.90  |  Q      |    V    |         |         |
14+55       0.4140      0.93  |  Q      |     V   |         |         |
15+ 0       0.4206      0.96  |  Q      |     V   |         |         |
15+ 5       0.4275      0.99  |  Q      |     V   |         |         |
15+10       0.4346      1.03  |   Q     |     V   |         |         |
15+15       0.4420      1.07  |   Q     |      V  |         |         |
15+20       0.4497      1.12  |   Q     |      V  |         |         |
15+25       0.4577      1.17  |   Q     |      V  |         |         |
15+30       0.4659      1.19  |   Q     |       V |         |         |
15+35       0.4741      1.19  |   Q     |       V |         |         |
15+40       0.4824      1.20  |   Q     |       V |         |         |
15+45       0.4912      1.28  |    Q    |        V|         |         |
15+50       0.5010      1.42  |    Q    |        V|         |         |
15+55       0.5122      1.62  |     Q   |         V         |         |
16+ 0       0.5258      1.97  |      Q  |         V         |         |
16+ 5       0.5476      3.17  |         | Q       |V        |         |
16+10       0.5934      6.65  |         |         |  V  Q   |         |
16+15       0.6602      9.69  |         |         |    V    |       Q |
16+20       0.7205      8.76  |         |         |       V |    Q    |
16+25       0.7543      4.90  |         |        Q|        V|         |
16+30       0.7737      2.81  |         |Q        |         V         |
16+35       0.7858      1.76  |      Q  |         |         V         |
16+40       0.7956      1.42  |    Q    |         |         |V        |
16+45       0.8041      1.23  |   Q     |         |         |V        |
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16+50       0.8114      1.06  |   Q     |         |         |V        |
16+55       0.8181      0.98  |  Q      |         |         |V        |
17+ 0       0.8244      0.92  |  Q      |         |         | V       |
17+ 5       0.8304      0.87  |  Q      |         |         | V       |
17+10       0.8361      0.82  |  Q      |         |         | V       |
17+15       0.8415      0.78  |  Q      |         |         | V       |
17+20       0.8466      0.75  |  Q      |         |         |  V      |
17+25       0.8516      0.72  | Q       |         |         |  V      |
17+30       0.8564      0.70  | Q       |         |         |  V      |
17+35       0.8610      0.67  | Q       |         |         |  V      |
17+40       0.8655      0.65  | Q       |         |         |  V      |
17+45       0.8699      0.63  | Q       |         |         |  V      |
17+50       0.8741      0.61  | Q       |         |         |   V     |
17+55       0.8782      0.60  | Q       |         |         |   V     |
18+ 0       0.8822      0.58  | Q       |         |         |   V     |
18+ 5       0.8861      0.57  | Q       |         |         |   V     |
18+10       0.8898      0.53  | Q       |         |         |   V     |
18+15       0.8932      0.49  |Q        |         |         |   V     |
18+20       0.8963      0.45  |Q        |         |         |    V    |
18+25       0.8992      0.42  |Q        |         |         |    V    |
18+30       0.9020      0.41  |Q        |         |         |    V    |
18+35       0.9047      0.40  |Q        |         |         |    V    |
18+40       0.9074      0.39  |Q        |         |         |    V    |
18+45       0.9100      0.38  |Q        |         |         |    V    |
18+50       0.9125      0.37  |Q        |         |         |    V    |
18+55       0.9151      0.36  |Q        |         |         |    V    |
19+ 0       0.9175      0.36  |Q        |         |         |    V    |
19+ 5       0.9199      0.35  |Q        |         |         |    V    |
19+10       0.9223      0.34  |Q        |         |         |     V   |
19+15       0.9246      0.34  |Q        |         |         |     V   |
19+20       0.9269      0.33  |Q        |         |         |     V   |
19+25       0.9292      0.33  |Q        |         |         |     V   |
19+30       0.9314      0.32  |Q        |         |         |     V   |
19+35       0.9336      0.32  |Q        |         |         |     V   |
19+40       0.9357      0.31  |Q        |         |         |     V   |
19+45       0.9379      0.31  |Q        |         |         |     V   |
19+50       0.9399      0.30  |Q        |         |         |     V   |
19+55       0.9420      0.30  |Q        |         |         |     V   |
20+ 0       0.9440      0.30  |Q        |         |         |     V   |
20+ 5       0.9460      0.29  |Q        |         |         |     V   |
20+10       0.9480      0.29  |Q        |         |         |      V  |
20+15       0.9500      0.28  |Q        |         |         |      V  |
20+20       0.9519      0.28  |Q        |         |         |      V  |
20+25       0.9538      0.28  |Q        |         |         |      V  |
20+30       0.9557      0.27  |Q        |         |         |      V  |
20+35       0.9576      0.27  |Q        |         |         |      V  |
20+40       0.9594      0.27  |Q        |         |         |      V  |
20+45       0.9612      0.26  |Q        |         |         |      V  |
20+50       0.9630      0.26  |Q        |         |         |      V  |
20+55       0.9648      0.26  |Q        |         |         |      V  |
21+ 0       0.9665      0.26  |Q        |         |         |      V  |
21+ 5       0.9683      0.25  |Q        |         |         |      V  |
21+10       0.9700      0.25  Q         |         |         |      V  |
21+15       0.9717      0.25  Q         |         |         |      V  |
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   21+20       0.9734      0.24  Q         |         |         |       V |
   21+25       0.9751      0.24  Q         |         |         |       V |
   21+30       0.9767      0.24  Q         |         |         |       V |
   21+35       0.9784      0.24  Q         |         |         |       V |
   21+40       0.9800      0.24  Q         |         |         |       V |
   21+45       0.9816      0.23  Q         |         |         |       V |
   21+50       0.9832      0.23  Q         |         |         |       V |
   21+55       0.9848      0.23  Q         |         |         |       V |
   22+ 0       0.9863      0.23  Q         |         |         |       V |
   22+ 5       0.9879      0.23  Q         |         |         |       V |
   22+10       0.9894      0.22  Q         |         |         |       V |
   22+15       0.9909      0.22  Q         |         |         |       V |
   22+20       0.9924      0.22  Q         |         |         |       V |
   22+25       0.9939      0.22  Q         |         |         |       V |
   22+30       0.9954      0.22  Q         |         |         |       V |
   22+35       0.9969      0.21  Q         |         |         |       V |
   22+40       0.9984      0.21  Q         |         |         |        V|
   22+45       0.9998      0.21  Q         |         |         |        V|
   22+50       1.0013      0.21  Q         |         |         |        V|
   22+55       1.0027      0.21  Q         |         |         |        V|
   23+ 0       1.0041      0.21  Q         |         |         |        V|
   23+ 5       1.0055      0.20  Q         |         |         |        V|
   23+10       1.0069      0.20  Q         |         |         |        V|
   23+15       1.0083      0.20  Q         |         |         |        V|
   23+20       1.0097      0.20  Q         |         |         |        V|
   23+25       1.0110      0.20  Q         |         |         |        V|
   23+30       1.0124      0.20  Q         |         |         |        V|
   23+35       1.0137      0.20  Q         |         |         |        V|
   23+40       1.0151      0.19  Q         |         |         |        V|
   23+45       1.0164      0.19  Q         |         |         |        V|
   23+50       1.0177      0.19  Q         |         |         |        V|
   23+55       1.0190      0.19  Q         |         |         |        V|
   24+ 0       1.0203      0.19  Q         |         |         |        V|
   24+ 5       1.0216      0.18  Q         |         |         |        V|
   24+10       1.0226      0.15  Q         |         |         |        V|
   24+15       1.0233      0.09  Q         |         |         |        V|
   24+20       1.0235      0.04  Q         |         |         |        V|
   24+25       1.0236      0.02  Q         |         |         |        V|
   24+30       1.0237      0.01  Q         |         |         |        V|
   24+35       1.0237      0.00  Q         |         |         |        V|
   24+40       1.0237      0.00  Q         |         |         |         V
-----------------------------------------------------------------------
```

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

        Copyright (c) CIVILCADD/CIVILDESIGN, 1989 - 2004, Version 7.0

                Study date  11/05/21

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San Bernardino County Synthetic Unit Hydrology Method
                Manual date - August 1986


Program License Serial Number 4027

---------------------------------------------------------------------
Unit Hydrograph
Post Development
2-year / 24-hour

--------------------------------------------------------------------

        Storm Event Year = 2

        Antecedent Moisture Condition = 2

 English (in-lb) Input Units Used

 English Rainfall Data (Inches) Input Values Used

 English Units used in output format




Area averaged rainfall intensity isohyetal data:
        Sub-Area        Duration        Isohyetal
        (Ac.)            (hours)         (In)
Rainfall data for year 2
            11.90            1           0.60
--------------------------------------------------------------------
Rainfall data for year 2
            11.90            6           1.45
--------------------------------------------------------------------
Rainfall data for year 2
            11.90           24           2.50
--------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

******** Area-averaged max loss rate, Fm ********
```

SCS curve No.(AMCII)	SCS curve NO.(AMC 2)	Area (Ac.)	Area Fraction	Fp(Fig C6) (In/Hr)	Ap (dec.)	Fm (In/Hr)
32.0	32.0	0.50	0.042	0.978	0.850	0.831
33.0	33.0	11.40	0.958	0.972	0.550	0.534

Area-averaged adjusted loss rate Fm (In/Hr) = 0.547

********* Area-Averaged low loss rate fraction, Yb **********

Area (Ac.)	Area Fract	SCS CN (AMC2)	SCS CN (AMC2)	S	Pervious Yield Fr
0.42	0.036	32.0	32.0	12.50	0.000
0.08	0.006	98.0	98.0	0.20	0.908
6.27	0.527	33.0	33.0	12.50	0.000
5.13	0.431	98.0	98.0	0.20	0.908

Area-averaged catchment yield fraction, Y = 0.397
Area-averaged low loss fraction, Yb = 0.603
Direct entry of lag time by user
++
Watershed area =   11.90(Ac.)
Catchment Lag time =   0.157 hours
Unit interval =   5.000 minutes
Unit interval percentage of lag time = 53.0786
Hydrograph baseflow =   0.00(CFS)
Average maximum watershed loss rate(Fm) = 0.547(In/Hr)
Average low loss rate fraction (Yb) = 0.603 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall = 0.222(In)
Computed peak 30-minute rainfall = 0.455(In)
Specified peak 1-hour rainfall = 0.600(In)
Computed peak 3-hour rainfall = 1.031(In)
Specified peak 6-hour rainfall = 1.450(In)
Specified peak 24-hour rainfall = 2.500(In)

Rainfall depth area reduction factors:
Using a total area of   11.90(Ac.) (Ref: fig. E-4)

5-minute factor = 0.999   Adjusted rainfall = 0.222(In)
30-minute factor = 0.999   Adjusted rainfall = 0.454(In)
1-hour factor = 0.999   Adjusted rainfall = 0.600(In)
3-hour factor = 1.000   Adjusted rainfall = 1.031(In)
6-hour factor = 1.000   Adjusted rainfall = 1.450(In)
24-hour factor = 1.000   Adjusted rainfall = 2.500(In)

U n i t   H y d r o g r a p h
+++

Interval Number	'S' Graph Mean values	Unit Hydrograph ((CFS))

(K =   143.92 (CFS))

1	5.135	7.391
2	33.307	40.544
3	73.471	57.802
4	92.153	26.887
5	97.775	8.090
6	99.055	1.842
7	100.000	1.360

Peak Unit Number	Adjusted mass rainfall (In)	Unit rainfall (In)
1	0.2219	0.2219
2	0.2929	0.0709
3	0.3444	0.0516
4	0.3864	0.0420
5	0.4225	0.0361
6	0.4545	0.0320
7	0.4834	0.0289
8	0.5099	0.0265
9	0.5345	0.0246
10	0.5575	0.0230
11	0.5792	0.0217
12	0.5997	0.0205
13	0.6238	0.0241
14	0.6470	0.0232
15	0.6694	0.0224
16	0.6910	0.0216
17	0.7120	0.0210
18	0.7323	0.0203
19	0.7521	0.0198
20	0.7714	0.0193
21	0.7901	0.0188
22	0.8085	0.0183
23	0.8264	0.0179
24	0.8439	0.0175
25	0.8611	0.0172
26	0.8779	0.0168
27	0.8943	0.0165
28	0.9105	0.0162
29	0.9264	0.0159
30	0.9420	0.0156
31	0.9574	0.0153
32	0.9725	0.0151
33	0.9873	0.0149
34	1.0020	0.0146
35	1.0164	0.0144
36	1.0306	0.0142
37	1.0446	0.0140
38	1.0584	0.0138
39	1.0720	0.0136
40	1.0855	0.0135
41	1.0988	0.0133
42	1.1119	0.0131
43	1.1248	0.0130

44	1.1377	0.0128
45	1.1503	0.0127
46	1.1628	0.0125
47	1.1752	0.0124
48	1.1875	0.0122
49	1.1996	0.0121
50	1.2116	0.0120
51	1.2235	0.0119
52	1.2352	0.0118
53	1.2469	0.0116
54	1.2584	0.0115
55	1.2698	0.0114
56	1.2811	0.0113
57	1.2924	0.0112
58	1.3035	0.0111
59	1.3145	0.0110
60	1.3254	0.0109
61	1.3363	0.0108
62	1.3470	0.0107
63	1.3577	0.0107
64	1.3682	0.0106
65	1.3787	0.0105
66	1.3891	0.0104
67	1.3994	0.0103
68	1.4097	0.0102
69	1.4199	0.0102
70	1.4300	0.0101
71	1.4400	0.0100
72	1.4499	0.0100
73	1.4578	0.0079
74	1.4656	0.0078
75	1.4734	0.0078
76	1.4811	0.0077
77	1.4887	0.0076
78	1.4963	0.0076
79	1.5038	0.0075
80	1.5112	0.0075
81	1.5186	0.0074
82	1.5260	0.0073
83	1.5333	0.0073
84	1.5405	0.0072
85	1.5477	0.0072
86	1.5548	0.0071
87	1.5619	0.0071
88	1.5689	0.0070
89	1.5759	0.0070
90	1.5828	0.0069
91	1.5897	0.0069
92	1.5966	0.0068
93	1.6034	0.0068
94	1.6101	0.0068
95	1.6168	0.0067
96	1.6235	0.0067
97	1.6301	0.0066

98	1.6367	0.0066
99	1.6432	0.0065
100	1.6497	0.0065
101	1.6562	0.0065
102	1.6626	0.0064
103	1.6690	0.0064
104	1.6754	0.0063
105	1.6817	0.0063
106	1.6879	0.0063
107	1.6942	0.0062
108	1.7004	0.0062
109	1.7066	0.0062
110	1.7127	0.0061
111	1.7188	0.0061
112	1.7249	0.0061
113	1.7309	0.0060
114	1.7369	0.0060
115	1.7429	0.0060
116	1.7488	0.0059
117	1.7547	0.0059
118	1.7606	0.0059
119	1.7664	0.0058
120	1.7723	0.0058
121	1.7781	0.0058
122	1.7838	0.0058
123	1.7895	0.0057
124	1.7952	0.0057
125	1.8009	0.0057
126	1.8066	0.0056
127	1.8122	0.0056
128	1.8178	0.0056
129	1.8234	0.0056
130	1.8289	0.0055
131	1.8344	0.0055
132	1.8399	0.0055
133	1.8454	0.0055
134	1.8508	0.0054
135	1.8562	0.0054
136	1.8616	0.0054
137	1.8670	0.0054
138	1.8723	0.0053
139	1.8776	0.0053
140	1.8829	0.0053
141	1.8882	0.0053
142	1.8935	0.0053
143	1.8987	0.0052
144	1.9039	0.0052
145	1.9091	0.0052
146	1.9142	0.0052
147	1.9194	0.0051
148	1.9245	0.0051
149	1.9296	0.0051
150	1.9347	0.0051
151	1.9397	0.0051

152	1.9448	0.0050
153	1.9498	0.0050
154	1.9548	0.0050
155	1.9598	0.0050
156	1.9647	0.0050
157	1.9697	0.0049
158	1.9746	0.0049
159	1.9795	0.0049
160	1.9844	0.0049
161	1.9892	0.0049
162	1.9941	0.0048
163	1.9989	0.0048
164	2.0037	0.0048
165	2.0085	0.0048
166	2.0133	0.0048
167	2.0180	0.0048
168	2.0228	0.0047
169	2.0275	0.0047
170	2.0322	0.0047
171	2.0369	0.0047
172	2.0416	0.0047
173	2.0462	0.0047
174	2.0509	0.0046
175	2.0555	0.0046
176	2.0601	0.0046
177	2.0647	0.0046
178	2.0693	0.0046
179	2.0738	0.0046
180	2.0784	0.0045
181	2.0829	0.0045
182	2.0874	0.0045
183	2.0919	0.0045
184	2.0964	0.0045
185	2.1009	0.0045
186	2.1053	0.0045
187	2.1098	0.0044
188	2.1142	0.0044
189	2.1186	0.0044
190	2.1230	0.0044
191	2.1274	0.0044
192	2.1318	0.0044
193	2.1361	0.0044
194	2.1405	0.0043
195	2.1448	0.0043
196	2.1491	0.0043
197	2.1534	0.0043
198	2.1577	0.0043
199	2.1620	0.0043
200	2.1662	0.0043
201	2.1705	0.0042
202	2.1747	0.0042
203	2.1789	0.0042
204	2.1832	0.0042
205	2.1874	0.0042

206	2.1915	0.0042
207	2.1957	0.0042
208	2.1999	0.0042
209	2.2040	0.0041
210	2.2082	0.0041
211	2.2123	0.0041
212	2.2164	0.0041
213	2.2205	0.0041
214	2.2246	0.0041
215	2.2287	0.0041
216	2.2327	0.0041
217	2.2368	0.0041
218	2.2408	0.0040
219	2.2449	0.0040
220	2.2489	0.0040
221	2.2529	0.0040
222	2.2569	0.0040
223	2.2609	0.0040
224	2.2649	0.0040
225	2.2688	0.0040
226	2.2728	0.0040
227	2.2767	0.0039
228	2.2807	0.0039
229	2.2846	0.0039
230	2.2885	0.0039
231	2.2924	0.0039
232	2.2963	0.0039
233	2.3002	0.0039
234	2.3041	0.0039
235	2.3079	0.0039
236	2.3118	0.0039
237	2.3156	0.0038
238	2.3195	0.0038
239	2.3233	0.0038
240	2.3271	0.0038
241	2.3309	0.0038
242	2.3347	0.0038
243	2.3385	0.0038
244	2.3423	0.0038
245	2.3461	0.0038
246	2.3498	0.0038
247	2.3536	0.0037
248	2.3573	0.0037
249	2.3610	0.0037
250	2.3648	0.0037
251	2.3685	0.0037
252	2.3722	0.0037
253	2.3759	0.0037
254	2.3795	0.0037
255	2.3832	0.0037
256	2.3869	0.0037
257	2.3906	0.0037
258	2.3942	0.0037
259	2.3978	0.0036

260	2.4015	0.0036
261	2.4051	0.0036
262	2.4087	0.0036
263	2.4123	0.0036
264	2.4159	0.0036
265	2.4195	0.0036
266	2.4231	0.0036
267	2.4267	0.0036
268	2.4302	0.0036
269	2.4338	0.0036
270	2.4374	0.0036
271	2.4409	0.0035
272	2.4444	0.0035
273	2.4480	0.0035
274	2.4515	0.0035
275	2.4550	0.0035
276	2.4585	0.0035
277	2.4620	0.0035
278	2.4655	0.0035
279	2.4690	0.0035
280	2.4724	0.0035
281	2.4759	0.0035
282	2.4794	0.0035
283	2.4828	0.0035
284	2.4863	0.0034
285	2.4897	0.0034
286	2.4931	0.0034
287	2.4965	0.0034
288	2.5000	0.0034

Unit Period (number)	Unit Rainfall (In)	Unit Soil-Loss (In)	Effective Rainfall (In)
1	0.0034	0.0021	0.0014
2	0.0034	0.0021	0.0014
3	0.0034	0.0021	0.0014
4	0.0034	0.0021	0.0014
5	0.0035	0.0021	0.0014
6	0.0035	0.0021	0.0014
7	0.0035	0.0021	0.0014
8	0.0035	0.0021	0.0014
9	0.0035	0.0021	0.0014
10	0.0035	0.0021	0.0014
11	0.0035	0.0021	0.0014
12	0.0035	0.0021	0.0014
13	0.0036	0.0021	0.0014
14	0.0036	0.0021	0.0014
15	0.0036	0.0022	0.0014
16	0.0036	0.0022	0.0014
17	0.0036	0.0022	0.0014
18	0.0036	0.0022	0.0014
19	0.0036	0.0022	0.0014
20	0.0036	0.0022	0.0014

21	0.0037	0.0022	0.0015
22	0.0037	0.0022	0.0015
23	0.0037	0.0022	0.0015
24	0.0037	0.0022	0.0015
25	0.0037	0.0022	0.0015
26	0.0037	0.0022	0.0015
27	0.0037	0.0022	0.0015
28	0.0037	0.0023	0.0015
29	0.0038	0.0023	0.0015
30	0.0038	0.0023	0.0015
31	0.0038	0.0023	0.0015
32	0.0038	0.0023	0.0015
33	0.0038	0.0023	0.0015
34	0.0038	0.0023	0.0015
35	0.0038	0.0023	0.0015
36	0.0039	0.0023	0.0015
37	0.0039	0.0023	0.0015
38	0.0039	0.0023	0.0015
39	0.0039	0.0024	0.0016
40	0.0039	0.0024	0.0016
41	0.0039	0.0024	0.0016
42	0.0039	0.0024	0.0016
43	0.0040	0.0024	0.0016
44	0.0040	0.0024	0.0016
45	0.0040	0.0024	0.0016
46	0.0040	0.0024	0.0016
47	0.0040	0.0024	0.0016
48	0.0040	0.0024	0.0016
49	0.0041	0.0025	0.0016
50	0.0041	0.0025	0.0016
51	0.0041	0.0025	0.0016
52	0.0041	0.0025	0.0016
53	0.0041	0.0025	0.0016
54	0.0041	0.0025	0.0016
55	0.0042	0.0025	0.0017
56	0.0042	0.0025	0.0017
57	0.0042	0.0025	0.0017
58	0.0042	0.0025	0.0017
59	0.0042	0.0026	0.0017
60	0.0043	0.0026	0.0017
61	0.0043	0.0026	0.0017
62	0.0043	0.0026	0.0017
63	0.0043	0.0026	0.0017
64	0.0043	0.0026	0.0017
65	0.0044	0.0026	0.0017
66	0.0044	0.0026	0.0017
67	0.0044	0.0027	0.0018
68	0.0044	0.0027	0.0018
69	0.0045	0.0027	0.0018
70	0.0045	0.0027	0.0018
71	0.0045	0.0027	0.0018
72	0.0045	0.0027	0.0018
73	0.0045	0.0027	0.0018
74	0.0046	0.0027	0.0018

75	0.0046	0.0028	0.0018
76	0.0046	0.0028	0.0018
77	0.0046	0.0028	0.0018
78	0.0047	0.0028	0.0018
79	0.0047	0.0028	0.0019
80	0.0047	0.0028	0.0019
81	0.0047	0.0029	0.0019
82	0.0048	0.0029	0.0019
83	0.0048	0.0029	0.0019
84	0.0048	0.0029	0.0019
85	0.0048	0.0029	0.0019
86	0.0049	0.0029	0.0019
87	0.0049	0.0030	0.0019
88	0.0049	0.0030	0.0020
89	0.0050	0.0030	0.0020
90	0.0050	0.0030	0.0020
91	0.0050	0.0030	0.0020
92	0.0050	0.0030	0.0020
93	0.0051	0.0031	0.0020
94	0.0051	0.0031	0.0020
95	0.0051	0.0031	0.0020
96	0.0052	0.0031	0.0021
97	0.0052	0.0031	0.0021
98	0.0052	0.0032	0.0021
99	0.0053	0.0032	0.0021
100	0.0053	0.0032	0.0021
101	0.0053	0.0032	0.0021
102	0.0054	0.0032	0.0021
103	0.0054	0.0033	0.0022
104	0.0054	0.0033	0.0022
105	0.0055	0.0033	0.0022
106	0.0055	0.0033	0.0022
107	0.0056	0.0034	0.0022
108	0.0056	0.0034	0.0022
109	0.0056	0.0034	0.0022
110	0.0057	0.0034	0.0023
111	0.0057	0.0035	0.0023
112	0.0058	0.0035	0.0023
113	0.0058	0.0035	0.0023
114	0.0058	0.0035	0.0023
115	0.0059	0.0036	0.0023
116	0.0059	0.0036	0.0024
117	0.0060	0.0036	0.0024
118	0.0060	0.0036	0.0024
119	0.0061	0.0037	0.0024
120	0.0061	0.0037	0.0024
121	0.0062	0.0037	0.0025
122	0.0062	0.0038	0.0025
123	0.0063	0.0038	0.0025
124	0.0063	0.0038	0.0025
125	0.0064	0.0039	0.0026
126	0.0065	0.0039	0.0026
127	0.0065	0.0039	0.0026
128	0.0066	0.0040	0.0026

129	0.0067	0.0040	0.0026
130	0.0067	0.0040	0.0027
131	0.0068	0.0041	0.0027
132	0.0068	0.0041	0.0027
133	0.0069	0.0042	0.0028
134	0.0070	0.0042	0.0028
135	0.0071	0.0043	0.0028
136	0.0071	0.0043	0.0028
137	0.0072	0.0044	0.0029
138	0.0073	0.0044	0.0029
139	0.0074	0.0045	0.0029
140	0.0075	0.0045	0.0030
141	0.0076	0.0046	0.0030
142	0.0076	0.0046	0.0030
143	0.0078	0.0047	0.0031
144	0.0078	0.0047	0.0031
145	0.0100	0.0060	0.0040
146	0.0100	0.0060	0.0040
147	0.0102	0.0061	0.0040
148	0.0102	0.0062	0.0041
149	0.0104	0.0063	0.0041
150	0.0105	0.0063	0.0042
151	0.0107	0.0064	0.0042
152	0.0107	0.0065	0.0043
153	0.0109	0.0066	0.0043
154	0.0110	0.0066	0.0044
155	0.0112	0.0068	0.0045
156	0.0113	0.0068	0.0045
157	0.0115	0.0070	0.0046
158	0.0116	0.0070	0.0046
159	0.0119	0.0072	0.0047
160	0.0120	0.0072	0.0048
161	0.0122	0.0074	0.0049
162	0.0124	0.0075	0.0049
163	0.0127	0.0076	0.0050
164	0.0128	0.0077	0.0051
165	0.0131	0.0079	0.0052
166	0.0133	0.0080	0.0053
167	0.0136	0.0082	0.0054
168	0.0138	0.0083	0.0055
169	0.0142	0.0086	0.0056
170	0.0144	0.0087	0.0057
171	0.0149	0.0090	0.0059
172	0.0151	0.0091	0.0060
173	0.0156	0.0094	0.0062
174	0.0159	0.0096	0.0063
175	0.0165	0.0099	0.0065
176	0.0168	0.0101	0.0067
177	0.0175	0.0106	0.0070
178	0.0179	0.0108	0.0071
179	0.0188	0.0113	0.0075
180	0.0193	0.0116	0.0077
181	0.0203	0.0123	0.0081
182	0.0210	0.0126	0.0083

183	0.0224	0.0135	0.0089
184	0.0232	0.0140	0.0092
185	0.0205	0.0124	0.0081
186	0.0217	0.0131	0.0086
187	0.0246	0.0148	0.0098
188	0.0265	0.0160	0.0105
189	0.0320	0.0193	0.0127
190	0.0361	0.0217	0.0143
191	0.0516	0.0311	0.0205
192	0.0709	0.0427	0.0282
193	0.2219	0.0456	0.1764
194	0.0420	0.0253	0.0167
195	0.0289	0.0174	0.0115
196	0.0230	0.0139	0.0091
197	0.0241	0.0145	0.0096
198	0.0216	0.0130	0.0086
199	0.0198	0.0119	0.0079
200	0.0183	0.0110	0.0073
201	0.0172	0.0103	0.0068
202	0.0162	0.0097	0.0064
203	0.0153	0.0093	0.0061
204	0.0146	0.0088	0.0058
205	0.0140	0.0084	0.0056
206	0.0135	0.0081	0.0053
207	0.0130	0.0078	0.0051
208	0.0125	0.0075	0.0050
209	0.0121	0.0073	0.0048
210	0.0118	0.0071	0.0047
211	0.0114	0.0069	0.0045
212	0.0111	0.0067	0.0044
213	0.0108	0.0065	0.0043
214	0.0106	0.0064	0.0042
215	0.0103	0.0062	0.0041
216	0.0101	0.0061	0.0040
217	0.0079	0.0047	0.0031
218	0.0077	0.0046	0.0031
219	0.0075	0.0045	0.0030
220	0.0073	0.0044	0.0029
221	0.0072	0.0043	0.0029
222	0.0070	0.0042	0.0028
223	0.0069	0.0042	0.0027
224	0.0068	0.0041	0.0027
225	0.0066	0.0040	0.0026
226	0.0065	0.0039	0.0026
227	0.0064	0.0038	0.0025
228	0.0063	0.0038	0.0025
229	0.0062	0.0037	0.0025
230	0.0061	0.0037	0.0024
231	0.0060	0.0036	0.0024
232	0.0059	0.0035	0.0023
233	0.0058	0.0035	0.0023
234	0.0057	0.0034	0.0023
235	0.0056	0.0034	0.0022
236	0.0055	0.0033	0.0022

237	0.0055	0.0033	0.0022
238	0.0054	0.0032	0.0021
239	0.0053	0.0032	0.0021
240	0.0053	0.0032	0.0021
241	0.0052	0.0031	0.0021
242	0.0051	0.0031	0.0020
243	0.0051	0.0030	0.0020
244	0.0050	0.0030	0.0020
245	0.0049	0.0030	0.0020
246	0.0049	0.0029	0.0019
247	0.0048	0.0029	0.0019
248	0.0048	0.0029	0.0019
249	0.0047	0.0028	0.0019
250	0.0047	0.0028	0.0019
251	0.0046	0.0028	0.0018
252	0.0046	0.0028	0.0018
253	0.0045	0.0027	0.0018
254	0.0045	0.0027	0.0018
255	0.0044	0.0027	0.0018
256	0.0044	0.0027	0.0017
257	0.0044	0.0026	0.0017
258	0.0043	0.0026	0.0017
259	0.0043	0.0026	0.0017
260	0.0042	0.0026	0.0017
261	0.0042	0.0025	0.0017
262	0.0042	0.0025	0.0017
263	0.0041	0.0025	0.0016
264	0.0041	0.0025	0.0016
265	0.0041	0.0024	0.0016
266	0.0040	0.0024	0.0016
267	0.0040	0.0024	0.0016
268	0.0040	0.0024	0.0016
269	0.0039	0.0024	0.0016
270	0.0039	0.0023	0.0015
271	0.0039	0.0023	0.0015
272	0.0038	0.0023	0.0015
273	0.0038	0.0023	0.0015
274	0.0038	0.0023	0.0015
275	0.0037	0.0023	0.0015
276	0.0037	0.0022	0.0015
277	0.0037	0.0022	0.0015
278	0.0037	0.0022	0.0015
279	0.0036	0.0022	0.0014
280	0.0036	0.0022	0.0014
281	0.0036	0.0022	0.0014
282	0.0036	0.0022	0.0014
283	0.0035	0.0021	0.0014
284	0.0035	0.0021	0.0014
285	0.0035	0.0021	0.0014
286	0.0035	0.0021	0.0014
287	0.0035	0.0021	0.0014
288	0.0034	0.0021	0.0014


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      Total soil rain loss =      1.42(In)
      Total effective rainfall =      1.08(In)
      Peak flow rate in flood hydrograph =     11.92(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        5.0      10.0      15.0      20.0
-----------------------------------------------------------------------
  0+ 5       0.0001      0.01  Q        |         |         |         |
  0+10       0.0005      0.07  Q        |         |         |         |
  0+15       0.0015      0.14  Q        |         |         |         |
  0+20       0.0027      0.18  Q        |         |         |         |
  0+25       0.0041      0.19  Q        |         |         |         |
  0+30       0.0054      0.20  Q        |         |         |         |
  0+35       0.0068      0.20  Q        |         |         |         |
  0+40       0.0081      0.20  Q        |         |         |         |
  0+45       0.0095      0.20  Q        |         |         |         |
  0+50       0.0109      0.20  Q        |         |         |         |
  0+55       0.0123      0.20  Q        |         |         |         |
  1+ 0       0.0137      0.20  Q        |         |         |         |
  1+ 5       0.0150      0.20  Q        |         |         |         |
  1+10       0.0164      0.20  Q        |         |         |         |
  1+15       0.0178      0.20  Q        |         |         |         |
  1+20       0.0192      0.20  Q        |         |         |         |
  1+25       0.0206      0.20  Q        |         |         |         |
  1+30       0.0221      0.21  Q        |         |         |         |
  1+35       0.0235      0.21  Q        |         |         |         |
  1+40       0.0249      0.21  Q        |         |         |         |
  1+45       0.0263      0.21  Q        |         |         |         |
  1+50       0.0277      0.21  QV       |         |         |         |
  1+55       0.0292      0.21  QV       |         |         |         |
  2+ 0       0.0306      0.21  QV       |         |         |         |
  2+ 5       0.0321      0.21  QV       |         |         |         |
  2+10       0.0335      0.21  QV       |         |         |         |
  2+15       0.0350      0.21  QV       |         |         |         |
  2+20       0.0364      0.21  QV       |         |         |         |
  2+25       0.0379      0.21  QV       |         |         |         |
  2+30       0.0394      0.21  QV       |         |         |         |
  2+35       0.0409      0.21  QV       |         |         |         |
  2+40       0.0424      0.22  QV       |         |         |         |
  2+45       0.0438      0.22  QV       |         |         |         |
  2+50       0.0453      0.22  QV       |         |         |         |
  2+55       0.0468      0.22  QV       |         |         |         |
  3+ 0       0.0483      0.22  QV       |         |         |         |
  3+ 5       0.0499      0.22  QV       |         |         |         |
  3+10       0.0514      0.22  QV       |         |         |         |
  3+15       0.0529      0.22  QV       |         |         |         |
  3+20       0.0544      0.22  Q V      |         |         |         |
  3+25       0.0560      0.22  Q V      |         |         |         |
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3+30       0.0575      0.22  Q V       |         |         |         |
3+35       0.0591      0.22  Q V       |         |         |         |
3+40       0.0606      0.23  Q V       |         |         |         |
3+45       0.0622      0.23  Q V       |         |         |         |
3+50       0.0637      0.23  Q V       |         |         |         |
3+55       0.0653      0.23  Q V       |         |         |         |
4+ 0       0.0669      0.23  Q V       |         |         |         |
4+ 5       0.0685      0.23  Q V       |         |         |         |
4+10       0.0701      0.23  Q V       |         |         |         |
4+15       0.0717      0.23  Q V       |         |         |         |
4+20       0.0733      0.23  Q V       |         |         |         |
4+25       0.0749      0.23  Q V       |         |         |         |
4+30       0.0765      0.24  Q V       |         |         |         |
4+35       0.0782      0.24  Q V       |         |         |         |
4+40       0.0798      0.24  Q V       |         |         |         |
4+45       0.0814      0.24  Q  V      |         |         |         |
4+50       0.0831      0.24  Q  V      |         |         |         |
4+55       0.0847      0.24  Q  V      |         |         |         |
5+ 0       0.0864      0.24  Q  V      |         |         |         |
5+ 5       0.0881      0.24  Q  V      |         |         |         |
5+10       0.0898      0.24  Q  V      |         |         |         |
5+15       0.0914      0.25  Q  V      |         |         |         |
5+20       0.0931      0.25  Q  V      |         |         |         |
5+25       0.0948      0.25  Q  V      |         |         |         |
5+30       0.0966      0.25  Q  V      |         |         |         |
5+35       0.0983      0.25  Q  V      |         |         |         |
5+40       0.1000      0.25  Q  V      |         |         |         |
5+45       0.1017      0.25  Q  V      |         |         |         |
5+50       0.1035      0.25  Q  V      |         |         |         |
5+55       0.1052      0.25  Q  V      |         |         |         |
6+ 0       0.1070      0.26  Q  V      |         |         |         |
6+ 5       0.1088      0.26  Q   V     |         |         |         |
6+10       0.1105      0.26  Q   V     |         |         |         |
6+15       0.1123      0.26  Q   V     |         |         |         |
6+20       0.1141      0.26  Q   V     |         |         |         |
6+25       0.1159      0.26  Q   V     |         |         |         |
6+30       0.1178      0.26  Q   V     |         |         |         |
6+35       0.1196      0.27  Q   V     |         |         |         |
6+40       0.1214      0.27  Q   V     |         |         |         |
6+45       0.1233      0.27  Q   V     |         |         |         |
6+50       0.1251      0.27  Q   V     |         |         |         |
6+55       0.1270      0.27  Q   V     |         |         |         |
7+ 0       0.1289      0.27  Q   V     |         |         |         |
7+ 5       0.1307      0.27  Q   V     |         |         |         |
7+10       0.1326      0.28  Q   V     |         |         |         |
7+15       0.1345      0.28  Q    V    |         |         |         |
7+20       0.1365      0.28  Q    V    |         |         |         |
7+25       0.1384      0.28  Q    V    |         |         |         |
7+30       0.1403      0.28  Q    V    |         |         |         |
7+35       0.1423      0.28  Q    V    |         |         |         |
7+40       0.1442      0.28  Q    V    |         |         |         |
7+45       0.1462      0.29  Q    V    |         |         |         |
7+50       0.1482      0.29  Q    V    |         |         |         |
7+55       0.1502      0.29  Q    V    |         |         |         |
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 8+ 0       0.1522      0.29  Q    V    |         |         |         |
 8+ 5       0.1542      0.29  Q    V    |         |         |         |
 8+10       0.1563      0.30  Q    V    |         |         |         |
 8+15       0.1583      0.30  Q    V    |         |         |         |
 8+20       0.1604      0.30  Q    V    |         |         |         |
 8+25       0.1625      0.30  Q     V   |         |         |         |
 8+30       0.1645      0.30  Q     V   |         |         |         |
 8+35       0.1666      0.31  Q     V   |         |         |         |
 8+40       0.1688      0.31  Q     V   |         |         |         |
 8+45       0.1709      0.31  Q     V   |         |         |         |
 8+50       0.1730      0.31  Q     V   |         |         |         |
 8+55       0.1752      0.31  Q     V   |         |         |         |
 9+ 0       0.1774      0.32  Q     V   |         |         |         |
 9+ 5       0.1796      0.32  Q     V   |         |         |         |
 9+10       0.1818      0.32  Q     V   |         |         |         |
 9+15       0.1840      0.32  Q     V   |         |         |         |
 9+20       0.1862      0.32  Q     V   |         |         |         |
 9+25       0.1885      0.33  Q      V  |         |         |         |
 9+30       0.1907      0.33  Q      V  |         |         |         |
 9+35       0.1930      0.33  Q      V  |         |         |         |
 9+40       0.1953      0.33  Q      V  |         |         |         |
 9+45       0.1977      0.34  Q      V  |         |         |         |
 9+50       0.2000      0.34  Q      V  |         |         |         |
 9+55       0.2024      0.34  Q      V  |         |         |         |
10+ 0       0.2048      0.35  Q      V  |         |         |         |
10+ 5       0.2072      0.35  Q      V  |         |         |         |
10+10       0.2096      0.35  Q      V  |         |         |         |
10+15       0.2120      0.35  Q      V  |         |         |         |
10+20       0.2145      0.36  Q       V |         |         |         |
10+25       0.2170      0.36  Q       V |         |         |         |
10+30       0.2195      0.36  Q       V |         |         |         |
10+35       0.2220      0.37  Q       V |         |         |         |
10+40       0.2245      0.37  Q       V |         |         |         |
10+45       0.2271      0.37  Q       V |         |         |         |
10+50       0.2297      0.38  Q       V |         |         |         |
10+55       0.2323      0.38  Q       V |         |         |         |
11+ 0       0.2350      0.38  Q       V |         |         |         |
11+ 5       0.2376      0.39  Q       V |         |         |         |
11+10       0.2403      0.39  Q       V |         |         |         |
11+15       0.2431      0.40  Q        V|         |         |         |
11+20       0.2458      0.40  Q        V|         |         |         |
11+25       0.2486      0.40  Q        V|         |         |         |
11+30       0.2514      0.41  Q        V|         |         |         |
11+35       0.2543      0.41  Q        V|         |         |         |
11+40       0.2571      0.42  Q        V|         |         |         |
11+45       0.2600      0.42  Q        V|         |         |         |
11+50       0.2630      0.43  Q        V|         |         |         |
11+55       0.2660      0.43  Q        V|         |         |         |
12+ 0       0.2690      0.44  Q         V         |         |         |
12+ 5       0.2721      0.45  Q         V         |         |         |
12+10       0.2754      0.49  Q         V         |         |         |
12+15       0.2791      0.54  |Q        V         |         |         |
12+20       0.2830      0.57  |Q        V         |         |         |
12+25       0.2870      0.58  |Q        V         |         |         |
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12+30       0.2910      0.59  |Q        V         |         |         |
12+35       0.2951      0.59  |Q        |V        |         |         |
12+40       0.2993      0.60  |Q        |V        |         |         |
12+45       0.3034      0.61  |Q        |V        |         |         |
12+50       0.3077      0.62  |Q        |V        |         |         |
12+55       0.3120      0.62  |Q        |V        |         |         |
13+ 0       0.3163      0.63  |Q        |V        |         |         |
13+ 5       0.3207      0.64  |Q        |V        |         |         |
13+10       0.3252      0.65  |Q        | V       |         |         |
13+15       0.3297      0.66  |Q        | V       |         |         |
13+20       0.3343      0.67  |Q        | V       |         |         |
13+25       0.3390      0.68  |Q        | V       |         |         |
13+30       0.3437      0.69  |Q        | V       |         |         |
13+35       0.3486      0.70  |Q        |  V      |         |         |
13+40       0.3535      0.71  |Q        |  V      |         |         |
13+45       0.3584      0.72  |Q        |  V      |         |         |
13+50       0.3635      0.73  |Q        |  V      |         |         |
13+55       0.3686      0.75  |Q        |  V      |         |         |
14+ 0       0.3739      0.76  |Q        |  V      |         |         |
14+ 5       0.3792      0.78  |Q        |   V     |         |         |
14+10       0.3847      0.79  |Q        |   V     |         |         |
14+15       0.3903      0.81  |Q        |   V     |         |         |
14+20       0.3960      0.83  |Q        |   V     |         |         |
14+25       0.4018      0.85  |Q        |   V     |         |         |
14+30       0.4078      0.87  |Q        |    V    |         |         |
14+35       0.4139      0.89  |Q        |    V    |         |         |
14+40       0.4202      0.91  |Q        |    V    |         |         |
14+45       0.4267      0.94  |Q        |    V    |         |         |
14+50       0.4334      0.97  |Q        |     V   |         |         |
14+55       0.4402      1.00  |Q        |     V   |         |         |
15+ 0       0.4474      1.03  | Q       |     V   |         |         |
15+ 5       0.4547      1.07  | Q       |     V   |         |         |
15+10       0.4624      1.11  | Q       |      V  |         |         |
15+15       0.4704      1.16  | Q       |      V  |         |         |
15+20       0.4787      1.21  | Q       |      V  |         |         |
15+25       0.4874      1.26  | Q       |       V |         |         |
15+30       0.4961      1.26  | Q       |       V |         |         |
15+35       0.5046      1.24  | Q       |       V |         |         |
15+40       0.5135      1.29  | Q       |        V|         |         |
15+45       0.5232      1.41  | Q       |        V|         |         |
15+50       0.5342      1.59  |  Q      |        V|         |         |
15+55       0.5470      1.86  |  Q      |         V         |         |
16+ 0       0.5630      2.32  |   Q     |         |V        |         |
16+ 5       0.5915      4.15  |       Q |         | V       |         |
16+10       0.6577      9.61  |         |        Q|   V     |         |
16+15       0.7398     11.92  |         |         |  Q   V  |         |
16+20       0.7847      6.52  |         |  Q      |        V|         |
16+25       0.8058      3.06  |     Q   |         |         V         |
16+30       0.8181      1.79  |  Q      |         |         V         |
16+35       0.8289      1.57  |  Q      |         |         V         |
16+40       0.8375      1.24  | Q       |         |         |V        |
16+45       0.8454      1.14  | Q       |         |         |V        |
16+50       0.8526      1.06  | Q       |         |         |V        |
16+55       0.8595      0.99  |Q        |         |         | V       |
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17+ 0       0.8659      0.93  |Q        |         |         | V       |
17+ 5       0.8719      0.88  |Q        |         |         | V       |
17+10       0.8777      0.84  |Q        |         |         | V       |
17+15       0.8832      0.80  |Q        |         |         | V       |
17+20       0.8885      0.77  |Q        |         |         |  V      |
17+25       0.8937      0.74  |Q        |         |         |  V      |
17+30       0.8986      0.72  |Q        |         |         |  V      |
17+35       0.9034      0.69  |Q        |         |         |  V      |
17+40       0.9080      0.67  |Q        |         |         |  V      |
17+45       0.9125      0.65  |Q        |         |         |   V     |
17+50       0.9169      0.64  |Q        |         |         |   V     |
17+55       0.9212      0.62  |Q        |         |         |   V     |
18+ 0       0.9253      0.60  |Q        |         |         |   V     |
18+ 5       0.9294      0.58  |Q        |         |         |   V     |
18+10       0.9331      0.54  |Q        |         |         |   V     |
18+15       0.9364      0.48  Q         |         |         |   V     |
18+20       0.9395      0.45  Q         |         |         |    V    |
18+25       0.9425      0.43  Q         |         |         |    V    |
18+30       0.9454      0.42  Q         |         |         |    V    |
18+35       0.9482      0.41  Q         |         |         |    V    |
18+40       0.9510      0.40  Q         |         |         |    V    |
18+45       0.9537      0.39  Q         |         |         |    V    |
18+50       0.9563      0.39  Q         |         |         |    V    |
18+55       0.9590      0.38  Q         |         |         |    V    |
19+ 0       0.9615      0.37  Q         |         |         |    V    |
19+ 5       0.9640      0.37  Q         |         |         |    V    |
19+10       0.9665      0.36  Q         |         |         |     V   |
19+15       0.9689      0.35  Q         |         |         |     V   |
19+20       0.9713      0.35  Q         |         |         |     V   |
19+25       0.9737      0.34  Q         |         |         |     V   |
19+30       0.9760      0.34  Q         |         |         |     V   |
19+35       0.9783      0.33  Q         |         |         |     V   |
19+40       0.9805      0.33  Q         |         |         |     V   |
19+45       0.9827      0.32  Q         |         |         |     V   |
19+50       0.9849      0.32  Q         |         |         |     V   |
19+55       0.9871      0.31  Q         |         |         |     V   |
20+ 0       0.9892      0.31  Q         |         |         |     V   |
20+ 5       0.9913      0.30  Q         |         |         |     V   |
20+10       0.9933      0.30  Q         |         |         |      V  |
20+15       0.9954      0.30  Q         |         |         |      V  |
20+20       0.9974      0.29  Q         |         |         |      V  |
20+25       0.9994      0.29  Q         |         |         |      V  |
20+30       1.0014      0.29  Q         |         |         |      V  |
20+35       1.0033      0.28  Q         |         |         |      V  |
20+40       1.0052      0.28  Q         |         |         |      V  |
20+45       1.0071      0.28  Q         |         |         |      V  |
20+50       1.0090      0.27  Q         |         |         |      V  |
20+55       1.0109      0.27  Q         |         |         |      V  |
21+ 0       1.0127      0.27  Q         |         |         |      V  |
21+ 5       1.0145      0.26  Q         |         |         |      V  |
21+10       1.0163      0.26  Q         |         |         |      V  |
21+15       1.0181      0.26  Q         |         |         |      V  |
21+20       1.0199      0.26  Q         |         |         |       V |
21+25       1.0216      0.25  Q         |         |         |       V |
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  21+30       1.0234      0.25  Q         |         |         |      V |
  21+35       1.0251      0.25  Q         |         |         |      V |
  21+40       1.0268      0.25  Q         |         |         |      V |
  21+45       1.0285      0.24  Q         |         |         |      V |
  21+50       1.0301      0.24  Q         |         |         |      V |
  21+55       1.0318      0.24  Q         |         |         |      V |
  22+ 0       1.0334      0.24  Q         |         |         |      V |
  22+ 5       1.0351      0.24  Q         |         |         |      V |
  22+10       1.0367      0.23  Q         |         |         |      V |
  22+15       1.0383      0.23  Q         |         |         |      V |
  22+20       1.0398      0.23  Q         |         |         |      V |
  22+25       1.0414      0.23  Q         |         |         |      V |
  22+30       1.0430      0.23  Q         |         |         |      V |
  22+35       1.0445      0.22  Q         |         |         |      V |
  22+40       1.0461      0.22  Q         |         |         |       V|
  22+45       1.0476      0.22  Q         |         |         |       V|
  22+50       1.0491      0.22  Q         |         |         |       V|
  22+55       1.0506      0.22  Q         |         |         |       V|
  23+ 0       1.0521      0.22  Q         |         |         |       V|
  23+ 5       1.0535      0.21  Q         |         |         |       V|
  23+10       1.0550      0.21  Q         |         |         |       V|
  23+15       1.0565      0.21  Q         |         |         |       V|
  23+20       1.0579      0.21  Q         |         |         |       V|
  23+25       1.0593      0.21  Q         |         |         |       V|
  23+30       1.0608      0.21  Q         |         |         |       V|
  23+35       1.0622      0.21  Q         |         |         |       V|
  23+40       1.0636      0.20  Q         |         |         |       V|
  23+45       1.0650      0.20  Q         |         |         |       V|
  23+50       1.0664      0.20  Q         |         |         |       V|
  23+55       1.0677      0.20  Q         |         |         |       V|
  24+ 0       1.0691      0.20  Q         |         |         |       V|
  24+ 5       1.0704      0.19  Q         |         |         |       V|
  24+10       1.0713      0.13  Q         |         |         |       V|
  24+15       1.0717      0.05  Q         |         |         |       V|
  24+20       1.0718      0.02  Q         |         |         |       V|
  24+25       1.0718      0.00  Q         |         |         |       V|
  24+30       1.0718      0.00  Q         |         |         |       V|
-----------------------------------------------------------------------
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FLOOD HYDROGRAPH ROUTING PROGRAM

Study date: 11/05/21

2-year / 24-hour

Program License Serial Number 4027

```
********************* HYDROGRAPH INFORMATION **********************

                From study/file name: PostDev.rte
****************************HYDROGRAPH DATA****************************
                Number of intervals =   294
                Time interval =    5.0 (Min.)
                Maximum/Peak flow rate =       11.922 (CFS)
                Total volume =       1.072 (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       0.000 to Point/Station       0.000
**** RETARDING BASIN ROUTING ****
_______________________________________________________________________

User entry of depth-outflow-storage data
----------------------------------------------------------------------
Total number of inflow hydrograph intervals = 294
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
1.000	0.045	0.261	0.044	0.046
2.000	0.162	0.273	0.161	0.163
3.000	0.307	0.284	0.306	0.308
4.000	0.479	0.295	0.478	0.480
5.000	0.678	0.306	0.677	0.679
6.000	0.903	0.316	0.902	0.904
6.700	1.075	4.923	1.058	1.092
7.000	1.242	9.176	1.210	1.274
8.000	1.522	14.309	1.473	1.571

Hydrograph Detention Basin Routing

Graph values: 'I'= unit inflow; 'O'=outflow at time shown

Time (Hours)	Inflow (CFS)	Outflow (CFS)	Storage (Ac.Ft)	.0	3.0	5.96	8.94	11.92	Depth (Ft.)
0.083	0.01	0.00	0.000	O					0.00
0.167	0.07	0.00	0.000	O					0.01
0.250	0.14	0.01	0.001	O					0.02
0.333	0.18	0.01	0.002	O					0.05
0.417	0.19	0.02	0.003	O					0.07
0.500	0.20	0.03	0.004	O					0.10
0.583	0.20	0.03	0.006	O					0.12
0.667	0.20	0.04	0.007	O					0.15
0.750	0.20	0.04	0.008	O					0.17
0.833	0.20	0.05	0.009	O					0.20
0.917	0.20	0.06	0.010	O					0.22
1.000	0.20	0.06	0.011	O					0.24
1.083	0.20	0.07	0.012	O					0.26
1.167	0.20	0.07	0.013	O					0.28
1.250	0.20	0.08	0.013	O					0.30
1.333	0.20	0.08	0.014	O					0.32
1.417	0.20	0.09	0.015	O					0.34
1.500	0.21	0.09	0.016	O					0.35
1.583	0.21	0.10	0.017	O					0.37
1.667	0.21	0.10	0.017	O					0.39
1.750	0.21	0.11	0.018	O					0.40
1.833	0.21	0.11	0.019	O					0.42
1.917	0.21	0.11	0.020	O					0.43
2.000	0.21	0.12	0.020	O					0.45
2.083	0.21	0.12	0.021	O					0.46
2.167	0.21	0.12	0.021	O					0.48
2.250	0.21	0.13	0.022	O					0.49
2.333	0.21	0.13	0.023	O					0.50
2.417	0.21	0.13	0.023	O					0.51
2.500	0.21	0.14	0.024	O					0.53
2.583	0.21	0.14	0.024	O					0.54
2.667	0.22	0.14	0.025	O					0.55
2.750	0.22	0.15	0.025	O					0.56
2.833	0.22	0.15	0.026	O					0.57

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 2.917     0.22     0.15      0.026  O       |       |       |       |        0.58
 3.000     0.22     0.15      0.027  O       |       |       |       |        0.59
 3.083     0.22     0.16      0.027  O       |       |       |       |        0.60
 3.167     0.22     0.16      0.027  O       |       |       |       |        0.61
 3.250     0.22     0.16      0.028  O       |       |       |       |        0.62
 3.333     0.22     0.16      0.028  O       |       |       |       |        0.63
 3.417     0.22     0.17      0.029  O       |       |       |       |        0.64
 3.500     0.22     0.17      0.029  O       |       |       |       |        0.65
 3.583     0.22     0.17      0.029  O       |       |       |       |        0.65
 3.667     0.23     0.17      0.030  O       |       |       |       |        0.66
 3.750     0.23     0.17      0.030  O       |       |       |       |        0.67
 3.833     0.23     0.18      0.030  O       |       |       |       |        0.68
 3.917     0.23     0.18      0.031  O       |       |       |       |        0.69
 4.000     0.23     0.18      0.031  O       |       |       |       |        0.69
 4.083     0.23     0.18      0.032  O       |       |       |       |        0.70
 4.167     0.23     0.18      0.032  O       |       |       |       |        0.71
 4.250     0.23     0.19      0.032  O       |       |       |       |        0.71
 4.333     0.23     0.19      0.032  O       |       |       |       |        0.72
 4.417     0.23     0.19      0.033  O       |       |       |       |        0.73
 4.500     0.24     0.19      0.033  O       |       |       |       |        0.74
 4.583     0.24     0.19      0.033  O       |       |       |       |        0.74
 4.667     0.24     0.20      0.034  O       |       |       |       |        0.75
 4.750     0.24     0.20      0.034  O       |       |       |       |        0.75
 4.833     0.24     0.20      0.034  O       |       |       |       |        0.76
 4.917     0.24     0.20      0.035  O       |       |       |       |        0.77
 5.000     0.24     0.20      0.035  O       |       |       |       |        0.77
 5.083     0.24     0.20      0.035  O       |       |       |       |        0.78
 5.167     0.24     0.20      0.035  O       |       |       |       |        0.79
 5.250     0.25     0.21      0.036  O       |       |       |       |        0.79
 5.333     0.25     0.21      0.036  O       |       |       |       |        0.80
 5.417     0.25     0.21      0.036  O       |       |       |       |        0.80
 5.500     0.25     0.21      0.036  O       |       |       |       |        0.81
 5.583     0.25     0.21      0.037  O       |       |       |       |        0.81
 5.667     0.25     0.21      0.037  O       |       |       |       |        0.82
 5.750     0.25     0.22      0.037  O       |       |       |       |        0.83
 5.833     0.25     0.22      0.037  O       |       |       |       |        0.83
 5.917     0.25     0.22      0.038  O       |       |       |       |        0.84
 6.000     0.26     0.22      0.038  O       |       |       |       |        0.84
 6.083     0.26     0.22      0.038  O       |       |       |       |        0.85
 6.167     0.26     0.22      0.038  O       |       |       |       |        0.85
 6.250     0.26     0.22      0.039  O       |       |       |       |        0.86
 6.333     0.26     0.23      0.039  O       |       |       |       |        0.86
 6.417     0.26     0.23      0.039  O       |       |       |       |        0.87
 6.500     0.26     0.23      0.039  O       |       |       |       |        0.88
 6.583     0.27     0.23      0.040  O       |       |       |       |        0.88
 6.667     0.27     0.23      0.040  O       |       |       |       |        0.89
 6.750     0.27     0.23      0.040  O       |       |       |       |        0.89
 6.833     0.27     0.23      0.040  O       |       |       |       |        0.90
 6.917     0.27     0.24      0.041  O       |       |       |       |        0.90
 7.000     0.27     0.24      0.041  O       |       |       |       |        0.91
 7.083     0.27     0.24      0.041  O       |       |       |       |        0.91
 7.167     0.28     0.24      0.041  O       |       |       |       |        0.92
 7.250     0.28     0.24      0.042  O       |       |       |       |        0.92
 7.333     0.28     0.24      0.042  O       |       |       |       |        0.93
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7.417	0.28	0.24	0.042	O	|	|	|	|	0.93
7.500	0.28	0.25	0.042	O	|	|	|	|	0.94
7.583	0.28	0.25	0.043	O	|	|	|	|	0.95
7.667	0.28	0.25	0.043	O	|	|	|	|	0.95
7.750	0.29	0.25	0.043	O	|	|	|	|	0.96
7.833	0.29	0.25	0.043	O	|	|	|	|	0.96
7.917	0.29	0.25	0.044	O	|	|	|	|	0.97
8.000	0.29	0.25	0.044	O	|	|	|	|	0.97
8.083	0.29	0.26	0.044	O	|	|	|	|	0.98
8.167	0.30	0.26	0.044	O	|	|	|	|	0.99
8.250	0.30	0.26	0.045	O	|	|	|	|	0.99
8.333	0.30	0.26	0.045	O	|	|	|	|	1.00
8.417	0.30	0.26	0.045	O	|	|	|	|	1.00
8.500	0.30	0.26	0.045	O	|	|	|	|	1.00
8.583	0.31	0.26	0.046	O	|	|	|	|	1.01
8.667	0.31	0.26	0.046	O	|	|	|	|	1.01
8.750	0.31	0.26	0.046	O	|	|	|	|	1.01
8.833	0.31	0.26	0.047	O	|	|	|	|	1.01
8.917	0.31	0.26	0.047	O	|	|	|	|	1.02
9.000	0.32	0.26	0.047	O	|	|	|	|	1.02
9.083	0.32	0.26	0.048	O	|	|	|	|	1.02
9.167	0.32	0.26	0.048	O	|	|	|	|	1.03
9.250	0.32	0.26	0.049	O	|	|	|	|	1.03
9.333	0.32	0.26	0.049	O	|	|	|	|	1.03
9.417	0.33	0.26	0.050	O	|	|	|	|	1.04
9.500	0.33	0.26	0.050	O	|	|	|	|	1.04
9.583	0.33	0.26	0.050	O	|	|	|	|	1.05
9.667	0.33	0.26	0.051	O	|	|	|	|	1.05
9.750	0.34	0.26	0.051	O	|	|	|	|	1.06
9.833	0.34	0.26	0.052	O	|	|	|	|	1.06
9.917	0.34	0.26	0.053	O	|	|	|	|	1.06
10.000	0.35	0.26	0.053	O	|	|	|	|	1.07
10.083	0.35	0.26	0.054	O	|	|	|	|	1.07
10.167	0.35	0.26	0.054	O	|	|	|	|	1.08
10.250	0.35	0.26	0.055	O	|	|	|	|	1.08
10.333	0.36	0.26	0.056	O	|	|	|	|	1.09
10.417	0.36	0.26	0.056	O	|	|	|	|	1.10
10.500	0.36	0.26	0.057	O	|	|	|	|	1.10
10.583	0.37	0.26	0.058	O	|	|	|	|	1.11
10.667	0.37	0.26	0.058	O	|	|	|	|	1.11
10.750	0.37	0.26	0.059	OI	|	|	|	|	1.12
10.833	0.38	0.26	0.060	OI	|	|	|	|	1.13
10.917	0.38	0.26	0.061	OI	|	|	|	|	1.13
11.000	0.38	0.26	0.062	OI	|	|	|	|	1.14
11.083	0.39	0.26	0.062	OI	|	|	|	|	1.15
11.167	0.39	0.26	0.063	OI	|	|	|	|	1.16
11.250	0.40	0.26	0.064	OI	|	|	|	|	1.16
11.333	0.40	0.26	0.065	OI	|	|	|	|	1.17
11.417	0.40	0.26	0.066	OI	|	|	|	|	1.18
11.500	0.41	0.26	0.067	OI	|	|	|	|	1.19
11.583	0.41	0.26	0.068	OI	|	|	|	|	1.20
11.667	0.42	0.26	0.069	OI	|	|	|	|	1.21
11.750	0.42	0.26	0.070	OI	|	|	|	|	1.22
11.833	0.43	0.26	0.071	OI	|	|	|	|	1.22

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11.917    0.43    0.26      0.072  OI      |       |       |       |    1.23
12.000    0.44    0.26      0.074  OI      |       |       |       |    1.24
12.083    0.45    0.26      0.075  OI      |       |       |       |    1.25
12.167    0.49    0.26      0.076  OI      |       |       |       |    1.27
12.250    0.54    0.26      0.078  OI      |       |       |       |    1.28
12.333    0.57    0.26      0.080  OI      |       |       |       |    1.30
12.417    0.58    0.26      0.082  OI      |       |       |       |    1.32
12.500    0.59    0.27      0.084  OI      |       |       |       |    1.34
12.583    0.59    0.27      0.086  OI      |       |       |       |    1.35
12.667    0.60    0.27      0.089  OI      |       |       |       |    1.37
12.750    0.61    0.27      0.091  OI      |       |       |       |    1.39
12.833    0.62    0.27      0.093  OI      |       |       |       |    1.41
12.917    0.62    0.27      0.096  OI      |       |       |       |    1.43
13.000    0.63    0.27      0.098  OI      |       |       |       |    1.46
13.083    0.64    0.27      0.101  OI      |       |       |       |    1.48
13.167    0.65    0.27      0.104  OI      |       |       |       |    1.50
13.250    0.66    0.27      0.106  OI      |       |       |       |    1.52
13.333    0.67    0.27      0.109  OI      |       |       |       |    1.55
13.417    0.68    0.27      0.112  OI      |       |       |       |    1.57
13.500    0.69    0.27      0.115  OI      |       |       |       |    1.59
13.583    0.70    0.27      0.117  OI      |       |       |       |    1.62
13.667    0.71    0.27      0.120  OI      |       |       |       |    1.65
13.750    0.72    0.27      0.124  OI      |       |       |       |    1.67
13.833    0.73    0.27      0.127  OI      |       |       |       |    1.70
13.917    0.75    0.27      0.130  O I     |       |       |       |    1.73
14.000    0.76    0.27      0.133  O I     |       |       |       |    1.75
14.083    0.78    0.27      0.137  O I     |       |       |       |    1.78
14.167    0.79    0.27      0.140  O I     |       |       |       |    1.81
14.250    0.81    0.27      0.144  O I     |       |       |       |    1.85
14.333    0.83    0.27      0.148  O I     |       |       |       |    1.88
14.417    0.85    0.27      0.152  O I     |       |       |       |    1.91
14.500    0.87    0.27      0.156  O I     |       |       |       |    1.95
14.583    0.89    0.27      0.160  O I     |       |       |       |    1.98
14.667    0.91    0.27      0.164  O I     |       |       |       |    2.01
14.750    0.94    0.27      0.169  O I     |       |       |       |    2.05
14.833    0.97    0.27      0.173  O I     |       |       |       |    2.08
14.917    1.00    0.27      0.178  O I     |       |       |       |    2.11
15.000    1.03    0.27      0.183  O I     |       |       |       |    2.15
15.083    1.07    0.28      0.189  O I     |       |       |       |    2.18
15.167    1.11    0.28      0.194  O I     |       |       |       |    2.22
15.250    1.16    0.28      0.200  O  I    |       |       |       |    2.26
15.333    1.21    0.28      0.206  O  I    |       |       |       |    2.31
15.417    1.26    0.28      0.213  O  I    |       |       |       |    2.35
15.500    1.26    0.28      0.220  O  I    |       |       |       |    2.40
15.583    1.24    0.28      0.227  O  I    |       |       |       |    2.45
15.667    1.29    0.28      0.233  O  I    |       |       |       |    2.49
15.750    1.41    0.28      0.241  O  I    |       |       |       |    2.54
15.833    1.59    0.28      0.249  O   I   |       |       |       |    2.60
15.917    1.86    0.28      0.259  O   I   |       |       |       |    2.67
16.000    2.32    0.28      0.272  O     I |       |       |       |    2.76
16.083    4.15    0.28      0.292  O       |  I    |       |       |    2.90
16.167    9.61    0.29      0.337  O       |       |       |I      |    3.18
16.250   11.92    0.29      0.409  O       |       |       |       I    3.60
16.333    6.52    0.29      0.471  O       |       |I      |       |    3.95
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16.417    3.06    0.30      0.502  O        I       |       |       |    4.12
16.500    1.79    0.30      0.517  O   I    |       |       |       |    4.19
16.583    1.57    0.30      0.526  O   I    |       |       |       |    4.24
16.667    1.24    0.30      0.534  O  I     |       |       |       |    4.28
16.750    1.14    0.30      0.540  O  I     |       |       |       |    4.31
16.833    1.06    0.30      0.545  O I      |       |       |       |    4.33
16.917    0.99    0.30      0.550  O I      |       |       |       |    4.36
17.000    0.93    0.30      0.555  O I      |       |       |       |    4.38
17.083    0.88    0.30      0.559  O I      |       |       |       |    4.40
17.167    0.84    0.30      0.563  O I      |       |       |       |    4.42
17.250    0.80    0.30      0.567  O I      |       |       |       |    4.44
17.333    0.77    0.30      0.570  O I      |       |       |       |    4.46
17.417    0.74    0.30      0.573  OI       |       |       |       |    4.47
17.500    0.72    0.30      0.576  OI       |       |       |       |    4.49
17.583    0.69    0.30      0.579  OI       |       |       |       |    4.50
17.667    0.67    0.30      0.581  OI       |       |       |       |    4.51
17.750    0.65    0.30      0.584  OI       |       |       |       |    4.53
17.833    0.64    0.30      0.586  OI       |       |       |       |    4.54
17.917    0.62    0.30      0.589  OI       |       |       |       |    4.55
18.000    0.60    0.30      0.591  OI       |       |       |       |    4.56
18.083    0.58    0.30      0.593  OI       |       |       |       |    4.57
18.167    0.54    0.30      0.595  OI       |       |       |       |    4.58
18.250    0.48    0.30      0.596  OI       |       |       |       |    4.59
18.333    0.45    0.30      0.597  OI       |       |       |       |    4.59
18.417    0.43    0.30      0.598  OI       |       |       |       |    4.60
18.500    0.42    0.30      0.599  OI       |       |       |       |    4.60
18.583    0.41    0.30      0.600  OI       |       |       |       |    4.61
18.667    0.40    0.30      0.600  OI       |       |       |       |    4.61
18.750    0.39    0.30      0.601  OI       |       |       |       |    4.61
18.833    0.39    0.30      0.602  OI       |       |       |       |    4.62
18.917    0.38    0.30      0.602  OI       |       |       |       |    4.62
19.000    0.37    0.30      0.603  O        |       |       |       |    4.62
19.083    0.37    0.30      0.603  O        |       |       |       |    4.62
19.167    0.36    0.30      0.604  O        |       |       |       |    4.63
19.250    0.35    0.30      0.604  O        |       |       |       |    4.63
19.333    0.35    0.30      0.604  O        |       |       |       |    4.63
19.417    0.34    0.30      0.605  O        |       |       |       |    4.63
19.500    0.34    0.30      0.605  O        |       |       |       |    4.63
19.583    0.33    0.30      0.605  O        |       |       |       |    4.63
19.667    0.33    0.30      0.605  O        |       |       |       |    4.63
19.750    0.32    0.30      0.605  O        |       |       |       |    4.64
19.833    0.32    0.30      0.606  O        |       |       |       |    4.64
19.917    0.31    0.30      0.606  O        |       |       |       |    4.64
20.000    0.31    0.30      0.606  O        |       |       |       |    4.64
20.083    0.30    0.30      0.606  O        |       |       |       |    4.64
20.167    0.30    0.30      0.606  O        |       |       |       |    4.64
20.250    0.30    0.30      0.606  O        |       |       |       |    4.64
20.333    0.29    0.30      0.606  O        |       |       |       |    4.64
20.417    0.29    0.30      0.606  O        |       |       |       |    4.64
20.500    0.29    0.30      0.606  O        |       |       |       |    4.64
20.583    0.28    0.30      0.605  O        |       |       |       |    4.64
20.667    0.28    0.30      0.605  O        |       |       |       |    4.63
20.750    0.28    0.30      0.605  O        |       |       |       |    4.63
20.833    0.27    0.30      0.605  O        |       |       |       |    4.63
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20.917	0.27	0.30	0.605	O	|	|	|	|	4.63
21.000	0.27	0.30	0.604	O	|	|	|	|	4.63
21.083	0.26	0.30	0.604	O	|	|	|	|	4.63
21.167	0.26	0.30	0.604	O	|	|	|	|	4.63
21.250	0.26	0.30	0.604	O	|	|	|	|	4.63
21.333	0.26	0.30	0.603	O	|	|	|	|	4.62
21.417	0.25	0.30	0.603	O	|	|	|	|	4.62
21.500	0.25	0.30	0.603	O	|	|	|	|	4.62
21.583	0.25	0.30	0.602	O	|	|	|	|	4.62
21.667	0.25	0.30	0.602	O	|	|	|	|	4.62
21.750	0.24	0.30	0.602	O	|	|	|	|	4.62
21.833	0.24	0.30	0.601	O	|	|	|	|	4.61
21.917	0.24	0.30	0.601	O	|	|	|	|	4.61
22.000	0.24	0.30	0.600	O	|	|	|	|	4.61
22.083	0.24	0.30	0.600	O	|	|	|	|	4.61
22.167	0.23	0.30	0.599	O	|	|	|	|	4.61
22.250	0.23	0.30	0.599	O	|	|	|	|	4.60
22.333	0.23	0.30	0.598	O	|	|	|	|	4.60
22.417	0.23	0.30	0.598	O	|	|	|	|	4.60
22.500	0.23	0.30	0.597	O	|	|	|	|	4.60
22.583	0.22	0.30	0.597	O	|	|	|	|	4.59
22.667	0.22	0.30	0.596	O	|	|	|	|	4.59
22.750	0.22	0.30	0.596	O	|	|	|	|	4.59
22.833	0.22	0.30	0.595	O	|	|	|	|	4.58
22.917	0.22	0.30	0.595	O	|	|	|	|	4.58
23.000	0.22	0.30	0.594	O	|	|	|	|	4.58
23.083	0.21	0.30	0.594	O	|	|	|	|	4.58
23.167	0.21	0.30	0.593	O	|	|	|	|	4.57
23.250	0.21	0.30	0.592	O	|	|	|	|	4.57
23.333	0.21	0.30	0.592	O	|	|	|	|	4.57
23.417	0.21	0.30	0.591	O	|	|	|	|	4.56
23.500	0.21	0.30	0.590	O	|	|	|	|	4.56
23.583	0.21	0.30	0.590	O	|	|	|	|	4.56
23.667	0.20	0.30	0.589	O	|	|	|	|	4.55
23.750	0.20	0.30	0.588	O	|	|	|	|	4.55
23.833	0.20	0.30	0.588	O	|	|	|	|	4.55
23.917	0.20	0.30	0.587	O	|	|	|	|	4.54
24.000	0.20	0.30	0.586	O	|	|	|	|	4.54
24.083	0.19	0.30	0.586	O	|	|	|	|	4.54
24.167	0.13	0.30	0.585	O	|	|	|	|	4.53
24.250	0.05	0.30	0.583	O	|	|	|	|	4.52
24.333	0.02	0.30	0.581	O	|	|	|	|	4.51
24.417	0.00	0.30	0.579	O	|	|	|	|	4.50
24.500	0.00	0.30	0.577	O	|	|	|	|	4.49
24.583	0.00	0.30	0.575	O	|	|	|	|	4.48
24.667	0.00	0.30	0.573	O	|	|	|	|	4.47
24.750	0.00	0.30	0.571	O	|	|	|	|	4.46
24.833	0.00	0.30	0.569	O	|	|	|	|	4.45
24.917	0.00	0.30	0.567	O	|	|	|	|	4.44
25.000	0.00	0.30	0.565	O	|	|	|	|	4.43
25.083	0.00	0.30	0.563	O	|	|	|	|	4.42
25.167	0.00	0.30	0.561	O	|	|	|	|	4.41
25.250	0.00	0.30	0.559	O	|	|	|	|	4.40
25.333	0.00	0.30	0.557	O	|	|	|	|	4.39

25.417	0.00	0.30	0.555	O	|	|	|	|	4.38
25.500	0.00	0.30	0.553	O	|	|	|	|	4.37
25.583	0.00	0.30	0.550	O	|	|	|	|	4.36
25.667	0.00	0.30	0.548	O	|	|	|	|	4.35
25.750	0.00	0.30	0.546	O	|	|	|	|	4.34
25.833	0.00	0.30	0.544	O	|	|	|	|	4.33
25.917	0.00	0.30	0.542	O	|	|	|	|	4.32
26.000	0.00	0.30	0.540	O	|	|	|	|	4.31
26.083	0.00	0.30	0.538	O	|	|	|	|	4.30
26.167	0.00	0.30	0.536	O	|	|	|	|	4.29
26.250	0.00	0.30	0.534	O	|	|	|	|	4.28
26.333	0.00	0.30	0.532	O	|	|	|	|	4.27
26.417	0.00	0.30	0.530	O	|	|	|	|	4.26
26.500	0.00	0.30	0.528	O	|	|	|	|	4.25
26.583	0.00	0.30	0.526	O	|	|	|	|	4.24
26.667	0.00	0.30	0.524	O	|	|	|	|	4.22
26.750	0.00	0.30	0.522	O	|	|	|	|	4.21
26.833	0.00	0.30	0.520	O	|	|	|	|	4.20
26.917	0.00	0.30	0.518	O	|	|	|	|	4.19
27.000	0.00	0.30	0.516	O	|	|	|	|	4.18
27.083	0.00	0.30	0.514	O	|	|	|	|	4.17
27.167	0.00	0.30	0.511	O	|	|	|	|	4.16
27.250	0.00	0.30	0.509	O	|	|	|	|	4.15
27.333	0.00	0.30	0.507	O	|	|	|	|	4.14
27.417	0.00	0.30	0.505	O	|	|	|	|	4.13
27.500	0.00	0.30	0.503	O	|	|	|	|	4.12
27.583	0.00	0.30	0.501	O	|	|	|	|	4.11
27.667	0.00	0.30	0.499	O	|	|	|	|	4.10
27.750	0.00	0.30	0.497	O	|	|	|	|	4.09
27.833	0.00	0.30	0.495	O	|	|	|	|	4.08
27.917	0.00	0.30	0.493	O	|	|	|	|	4.07
28.000	0.00	0.30	0.491	O	|	|	|	|	4.06
28.083	0.00	0.30	0.489	O	|	|	|	|	4.05
28.167	0.00	0.30	0.487	O	|	|	|	|	4.04
28.250	0.00	0.30	0.485	O	|	|	|	|	4.03
28.333	0.00	0.30	0.483	O	|	|	|	|	4.02
28.417	0.00	0.30	0.481	O	|	|	|	|	4.01
28.500	0.00	0.29	0.479	O	|	|	|	|	4.00
28.583	0.00	0.29	0.477	O	|	|	|	|	3.99
28.667	0.00	0.29	0.475	O	|	|	|	|	3.98
28.750	0.00	0.29	0.473	O	|	|	|	|	3.96
28.833	0.00	0.29	0.471	O	|	|	|	|	3.95
28.917	0.00	0.29	0.469	O	|	|	|	|	3.94
29.000	0.00	0.29	0.467	O	|	|	|	|	3.93
29.083	0.00	0.29	0.465	O	|	|	|	|	3.92
29.167	0.00	0.29	0.463	O	|	|	|	|	3.90
29.250	0.00	0.29	0.461	O	|	|	|	|	3.89
29.333	0.00	0.29	0.459	O	|	|	|	|	3.88
29.417	0.00	0.29	0.457	O	|	|	|	|	3.87
29.500	0.00	0.29	0.455	O	|	|	|	|	3.86
29.583	0.00	0.29	0.453	O	|	|	|	|	3.85
29.667	0.00	0.29	0.451	O	|	|	|	|	3.83
29.750	0.00	0.29	0.448	O	|	|	|	|	3.82
29.833	0.00	0.29	0.446	O	|	|	|	|	3.81

29.917	0.00	0.29	0.444	O	|	|	|	|	3.80
30.000	0.00	0.29	0.442	O	|	|	|	|	3.79
30.083	0.00	0.29	0.440	O	|	|	|	|	3.78
30.167	0.00	0.29	0.438	O	|	|	|	|	3.76
30.250	0.00	0.29	0.436	O	|	|	|	|	3.75
30.333	0.00	0.29	0.434	O	|	|	|	|	3.74
30.417	0.00	0.29	0.432	O	|	|	|	|	3.73
30.500	0.00	0.29	0.430	O	|	|	|	|	3.72
30.583	0.00	0.29	0.428	O	|	|	|	|	3.71
30.667	0.00	0.29	0.426	O	|	|	|	|	3.69
30.750	0.00	0.29	0.424	O	|	|	|	|	3.68
30.833	0.00	0.29	0.422	O	|	|	|	|	3.67
30.917	0.00	0.29	0.420	O	|	|	|	|	3.66
31.000	0.00	0.29	0.418	O	|	|	|	|	3.65
31.083	0.00	0.29	0.416	O	|	|	|	|	3.64
31.167	0.00	0.29	0.414	O	|	|	|	|	3.62
31.250	0.00	0.29	0.412	O	|	|	|	|	3.61
31.333	0.00	0.29	0.410	O	|	|	|	|	3.60
31.417	0.00	0.29	0.408	O	|	|	|	|	3.59
31.500	0.00	0.29	0.406	O	|	|	|	|	3.58
31.583	0.00	0.29	0.404	O	|	|	|	|	3.57
31.667	0.00	0.29	0.402	O	|	|	|	|	3.55
31.750	0.00	0.29	0.400	O	|	|	|	|	3.54
31.833	0.00	0.29	0.398	O	|	|	|	|	3.53
31.917	0.00	0.29	0.396	O	|	|	|	|	3.52
32.000	0.00	0.29	0.394	O	|	|	|	|	3.51
32.083	0.00	0.29	0.392	O	|	|	|	|	3.50
32.167	0.00	0.29	0.390	O	|	|	|	|	3.48
32.250	0.00	0.29	0.388	O	|	|	|	|	3.47
32.333	0.00	0.29	0.386	O	|	|	|	|	3.46
32.417	0.00	0.29	0.384	O	|	|	|	|	3.45
32.500	0.00	0.29	0.382	O	|	|	|	|	3.44
32.583	0.00	0.29	0.380	O	|	|	|	|	3.43
32.667	0.00	0.29	0.378	O	|	|	|	|	3.42
32.750	0.00	0.29	0.376	O	|	|	|	|	3.40
32.833	0.00	0.29	0.374	O	|	|	|	|	3.39
32.917	0.00	0.29	0.372	O	|	|	|	|	3.38
33.000	0.00	0.29	0.370	O	|	|	|	|	3.37
33.083	0.00	0.29	0.368	O	|	|	|	|	3.36
33.167	0.00	0.29	0.366	O	|	|	|	|	3.35
33.250	0.00	0.29	0.365	O	|	|	|	|	3.33
33.333	0.00	0.29	0.363	O	|	|	|	|	3.32
33.417	0.00	0.29	0.361	O	|	|	|	|	3.31
33.500	0.00	0.29	0.359	O	|	|	|	|	3.30
33.583	0.00	0.29	0.357	O	|	|	|	|	3.29
33.667	0.00	0.29	0.355	O	|	|	|	|	3.28
33.750	0.00	0.29	0.353	O	|	|	|	|	3.27
33.833	0.00	0.29	0.351	O	|	|	|	|	3.25
33.917	0.00	0.29	0.349	O	|	|	|	|	3.24
34.000	0.00	0.29	0.347	O	|	|	|	|	3.23
34.083	0.00	0.29	0.345	O	|	|	|	|	3.22
34.167	0.00	0.29	0.343	O	|	|	|	|	3.21
34.250	0.00	0.29	0.341	O	|	|	|	|	3.20
34.333	0.00	0.29	0.339	O	|	|	|	|	3.18

34.417	0.00	0.29	0.337	O	|	|	|	|	3.17
34.500	0.00	0.29	0.335	O	|	|	|	|	3.16
34.583	0.00	0.29	0.333	O	|	|	|	|	3.15
34.667	0.00	0.29	0.331	O	|	|	|	|	3.14
34.750	0.00	0.29	0.329	O	|	|	|	|	3.13
34.833	0.00	0.29	0.327	O	|	|	|	|	3.12
34.917	0.00	0.29	0.325	O	|	|	|	|	3.10
35.000	0.00	0.29	0.323	O	|	|	|	|	3.09
35.083	0.00	0.28	0.321	O	|	|	|	|	3.08
35.167	0.00	0.28	0.319	O	|	|	|	|	3.07
35.250	0.00	0.28	0.317	O	|	|	|	|	3.06
35.333	0.00	0.28	0.315	O	|	|	|	|	3.05
35.417	0.00	0.28	0.313	O	|	|	|	|	3.04
35.500	0.00	0.28	0.311	O	|	|	|	|	3.03
35.583	0.00	0.28	0.309	O	|	|	|	|	3.01
35.667	0.00	0.28	0.307	O	|	|	|	|	3.00
35.750	0.00	0.28	0.305	O	|	|	|	|	2.99
35.833	0.00	0.28	0.304	O	|	|	|	|	2.98
35.917	0.00	0.28	0.302	O	|	|	|	|	2.96
36.000	0.00	0.28	0.300	O	|	|	|	|	2.95
36.083	0.00	0.28	0.298	O	|	|	|	|	2.94
36.167	0.00	0.28	0.296	O	|	|	|	|	2.92
36.250	0.00	0.28	0.294	O	|	|	|	|	2.91
36.333	0.00	0.28	0.292	O	|	|	|	|	2.90
36.417	0.00	0.28	0.290	O	|	|	|	|	2.88
36.500	0.00	0.28	0.288	O	|	|	|	|	2.87
36.583	0.00	0.28	0.286	O	|	|	|	|	2.85
36.667	0.00	0.28	0.284	O	|	|	|	|	2.84
36.750	0.00	0.28	0.282	O	|	|	|	|	2.83
36.833	0.00	0.28	0.280	O	|	|	|	|	2.81
36.917	0.00	0.28	0.278	O	|	|	|	|	2.80
37.000	0.00	0.28	0.276	O	|	|	|	|	2.79
37.083	0.00	0.28	0.274	O	|	|	|	|	2.77
37.167	0.00	0.28	0.272	O	|	|	|	|	2.76
37.250	0.00	0.28	0.270	O	|	|	|	|	2.75
37.333	0.00	0.28	0.268	O	|	|	|	|	2.73
37.417	0.00	0.28	0.267	O	|	|	|	|	2.72
37.500	0.00	0.28	0.265	O	|	|	|	|	2.71
37.583	0.00	0.28	0.263	O	|	|	|	|	2.69
37.667	0.00	0.28	0.261	O	|	|	|	|	2.68
37.750	0.00	0.28	0.259	O	|	|	|	|	2.67
37.833	0.00	0.28	0.257	O	|	|	|	|	2.65
37.917	0.00	0.28	0.255	O	|	|	|	|	2.64
38.000	0.00	0.28	0.253	O	|	|	|	|	2.63
38.083	0.00	0.28	0.251	O	|	|	|	|	2.61
38.167	0.00	0.28	0.249	O	|	|	|	|	2.60
38.250	0.00	0.28	0.247	O	|	|	|	|	2.59
38.333	0.00	0.28	0.245	O	|	|	|	|	2.57
38.417	0.00	0.28	0.243	O	|	|	|	|	2.56
38.500	0.00	0.28	0.241	O	|	|	|	|	2.55
38.583	0.00	0.28	0.240	O	|	|	|	|	2.53
38.667	0.00	0.28	0.238	O	|	|	|	|	2.52
38.750	0.00	0.28	0.236	O	|	|	|	|	2.51
38.833	0.00	0.28	0.234	O	|	|	|	|	2.50

38.917	0.00	0.28	0.232	O	|	|	|	|	2.48
39.000	0.00	0.28	0.230	O	|	|	|	|	2.47
39.083	0.00	0.28	0.228	O	|	|	|	|	2.46
39.167	0.00	0.28	0.226	O	|	|	|	|	2.44
39.250	0.00	0.28	0.224	O	|	|	|	|	2.43
39.333	0.00	0.28	0.222	O	|	|	|	|	2.42
39.417	0.00	0.28	0.220	O	|	|	|	|	2.40
39.500	0.00	0.28	0.219	O	|	|	|	|	2.39
39.583	0.00	0.28	0.217	O	|	|	|	|	2.38
39.667	0.00	0.28	0.215	O	|	|	|	|	2.36
39.750	0.00	0.28	0.213	O	|	|	|	|	2.35
39.833	0.00	0.28	0.211	O	|	|	|	|	2.34
39.917	0.00	0.28	0.209	O	|	|	|	|	2.32
40.000	0.00	0.28	0.207	O	|	|	|	|	2.31
40.083	0.00	0.28	0.205	O	|	|	|	|	2.30
40.167	0.00	0.28	0.203	O	|	|	|	|	2.28
40.250	0.00	0.28	0.201	O	|	|	|	|	2.27
40.333	0.00	0.28	0.199	O	|	|	|	|	2.26
40.417	0.00	0.28	0.198	O	|	|	|	|	2.25
40.500	0.00	0.28	0.196	O	|	|	|	|	2.23
40.583	0.00	0.28	0.194	O	|	|	|	|	2.22
40.667	0.00	0.28	0.192	O	|	|	|	|	2.21
40.750	0.00	0.28	0.190	O	|	|	|	|	2.19
40.833	0.00	0.27	0.188	O	|	|	|	|	2.18
40.917	0.00	0.27	0.186	O	|	|	|	|	2.17
41.000	0.00	0.27	0.184	O	|	|	|	|	2.15
41.083	0.00	0.27	0.182	O	|	|	|	|	2.14
41.167	0.00	0.27	0.181	O	|	|	|	|	2.13
41.250	0.00	0.27	0.179	O	|	|	|	|	2.11
41.333	0.00	0.27	0.177	O	|	|	|	|	2.10
41.417	0.00	0.27	0.175	O	|	|	|	|	2.09
41.500	0.00	0.27	0.173	O	|	|	|	|	2.08
41.583	0.00	0.27	0.171	O	|	|	|	|	2.06
41.667	0.00	0.27	0.169	O	|	|	|	|	2.05
41.750	0.00	0.27	0.167	O	|	|	|	|	2.04
41.833	0.00	0.27	0.165	O	|	|	|	|	2.02
41.917	0.00	0.27	0.164	O	|	|	|	|	2.01
42.000	0.00	0.27	0.162	O	|	|	|	|	2.00
42.083	0.00	0.27	0.160	O	|	|	|	|	1.98
42.167	0.00	0.27	0.158	O	|	|	|	|	1.96
42.250	0.00	0.27	0.156	O	|	|	|	|	1.95
42.333	0.00	0.27	0.154	O	|	|	|	|	1.93
42.417	0.00	0.27	0.152	O	|	|	|	|	1.92
42.500	0.00	0.27	0.150	O	|	|	|	|	1.90
42.583	0.00	0.27	0.149	O	|	|	|	|	1.88
42.667	0.00	0.27	0.147	O	|	|	|	|	1.87
42.750	0.00	0.27	0.145	O	|	|	|	|	1.85
42.833	0.00	0.27	0.143	O	|	|	|	|	1.84
42.917	0.00	0.27	0.141	O	|	|	|	|	1.82
43.000	0.00	0.27	0.139	O	|	|	|	|	1.81
43.083	0.00	0.27	0.137	O	|	|	|	|	1.79
43.167	0.00	0.27	0.135	O	|	|	|	|	1.77
43.250	0.00	0.27	0.134	O	|	|	|	|	1.76
43.333	0.00	0.27	0.132	O	|	|	|	|	1.74

43.417	0.00	0.27	0.130	O	|	|	|	|	1.73
43.500	0.00	0.27	0.128	O	|	|	|	|	1.71
43.583	0.00	0.27	0.126	O	|	|	|	|	1.69
43.667	0.00	0.27	0.124	O	|	|	|	|	1.68
43.750	0.00	0.27	0.122	O	|	|	|	|	1.66
43.833	0.00	0.27	0.121	O	|	|	|	|	1.65
43.917	0.00	0.27	0.119	O	|	|	|	|	1.63
44.000	0.00	0.27	0.117	O	|	|	|	|	1.61
44.083	0.00	0.27	0.115	O	|	|	|	|	1.60
44.167	0.00	0.27	0.113	O	|	|	|	|	1.58
44.250	0.00	0.27	0.111	O	|	|	|	|	1.57
44.333	0.00	0.27	0.110	O	|	|	|	|	1.55
44.417	0.00	0.27	0.108	O	|	|	|	|	1.54
44.500	0.00	0.27	0.106	O	|	|	|	|	1.52
44.583	0.00	0.27	0.104	O	|	|	|	|	1.50
44.667	0.00	0.27	0.102	O	|	|	|	|	1.49
44.750	0.00	0.27	0.100	O	|	|	|	|	1.47
44.833	0.00	0.27	0.099	O	|	|	|	|	1.46
44.917	0.00	0.27	0.097	O	|	|	|	|	1.44
45.000	0.00	0.27	0.095	O	|	|	|	|	1.43
45.083	0.00	0.27	0.093	O	|	|	|	|	1.41
45.167	0.00	0.27	0.091	O	|	|	|	|	1.39
45.250	0.00	0.27	0.089	O	|	|	|	|	1.38
45.333	0.00	0.27	0.088	O	|	|	|	|	1.36
45.417	0.00	0.27	0.086	O	|	|	|	|	1.35
45.500	0.00	0.26	0.084	O	|	|	|	|	1.33
45.583	0.00	0.26	0.082	O	|	|	|	|	1.32
45.667	0.00	0.26	0.080	O	|	|	|	|	1.30
45.750	0.00	0.26	0.078	O	|	|	|	|	1.29
45.833	0.00	0.26	0.077	O	|	|	|	|	1.27
45.917	0.00	0.26	0.075	O	|	|	|	|	1.25
46.000	0.00	0.26	0.073	O	|	|	|	|	1.24
46.083	0.00	0.26	0.071	O	|	|	|	|	1.22
46.167	0.00	0.26	0.069	O	|	|	|	|	1.21
46.250	0.00	0.26	0.067	O	|	|	|	|	1.19
46.333	0.00	0.26	0.066	O	|	|	|	|	1.18
46.417	0.00	0.26	0.064	O	|	|	|	|	1.16
46.500	0.00	0.26	0.062	O	|	|	|	|	1.15
46.583	0.00	0.26	0.060	O	|	|	|	|	1.13
46.667	0.00	0.26	0.058	O	|	|	|	|	1.11
46.750	0.00	0.26	0.057	O	|	|	|	|	1.10
46.833	0.00	0.26	0.055	O	|	|	|	|	1.08
46.917	0.00	0.26	0.053	O	|	|	|	|	1.07
47.000	0.00	0.26	0.051	O	|	|	|	|	1.05
47.083	0.00	0.26	0.049	O	|	|	|	|	1.04
47.167	0.00	0.26	0.048	O	|	|	|	|	1.02
47.250	0.00	0.26	0.046	O	|	|	|	|	1.01
47.333	0.00	0.26	0.044	O	|	|	|	|	0.98
47.417	0.00	0.25	0.042	O	|	|	|	|	0.94
47.500	0.00	0.24	0.041	O	|	|	|	|	0.90
47.583	0.00	0.23	0.039	O	|	|	|	|	0.87
47.667	0.00	0.22	0.038	O	|	|	|	|	0.83
47.750	0.00	0.21	0.036	O	|	|	|	|	0.80
47.833	0.00	0.20	0.035	O	|	|	|	|	0.77

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47.917    0.00    0.19      0.033  O       |       |       |       |      0.74
48.000    0.00    0.19      0.032  O       |       |       |       |      0.71
48.083    0.00    0.18      0.031  O       |       |       |       |      0.68
48.167    0.00    0.17      0.030  O       |       |       |       |      0.66
48.250    0.00    0.16      0.028  O       |       |       |       |      0.63
48.333    0.00    0.16      0.027  O       |       |       |       |      0.61
48.417    0.00    0.15      0.026  O       |       |       |       |      0.58
48.500    0.00    0.15      0.025  O       |       |       |       |      0.56
48.583    0.00    0.14      0.024  O       |       |       |       |      0.54
48.667    0.00    0.13      0.023  O       |       |       |       |      0.52
48.750    0.00    0.13      0.022  O       |       |       |       |      0.50
48.833    0.00    0.12      0.021  O       |       |       |       |      0.48
48.917    0.00    0.12      0.021  O       |       |       |       |      0.46
49.000    0.00    0.11      0.020  O       |       |       |       |      0.44
49.083    0.00    0.11      0.019  O       |       |       |       |      0.42
49.167    0.00    0.11      0.018  O       |       |       |       |      0.41
49.250    0.00    0.10      0.018  O       |       |       |       |      0.39
49.333    0.00    0.10      0.017  O       |       |       |       |      0.38


       Remaining water in basin =    0.02 (Ac.Ft)


       ****************************HYDROGRAPH DATA****************************
                       Number of intervals =   592
                       Time interval =    5.0 (Min.)
                       Maximum/Peak flow rate =       0.302 (CFS)
                       Total volume =       1.055 (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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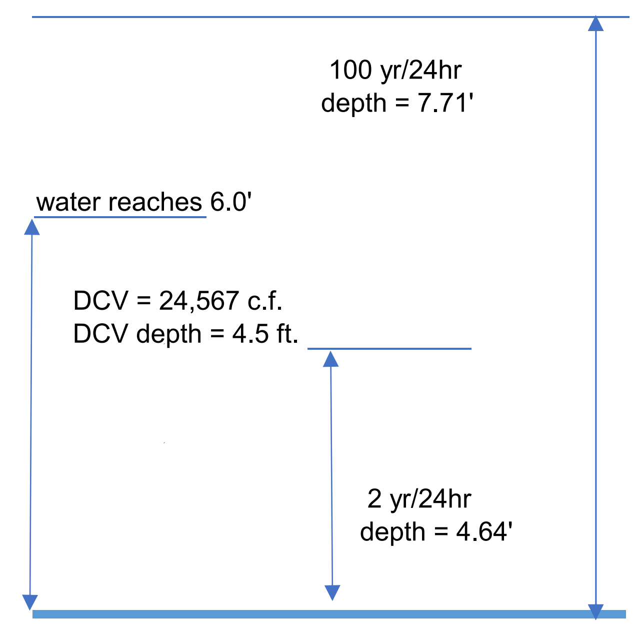
TRACT 20394

DETENTION BASIN

STAGE-VOLUME-DISCHARGE RELATIONSHIP

Basin	Elevation (ft)	Depth (ft)	Total Area (sf)	Volume (cf)	Volume (ac-ft)	Cumulative Volume (ac-ft)	Outflow see note #1 (cfs)	Outflow see note #2 (cfs)	Outflow see note #3 (cfs)	Cumulative Outflow (cfs)
	839.0	8.0	12835			1.522	0.119	0.220	13.970	14.309
				12168	0.2793					
	838.0	7.0	11500			1.242	0.106	0.220	8.850	9.176
				7281	0.1671					
	837.7	6.7	11112			1.075	0.103	0.220	4.600	4.923
				7518	0.1726					
	837.0	6.0	10367			0.903	0.096	0.220	0.000	0.316
				9806	0.2251					
	836.0	5.0	9244			0.678	0.086	0.220	0.000	0.306
				8658	0.1987					
	835.0	4.0	8071			0.479	0.075	0.220	0.000	0.295
				7493	0.1720					
	834.0	3.0	6914			0.307	0.064	0.220	0.000	0.284
				6317	0.1450					
	833.0	2.0	5719			0.162	0.053	0.220	0.000	0.273
				5099	0.1170					
	832.0	1.0	4478			0.045	0.041	0.220	0.000	0.261
				1948	0.0447					
	831.0	0.0	3313			0.000	0.031	0.220	0.000	0.251



Note #1: outflow with Infiltration Rate = 0.4 in/hr

Note #2: Project used 2 Drywells, Percolation Rate = 0.11 cfs / drywell (per Torrent Resources w/ infiltration rate 10 in/hr), Percolation Rate (Drywell) = 2 x 0.11 = 0.22 cfs

Note #3: outflow 3'L x 0.67'H opening when water reaches 6.0 ft at elevation 437.0

Infiltration Rate 0.4 " per hour (per Soil Report)

Worksheet H: Factor of Safety and Design Infiltration Rate Worksheet

Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	2	0.50
		Predominant soil texture	0.25	1	0.25
		Site soil variability	0.25	2	0.50
		Depth to groundwater / impervious layer	0.25	1	0.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			1.50
B	Design	Tributary area size	0.25	3	0.75
		Level of pretreatment/ expected sediment loads	0.25	3	0.75
		Redundancy	0.25	3	0.75
		Compaction during construction	0.25	2	0.50
		Design Safety Factor, $S_B = \Sigma p$			2.75
Combined Safety Factor, $S_{TOT} = S_A \times S_B$				4.125	
Measured Infiltration Rate, inch/hr, K_M (corrected for test-specific bias)				--	
Design Infiltration Rate, in/hr, $K_{DESIGN} = S_{TOT} / K_M$				10.00 (SEE BELOW)	

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

Based on latest Geotechnical Update Report of Infiltration Testing for the Proposed Infiltration Basin, Lot A, by Leighton and Associates, In., dated July 26, 2021, Infiltration Recommendations:

"Due to the presence of finer-grained soils in the upper 30 to 35 ft., we recommend that infiltration consists of dry wells extending to a minimum depth of 45 ft. below the existing ground surface (bgs), to an approximate elevation of 795 feet msi."

"For dry wells that extend to a depth of 45 feet bgs, we recommend using a ***design rate of 10 inches per hour for soils in the depth zone of 35 to 45 feet bgs***, and an average of 0.5 inch per hour for soils above 35 ft."

DRAFT

Maxwell® IV Drainage System Calculations Prepared on July 27, 2021

Project: **Example Project - California**

Contact: Dylan Nguyen at MDS Consulting - Irvine, CA

Given:

Measured Infiltration Rate	10.00 in/hr	(Provided by civil)
Safety Factor	1.00	
Design Infiltration Rate	10.00 in/hr	
Required Drawdown Time	96 hours	
Depth to Emergency Overflow	0 ft	
Min. Depth to Infiltration	10 ft	
Groundwater Depth for Design	80 ft	

Proposed:

Drywell Rock Shaft Diameter	4 ft
Drywell Chamber Depth	15 ft
Rock Porosity	40 %
Depth to Infiltration	11 ft
Drywell Bottom Depth	45 ft

Apply Safety Factor to get Design Rate.

$10.00 \frac{in}{hr} \div 1 = 10.00 \frac{in}{hr}$

Convert Design Rate from in/hr to ft/sec.

$10.00 \frac{in}{hr} \times \frac{1\ ft}{12\ in} \times \frac{1\ hr}{3600\ sec} = 0.000231 \frac{ft}{sec}$

A 4 foot diameter drywell provides 12.57 SF of infiltration area per foot of depth, plus 12.57 SF at the bottom.

For a 45 foot deep drywell, infiltration occurs between 11 feet and 45 feet below grade. This provides 34 feet of infiltration depth in addition to the bottom area. Infiltration area per drywell is calculated below.

$6\ ft \times 18.85 \frac{ft^2}{ft} + 28\ ft \times 12.57 \frac{ft^2}{ft} + 12.57\ ft^2 = 478\ ft^2$

Combine design rate with infiltration area to get flow (disposal) rate for each drywell.

$0.000231 \frac{ft}{sec} \times 478\ ft^2 = 0.11054 \frac{ft^3}{sec}$

Volume of disposal for each drywell based on various time frames are included below.

96 hrs: 0.1105 CFS x 96 hours x $\frac{3600\ sec}{1\ hr}$ = 38,202 cubic feet of retained water disposed of.

3 hrs: 0.1105 CFS x 3 hours x $\frac{3600\ sec}{1\ hr}$ = 1,194 cubic feet of retained water disposed of.

Chamber diameter = 4 feet. Drywell rock shaft diameter = 4 feet.

Volume provided in each drywell with chamber depth of 15 feet.

$15\ ft \times 12.57\ ft^2 + 2\ ft \times 28.27\ ft^2 \times 40\ \% + 28\ ft \times 12.57\ ft^2 \times 40\ \% = 352\ ft^3$

The MaxWell System is composed of 1 drywell(s) .

Total volume provided = 352 ft^3

Total 3 hour infiltration volume = 1,194 ft^3

Total 96 hour infiltration volume = 38,202 ft^3

Total infiltration flowrate = 0.11054 $\frac{ft^3}{sec}$

Note: At 48 hr drawdown time for WQMP calculations,
total infiltration volume for 2 proposed drywells = 38,202 ft^3

Torrent Resources (CA) Incorporated
9950 Alder Avenue
Bloomington, CA 92316
Phone 909-829-0740

Form 4.2-3 HCOC Assessment for Runoff Volume (DA -1)

~~Weighted Curve Number Determination for: Pre-developed DA~~	~~DMA A~~	~~DMA B~~	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
~~**1a** Land Cover type~~	—	—						
~~**2a** Hydrologic Soil Group (HSG)~~	—	—						
~~**3a** DMA Area, ft² *sum of areas of DMA should equal area of DA*~~	—	—						
~~**4a** Curve Number (CN) *use Items 1 and 2 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*~~	—	—						
~~Weighted Curve Number Determination for: Post-developed DA~~	~~DMA A~~	~~DMA B~~	DMA C	DMA D	DMA E	DMA F	DMA G	DMA H
~~**1b** Land Cover type~~	—	—						
~~**2b** Hydrologic Soil Group (HSG)~~	—	—						
~~**3b** DMA Area, ft² *sum of areas of DMA should equal area of DA*~~	—	—						
~~**4b** Curve Number (CN) *use Items 5 and 6 to select the appropriate CN from Appendix C-2 of the TGD for WQMP*~~	—	—						

~~**5** Pre-Developed area-weighted CN:~~	~~**7** Pre-developed soil storage capacity, S (in):~~ ~~*S = (1000 / Item 5) - 10*~~	**9** Initial abstraction, I_a (in): *I_a = 0.2 * Item 7*
~~**6** Post-Developed area-weighted CN:~~	~~**8** Post-developed soil storage capacity, S (in):~~ ~~*S = (1000 / Item 6) - 10*~~	**10** Initial abstraction, I_a (in): *I_a = 0.2 * Item 8*

~~**11** Precipitation for 2 yr, 24 hr storm (in):~~
~~*Go to: http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*~~

12 Pre-developed Volume **44,592 cu-ft**
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume **46,687 cu-ft**
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 10)^2 / ((Item 11 – Item 10 + Item 8)*

14 Volume Reduction needed to meet HCOC Requirement, (ft³): **239.35 cu-ft**
*V_{HCOC} = (Item 13 * 0.95) – Item 12*

Form 4.2-4 HCOC Assessment for Time of Concentration (DA 1)

Compute time of concentration for pre and post developed conditions for each DA *(For projects using the Hydrology Manual complete the form below)*

~~Variables~~	~~Pre-developed DA1~~ *~~Use additional forms if there are more than 4 DMA~~*				~~Post-developed DA1~~ *~~Use additional forms if there are more than 4 DMA~~*			
	~~DMA A~~	~~DMA B~~	~~DMA C~~	~~DMA D~~	~~DMA A~~	~~DMA B~~	~~DMA C~~	~~DMA D~~
~~1 Length of flowpath (ft)~~ *~~Use Form 3-2 Item 5 for pre-developed condition~~*	—	—	—	—	—	—	—	—
~~2 Change in elevation (ft)~~	—	—	—	—	—	—	—	—
~~3 Slope (ft/ft),~~ *~~S_o = Item 2 / Item 1~~*	—	—	—	—	—	—	—	—
~~4 Land cover~~	—	—	—	—	—	—	—	—
~~5 Initial DMA Time of Concentration (min)~~ *~~Appendix C-1 of the TGD for WQMP~~*	—	—	—	—	—	—	—	—
~~6 Length of conveyance from DMA outlet to project site outlet (ft)~~ *~~May be zero if DMA outlet is at project site outlet~~*	—	—	—	—	—	—	—	—
~~7 Cross-sectional area of channel (ft²)~~	—	—	—	—	—	—	—	—
~~8 Wetted perimeter of channel (ft)~~	—	—	—	—	—	—	—	—
~~9 Manning's roughness of channel (n)~~	—	—	—	—	—	—	—	—
~~10 Channel flow velocity (ft/sec)~~ *~~V_{fps} = (1.49 / Item 9) * (Item 7/Item 8)^0.67 * (Item 3)^0.5~~*	—	—	—	—	—	—	—	—
~~11 Travel time to outlet (min)~~ *~~T_t = Item 6 / (Item 10 * 60)~~*	—	—	—	—	—	—	—	—
~~12 Total time of concentration (min)~~ *~~T_c = Item 5 + Item 11~~*	—	—	—	—	—	—	—	—

13 Pre-developed time of concentration (min): *Minimum of Item 12 pre-developed DMA* **28.38 mins**

14 Post-developed time of concentration (min): *Minimum of Item 12 post-developed DMA* **31.21 mins**

15 Additional time of concentration needed to meet HCOC requirement (min): *T_{C-HCOC} = (Item 14 * 0.95) – Item 13* **1.27 mins**

Form 4.2-5 HCOC Assessment for Peak Runoff (DA 1)

Compute peak runoff for pre- and post-developed conditions

~~Variables~~	~~Pre-developed DA to Project Outlet (*Use additional forms if more than 3 DMA*)~~			~~Post-developed DA to Project Outlet (*Use additional forms if more than 3 DMA*)~~		
	~~DMA A~~	~~DMA B~~	~~DMA C~~	~~DMA A~~	~~DMA B~~	~~DMA C~~
~~1 Rainfall Intensity for storm duration equal to time of concentration~~ ~~*I_{peak} = 10^(LOG Form 4.2-1 Item 4 - 0.6 LOG Form 4.2-4 Item 5 /60)*~~	—	—	—	—	—	—
~~2 Drainage Area of each DMA (ft^2)~~ ~~*For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*~~	—	—	—	—	—	—
~~3 Ratio of pervious area to total area~~ ~~*For DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*~~	—	—	—	—	—	—
~~4 Pervious area infiltration rate (in/hr)~~ ~~*Use pervious area CN and antecedent moisture condition with Appendix C-3 of the TGD for WQMP*~~	—	—	—	—	—	—
~~5 Maximum loss rate (in/hr)~~ ~~*F_m = Item 3 * Item 4*~~ ~~*Use area-weighted F_m from DMA with outlet at project site outlet, include upstream DMA (Using example schematic in Form 3-1, DMA A will include drainage from DMA C)*~~	—	—	—	—	—	—
~~6 Peak Flow from DMA (cfs)~~ ~~*Q_p =Item 2 * 0.9 * (Item 1 - Item 5)*~~	—	—	—	—	—	—
~~7 Time of concentration adjustment factor for other DMA to site discharge point~~ ~~*Form 4.2-4 Item 12 DMA / Other DMA upstream of site discharge point (If ratio is greater than 1.0, then use maximum value of 1.0)*~~ ~~DMA A~~	~~*n/a*~~	—	—	~~*n/a*~~	—	—
~~DMA B~~	—	~~*n/a*~~	—	—	~~*n/a*~~	—
~~DMA C~~	—	—	~~*n/a*~~	—	—	~~*n/a*~~

~~8 Pre-developed Q_p at T_c for DMA A:~~ ~~*Q_p = Item 6_{DMAA} + [Item 6_{DMAB} * (Item 1_{DMAA} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAA/2}$] + [Item 6_{DMAC} * (Item 1_{DMAA} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAA/3}$]*~~	~~9 Pre-developed Q_p at T_c for DMA B:~~ ~~*Q_p = Item 6_{DMAB} + [Item 6_{DMAA} * (Item 1_{DMAB} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAB/1}$] + [Item 6_{DMAC} * (Item 1_{DMAB} - Item 5_{DMAC})/(Item 1_{DMAC} - Item 5_{DMAC})* Item $7_{DMAB/3}$]*~~	~~10 Pre-developed Q_p at T_c for DMA C:~~ ~~*Q_p = Item 6_{DMAC} + [Item 6_{DMAA} * (Item 1_{DMAC} - Item 5_{DMAA})/(Item 1_{DMAA} - Item 5_{DMAA})* Item $7_{DMAC/1}$] + [Item 6_{DMAB} * (Item 1_{DMAC} - Item 5_{DMAB})/(Item 1_{DMAB} - Item 5_{DMAB})* Item $7_{DMAC/2}$]*~~
10 Peak runoff from pre-developed condition confluence analysis (cfs): **9.69 cfs**		
~~11 Post-developed Q_p at T_c for DMA A:~~ ~~*Same as Item 8 for post-developed values*~~	~~12 Post-developed Q_p at T_c for DMA B:~~ ~~*Same as Item 9 for post-developed values*~~	~~13 Post-developed Q_p at T_c for DMA C:~~ ~~*Same as Item 10 for post-developed values*~~
14 Peak runoff from post-developed condition confluence analysis (cfs) *:* **11.92 cfs**		
15 Peak runoff reduction needed to meet HCOC Requirement (cfs): $Q_{p\text{-}HCOC}$ = *(Item 14 * 0.95) – Item 10* **1.63 cfs**		

4.3 Project Conformance Analysis

Complete the following forms for each project site DA to document that the proposed LID BMPs conform to the project DCV developed to meet performance criteria specified in the MS4 Permit (WQMP Template Section 4.2). For the LID DCV, the forms are ordered according to hierarchy of BMP selection as required by the MS4 Permit (see Section 5.3.1 in the TGD for WQMP). The forms compute the following for on-site LID BMP:

- Site Design and Hydrologic Source Controls (Form 4.3-2)
- Retention and Infiltration (Form 4.3-3)
- Harvested and Use (Form 4.3-4) or
- Biotreatment (Form 4.3-5).

At the end of each form, additional fields facilitate the determination of the extent of mitigation provided by the specific BMP category, allowing for use of the next category of BMP in the hierarchy, if necessary.

The first step in the analysis, using Section 5.3.2.1 of the TGD for WQMP, is to complete Forms 4.3-1 and 4.3-3) to determine if retention and infiltration BMPs are infeasible for the project. For each feasibility criterion in Form 4.3-1, if the answer is “Yes,” provide all study findings that includes relevant calculations, maps, data sources, etc. used to make the determination of infeasibility.

Next, complete Forms 4.3-2 and 4.3-4 to determine the feasibility of applicable HSC and harvest and use BMPs, and, if their implementation is feasible, the extent of mitigation of the DCV.

If no site constraints exist that would limit the type of BMP to be implemented in a DA, evaluate the use of combinations of LID BMPs, including all applicable HSC BMPs to maximize on-site retention of the DCV. If no combination of BMP can mitigate the entire DCV, implement the single BMP type, or combination of BMP types, that maximizes on-site retention of the DCV within the minimum effective area.

If the combination of LID HSC, retention and infiltration, and harvest and use BMPs are unable to mitigate the entire DCV, then biotreatment BMPs may be implemented by the project proponent. If biotreatment BMPs are used, then they must be sized to provide sufficient capacity for effective treatment of the remainder of the volume-based performance criteria that cannot be achieved with LID BMPs (TGD for WQMP Section 5.4.4.2). **Under no circumstances shall any portion of the DCV be released from the site without effective mitigation and/or treatment**.

Form 4.3-1 Infiltration BMP Feasibility (DA 1)

Feasibility Criterion – Complete evaluation for each DA on the Project Site

1 Would infiltration BMP pose significant risk for groundwater related concerns? Yes ☐ No ☒
Refer to Section 5.3.2.1 of the TGD for WQMP

If Yes, Provide basis: (attach)

2 Would installation of infiltration BMP significantly increase the risk of geotechnical hazards? Yes ☐ No ☒
(Yes, if the answer to any of the following questions is yes, as established by a geotechnical expert):

- The location is less than 50 feet away from slopes steeper than 15 percent
- The location is less than eight feet from building foundations or an alternative setback.
- A study certified by a geotechnical professional or an available watershed study determines that stormwater infiltration would result in significantly increased risks of geotechnical hazards.

If Yes, Provide basis:

3 Would infiltration of runoff on a Project site violate downstream water rights? Yes ☐ No ☒

If Yes, Provide basis: (attach)

4 Is proposed infiltration facility located on hydrologic soil group (HSG) D soils or does the site geotechnical investigation indicate presence of soil characteristics, which support categorization as D soils? Yes ☐ No ☒

If Yes, Provide basis:

5 Is the design infiltration rate, after accounting for safety factor of 2.0, below proposed facility less than 0.3 in/hr (accounting for soil amendments)? Yes ☐ No ☒

If Yes, Provide basis: (attach)

6 Would on-site infiltration or reduction of runoff over pre-developed conditions be partially or fully inconsistent with watershed management strategies as defined in the WAP, or impair beneficial uses? Yes ☐ No ☒
See Section 3.5 of the TGD for WQMP and WAP

If Yes, Provide basis: (attach) N/A

7 Any answer from Item 1 through Item 3 is "Yes": Yes ☐ No ☒
If yes, infiltration of any volume is not feasible onsite. Proceed to Form 4.3-4, Harvest and Use BMP. If no, then proceed to Item 9 below.

8 Any answer from Item 4 through Item 6 is "Yes": Yes ☐ No ☒
If yes, infiltration is permissible but is not required to be considered. Proceed to Form 4.3-2, Hydrologic Source Control BMP.
If no, then proceed to Item 9, below.

9 All answers to Item 1 through Item 6 are "No": Yes ☒ No ☐
Infiltration of the full DCV is potentially feasible, LID infiltration BMP must be designed to infiltrate the full DCV to the MEP.
Proceed to Form 4.3-2, Hydrologic Source Control BMP.

~~4.3.1 Site Design Hydrologic Source Control BMP~~

~~Section XI.E. of the Permit emphasizes the use of LID preventative measures; and the use of LID HSC BMPs reduces the portion of the DCV that must be addressed in downstream BMPs. Therefore, all applicable HSC shall be provided except where they are mutually exclusive with each other, or with other BMPs. Mutual exclusivity may result from overlapping BMP footprints such that either would be potentially feasible by itself, but both could not be implemented. Please note that while there are no numeric standards regarding the use of HSC, if a project cannot feasibly meet BMP sizing requirements or cannot fully address HCOCs, feasibility of all applicable HSC must be part of demonstrating that the BMP system has been designed to retain the maximum feasible portion of the DCV. Complete Form 4.3-2 to identify and calculate estimated retention volume from implementing site design HSC BMP. Refer to Section 5.4.1 in the TGD for more detailed guidance.~~

~~See attached Summary of Form 4.3-2.~~

Form 4.3-2 Site Design Hydrologic Source Control BMPs (DA 1)			
1 Implementation of Impervious Area Dispersion BMP (i.e. routing runoff from impervious to pervious areas), excluding impervious areas planned for routing to on-lot infiltration BMP: Yes ☐ No ☒ *If yes, complete Items 2-5; If no, proceed to Item 6*	~~DA DMA BMP Type~~	~~DA DMA BMP Type~~	~~DA DMA BMP Type~~ *~~(Use additional forms for more BMPs)~~*
~~2 Total impervious area draining to pervious area (ft²)~~	—	—	—
~~3 Ratio of pervious area receiving runoff to impervious area~~	—	—	—
~~4 Retention volume achieved from impervious area dispersion (ft³)~~ *~~V = Item2 * Item 3 * (0.5/12), assuming retention of 0.5 inches of runoff~~*	—	—	—
5 Sum of retention volume achieved from impervious area dispersion (ft³): **0** *$V_{retention}$ =Sum of Item 4 for all BMPs:* **0**			
~~6 Implementation of Localized On-lot Infiltration BMPs (e.g. on-lot rain gardens): Yes ☐ No ☒~~ *~~If yes, complete Items 7-13 for aggregate of all on-lot infiltration BMP in each DA; If no, proceed to Item 14~~*	~~DA 1 DMA BMP Type~~	~~DA DMA BMP Type~~	~~DA DMA BMP Type~~ *~~(Use additional forms for more BMPs)~~*
~~7 Ponding surface area (ft²)~~		—	—
~~8 Ponding depth (ft)~~		—	—
~~9 Surface area of amended soil/gravel (ft²)~~		—	—
~~10 Average depth of amended soil/gravel (ft)~~		—	—
~~11 Average porosity of amended soil/gravel~~		—	—
~~12 Retention volume achieved from on-lot infiltration (ft³)~~ *~~$V_{retention}$ = (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)~~*		—	—
13 Runoff volume retention from on-lot infiltration (ft³): **0** *$V_{retention}$ =Sum of Item 12 for all BMPs :* **0**			

Form 4.3-2 cont. Site Design Hydrologic Source Control BMPs (DA 1)

14 Implementation of evapotranspiration BMP (green, brown, or blue roofs): Yes ☐ No ☒ *If yes, complete Items 15-20. If no, proceed to Item 21*	~~DA DMA BMP Type~~	~~DA DMA BMP Type~~	~~DA DMA BMP Type~~ ~~*(Use additional forms for more BMPs)*~~
~~15 Rooftop area planned for ET BMP (ft²)~~	—	—	—
~~16 Average wet season ET demand (in/day)~~ ~~*Use local values, typical ~ 0.1*~~	—	—	—
~~17 Daily ET demand (ft³/day)~~ ~~*Item 15 * (Item 16 / 12)*~~	—	—	—
~~18 Drawdown time (hrs)~~ ~~*Copy Item 6 in Form 4.2-1*~~	—	—	—
~~19 Retention Volume (ft³)~~ ~~*Vretention = Item 17 * (Item 18 / 24)*~~	—	—	—
~~20~~ Runoff volume retention from evapotranspiration BMPs (ft³): **0** *Vretention =Sum of Item 19 for all BMPs:* **0**			
21 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 20-2. If no, proceed to Item 24*	~~DA 1 DMA BMP Type~~	~~DA DMA BMP Type~~	~~DA DMA BMP Type~~ ~~*(Use additional forms for more BMPs)*~~
~~22 Number of Street Trees~~		—	—
~~23 Average canopy cover over impervious area (ft²)~~		—	—
~~24 Runoff volume retention from street trees (ft³)~~ ~~*Vretention = Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches*~~	—	—	—
25 Runoff volume retention from street tree BMPs (ft³): **0** *Vretention = Sum of Item 24 for all BMPs* **0**			
26 Implementation of residential rain barrels/cisterns: Yes☐ No ☒ *If yes, complete Items 27-28; If no, proceed to Item 29*	~~DA DMA BMP Type~~	~~DA DMA BMP Type~~	~~DA DMA BMP Type~~ ~~*(Use additional forms for more BMPs)*~~
~~27 Number of rain barrels/cisterns~~	—	—	—
~~28 Runoff volume retention from rain barrels/cisterns (ft³)~~ ~~*Vretention = Item 27 * 3*~~	—	—	—
29 Runoff volume retention from residential rain barrels/Cisterns (ft3): **0** *Vretention =Sum of Item 28 for all BMPs:* **0**			
~~30~~ Total Retention Volume from Site Design Hydrologic Source Control BMPs: **0** *Sum of Items 5, 13, 20, 25 and 29:*			

4.3.2 Infiltration BMPs

Use Form 4.3-3 to compute on-site retention of runoff from proposed retention and infiltration BMPs. Volume retention estimates are sensitive to the percolation rate used, which determines the amount of runoff that can be infiltrated within the specified drawdown time. The infiltration safety factor reduces field measured percolation to account for potential inaccuracy associated with field measurements, declining BMP performance over time, and compaction during construction. Appendix D of the TGD for WQMP provides guidance on estimating an appropriate safety factor to use in Form 4.3-3.

If site constraints limit the use of BMPs to a single type and implementation of retention and infiltration BMPs mitigate no more than 40% of the DCV, then they are considered infeasible and the Project Proponent may evaluate the effectiveness of BMPs lower in the LID hierarchy of use (Section 5.5.1 of the TGD for WQMP)

If implementation of infiltrations BMPs is feasible as determined using Form 4.3-1, then LID infiltration BMPs shall be implemented to the MEP (section 4.1 of the TGD for WQMP).

See attached Summary of Form 4.3-3.

Form 4.3-3 Infiltration LID BMP - including underground BMPs (DA 1)

1 Remaining LID DCV not met by site design HSC BMP (ft³): **23,282** *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30*

BMP Type *Use columns to the right to compute runoff volume retention from proposed infiltration BMP (select BMP from Table 5-4 in TGD for WQMP) - Use additional forms for more BMPs*	**INFILTRATION BASIN** w/ 2 drywells		
2 Infiltration rate of underlying soils (in/hr) *See Section 5.4.2 and Appendix D of the TGD for WQMP for minimum requirements for assessment methods*			
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*			
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	10 in/hr	*Design rate	Per geotechnical report
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48 hrs		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	-		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	-		
8 Infiltrating surface area, *SA_{BMP}* (ft²) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	-		
9 Amended soil depth, *d_{media}* (ft) *Only included in certain BMP types, see Table 5-4 in the TGD for WQMP for reference to BMP design details*	-		
10 Amended soil porosity	-		
11 Gravel depth, *d_{media}* (ft) *Only included in certain BMP types, see Table 5-4 of the TGD for WQMP for BMP design details*	-		
12 Gravel porosity	-		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	-		
14 Above Ground Retention Volume (ft³) *$V_{retention}$ = Item 8 * [Item7 + (Item 9 * Item 10) + (Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]*	**0**	0	0
15 Underground Retention Volume (ft³) *Volume determined using manufacturer's specifications and calculations*	**38,202**	*See calculations	Per manufacturer's calculations at 48 hrs

16 Total Retention Volume from LID Infiltration BMPs: **38,202** *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*

17 Fraction of DCV achieved with infiltration BMP: **164 %** *Retention% = Item 16 / Form 4.2-1 Item 7*

18 Is full LID DCV retained on-site with combination of hydrologic source control and LID retention and infiltration BMPs? Yes ☒ No ☐

If yes, demonstrate conformance using Form 4.3-10; If no, then reduce Item 3, Factor of Safety to 2.0 and increase Item 8, Infiltrating Surface Area, such that the portion of the site area used for retention and infiltration BMPs equals or exceeds the minimum effective area thresholds (Table 5-7 of the TGD for WQMP) for the applicable category of development and repeat all above calculations.

~~4.3.3 Harvest and Use BMP~~

Harvest and use BMP may be considered if the full LID DCV cannot be met by maximizing infiltration BMPs. Use Form 4.3-4 to compute on-site retention of runoff from proposed harvest and use BMPs.

Volume retention estimates for harvest and use BMPs are sensitive to the on-site demand for captured stormwater. Since irrigation water demand is low in the wet season, when most rainfall events occur in San Bernardino County, the volume of water that can be used within a specified drawdown period is relatively low. The bottom portion of Form 4.3-4 facilitates the necessary computations to show infeasibility if a minimum incremental benefit of 40 percent of the LID DCV would not be achievable with MEP implementation of on-site harvest and use of stormwater (Section 5.5.4 of the TGD for WQMP).

Form 4.3-4 Harvest and Use BMPs (DA 1)			
1 Remaining LID DCV not met by site design HSC or infiltration BMP (ft^3): **0** *V_{unmet} = Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16*			
~~BMP Type(s)~~ ~~*Compute runoff volume retention from proposed harvest and use BMP (Select BMPs from Table 5-4 of the TGD for WQMP) - Use additional forms for more BMPs*~~	~~DA DMA~~ ~~BMP Type~~	~~DA DMA~~ ~~BMP Type~~	~~DA DMA~~ ~~BMP Type~~ ~~*(Use additional forms for more BMPs)*~~
~~2 Describe cistern or runoff detention facility~~	—	—	—
~~3 Storage volume for proposed detention type (ft^3) *Volume of cistern*~~	—	—	—
~~4 Landscaped area planned for use of harvested stormwater (ft^2)~~	—	—	—
~~5 Average wet season daily irrigation demand (in/day)~~ ~~Use local values, typical ~ 0.1 in/day~~	—	—	—
~~6 Daily water demand (ft^3/day) *Item 4 * (Item 5 / 12)*~~	—	—	—
~~7 Drawdown time (hrs) *Copy Item 6 from Form 4.2-1*~~	—	—	—
8 Retention Volume (ft^3) *$V_{retention}$ = Minimum of (Item 3) or (Item 6 * (Item 7 / 24))*	—	—	—
9 Total Retention Volume (ft^3) from Harvest and Use BMP : **0 (zero)** *Sum of Item 8 for all harvest and use BMP included in plan*			
10 Is the full DCV retained with a combination of LID HSC, retention and infiltration, and harvest and use BMPs? Yes ☒ No ☐ *If yes, demonstrate conformance using Form 4.3-10. If no, then re-evaluate combinations of all LID BMP and optimize their implementation such that the maximum portion of the DCV is retained on-site (using a single BMP type or combination of BMP types). If the full DCV cannot be mitigated after this optimization process, proceed to Section 4.3.4.*			

4.3.4 Biotreatment BMP

Biotreatment BMPs may be considered if the full LID DCV cannot be met by maximizing retention and infiltration, and harvest and use BMPs. A key consideration when using biotreatment BMP is the effectiveness of the proposed BMP in addressing the pollutants of concern for the project (see Table 5-5 of the TGD for WQMP).

Use Form 4.3-5 to summarize the potential for volume based and/or flow based biotreatment options to biotreat the remaining unmet LID DCV w. Biotreatment computations are included as follows:

- Use Form 4.3-6 to compute biotreatment in small volume based biotreatment BMP (e.g. bioretention w/underdrains);
- Use Form 4.3-7 to compute biotreatment in large volume based biotreatment BMP (e.g. constructed wetlands);
- Use Form 4.3-8 to compute sizing criteria for flow-based biotreatment BMP (e.g. bioswales)

Form 4.3-5 Selection and Evaluation of Biotreatment BMP (DA 1)

1 Remaining LID DCV not met by site design HSC, infiltration, or harvest and use BMP for potential biotreatment (ft^3): **0** *Form 4.2-1 Item 7 - Form 4.3-2 Item 30 – Form 4.3-3 Item 16- Form 4.3-4 Item 9*		
2 Biotreatment BMP Selected *(Select biotreatment BMP(s) necessary to ensure all pollutants of concern are addressed through Unit Operations and Processes, described in Table 5-5 of the TGD for WQMP)*	Volume-based biotreatment *Use Forms 4.3-6 and 4.3-7 to compute treated volume* ☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended detention	Flow-based biotreatment *Use Form 4.3-8 to compute treated volume* ☐ Vegetated swale (added to treat DMA-B) ☐ Vegetated filter strip ☒ Proprietary biotreatment **PRE TREATMENT ONLY**
3 Volume biotreated in volume based biotreatment BMP (ft^3): **0** *Form 4.3-6 Item 15 + Form 4.3-7 Item 13*	4 Compute remaining LID DCV with implementation of volume based biotreatment BMP (ft^3): **0** *Item 1 – Item 3*	5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: **0 %** *Item 4 / Item 1*
6 Flow-based biotreatment BMP capacity provided (cfs): **0** *Use Figure 5-2 of the TGD for WQMP to determine flow capacity required to provide biotreatment of remaining percentage of unmet LID DCV (Item 5), for the project's precipitation zone (Form 3-1 Item 1)*		
7 Metrics for MEP determination: - Provided a WQMP with the portion of site area used for suite of LID BMP equal to minimum thresholds in Table 5-7 of the TGD for WQMP for the proposed category of development: ☐ *If maximized on-site retention BMPs is feasible for partial capture, then LID BMP implementation must be optimized to retain and infiltrate the maximum portion of the DCV possible within the prescribed minimum effective area. The remaining portion of the DCV shall then be mitigated using biotreatment BMP.*		

~~Form 4.3-6 Volume Based Biotreatment (DA 1) –~~
~~Bioretention and Planter Boxes with Underdrains~~

~~Biotreatment BMP Type~~ *~~(Bioretention w/underdrain, planter box w/underdrain, other comparable BMP)~~*	~~DA DMA BMP Type~~	~~DA DMA BMP Type~~	~~DA DMA BMP Type~~ *~~(Use additional forms for more BMPs)~~*
~~1~~ ~~Pollutants addressed with BMP~~ *~~List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP~~*	—	—	—
~~2~~ ~~Amended soil infiltration rate~~ *~~Typical ~ 5.0~~*	—	—	—
~~3~~ ~~Amended soil infiltration safety factor~~ *~~Typical ~ 2.0~~*	—	—	—
~~4~~ ~~Amended soil design percolation rate (in/hr)~~ *~~P_{design} = Item 2 / Item 3~~*	—	—	—
~~5~~ ~~Ponded water drawdown time (hr)~~ *~~Copy Item 6 from Form 4.2-1~~*	—	—	—
~~6~~ ~~Maximum ponding depth (ft)~~ *~~see Table 5-6 of the TGD for WQMP for reference to BMP design details~~*	—	—	—
~~7~~ ~~Ponding Depth (ft)~~ *~~d_{BMP} = Minimum of (1/12 * Item 4 * Item 5) or Item 6~~*	—	—	—
~~8~~ ~~Amended soil surface area (ft²)~~	—	—	—
~~9~~ ~~Amended soil depth (ft)~~ *~~see Table 5-6 of the TGD for WQMP for reference to BMP design details~~*	—	—	—
~~10~~ ~~Amended soil porosity, *n*~~	—	—	—
~~11~~ ~~Gravel depth (ft)~~ *~~see Table 5-6 of the TGD for WQMP for reference to BMP design details~~*	—	—	—
~~12~~ ~~Gravel porosity, *n*~~	—	—	—
~~13~~ ~~Duration of storm as basin is filling (hrs)~~ *~~Typical ~ 3hrs~~*	—	—	—
~~14~~ ~~Biotreated Volume (ft³)~~ *~~$V_{biotreated}$ = Item 8 * [(Item 7/2) + (Item 9 * Item 10) +(Item 11 * Item 12) + (Item 13 * (Item 4 / 12))]~~*	—	—	—
15 Total biotreated volume from bioretention and/or planter box with underdrains BMP: **0** *Sum of Item 14 for all volume-based BMPs included in this form*			

~~Form 4.3-7 Volume Based Biotreatment (DA 1) – Constructed Wetlands and Extended Detention~~

~~Biotreatment BMP Type~~ *~~Constructed wetlands, extended wet detention, extended dry detention, or other comparable proprietary BMP. If BMP includes multiple modules (e.g. forebay and main basin), provide separate estimates for storage and pollutants treated in each module.~~*	~~DA DMA BMP Type~~		~~DA DMA BMP Type~~ *~~(Use additional forms for more BMPs)~~*	
	~~Forebay~~	~~Basin~~	~~Forebay~~	~~Basin~~
~~1 Pollutants addressed with BMP forebay and basin~~ *~~List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in Table 5-5 of the TGD for WQMP~~*	—	—	—	—
~~2 Bottom width (ft)~~	—	—	—	—
~~3 Bottom length (ft)~~	—	—	—	—
~~4 Bottom area (ft^2)~~ *~~A_{bottom} = Item 2 * Item 3~~*	—	—	—	—
~~5 Side slope (ft/ft)~~	—	—	—	—
~~6 Depth of storage (ft)~~	—	—	—	—
~~7 Water surface area (ft^2)~~ ~~$A_{surface}$ =(Item 2 + (2 * Item 5 * Item 6)) * (Item 3 + (2 * Item 5 * Item 6))~~	—	—	—	—
~~8 Storage volume (ft^3)~~ *~~For BMP with a forebay, ensure fraction of total storage is within ranges specified in BMP specific fact sheets, see Table 5-6 of the TGD for WQMP for reference to BMP design details~~* ~~V =Item 6 / 3 * [Item 4 + Item 7 + (Item 4 * Item 7)^0.5]~~	—	—	—	—
~~9 Drawdown Time (hrs)~~ *~~Copy Item 6 from Form 2.1~~*	—		—	
~~10 Outflow rate (cfs)~~ *~~Q_{BMP} = (Item $8_{forebay}$ + Item 8_{basin}) / (Item 9 * 3600)~~*	—		—	
~~11 Duration of design storm event (hrs)~~	—		—	
~~12 Biotreated Volume (ft^3)~~ *~~$V_{biotreated}$ = (Item $8_{forebay}$ + Item 8_{basin}) +(Item 10 * Item 11 * 3600)~~*	—		—	
~~13 Total biotreated volume from constructed wetlands, extended dry detention, or extended wet detention :~~ *~~(Sum of Item 12 for all BMP included in plan)~~*				

~~Form 4.3-8 Flow Based Biotreatment (DA 1)~~			
~~Biotreatment BMP Type~~ *~~Vegetated swale, vegetated filter strip, or other comparable proprietary BMP~~*			
~~1~~ ~~Pollutants addressed with BMP~~ *~~List all pollutant of concern that will be effectively reduced through specific Unit Operations and Processes described in TGD Table 5-5~~*			
~~2~~ ~~Flow depth for water quality treatment (ft)~~ *~~BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details~~*			
~~3~~ ~~Bed slope (ft/ft)~~ *~~BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details~~*			
~~4~~ ~~Manning's roughness coefficient~~			
~~5~~ ~~Bottom width (ft)~~ *~~b_w = (Form 4.3-5 Item 6 * Item 4) / (1.49 * Item $2^{1.67}$ * Item $3^{0.5}$)~~*			
~~6~~ ~~Side Slope (ft/ft)~~ *~~BMP specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details~~*			
~~7~~ ~~Cross sectional area (ft^2)~~ *~~A = (Item 5 * Item 2) + (Item 6 * Item 2^2)~~*			
~~8~~ ~~Water quality flow velocity (ft/sec)~~ *~~V = Form 4.3-5 Item 6 / Item 7~~*			
~~9~~ ~~Hydraulic residence time (min)~~ *~~Pollutant specific, see Table 5-6 of the TGD for WQMP for reference to BMP design details~~*			
~~10~~ ~~Length of flow based BMP (ft)~~ *~~L = Item 8 * Item 9 * 60~~*			
~~11~~ ~~Water surface area at water quality flow depth (ft^2)~~ *~~SA_{top} = (Item 5 + (2 * Item 2 * Item 6)) * Item 10~~*			

4.3.5 Conformance Summary

Complete Form 4.3-9 to demonstrate how on-site LID DCV is met with proposed site design hydrologic source control, infiltration, harvest and use, and/or biotreatment BMP. The bottom line of the form is used to describe the basis for infeasibility determination for on-site LID BMP to achieve full LID DCV, and provides methods for computing remaining volume to be addressed in an alternative compliance plan. If the project has more than one outlet, then complete additional versions of this form for each outlet.

Form 4.3-9 Conformance Summary and Alternative Compliance Volume Estimate (DA-1)
1 Total LID DCV for the Project DA-1 (ft^3): **23,282** *Copy Item 7 in Form 4.2-1*
2 On-site retention with site design hydrologic source control LID BMP (ft^3): **0** *Copy Item 30 in Form 4.3-2*
3 On-site retention with LID infiltration BMP (ft^3): **38,202** *Copy Item 16 in Form 4.3-3:*
4 On-site retention with LID harvest and use BMP (ft^3): **0** *Copy Item 9 in Form 4.3-4*
5 On-site biotreatment with volume based biotreatment BMP (ft^3): **0** *Copy Item 3 in Form 4.3-5*
6 Flow capacity provided by flow based biotreatment BMP (cfs): *Copy Item 6 in Form 4.3-5*
7 LID BMP performance criteria are achieved if answer to any of the following is "Yes": • Full retention of LID DCV with site design HSC, infiltration, or harvest and use BMP: Yes ☒ No ☐ *If yes, sum of Items 2, 3, and 4 is greater than Item 1* • Combination of on-site retention BMPs for a portion of the LID DCV and volume-based biotreatment BMP that address all pollutants of concern for the remaining LID DCV: Yes ☐ No ☒ *If yes, a) sum of Items 2, 3, 4, and 5 is greater than Item 1, and Items 2, 3 and 4 are maximized; or b) Item 6 is greater than Form 4.3--5 Item 6 and Items 2, 3 and 4 are maximized* • On-site retention and infiltration is determined to be infeasible and biotreatment BMP provide biotreatment for all pollutants of concern for full LID DCV: Yes ☐ No ☒ *If yes, Form 4.3-1 Items 7 and 8 were both checked yes*
8 If the LID DCV is not achieved by any of these means, then the project may be allowed to develop an alternative compliance plan. Check box that describes the scenario which caused the need for alternative compliance: • Combination of HSC, retention and infiltration, harvest and use, and biotreatment BMPs provide less than full LID DCV capture: ☐ *Checked yes for Form 4.3-5 Item 7, Item 6 is zero, and sum of Items 2, 3, 4, and 5 is less than Item 1. If so, apply water quality credits and calculate volume for alternative compliance, V_{alt} = (Item 1 – Item 2 – Item 3 – Item 4 – Item 5) * (100 - Form 2.4-1 Item 2)%* • An approved Watershed Action Plan (WAP) demonstrates that water quality and hydrologic impacts of urbanization are more effective when managed in at an off-site facility: ☐ *Attach appropriate WAP section, including technical documentation, showing effectiveness comparisons for the project site and regional watershed*

4.3.6 Hydromodification Control BMP

Use Form 4.3-10 to compute the remaining runoff volume retention, after LID BMP are implemented, needed to address HCOC, and the increase in time of concentration and decrease in peak runoff necessary to meet targets for protection of waterbodies with a potential HCOC. Describe hydromodification control BMP that address HCOC, which may include off-site BMP and/or in-stream controls. Section 5.6 of the TGD for WQMP provides additional details on selection and evaluation of hydromodification control BMP.

Form 4.3-10 Hydromodification Control BMPs (DA 1)

1 Volume reduction needed for HCOC performance criteria (ft^3): **239.35** *(Form 4.2-2 Item 4 * 0.95) – Form 4.2-2 Item 1*	2 On-site retention with site design hydrologic source control, infiltration, and harvest and use LID BMP (ft^3): **38,202** *Sum of Form 4.3-9 Items 2, 3, and 4* *Evaluate option to increase implementation of on-site retention in Forms 4.3-2, 4.3-3, and 4.3-4 in excess of LID DCV toward achieving HCOC volume reduction*
3 Remaining volume for HCOC volume capture (ft^3): **0** *Item 1 – Item 2*	4 Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): x *Existing downstream BMP may be used to demonstrate additional volume capture (if so, attach to this WQMP a hydrologic analysis showing how the additional volume would be retained during a 2-yr storm event for the regional watershed)*

5 If Item 4 is less than Item 3, incorporate in-stream controls on downstream waterbody segment to prevent impacts due to hydromodification ☐ *Attach in-stream control BMP selection and evaluation to this WQMP*

6 Is Form 4.2-2 Item 11 less than or equal to 5%: Yes ☒ No ☐ Tc for Post developed condition is more than Pre developed

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate increase in time of concentration achieved by proposed LID site design, LID BMP, and additional on-site or off-site retention BMP ☒
  BMP upstream of a waterbody segment with a potential HCOC may be used to demonstrate increased time of concentration through hydrograph attenuation (if so, show that the hydraulic residence time provided in BMP for a 2-year storm event is equal or greater than the addition time of concentration requirement in Form 4.2-4 Item 15)
- Increase time of concentration by preserving pre-developed flow path and/or increase travel time by reducing slope and increasing cross-sectional area and roughness for proposed on-site conveyance facilities ☐
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

7 Form 4.2-2 Item 12 less than or equal to 5%: Yes ☐ No ☒

If yes, HCOC performance criteria is achieved. If no, select one or more mitigation options below:

- Demonstrate reduction in peak runoff achieved by proposed LID site design, LID BMPs, and additional on-site or off-site retention BMPs ☒
  BMPs upstream of a waterbody segment with a potential HCOC may be used to demonstrate additional peak runoff reduction through hydrograph attenuation (if so, attach to this WQMP, a hydrograph analysis showing how the peak runoff would be reduced during a 2-yr storm event)
- Incorporate appropriate in-stream controls for downstream waterbody segment to prevent impacts due to hydromodification, in a plan approved and signed by a licensed engineer in the State of California ☐

4.4 Alternative Compliance Plan (if applicable)

Describe an alternative compliance plan (if applicable) for projects not fully able to infiltrate, harvest and use, or biotreat the DCV via on-site LID practices. A project proponent must develop an alternative compliance plan to address the remainder of the LID DCV. Depending on project type some projects may qualify for water quality credits that can be applied to reduce the DCV that must be treated prior to development of an alternative compliance plan (see Form 2.4-1, Water Quality Credits). Form 4.3-9 Item 8 includes instructions on how to apply water quality credits when computing the DCV that must be met through alternative compliance. Alternative compliance plans may include one or more of the following elements:

- On-site structural treatment control BMP - All treatment control BMP should be located as close to possible to the pollutant sources and should not be located within receiving waters;
- Off-site structural treatment control BMP - Pollutant removal should occur prior to discharge of runoff to receiving waters;
- Urban runoff fund or In-lieu program, if available

Depending upon the proposed alternative compliance plan, approval by the executive officer may or may not be required (see Section 6 of the TGD for WQMP).

Section 5 Inspection and Maintenance Responsibility for Post-Construction BMP

All BMP included as part of the project WQMP are required to be maintained through regular scheduled inspection and maintenance (refer to Section 8, Post Construction BMP Requirements, in the TGD for WQMP). Fully complete Form 5-1 summarizing all BMP included in the WQMP. Attach additional forms as needed. The WQMP shall also include a detailed Operation and Maintenance Plan for all BMP and may require a Maintenance Agreement (consult the jurisdiction's LIP). If a Maintenance Agreement is required, it must also be attached to the WQMP.

Form 5-1 BMP Inspection and Maintenance (use additional forms as necessary)

BMP	Responsible Party(s)	Inspection/ Maintenance Activities Required	Minimum Frequency of Activities
Education	HOA	Provide educational materials to homeowners regarding their actions on storm water runoff and the quality of receiving waters.	Upon turn-over, annually thereafter.
Employee Training/ Education Program	HOA	Provide training regarding the impacts of improper disposal of hazardous and waste materials, improper watering, fertilizers, pesticides, and maintenance activities on water quality through the San Bernardino County website.	Upon initial hiring, annually thereafter.
Stormdrain Stenciling	HOA	All storm drain inlets and catch basins will have stenciling that states "NO DUMPING ONLY RAIN IN THE DRAIN" or approved similar. Signs with prohibitive language regarding illegal dumping will be posted at public access points along the channel/creek. HOA will be responsible for maintaining the stenciling and signage for the storm drain inlets and catch basins on an annual basis. Signage at the channel/creek will be maintained by HOA on an annual basis.	Yearly and as needed
Sweeping Private Streets	HOA	Private streets utilizing a vacuum assisted sweeper will be swept on a weekly basis. Parking lots will be swept at least quarterly, including just prior to the start of the rain season, October 1st	Weekly
Landscape Planning and Site Design	HOA/Homeowners (private)	Inspect all Common landscape areas and replace dead vegetation and remove trash. Properly manage pesticides and fertilizers per County Ordinances. Replace mulch as necessary. Inspect, adjust, and repair irrigation system.	Weekly.

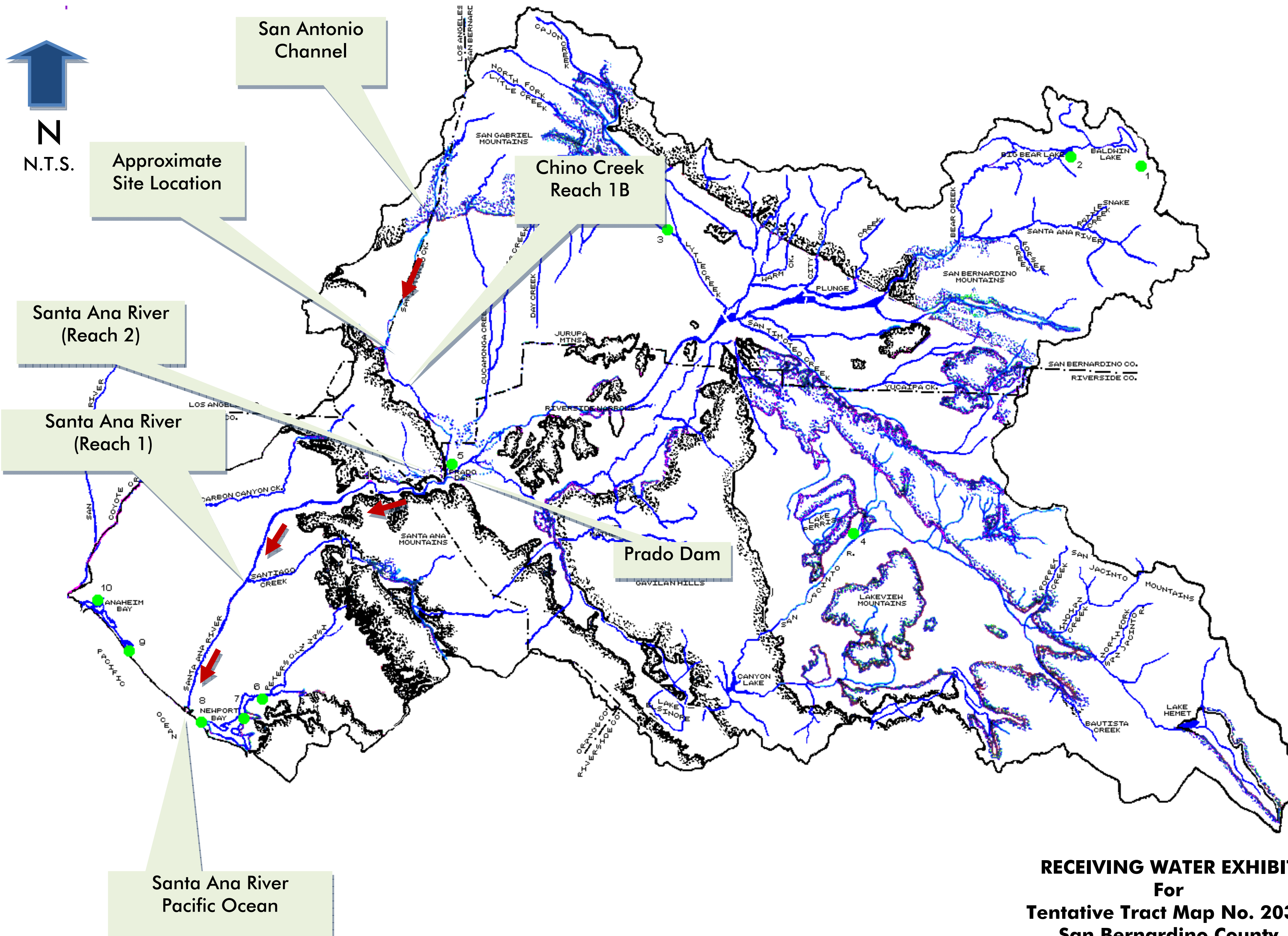
		Planting will comply with County Landscape Ordinance.	
Roof Runoff Controls	HOA / Homeowner	Inspect roof drains for accumulated debris and obstructions. Clean as needed.	Bi-annually
Concrete Channel	HOA	Inspect channel for accumulated debris and obstructions. Clean as needed.	Weekly.
Efficient Irrigation	HOA/Homeowners (private)	Verify that runoff minimizing landscape design continues to function by checking that water sensors are functioning properly, that irrigation heads are adjusted properly to eliminate overspray to hardscape areas, and to verify that irrigation timing and cycle lengths are adjusted in accordance with water demands, given time of year, weather and day or night time temperatures.	Minimum monthly or as needed together with landscape maintenance
Infiltration Basin	HOA	Inspect for sediment and debris accumulation. Remove trash and debris surrounding grate inlets. Observe for ponding water near grate inlets. Observe for unusual depression of soil near or around the location of the infiltration basin.	Inspect twice per year (October to May) and after heavy runoff events.
Common Area Litter Control	HOA	Trash receptacles will be provided in common areas and emptied on a weekly basis. Common areas and perimeter fences or walls will be patrolled by employees on a weekly basis and litter will be collected as needed. Trash disposal violations by tenants and home owners will be reported to the HOA for investigation.	Weekly
Catch Basin Inspection	HOA	Inspect all catch basins; remove litter and debris as necessary. Routine maintenance of drainage facilities, such as the catch basins and storm drain inlets. Catch basin and inlets will be cleaned if accumulated sediment/debris fills 25% or more of the sediment/debris storage capacity. Routine inspections of drainage facilities will be inspected annually and cleaned as needed.	Quarterly, prior to the “rainy season” (October 1st through April 30th), and after significant storm events; inspect for accumulation of any debris. Clean as necessary to ensure optimal function.

Section 6 WQMP Attachments

6.1. Site Plan and Drainage Plan

Include a site plan and drainage plan sheet set containing the following minimum information:

- Project location
- Site boundary
- Land uses and land covers, as applicable
- Suitability/feasibility constraints
- Structural Source Control BMP locations
- Site Design Hydrologic Source Control BMP locations
- LID BMP details
- Drainage delineations and flow information
- Drainage connections



RECEIVING WATER EXHIBIT
For
Tentative Tract Map No. 20394
San Bernardino County

I:\89704\DRAINAGE\WQMP\PRELIMINARY\references\RECEIVING WATER.doc 8/17/2021 11:28 AM

6.2 Electronic Data Submittal

Minimum requirements include submittal of PDF exhibits in addition to hard copies. Format must not require specialized software to open. If the local jurisdiction requires specialized electronic document formats (as described in their local Implementation Plan), this section will describe the contents (e.g., layering, nomenclature, geo-referencing, etc.) of these documents so that they may be interpreted efficiently and accurately.

6.3 Post-Construction

Operation and Maintenance Plans and Maintenance Agreements for BMPs within the WQMP, CC&R's.

RECORDING REQUESTED BY:
County of San Bernardino
Department of Public Works

AND WHEN RECORDED MAIL TO:
County of San Bernardino
Department of Public Works
825 E. Third Street, Room 117
San Bernardino, CA 92415-0835

SPACE ABOVE THIS LINE FOR RECORDER'S USE

COVENANT AND AGREEMENT REGARDING WATER QUALITY MANAGEMENT PLAN AND STORMWATER BEST MANAGEMENT PRACTICES TRANSFER, ACCESS AND MAINTENANCE

THIS PAGE ADDED TO PROVIDE ADEQUATE SPACE FOR RECORDING INFORMATION

Covenant and Agreement Regarding Water Quality Management Plan and Stormwater Best Management Practices Transfer, Access and Maintenance

OWNER NAME: ______________________________

PROPERTY ADDRESS: ______________________________

____

APN: ______________________________

THIS AGREEMENT is made and entered into in

______________________________ ,California, this ________ day of

______________________________ , by and between

______________________________ , hereinafter

referred to as Owner, and the COUNTY OF SAN BERNARDINO, a political subdivision of the State of California, hereinafter referred to as “the County”;

WHEREAS, the Owner owns real property (“Property”) in the County of San Bernardino, State of California, more specifically described in Exhibit “A” and depicted in Exhibit “B”, each of which exhibits is attached hereto and incorporated herein by this reference; and

WHEREAS, at the time of initial approval of development project known as

______________________________ within the Property described herein, the County required the project to employ Best Management Practices, hereinafter referred to as “BMPs,” to minimize pollutants in urban runoff; and

WHEREAS, the Owner has chosen to install and/or implement BMPs as described in the Water Quality Management Plan, dated ______________________, on file with the County and incorporated herein by this reference, hereinafter referred to as “WQMP”, to minimize pollutants in urban runoff and to minimize other adverse impacts of urban runoff; and

WHEREAS, said WQMP has been certified by the Owner and reviewed and approved by the County; and

WHEREAS, the Owner is aware that periodic and continuous maintenance, including, but not necessarily limited to, filter material replacement and sediment removal, is required to assure peak performance of all BMPs in the WQMP and that, furthermore, such maintenance activity will require compliance with all Local, State, or Federal laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs.

NOW THEREFORE, it is mutually stipulated and agreed as follows:

1. Owner shall comply with the WQMP.

2. All maintenance or replacement of BMPs proposed as part of the WQMP are the sole responsibility of the Owner in accordance with the terms of this Agreement.

3. Owner hereby provides the County's designee complete access, of any duration, to the BMPs and their immediate vicinity at any time, upon reasonable notice, or in the event of emergency, as determined by the County Director of Public Works, no advance notice, for the purpose of inspection, sampling, testing of the BMPs, and in case of emergency, to undertake all necessary repairs or other preventative measures at owner's expense as provided in paragraph 5 below. The County shall make every effort at all times to minimize or avoid interference with Owner's use of the Property. Denial of access to any premises or facility that contains WQMP features is a breach of this Agreement and may also be a violation of the County's Pollutant Discharge Elimination System regulations, which on the effective date of this Agreement are found in County Code Sections 35.0101 et seq. If there is reasonable cause to believe that an illicit discharge or breach of this Agreement is occurring on the premises then the authorized enforcement agency may seek issuance of a search warrant from any court of competent jurisdiction in addition to other enforcement actions. Owner recognizes that the County may perform routine and regular inspections, as well as emergency inspections, of the BMPs. Owner or Owner's successors or assigns shall pay County for all costs incurred by County in the inspection, sampling, testing of the BMPs within thirty (30) calendar days of County invoice.

4. Owner shall use its best efforts diligently to maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by Owner and Owner's representative or contractor in the removal and extraction of any material(s) from the BMPs and the ultimate disposal of the material(s) in a manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the County, the Owner shall provide the County with documentation identifying the material(s) removed, the quantity, and disposal destination), testing construction or reconstruction.

5. In the event Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within five (5) business days of being given written notice by the County , the County is hereby authorized to cause any maintenance necessary to be done and charge the entire cost and expense against the Property and/or to the Owner or Owner's successors or assigns, including administrative costs, attorneys fees and interest thereon at the maximum rate authorized by the County Code from the date of the notice of expense until paid in full. Owner or Owner's successors or assigns shall pay County within thirty (30) calendar days of County invoice.

6. The County may require the owner to post security in form and for a time period satisfactory to the County to guarantee the performance of the obligations stated herein. Should the Owner fail to perform the obligations under the Agreement, the County may, in the case of a cash bond, act for the Owner using the proceeds from it, or in the case of a surety bond, require the surety(ies) to perform the obligations of this Agreement.

7. The County agrees, from time to time, within ten (10) business days after request of Owner, to execute and deliver to Owner, or Owner's designee, an estoppel certificate requested by Owner, stating that this Agreement is in full force and effect, and that Owner is not in default hereunder with regard to any maintenance or payment obligations (or specifying in detail the nature of Owner's default). Owner shall pay all costs and expenses incurred by the County in its investigation of whether to issue an estoppel certificate within thirty (30) calendar days after receipt of a County invoice and prior to the County's issuance of such certificate. Where the County cannot issue an estoppel certificate, Owner shall pay the County within thirty (30) calendar days of receipt of a County invoice.

8. Owner shall not change any BMPs identified in the WQMP without an amendment to this Agreement approved by authorized representatives of both the County and the Owner.

9. County and Owner shall comply with all applicable laws, ordinances, rules, regulations, court orders and government agency orders now or hereinafter in effect in carrying out the terms of this Agreement. If a provision of this Agreement is terminated or held to be invalid, illegal or unenforceable, the validity, legality and enforceability of the remaining provisions shall remain in full effect.

10. In addition to any remedy available to County under this Agreement, if Owner violates any term of this Agreement and does not cure the violation within the time already provided in this Agreement, or, if not provided, within thirty (30) calendar days, or within such time authorized by the County if said cure reasonably requires more than the subject time, the County may bring an action at law or in equity in a court of competent jurisdiction to enforce compliance by the Owner with the terms of this Agreement. In such action, the County may recover any damages to which the County may be entitled for the violation, enjoin the violation by temporary or permanent injunction without the necessity of proving actual damages or the inadequacy of otherwise available legal remedies, or obtain other equitable relief, including, but not limited to, the restoration of the Property and/or the BMPs identified in the WQMP to the condition in which it/they existed prior to any such violation or injury.

11. This Agreement shall be recorded in the Office of the Recorder of San Bernardino County, California, at the expense of the Owner and shall constitute notice to all successors and assigns of the title to said Property of the obligation herein set forth, and also a lien in such amount as will fully reimburse the County, including interest as herein above set forth, subject to foreclosure in event of default in payment.

12. In event of legal action occasioned by any default or action of the Owner, or its successors or assigns, then the Owner and its successors or assigns agree(s) to hold the County harmless and pay all costs incurred by the County in enforcing the terms of this Agreement, including reasonable attorney's fees and costs, and that the same shall become a part of the lien against said Property.

13. It is the intent of the parties hereto that burdens and benefits herein undertaken shall constitute covenants that run with said Property and constitute a lien there against.

14. The obligations herein undertaken shall be binding upon the heirs, successors, executors, administrators and assigns of the parties hereto. The term "Owner" shall include not only the present Owner, but also its heirs, successors, executors, administrators, and assigns. Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. Owner shall provide such notice prior to such successor obtaining an

interest in all or part of the Property. Owner shall provide a copy of such notice to the County at the same time such notice is provided to the successor.

15. Time is of the essence in the performance of this Agreement.

16. Any notice to a party required or called for in this Agreement shall be served in person, or by deposit in the U.S. Mail, first class postage prepaid, to the address set forth below. Notice(s) shall be deemed effective upon receipt, or seventy-two (72) hours after deposit in the U.S. Mail, whichever is earlier. A party may change a notice address only by providing written notice thereof to the other party.

17. Owner agrees to indemnify, defend (with counsel reasonably approved by the County) and hold harmless the County and its authorized officers, employees, agents and volunteers from any and all claims, actions, losses, damages, and/or liability arising out of this Agreement from any cause whatsoever, including the acts, errors or omissions of any person and for any costs or expenses incurred by the County on account of any claim except where such indemnification is prohibited by law. This indemnification provision shall apply regardless of the existence or degree of fault of indemnitees. The Owner's indemnification obligation applies to the County's "active" as well as "passive" negligence but does not apply to the County's "sole negligence" or "willful misconduct" within the meaning of Civil Code Section 2782, or to any claims, actions, losses, damages, and/or liabilities, to the extent caused by the acts or omissions of any third party contractors undertaking any work (other than field inspections) or other maintenance on the Property on behalf of the County under this Agreement..

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IF TO COUNTY :

Director of Public Works

825 E. Third Street, Room 117

San Bernardino, CA 92415-0835

IF TO OWNER:

____

____

____

IN WITNESS THEREOF, the parties hereto have affixed their signatures as of the date first written above.

OWNER:

Company/Trust:____________________________

Signature: _______________________________

Name: _________________________________

Title: _________________________________

Date: _________________________________

OWNER:

Company/Trust:____________________________

Signature: _______________________________

Name: _________________________________

Title: _________________________________

Date: _________________________________

FOR: Maintenance Agreement, dated __________________________, for the project known as

____

____

(APN)______________________________,

As described in the WQMP dated __________________________________.

NOTARIES ON FOLLOWING PAGE

A notary acknowledgement is required for recordation.

ACCEPTED BY:

____

BRENDON BIGGS, M.S., P.E., Director of Public Works

Date: __________________________________

Attachment: Notary Acknowledgement

ATTACHMENT 1
Notary Acknowledgement)

EXHIBIT A
(Legal Description)

EXHIBIT B
(Map/illustration)

6.4 Other Supporting Documentation

- BMP Educational Materials
- Activity Restriction /CC&R's

July 26, 2021

Project No. 10557.006

Yorba Villas, LLC.
c/o Borstein Enterprises
11766 Wilshire Boulevard, Suite 280
Los Angeles, California 90025

Attention: Mr. Erik Pfahler
Senior Vice President

Subject: Geotechnical Update Report of Infiltration Testing
Proposed Infiltration Basin, Lot A
Yorba Villas Residential Development, Tract 20394
Northwest of Francis Avenue and Yorba Avenue
Chino Area of Unincorporated San Bernardino County, California

In accordance with your request and authorization, Leighton and Associates, Inc. (Leighton) has conducted infiltration testing in the area of the proposed infiltration basin, to be located near the southeast corner of the proposed Yorba Villas (formerly Chino Francis Estates) residential development. The development is located northwest of Francis Avenue and Yorba Avenue in unincorporated San Bernardino County, just north of the City of Chino, California. Leighton previously performed a geotechnical investigation for the proposed residential development which included infiltrating testing at several locations throughout the site.

Infiltration tests for the proposed basin were performed at depths of 15 feet and 35 feet below the existing ground surface (bgs). Although test results indicated relatively low infiltration rates, deeper infiltration systems are considered feasible within the proposed basin area based soil profiles observed in our borings, which extended to depths reaching approximately 51 feet bgs. This report summarizes our field exploration and testing and presents our conclusions and recommendations.

I N T R O D U C T I O N

Project Description

Based on correspondence with you and the *Site Plan*, *Vesting Tentative Tract No. 20397*, prepared by MDS Consulting and dated March 31, 2021, which you provided, we understand that a retention/water quality basin is proposed within the 16,385-square-foot Lot "A", located at the southeast corner of the Yorba Villas residential development. The basin is proposed to be graded with 4:1 (H:V) side slopes with a bottom elevation of 829 feet above mean sea level (approximately 10 feet below the existing grade). A storm drain outlet and access ramp will be located at the northwest corner of the basin and a "pocket park" will be located directly east of the proposed basin.

Scope of Work

The scope of our study has included the following tasks:

- Background Review: We reviewed available, relevant geotechnical geologic maps, reports, and aerial photographs available in our in-house library.

- Utility Coordination: We contacted Underground Services Alert (USA) at least 48 hours prior to drilling the borings to locate major utilities, underground services, and easements.

- Field Exploration: We excavated, logged, and sampled three (3) hollow-stem auger borings (LB-1 to LB-3) to a maximum depth of 51 feet below the existing ground surface. The borings were drilled using a subcontracted truck-mounted drill rig, logged, and sampled by a member of our technical staff under supervision of a licensed Civil Engineer. Relatively undisturbed soil samples were obtained at selected intervals within the borings using a Modified California split-barrel sampler lined with rings. Representative bulk samples of near-surface soils were also collected.

  All excavations were backfilled with onsite soil cuttings. Logs of the geotechnical borings are attached in Appendix A. Approximate boring and well permeameter test locations are shown on Figure 1 - *Exploration Location Map*.

- Infiltration Testing: We conducted well permeameter tests within two of our borings (LB-1 and LB-3) to evaluate infiltration rates of the subsurface soils at the depths and locations tested. The well permeameter tests were conducted based on the USBR 7300-89 method and in general accordance with San Bernardino County guidelines. The tests were conducted at depths of approximately 15 and 35 feet (bgs) to estimate infiltration rates, in borings LB-1 and LB-3, respectively. Water was provided by the drilling subcontractor by filling several Leighton-supplied 55-gallon drums with water. Infiltration test logs are included in Appendix B.

- Engineering Analysis: Data obtained from our testing was evaluated and analyzed to provide the recommendations presented in this report.

- Report Preparation: Results of our infiltration study and design recommendations have been summarized in this report.

FINDINGS

Site Description

The Yorba Villas residential development consists of approximately 12 acres of land that was previously utilized as grazing land for a goat farm. The site of the proposed basin is in the southeastern corner of the residential development site. Our previous geotechnical investigation (Leighton, 2019) described a residence, a pool, and other structures in the eastern portion of the residential development site. These previous structures and the pool have since been demolished. The site of the proposed basin is currently vacant, with scattered trees, and drains gently to the south.

Previous Studies

Leighton previously provided a geotechnical investigation report for the Yorba Villas residential project (Leighton, 2016) that included a subsurface investigation and provided conclusions and recommendations for grading and construction, and updated that report in 2019. Our previous geotechnical investigation included drilling of 5 exploratory borings to depths ranging from 21½ to 51½ feet bgs. Well permeameter tests were conducted at each of the 5 boring locations to depths ranging from 5 to 6 feet bgs to estimate the infiltration rate considering shallow infiltration trenches proposed at that time. Results of our previous infiltration testing indicated small-scale infiltration rates ranging from approximately 0.3 to 13 inches per hour (no factor of safety or correction factor applied).

Subsurface Soil Conditions

Our 2019 geotechnical investigation report (Leighton, 2019) described the overall subsurface conditions of the Yorba Villas residential development site as underlain by alluvial soil deposits mantled in some areas by minor amounts of goat manure. The manure, where encountered, was generally less than one inch thick. The alluvial soil encountered within our previous excavations generally consisted of combinations of sand and silt, with some gravel. The soil was generally moist and medium dense. In-situ moisture content within the upper approximately 15 feet generally ranged from 1 to 10 percent.

The soils encountered within our borings for the current exploration for the proposed basin generally consisted of slightly moist, stiff silt in the upper 10 feet bgs, followed by an approximate 5-foot-thick layer of slightly moist medium dense silty sand to 15 feet bgs, followed by moist, stiff silt to 30 feet. Soils generally appeared more granular below 35 feet with variation in fine-grained material and were observed to be coarser below 45 feet bgs. The soils encountered below 35 feet bgs generally consisted of moist, dense to very dense silty sands with gravels, and soils encountered below 45 feet bgs generally consisted of moist, medium dense sands with gravel. More detailed descriptions of the subsurface conditions are presented on the boring logs (Appendix A).

Groundwater

Groundwater was not encountered in our borings excavated to a maximum depth of 51.5 feet below the existing ground surface (bgs). Historical groundwater mapping indicates that groundwater was approximately 150 feet bgs in 1933 (CDWR, 1970).

Regional data for water wells located within a 1½-mile radius of the site was reviewed to evaluate historical ground water levels. The shallowest historical groundwater levels encountered were on the order of 235 feet bgs in 1985 for a well maintained by the Chino Basin Watermaster (Local Well ID CHINO-1002741) located 1.2 miles southeast of the site. Most recent water levels indicate groundwater is on the order of 258 feet bgs (CDWR, 2021). Shallow groundwater is not anticipated to impact the site.

Infiltration Testing

Two well permeameter tests (LB-1 and LB-3) were conducted to estimate the infiltration rate at the proposed detention and water quality basin within Lot "A" at the southeast corner of the overall Yorba Villas Residential Development. The well permeameter tests were conducted inside the drilled borings at depths of 15 feet and 35 feet below ground surface (approximate test bottom depths).

A well permeameter test is useful for field measurements of soil infiltration rates and is suited for testing when the design depth of the basin or chamber is deeper than current existing grades. Our testing was a clean-water, small-scale test, and correction factors need to be applied. Both falling- and constant-head tests were performed. The constant-head tests consisted of excavating a boring to the depth of the test (or deeper if it is partially backfilled with soil and a bentonite plug with a thin soil covering is placed just below the design test elevation). A layer of clean sand was placed in the boring bottom to support temporary perforated well casing pipe and a float valve. In addition, clean sand was poured around the outside of the well casing within the test zone to prevent the boring from caving/collapsing or eroding when water was added.

For the constant-head tests, a float valve, lowered into the boring, inside the casing, added water to the borings as water infiltrated into the soil, while maintaining a relatively constant water head in the boring. The falling-head tests consisted of adding water to a specified level and measured at specified time intervals as the water level drops, and then refilled; the process was repeated until a relatively stabilized rate of drop was achieved. The incremental infiltration rate as measured during intervals of the test was defined as the incremental flow rate of water infiltrated (volume divided by time), divided by the surface area of the infiltration interface, with resulting units of inches per hour. Well permeameter tests were conducted based on the USBR 7300-89 method.

Results of the infiltration testing are provided in Appendix B and are summarized below.

Boring	Test Depth (ft)	Soil Classification	Raw Infiltration Rate (in./hr)	Corrected Infiltration Rate (in./hr)
LB-1	15	Silty Sand	2.5	0.4
LB-3	35	Sand to Silty Sand with Gravel	2.2	1.1

INFILTRATION RECOMMENDATIONS

Based on our onsite observations, laboratory testing, and the infiltration tests performed, infiltration within the upper 30 feet may be slow. Soils in the range of approximately 10 to 12 feet are anticipated to have a corrected infiltration rate 0.4, which includes a higher correction factor because of the underlying silt at a depth of 15 feet or less. We have included the reduction factor, since monitoring of actual facility performance has shown that actual infiltration rates are lower than for small-scale tests, based on the *San Bernardino County Stormwater Program Technical Guidance Document for Water Quality Management Plans (WQMP)* for basin design aspects.

Although infiltration testing with a bottom depth of 15 feet bgs produced moderate rates for the test itself, impermeable silts were observed in our borings to be located above and below the tested layer (silt at a depth of 15 feet or shallower), and it is likely that water infiltrated at depths of approximately 10 to 12 feet bgs will tend to migrate laterally rather than vertically. Actual infiltration rates would be anticipated to decrease as the adjacent soils saturate.

Due to the presence of finer-grained soils in the upper 30 to 35 feet, we recommend that infiltration consist of dry wells extending to a minimum depth of 45 feet below the existing ground surface (bgs), to an approximate elevation of 795 feet msl. Actual infiltration rates for dry wells are anticipated to be much higher than the small scale tests, as the dry wells take advantage of deep soil layers, including highly permeable sands and gravels, and the driving head is much higher. For dry wells that extend to a depth of 45 feet bgs, we recommend using a design rate of 10 inches per hour for soils in the depth zone of 35 to 45 feet bgs, and an average of 0.5 inch per hour for soils above 35 feet. After the first dry well is constructed, it should be tested for infiltration. If the tested infiltration rates are sufficient to reduce the number of dry wells at that location, some or all of the remaining planned dry wells may be omitted, as appropriate, based on review of the test data.

Additional Review and Evaluation:

Infiltration rates are anticipated to vary significantly at this site based on location and depth. Infiltration concepts should be discussed with Leighton as infiltration plans are being developed. Leighton should review infiltration plans, including specific locations and depths of proposed facilities. Further testing may be recommended based on the infiltration facility design, particularly considering their type, depth and location.

General Design Considerations:

The periodic flow of water carrying sediments in the dry well, plus the introduction of wind-blown sediments and sediments from erosion, can eventually cause the bottom of the chamber to accumulate a layer of silt, which has the potential of significantly reducing the overall infiltration rate of the dry well. Therefore, we recommend that significant amounts of silt/sediment not be allowed to flow into the facility within storm water, especially during construction of the project and prior to achieving a mature landscape on site. As it is typically very difficult to remove silt from buried infiltration facilities, we recommend that an easily maintained, robust silt/sediment removal system be installed to pretreat storm water before it enters the infiltration facility. We suggest the drywells be placed such that a low flow trench receive runoff and mostly fill with water before draining into the drywell. This is intended to limit the amount of silt getting into the dry well and preserve its infiltration capabilities.

Infiltration facilities should not be constructed adjacent to or under buildings. Infiltration facilities should have a setback of at least 15 feet from buildings, but preferably more.

In general, the rate of infiltration reduces as the head of water in the infiltration facility reduces, and it also reduces with prolonged periods of infiltration. As such, water typically infiltrates much faster near the beginning of and/or immediately after storm events than at times well after a storm when the water level in the facility has receded, since the infiltration rate is then slower due to both lower head and longer overall duration of infiltration.

Estimating infiltration rates, especially based on small-scale testing, is inexact and indefinite, and often involves known and unknown soil complexities, potentially resulting in a condition where actual infiltration rates of the completed facility are significantly less than design rates.

<u>Construction Considerations:</u>
We recommend that Leighton evaluate the infiltration facility excavations, to confirm that granular, undisturbed alluvium is exposed in the bottoms and sides. Additional excavation or evaluation may be required if silty or clayey soils are exposed.

<u>Maintenance Considerations:</u>
The infiltration facilities should be routinely monitored, especially before and during the rainy season, and corrective measures should be implemented as/when needed. Things to check for include proper upkeep, proper infiltration, absence of accumulated silt, and that de-silting filters/features are clean and functioning. Pretreatment desilting features should be cleaned and maintained per manufacturers' recommendations. Even with measures to prevent silt from flowing into the infiltration facility, accumulated silt may need to be removed occasionally as part of maintenance.

L I M I T A T I O N S

This report was based in part on data obtained from a limited number of observations, site visits, soil excavations, samples, and tests. Such information is, by necessity, incomplete. The nature of many sites is such that differing soil or geologic conditions can be present within small distances and under varying climatic conditions. Changes in subsurface conditions can and do occur over time. Therefore, our findings, conclusions, and recommendations presented in this report are based on the assumption that Leighton and Associates, Inc. will provide geotechnical observation and testing during construction

This report was prepared for the sole use of Yorba Villas, LLC, for application to the design of the proposed residential development in accordance with generally accepted geotechnical engineering practices at this time in California.

C L O S I N G

We appreciate the opportunity to work with you on the development of this project. If you have any questions regarding this report, please call us at your convenience.

Respectfully submitted,
LEIGHTON AND ASSOCIATES, INC.

Luis Perez-Milicua, PE 89389
Project Engineer

Jose A. Tapia, PE 91630
Project Engineer

Jason D. Hertzberg, GE 2711
Principal Engineer

JAT/LP/SGO/JDH

Attachments: References
Figure 1 - Exploration Location Map
Appendix A - Borings Logs
Appendix B - Infiltration Logs
Appendix C - Laboratory Test Results

Distribution: (1) Addressee

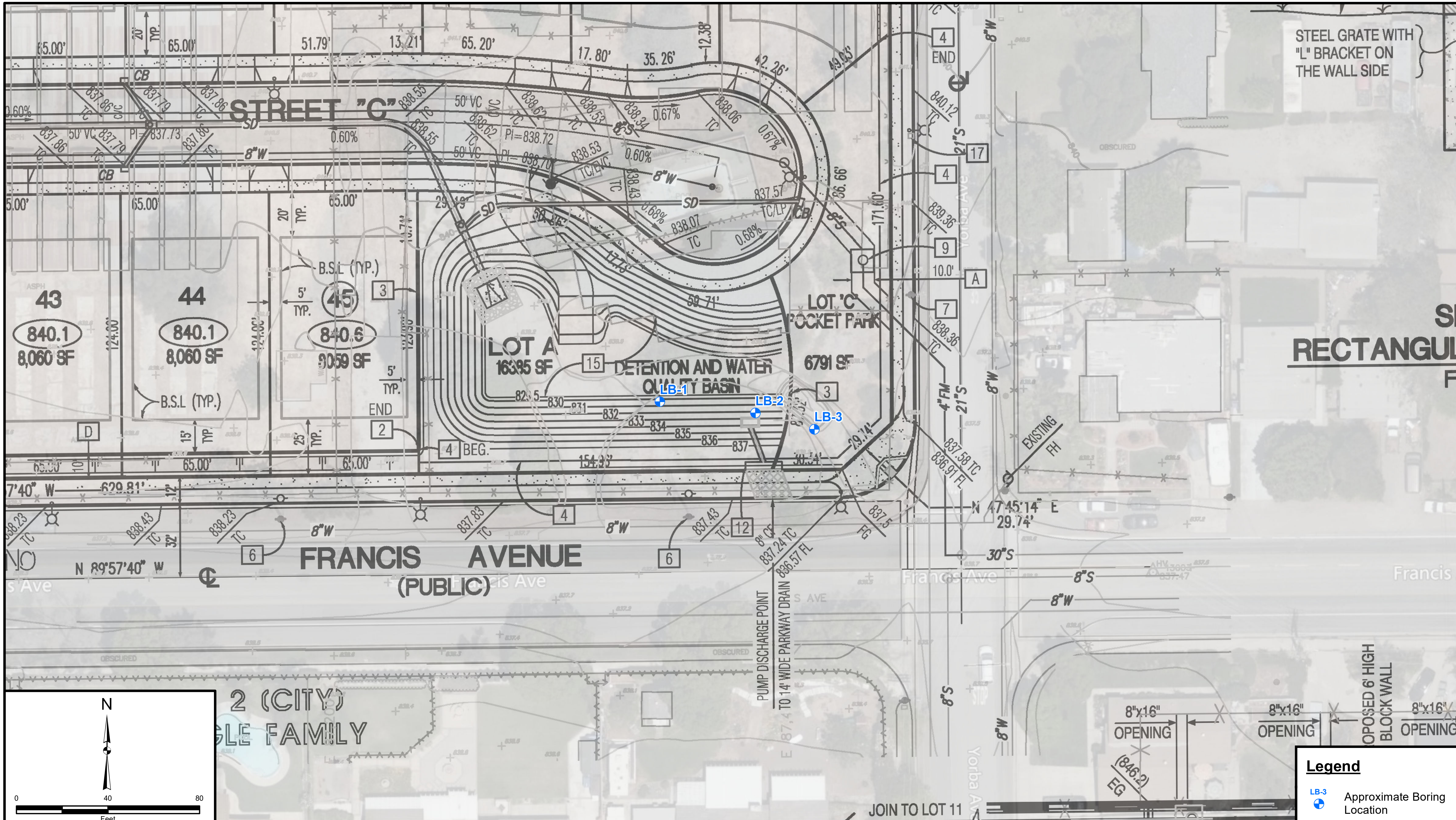
REFERENCES

California Department of Water Resources (CDWR) of California, 1970, Meeting Water Demands in Chino-Riverside Area, Bulletin No. 104-3, September 1970.

_____, 2021, Sustainable Groundwater Management Act Data Viewer (SGMA), http://www.water.ca.gov/waterdatalibrary/, accessed June 15, 2021.

Leighton and Associates, Inc., 2016, Geotechnical Investigation, Proposed Residential Development, APN's 1013-211-21 and 1013-211-22 Northwest of Francis Avenue and Yorba Avenue, City of Chino, California, Project Number 10557.004, dated August 26, 2016.

______2019, Geotechnical Investigation Proposed Residential Development, APN's 1013-211-21 and 1013-211-22 Northwest of Francis Avenue and Yorba Avenue, City of Chino, California, Project Number 10557.004, dated July 16, 2019.



Project: 10557.006 | Eng/Geol: JDH/SGO
Scale: 1 " = 40 ' | Date: June 2021
Base Map: ESRI ArcGIS Online 2021
Author: KVM (kmanchikanti)

EXPLORATION LOCATION MAP

Yorba Villas Infiltration Testing
Northwest of Yorba Avenue and Francis Avenue
Chino, California

Figure 1

Leighton

Map Saved as V:\Drafting\10557\006\Maps\10557-006_Fig2_ELM_2021-06-18.mxd on 6/18/2021 3:10:55 PM

APPENDIX A

BORING LOGS

GEOTECHNICAL BORING LOG LB-1

Project No.	10557.006	**Date Drilled**	6-10-21
Project	Yorba Villas	**Logged By**	JP
Drilling Co.	2R	**Hole Diameter**	10"
Drilling Method	Hollow Stem Auger - 150lb - Autohammer - 30" Drop	**Ground Elevation**	840'
Location	See Figure 2 - Boring Location Map	**Sampled By**	JP

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
840	0							ML	@Surface: SANDY SILT (ML), stiff, light brown, slightly moist, fine sand, non-plastic, organics	
835	5								@5': Moist	
830	10							SM	@10': SILTY SAND (SM), medium dense, light gray, slightly moist, fine sand, 10-15% fines	
	13.5			R-1	7 13 16			SM	@13.5': SILTY SAND (SM), medium dense, light gray, moist, fine sand, trace organics, 85% sand, 15% fines	SA
825	15								**TOTAL DEPTH = 15 FEET** **NO GROUNDWATER ENCOUNTERED** **CONVERTED TO INFILTRATION BORING FOR TESTING** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS ON 6/11/21**	
820	20									
815	25									
810	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-2

Project No.	10557.006	**Date Drilled**	6-10-21
Project	Yorba Villas	**Logged By**	JP
Drilling Co.	2R	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 150lb - Autohammer - 30" Drop	**Ground Elevation**	839'
Location	See Figure 2 - Boring Location Map	**Sampled By**	JP

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	0			B-1				ML	@Surface: SANDY SILT (ML), stiff, light brown, slightly moist, fine sand, non-plastic, organics	
835	5			R-1	6 7 9				@5': As above, stiff, light brown	
				R-2	5 6 8				@7': As above, stiff, light brown, rootlets, pores	
830	10			R-3	6 10 20			SM	@10': SILTY SAND with gravel (SM), medium dense, light gray, slightly moist, fine sand, fine to coarse gravel, sub-angular, 10-15% fines	
				R-4	6 10 12	101	3	SP	@12': Poorly-graded SAND (SP), medium dense, light gray, slightly moist, fine sand	
825	15			R-5	5 6 12	95	18	ML	@15': SILT (ML), stiff, variegated light gray and orange brown, moist, fine-grained, non-plastic, slight cementation	
				R-6	5 6 13	96	20		@17': As above, variegated light gray, orange brown, and dark brown, trace clay	
820	20			R-7	5 9 14				@20': CLAYEY SILT (ML), stiff, light gray, trace orange, moist, fine, low-plasticity, trace rootlets, organic specs	
815	25			R-8	10 12 14				@25': SILT (ML), stiff, light gray to light brown, moist, 1-inch sand layer in sampler, light brown, fine-medium sand	
810	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** * * This log is a part of a report by Leighton and should not be used as a stand-alone document. * * ***

GEOTECHNICAL BORING LOG LB-2

Project No.	10557.006	**Date Drilled**	6-10-21
Project	Yorba Villas	**Logged By**	JP
Drilling Co.	2R	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 150lb - Autohammer - 30" Drop	**Ground Elevation**	839'
Location	See Figure 2 - Boring Location Map	**Sampled By**	JP

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
	30			R-9	10 13 18	123	12	SM	@30': SILTY SAND (SM), medium dense, variegated, light gray, orange brown, and dark brown, fine sand, trace medium, trace gravel up to 1/2-inch, subangular, iron-oxidized clasts, 36% fines	-200
805										
	35			R-10	37 50/5.5	117	4	SM-SP	@35': Poorly-graded SAND to SILTY SAND with gravel (SP-SM), very dense, light brown to medium brown, fine to medium sand, moist, trace coarse, 32% gravel, 60% sand, 8% fines	SA
800										
	40			R-11	20 15 21	102	10	SM	@40': SILTY SAND (SM), dense, medium brown, moist, fine sand, trace coarse, bottom grades to: SANDY SILT (ML), stiff, moist, orange brown, fine sand, non-plastic, 33% fines	-200
795										
	45				50/4			SP	@45': No recovery, rig chatter on gravel	
790										
	50			R-12	9 50/6				@50': Poorly-graded SAND (SP), dense, medium brown, fine to medium sand, trace gravel, sub-angular, poor recovery	
									TOTAL DEPTH= 51 FEET **NO GROUNDWATER ENCOUNTERED** **BACKFILLED WITH SOIL CUTTINGS ON 6/10/21**	
785	55									
780	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
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- DS DIRECT SHEAR
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- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-3

Project No.	10557.006	**Date Drilled**	6-10-21
Project	Yorba Villas	**Logged By**	JP
Drilling Co.	2R	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 150lb - Autohammer - 30" Drop	**Ground Elevation**	839'
Location	See Figure 2 - Boring Location Map	**Sampled By**	JP

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0							ML	@Surface: SANDY SILT (ML), stiff, light brown, slightly moist, fine sand, non-plastic, organics	
835										
	5								@5': As above, stiff, light brown	
830										
	10							SM	@10': SILTY SAND with gravel (SM), medium dense, light gray, slightly moist, fine sand, fine to coarse gravel, sub-angular, 10-15% fines	
825										
	15							ML	@15': SILT (ML), stiff, variegated light gray and orange brown, moist, fine-grained, non-plastic	
820										
	20								@20': As above	
815										
	25									
810										
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-3

Project No.	10557.006	**Date Drilled**	6-10-21
Project	Yorba Villas	**Logged By**	JP
Drilling Co.	2R	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 150lb - Autohammer - 30" Drop	**Ground Elevation**	839'
Location	See Figure 2 - Boring Location Map	**Sampled By**	JP

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	**SOIL DESCRIPTION** *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	30							SM	@30': SILTY SAND (SM), medium dense, variegated, light gray, orange brown, and dark brown, fine sand, trace medium, trace gravel up to 1/2-inch, subangular, iron-oxidized clasts	
805										
	35							SP-SM	@35': Poorly-graded SAND to SILTY SAND with gravel (SP-SM), very dense, light brown to medium brown, fine to medium sand, moist, trace coarse	
800										
	40							SM	@40': SILTY SAND (SM), dense, medium brown, moist, fine sand, trace coarse, bottom grades to: SANDY SILT (ML), stiff, moist, orange brown, fine sand, non-plastic	
795										
	45							SP-SM	@45': Rig chatter on gravel, cuttings show Poorly-graded SAND to SILTY SAND with gravel (SP-SM), medium brown, moist, fine to medium sand, gravel up to 2 inches	
790										
	50								**TOTAL DEPTH= 50 FEET** **NO GROUNDWATER ENCOUNTERED** **BACKFILLED TO 35.2 FEET AND CONVERTED TO INFILTRATION BORING FOR TESTING** **BACKFILLED TO SURFACE WITH SOIL CUTTINGS ON 6/11/21**	
785										
	55									
780										
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

APPENDIX B

INFILTRATION LOGS

Results of Well Permeameter, from USBR 7300-89 Method.

Leighton

Project: 10557

Exploration #/Location:	*LB-1*	Initial estimated Depth to Water Surface (in.):	159
Depth Boring drilled to (ft):	15.15	Average depth of water in well, "h" (in.):	24
Tested by:	JAT	approx. h/r:	4.7
USCS Soil Type in test zone:	SM	Tu (Fig. 8) (ft):	86.8
Weather (start to finish):	Sunny	Tu>3h?:	yes, OK
Liquid Used/pH:	H2O		
Measured boring diameter:	10 in.	5 in. Well Radius	Cross-sectional area for vol calcs (in.^2): 78.5
Approx Depth to GW below GS:	100 ft		

Well Prep: Drilled to 15' bgs with 10" auger, placed #3 sand and 4" pipe with sand around test zone.

	ft	in.	Total (in.)	
Depth to Bot of well (or top of soil over Bentonite)	15.2 ft		182	
Pilot Tube stickup (+ is above ground)		5. in.	5	
Depth to top of sand outside of casing from top of pilot tube				
Depth to top of float assembly from top of pilot tube	10. ft	8. in.	128	123 Depth below GS (in.)
Float Assembly ID		A		
Float assembly Extension length (in.)		24		

Flow Meter:

Meter ID	3242
Meter Col	Black
Meter Unit	Gallons
DL ID	* Used meter with water from barrels.

0.05 gallons/pulse

Field Data **Calculations**

Date	Time	Data from Flow Meter		Depth to WL in Boring (measured from top of pilot tube)		Water Temp (deg F)	Comments	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3)			Flow (in^3/ min)	q, Flow (in^3/ hr)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date	Start time:	Reading (cu-ft or gal)	Interval Pulse Count											from supply	from Δh	Total					
6/11/2021	8:45	Gallons		ft	in.																
-																					
6/11/21	8:45	7414		12.61					0	146.3	36.1										
6/11/21	8:50	7416.5		12.59				5	5	146.1	36.3	0.24	36	578	-19	559	112	6704	0.9	1.35	**5.08**
6/11/21	8:55	7419.4		12.61				5	10	146.3	36.1	-0.24	36	670	19	689	138	8265	0.9	1.68	**6.27**
6/11/21	9:00	7422.9		12.6				5	15	146.2	36.2	0.12	36	809	-9	799	160	9589	0.921	1.94	**7.28**
6/11/21	9:05	7424.7		12.59				5	20	146.1	36.3	0.12	36	416	-9	406	81	4877	0.9	0.98	**3.69**
6/11/21	9:10	7427.3		12.6				5	25	146.2	36.2	-0.12	36	601	9	610	122	7320	0.9	1.48	**5.54**
6/11/21	9:15	7429.8		12.6				5	30	146.2	36.2	0	36	578	0	578	116	6930	0.9	1.40	**5.25**
6/11/21	9:20	7432.5		12.59				5	35	146.1	36.3	0.12	36	624	-9	614	123	7371	0.9	1.48	**5.58**
6/11/21	9:25	7434.5		12.6				5	40	146.2	36.2	-0.12	36	462	9	471	94	5657	0.9	1.14	**4.28**
6/11/21																					
6/11/21	9:30	7435.1		13.5					45	157.0	25.4										
6/11/21	10:00	7436.1		14			Adjustment	30	75	163.0	19.4	-6	22	231	471	702	23	1404	0.9	0.77	**1.65**

template updated: 8/14/19

Results of Well Permeameter, from USBR 7300-89 Method.

Leighton

Project: 10557

Exploration #/Location:	*LB-1*	Initial estimated Depth to Water Surface (in.):	154
Depth Boring drilled to (ft):	15.15	Average depth of water in well, "h" (in.):	29
Tested by:	JAT	approx. h/r:	5.8
USCS Soil Type in test zone:	SM	Tu (Fig. 8) (ft):	87.2
Weather (start to finish):	Sunny	Tu>3h?:	yes, OK
Liquid Used/pH:	H_2O		
Measured boring diameter:	10 in. (5 in. Well Radius)	Cross-sectional area for vol calcs (in.^2):	78.5
Approx Depth to GW below GS:	100 ft		

Well Prep: Drilled to 15' bgs with 10" auger, placed #3 sand and 4" pipe with sand around test zone.

	ft	in.	Total (in.)	
Depth to Bot of well (or top of soil over Bentonite)	15.2 ft		182	
Pilot Tube stickup (+ is above ground)		5. in.	5	
Depth to top of sand outside of casing from top of pilot tube				
Depth to top of float assembly from top of pilot tube	9. ft	0. in.	108	103 Depth below GS (in.)
Float Assembly ID		A		
Float assembly Extension length (in.)		0		

Flow Meter:

Meter ID	
Meter Col	Black
Meter Unit	Gallons
DL ID	

0.05 gallons/pulse

Field Data **Calculations**

Date	Time	Data from Flow Meter: Reading (cu-ft or gal)	Interval Pulse Count	Depth to WL in Boring (measured from top of pilot tube) ft	in.	Water Temp (deg F)	Comments	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3) from supply	from Δh	Total	Flow (in^3/ min)	q, Flow (in^3/ hr)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date 6/11/2021	Start time: 8:45	Gallons																			
-																					
6/11/21	10:20	7447.5		11.8					95	136.6	45.8										
6/11/21	10:25	7451.3		11.85				5	100	137.2	45.2	-0.6	46	878	47	925	185	11099	0.9	1.60	**6.79**
6/11/21	10:30	7455		11.9				5	105	137.8	44.6	-0.6	45	855	47	902	180	10822	0.9	1.59	**6.70**
6/11/21	10:35	7458.6		11.9				5	110	137.8	44.6	0	45	832	0	832	166	9979	0.921	1.47	**6.22**
6/11/21							Switch Barrel														
6/11/21	10:40	7459.5		12.8					115	148.6	33.8										
6/11/21	10:45	7459.6		13.4				5	120	155.8	26.6	-7.2	30	23	565	588	118	7060	0.9	2.42	**6.34**
6/11/21																					
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Results of Falling Head Infiltration Test

Leighton

Project: 10557

Exploration #/Location: *LB-1*

Depth Boring drilled to (ft): 15.15

Tested by: JAT

USCS Soil Type in test zone: SM

Weather (start to finish): Sunny

Liquid Used/pH: H2O

Measured boring diameter: 10 in. 5 in. Well Radius

Approx Depth to GW below GS: 100 ft

Well Prep: Drilled to 15' bgs with 10" auger, placed #3 sand and 4" pipe with sand around test zone.

Initial estimated Depth to Water Surface (in.): 150

Average depth of water in well, "h" (in.): 32

approx. h/r: 6.4

Tu (Fig. 8) (ft): 87.5

Tu>3h?: yes, OK

Cross-sectional area for vol calcs (in.^2): 37.4

	ft	in.	Total (in.)
Depth to Bot of well (or top of soil over Bentoni	15.2 ft		182
Pilot Tube stickup (+ is above ground)		5. in.	5
Depth to top of sand outside of casing from top of pilot tube			

Field Data / **Calculations**

Date	Time	Depth to WL in Boring (measured from top of pilot tube) ft	in.	Water Temp (deg F)	Comments	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3) from supply	Vol Change from Δh	Vol Change Total	Flow (in^3/ min)	q, Flow (in^3/ hr)	Average Infiltration Surface Area, (in^2)	V (Fig 9)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date	Start time:																		
6/11/2021	9:35																		
6/11/21	11:12	9.4		65			97	107.8	74.6										
6/11/21	11:17	12.3				5	102	142.6	39.8	-34.8	57	0	1302	1302	260	15625	1875	1.0	**8.51**
6/11/21	11:22	13.4				5	107	155.8	26.6	-13.2	33	0	494	494	99	5927	1121	1.0	**5.40**
6/11/21	11:27	14				5	112	163.0	19.4	-7.2	23	0	269	269	54	3233	801	1.0	**4.12**
6/11/21					refill														
6/11/21	11:32	9.5					117	109.0	73.4										
6/11/21	11:37	12.4				5	122	143.8	38.6	-34.8	56	0	1302	1302	260	15625	1837	1.0	**8.69**
6/11/21	11:42	13.1				5	127	152.2	30.2	-8.4	34	0	314	314	63	3771	1159	1.0	**3.32**
6/11/21	11:47	13.8				5	132	160.6	21.8	-8.4	26	0	314	314	63	3771	895	1.0	**4.30**
6/11/21					refill														
6/11/21	11:53	9.81					138	112.7	69.7										
6/11/21	11:58	12.23				5	143	141.8	40.6	-29.04	55	0	1087	1087	217	13038	1811	1.0	**7.36**
6/11/21	12:03	13.21				5	148	153.5	28.9	-11.76	35	0	440	440	88	5280	1170	1.0	**4.61**
6/11/21	12:08	14.05				5	153	163.6	18.8	-10.08	24	0	377	377	75	4526	827	1.0	**5.59**
6/11/21					refill														
6/11/21	12:15	10.71					160	123.5	58.9										
6/11/21	12:20	12.59				5	165	146.1	36.3	-22.56	48	0	844	844	169	10129	1573	1.0	**6.58**
6/11/21	12:25	13.43				5	170	156.2	26.2	-10.08	31	0	377	377	75	4526	1061	1.0	**4.36**
6/11/21	12:30	14.06				5	175	163.7	18.7	-7.56	22	0	283	283	57	3394	784	1.0	**4.42**
6/11/21					refill														
6/11/21	12:37	10.21					182	117.5	64.9										
6/11/21	12:42	12.76				5	187	148.1	34.3	-30.6	50	0	1145	1145	229	13739	1635	1.0	**8.58**
6/11/21	12:47	13.34				5	192	155.1	27.3	-6.96	31	0	260	260	52	3125	1046	1.0	**3.05**
6/11/21	12:52	13.91				5	197	161.9	20.5	-6.84	24	0	256	256	51	3071	829	1.0	**3.78**
6/11/21	12:57	14.27				5	202	166.2	16.2	-4.32	18	0	162	162	32	1940	654	1.0	**3.03**
6/11/21					refill														
6/11/21	1:05	10.31					0	118.7	63.7										
6/11/21	1:10	12.42				5	0	144.0	38.4	-25.32	51	0	947	947	189	11368	1681	1.0	**6.91**
6/11/21	1:15	13.32				5	0	154.8	27.6	-10.8	33	0	404	404	81	4849	1113	1.0	**4.45**
6/11/21	1:20	13.81				5	0	160.7	21.7	-5.88	25	0	220	220	44	2640	852	1.0	**3.17**
6/11/21	1:25	14.06				5	0	163.7	18.7	-3	20	0	112	112	22	1347	712	1.0	**1.93**
6/11/21																			
6/11/21	13:29	9.75					234	112.0	70.4										
6/11/21	13:34	12.11				5	239	140.3	42.1	-28.32	56	0	1060	1060	212	12715	1844	1.0	**7.04**
6/11/21	13:39	13.15				5	244	152.8	29.6	-12.48	36	0	467	467	93	5603	1204	1.0	**4.75**
6/11/21	13:44	13.64				5	249	158.7	23.7	-5.88	27	0	220	220	44	2640	916	1.0	**2.95**
6/11/21	13:49	14.06				5	254	163.7	18.7	-5.04	21	0	189	189	38	2263	744	1.0	**3.11**
6/11/21	13:54	14.35				5	259	167.2	15.2	-3.48	17	0	130	130	26	1562	610	1.0	**2.61**

Results of Falling Head Infiltration Test

Leighton

Project: 10557
Exploration #/Location: *LB-3*
Depth Boring drilled to (ft): 35.3
Tested by: JAT
USCS Soil Type in test zone: SP-SM
Weather (start to finish): Sunny
Liquid Used/pH: H2O
Measured boring diameter: 8 in. 4 in. Well Radius
Approx Depth to GW below GS: 100 ft
Well Prep: Drilled to 50', backfilled to 35.2', silt plug at bottom, placed #3 sand, placed 4" pipe (no pilot tube)

Initial estimated Depth to Water Surface (in.): 391
Average depth of water in well, "h" (in.): 33
approx. h/r: 8.2
Tu (Fig. 8) (ft): 67.4
Tu>3h?: yes, OK
Cross-sectional area for vol calcs (in.^2): 26.1

	ft	in.	Total (in.)
Depth to Bot of well (or top of soil over Bentonite)	35.3 ft		424
Pilot Tube stickup (+ is above ground)	0. ft		0
Depth to top of sand outside of casing from top of pilot tube			

Field Data / **Calculations**

Date	Time	Depth to WL in Boring (measured from top of pilot tube) ft	Depth to WL in Boring in.	Water Temp (deg F)	Comments	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3) from supply	Vol Change (in.^3) from Δh	Vol Change (in.^3) Total	Flow (in^3/ min)	q, Flow (in^3/ hr)	Average Infiltration Surface Area, (in^2)	V (Fig 9)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date 6/11/2021	Start time: 9:35																		
6/11/21	9:55	27.6		65			20	331.2	92.4										
6/11/21	10:00	28.56				5	25	342.7	80.9	-11.52	87	0	301	301	60	3610	2176	1.0	**1.69**
6/11/21	10:05	30.57				5	30	366.8	56.8	-24.12	69	0	630	630	126	7558	1729	1.0	**4.47**
6/11/21	10:10	33.59				5	35	403.1	20.5	-36.24	39	0	946	946	189	11355	971	1.0	**11.95**
6/11/21					refill														
6/11/21	10:12	27.42					37	329.0	94.6										
6/11/21	10:17	32.01				5	42	384.1	39.5	-55.08	67	0	1438	1438	288	17258	1684	1.0	**10.47**
6/11/21	10:22	33.98				5	47	407.8	15.8	-23.64	28	0	617	617	123	7407	695	1.0	**10.89**
6/11/21	10:27	35.2				5	52	422.4	1.2	-14.64	9	0	382	382	76	4587	214	1.0	**21.89**
6/11/21					refill														
6/11/21	10:29	27.51					54	330.1	93.5										
6/11/21	10:34	32.02				5	59	384.2	39.4	-54.12	66	0	1413	1413	283	16958	1668	1.0	**10.38**
6/11/21	10:39	32.09				5	64	385.1	38.5	-0.84	39	0	22	22	4	263	978	1.0	**0.27**
6/11/21	10:44	32.23				5	69	386.8	36.8	-1.68	38	0	44	44	9	526	947	1.0	**0.57**
6/11/21	10:49	32.34				5	74	388.1	35.5	-1.32	36	0	34	34	7	414	909	1.0	**0.46**
6/11/21	10:54	33.59				5	79	403.1	20.5	-15	28	0	392	392	78	4700	704	1.0	**6.82**
6/11/21	10:59	34.05				5	84	408.6	15.0	-5.52	18	0	144	144	29	1730	446	1.0	**3.96**
6/11/21	11:04	34.51				5	89	414.1	9.5	-5.52	12	0	144	144	29	1730	307	1.0	**5.75**
6/11/21					refill														
6/11/21	11:07	29.81					92	357.7	65.9										
6/11/21	11:12	31.29				5	97	375.5	48.1	-17.76	57	0	464	464	93	5565	1432	1.0	**3.97**
6/11/21	11:17	31.78				5	102	381.4	42.2	-5.88	45	0	154	154	31	1842	1135	1.0	**1.66**
6/11/21	11:24	32.5				7	109	390.0	33.6	-8.64	38	0	226	226	32	1934	953	1.0	**2.07**
6/11/21	11:29	32.95				5	114	395.4	28.2	-5.4	31	0	141	141	28	1692	776	1.0	**2.23**
6/11/21	11:34	33.49				5	119	401.9	21.7	-6.48	25	0	169	169	34	2030	627	1.0	**3.31**
6/11/21	11:39	33.82				5	124	405.8	17.8	-3.96	20	0	103	103	21	1241	496	1.0	**2.56**
6/11/21	11:44	34.6				5	129	415.2	8.4	-9.36	13	0	244	244	49	2933	329	1.0	**9.12**
6/11/21					refill														
6/11/21	11:48	29.42					133	353.0	70.6										
6/11/21	11:53	30.92				5	138	371.0	52.6	-18	62	0	470	470	94	5640	1546	1.0	**3.73**
6/11/21	11:58	31.61				5	143	379.3	44.3	-8.28	48	0	216	216	43	2594	1216	1.0	**2.18**
6/11/21	12:03	32.11				5	148	385.3	38.3	-6	41	0	157	157	31	1880	1037	1.0	**1.85**
6/11/21	12:08	32.45				5	153	389.4	34.2	-4.08	36	0	107	107	21	1278	910	1.0	**1.43**
6/11/21	12:13	33.62				5	158	403.4	20.2	-14.04	27	0	367	367	73	4399	683	1.0	**6.58**
6/11/21	12:18	33.98				5	163	407.8	15.8	-4.32	18	0	113	113	23	1354	452	1.0	**3.06**
6/11/21	12:23	34.24				5	168	410.9	12.7	-3.12	14	0	81	81	16	978	359	1.0	**2.78**
6/11/21					refill														

template updated: 6/30/2020

Results of Falling Head Infiltration Test

Leighton

Project:	10557	Initial estimated Depth to Water Surface (in.):	383
Exploration #/Location:	*LB-3*	Average depth of water in well, "h" (in.):	40
Depth Boring drilled to (ft):	35.3	approx. h/r:	10.1
Tested by:	JAT	Tu (Fig. 8) (ft):	68.1
USCS Soil Type in test zone:	SP-SM	Tu>3h?:	yes, OK
Weather (start to finish):	Sunny		
Liquid Used/pH:	H2O		
Measured boring diameter:	8 in. (4 in. Well Radius)	Cross-sectional area for vol calcs (in.^2):	26.1
Approx Depth to GW below GS:	100 ft		

Well Prep: Drilled to 50', backfilled to 35.2', silt plug at bottom, placed #3 sand, placed 4" pipe (no pilot tube)

	ft	in.	Total (in.)
Depth to Bot of well (or top of soil over Bentonite)	35.3 ft		424
Pilot Tube stickup (+ is above ground)	0. ft		0
Depth to top of sand outside of casing from top of pilot tube			

Field Data / **Calculations**

Date	Time	Depth to WL in Boring (measured from top of pilot tube) ft	in.	Water Temp (deg F)	Comments	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3) from supply	from Δh	Total	Flow (in^3/ min)	q, Flow (in^3/ hr)	Average Infiltration Surface Area, (in^2)	V (Fig 9)	**Infiltration Rate [flow/surf area] (in./hr) (FS=1)**
Start Date 6/11/2021	Start time: 9:35																		
6/11/21	12:26	29.61		65	Refilled		171	355.3	68.3										
6/11/21	12:31	31.63				5	176	379.6	44.0	-24.24	56	0	633	633	127	7595	1411	1.0	**5.50**
6/11/21	12:36	32.86				5	181	394.3	29.3	-14.76	37	0	385	385	77	4625	921	1.0	**5.13**
6/11/21	12:41	33.43				5	186	401.2	22.4	-6.84	26	0	179	179	36	2143	650	1.0	**3.37**
6/11/21	12:46	33.85				5	191	406.2	17.4	-5.04	20	0	132	132	26	1579	500	1.0	**3.22**
6/11/21	12:51	34.25				5	196	411.0	12.6	-4.8	15	0	125	125	25	1504	377	1.0	**4.08**
6/11/21																			
6/11/21	12:53	27.18			Refilled		198	326.2	97.4										
6/11/21	12:59	30.05				6	204	360.6	63.0	-34.44	80	0	899	899	150	8993	2015	1.0	**4.56**
6/11/21	13:04	31.76				5	209	381.1	42.5	-20.52	53	0	536	536	107	6430	1325	1.0	**4.96**
6/11/21	13:09	31.85				5	214	382.2	41.4	-1.08	42	0	28	28	6	338	1054	1.0	**0.33**
6/11/21	13:14	32.31				5	219	387.7	35.9	-5.52	39	0	144	144	29	1730	971	1.0	**1.82**
6/11/21	13:19	32.54				5	224	390.5	33.1	-2.76	34	0	72	72	14	865	867	1.0	**1.02**
6/11/21	13:24	32.6				5	229	391.2	32.4	-0.72	33	0	19	19	4	226	823	1.0	**0.28**
6/11/21	13:29	32.73				5	234	392.8	30.8	-1.56	32	0	41	41	8	489	794	1.0	**0.63**
6/11/21	13:34	33.39				5	239	400.7	22.9	-7.92	27	0	207	207	41	2482	675	1.0	**3.75**
6/11/21	13:39	33.61				5	244	403.3	20.3	-2.64	22	0	69	69	14	827	543	1.0	**1.56**
6/11/21	13:44	33.78				5	249	405.4	18.2	-2.04	19	0	53	53	11	639	484	1.0	**1.35**
6/11/21	13:49	34.05				5	254	408.6	15.0	-3.24	17	0	85	85	17	1015	417	1.0	**2.48**
6/11/21																			
6/11/21	13:55	28.51					260	342.1	81.5										
6/11/21	14:00	29.88				5	265	358.6	65.0	-16.44	73	0	429	429	86	5151	1840	1.0	**2.86**
6/11/21	14:05	30.93				5	270	371.2	52.4	-12.6	59	0	329	329	66	3948	1476	1.0	**2.73**
6/11/21	14:10	31.81				5	275	381.7	41.9	-10.56	47	0	276	276	55	3309	1185	1.0	**2.85**
6/11/21	14:15	32.51				5	280	390.1	33.5	-8.4	38	0	219	219	44	2632	947	1.0	**2.84**
6/11/21	14:20	32.72				5	285	392.6	31.0	-2.52	32	0	66	66	13	790	809	1.0	**1.00**
6/11/21	14:25	32.95				5	290	395.4	28.2	-2.76	30	0	72	72	14	865	743	1.0	**1.19**
6/11/21	14:30	33.22				5	295	398.6	25.0	-3.24	27	0	85	85	17	1015	668	1.0	**1.55**
6/11/21																			
6/11/21	14:35	25.01					300	300.1	123.5										
6/11/21	14:40	27.62				5	305	331.4	92.2	-31.32	108	0	818	818	164	9814	2708	1.0	**3.70**
6/11/21	14:45	29.85				5	310	358.2	65.4	-26.76	79	0	699	699	140	8385	1979	1.0	**4.33**
6/11/21	14:50	31.04				5	315	372.5	51.1	-14.28	58	0	373	373	75	4474	1463	1.0	**3.12**
6/11/21	14:55	31.82				5	320	381.8	41.8	-9.36	46	0	244	244	49	2933	1167	1.0	**2.57**
6/11/21	15:00	32.46				5	325	389.5	34.1	-7.68	38	0	201	201	40	2406	953	1.0	**2.58**
6/11/21	15:05	32.67				5	330	392.0	31.6	-2.52	33	0	66	66	13	790	824	1.0	**0.98**
6/11/21	15:10	32.69				5	335	392.3	31.3	-0.24	31	0	6	6	1	75	790	1.0	**0.10**
6/11/21	15:15	32.72				5	340	392.6	31.0	-0.36	31	0	9	9	2	113	782	1.0	**0.15**
6/11/21	15:20	32.74				5	345	392.9	30.7	-0.24	31	0	6	6	1	75	775	1.0	**0.10**

APPENDIX C

LABORATORY TEST RESULTS

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PARTICLE-SIZE DISTRIBUTION (GRADATION) of SOILS USING SIEVE ANALYSIS
ASTM D 6913

Project Name: Yorba Villas Infiltration
Project No.: 10557.006
Boring No.: LB-1
Sample No.: R-1
Soil Identification: Gray silty sand (SM)

Tested By: S. Felter Date: 06/22/21
Checked By: J. Ward Date: 06/24/21
Depth (feet): 13.5

		Moisture Content of Total Air - Dry Soil	
Container No.:	923	Wt. of Air-Dry Soil + Cont. (g)	0.0
Wt. of Air-Dried Soil + Cont.(g)	836.6	Wt. of Dry Soil + Cont. (g)	0.0
Wt. of Container (g)	108.1	Wt. of Container No.______ (g)	1.0
Dry Wt. of Soil (g)	728.5	Moisture Content (%)	0.0

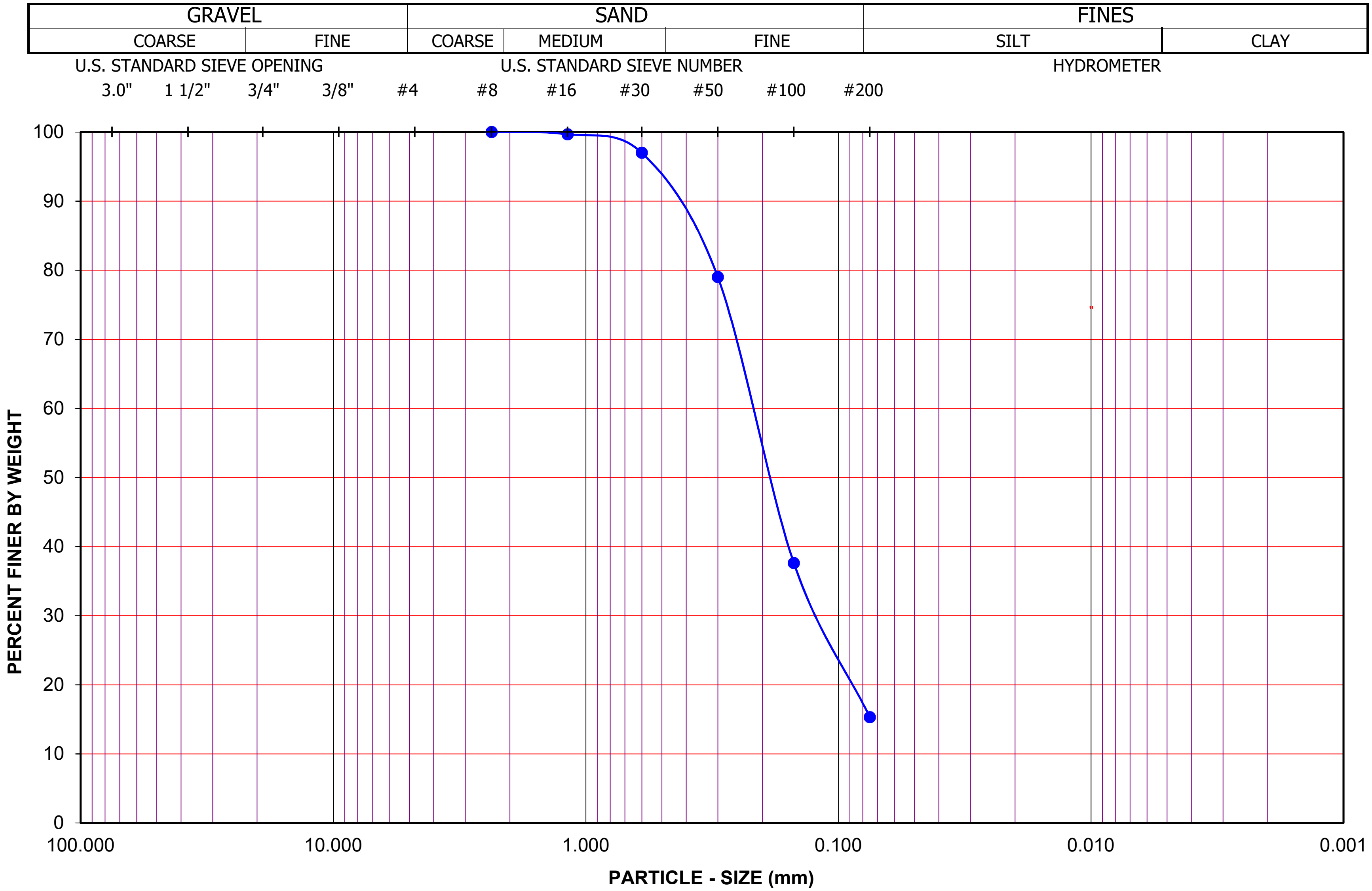
After Wet Sieve	Container No.	923
	Wt. of Dry Soil + Container (g)	760.2
	Wt. of Container (g)	108.1
	Dry Wt. of Soil Retained on # 200 Sieve (g)	652.1

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
1 1/2"	37.5		
1"	25.0		
3/4"	19.0		
1/2"	12.5		
3/8"	9.5		
#4	4.75		
#8	2.36	0.0	100.0
#16	1.18	2.2	99.7
#30	0.600	21.7	97.0
#50	0.300	153.1	79.0
#100	0.150	454.9	37.6
#200	0.075	617.1	15.3
PAN			

GRAVEL: **0 %**
SAND: **85 %**
FINES: **15 %**
GROUP SYMBOL: **SM**

$Cu = D60/D10 =$ ______
$Cc = (D30)^2/(D60*D10) =$ ______

Remarks: ______



Project Name: Yorba Villas Infiltration

Project No.: 10557.006

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 6913

Boring No.: LB-1

Sample No.: R-1

Depth (feet): 13.5

Soil Type : SM

Soil Identification: Gray silty sand (SM)

GR:SA:FI : (%) 0 : 85 : 15

Jun-21

SA LB-1, R-1 @ 13.5

PARTICLE-SIZE DISTRIBUTION (GRADATION) of SOILS USING SIEVE ANALYSIS

ASTM D 6913

Leighton

Project Name:	Yorba Villas Infiltration	Tested By:	S. Felter	Date:	06/22/21
Project No.:	10557.006	Checked By:	J. Ward	Date:	06/24/21
Boring No.:	LB-2	Depth (feet):	35.0		
Sample No.:	R-10				
Soil Identification:	Grayish brown poorly-graded sand with silt and gravel (SP-SM)g				

		Moisture Content of Total Air - Dry Soil	
Container No.:	9554	Wt. of Air-Dry Soil + Cont. (g)	0.0
Wt. of Air-Dried Soil + Cont.(g)	946.3	Wt. of Dry Soil + Cont. (g)	0.0
Wt. of Container (g)	108.1	Wt. of Container No.______ (g)	1.0
Dry Wt. of Soil (g)	838.2	Moisture Content (%)	0.0

After Wet Sieve	Container No.	9554
	Wt. of Dry Soil + Container (g)	889.2
	Wt. of Container (g)	108.1
	Dry Wt. of Soil Retained on # 200 Sieve (g)	781.1

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
1 1/2"	37.5	0.0	100.0
1"	25.0	57.8	93.1
3/4"	19.0	112.1	86.6
1/2"	12.5	160.8	80.8
3/8"	9.5	189.3	77.4
#4	4.75	266.5	68.2
#8	2.36	344.0	59.0
#16	1.18	434.3	48.2
#30	0.600	539.4	35.6
#50	0.300	649.8	22.5
#100	0.150	725.1	13.5
#200	0.075	768.4	8.3
PAN			

GRAVEL: **32 %**

SAND: **60 %**

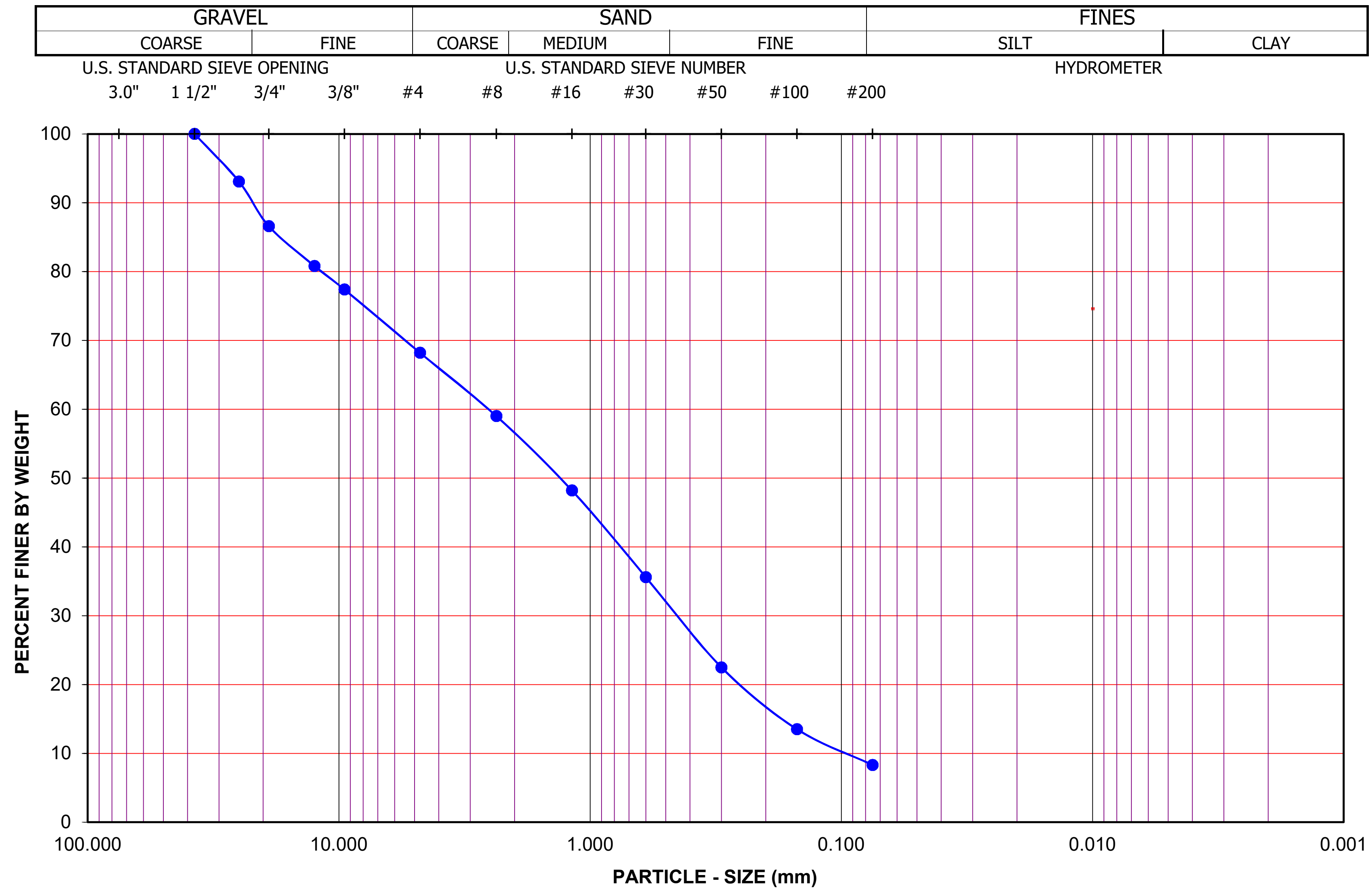
FINES: **8 %**

GROUP SYMBOL: **(SP-SM)g**

Cu = D60/D10 = 26.60

Cc = $(D30)^2/(D60*D10)$ = 0.86

Remarks:



Project Name: Yorba Villas Infiltration

Project No.: 10557.006

Boring No.: LB-2 Sample No.: R-10

Depth (feet): 35.0 Soil Type : (SP-SM)g

Soil Identification: Grayish brown poorly-graded sand with silt and gravel (SP-SM)g

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PARTICLE - SIZE DISTRIBUTION ASTM D 6913

GR:SA:FI : (%) 32 : 60 : 8

Jun-21

Boring No.	LB-2	LB-2							
Sample No.	R-9	R-11							
Depth (ft.)	30.0	40.0							
Sample Type	Ring	Ring							
Soil Identification	Brown silty sand (SM)	Brown silty sand (SM)							
Moisture Correction									
Wet Weight of Soil + Container (g)	0.0	0.0							
Dry Weight of Soil + Container (g)	0.0	0.0							
Weight of Container (g)	1.0	1.0							
Moisture Content (%)	0.0	0.0							
Sample Dry Weight Determination									
Weight of Sample + Container (g)	841.3	719.9							
Weight of Container (g)	106.4	107.3							
Weight of Dry Sample (g)	734.9	612.6							
Container No.:									
After Wash									
Method (A or B)	A	A							
Dry Weight of Sample + Cont. (g)	579.5	520.5							
Weight of Container (g)	106.4	107.3							
Dry Weight of Sample (g)	473.1	413.2							
% Passing No. 200 Sieve	**35.6**	**32.5**							
% Retained No. 200 Sieve	64.4	67.5							

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PERCENT PASSING
No. 200 SIEVE
ASTM D 1140

Project Name: Yorba Villas Infiltration
Project No.: 10557.006
Tested By: S. Felter Date: 06/22/21

GEOTECHNICAL INVESTIGATION, PROPOSED RESIDENTIAL DEVELOPMENT, APN'S 1013-211-21 AND 1013-211-22, NORTHWEST OF FRANCIS AVENUE AND YORBA AVENUE, CITY OF CHINO, CALIFORNIA

Prepared For:

COASTAL COMMERCIAL PROPERTIES
1020 Second Street, Suite C
Encinitas, California 92024

Project No. 10557.004

August 26, 2016

Leighton and Associates, Inc.
A LEIGHTON GROUP COMPANY

Leighton and Associates, Inc.
A LEIGHTON GROUP COMPANY

August 26, 2016

Project No. 10557.004

To: Coastal Commercial Properties
1020 Second Street, Suite C
Encinitas, California 92024

Attention: Mr. Brett Crowder

Subject: Geotechnical Investigation, Proposed Residential Development, APNs 1013-211-21 and 1013-211-22, Northwest of Francis Avenue and Yorba Avenue, City of Chino, California

In response to your request, Leighton and Associates, Inc. has conducted a geotechnical investigation for the proposed residential development to be located on APN 1013-211-21 and 1013-211-22, northwest of Francis Avenue and Yorba Avenue, in the City of Chino, California. This report updates our original geotechnical report for the subject property dated January 9, 2014.

Based on the results of our study, it is our professional opinion that the proposed development of the site is feasible from a geotechnical perspective, based on the current preliminary project plans. The accompanying geotechnical report presents a summary of our current investigation and provides geotechnical conclusions and recommendations.

10532 Acacia Street, Suite B-6 ▪ Rancho Cucamonga, CA 91730-5455
909.484.2205 ▪ 909.484.2170 Fax

We appreciate the opportunity to work with you on the development of this project. If you have any questions regarding this report, please call us at your convenience.

Respectfully submitted,

LEIGHTON AND ASSOCIATES, INC.

REGISTERED PROFESSIONAL ENGINEER
JASON D. HERTZBERG
No. 2711
GEOTECHNICAL
STATE OF CALIFORNIA

Jason D. Hertzberg, GE 2711
Principal Engineer

Philip A. Buchiarelli, CEG 1715
Principal Geologist

JDO/JDH/PB/rsm

Distribution: (2) Addressee

Leighton

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1.0 INTRODUCTION

1.1 Site Location and Description

The subject property consists of approximately 12 acres and was recently utilized as grazing land for a neighboring goat farm. The property is roughly broken up into thirds, with the western third occupied by numerous small rectangular concrete pads (presumably residential structures all of which had been demolished by the mid-1990s) and one maintenance shed used for the storage of materials associated with the goats currently grazing the site. The middle third is occupied by numerous elongated concrete slabs and a few animals pens associated with a former rabbit farm (present between the 1960 and mid 1990s), bee hives, and an empty maintenance shed. The eastern third of the site is primarily vacant, with a residence containing several structures and a pool. The property slopes gently to the south.

1.2 Proposed Development

The preliminary plans that have been provided by you depict a residential development with 46 lots that we assume would be planed for single family residential homes, as well as drainage, utility, street, sidewalk, a small park, landscape and associated improvements. We would expect relatively shallow cuts and fills to achieve design grade (generally on the order of 5 feet or less).

1.3 Purpose of Investigation

This report presents the updated results of our geotechnical investigation for the subject site located northwest of Francis Avenue and Yorba Avenue in Chino, California (Figure 1). The purpose of this study has been to evaluate the general geotechnical conditions at the site with respect to the proposed development and provide preliminary geotechnical recommendations for design and construction.

Our geotechnical exploration included hollow-stem auger soil borings, laboratory testing and geotechnical analysis to evaluate the existing conditions and develop the recommendations contained in this report. We also conducted infiltration testing to evaluate general infiltration characteristics at the depths tested for water quality basin design.

1.4 Scope of Investigation

The scope of our study has included the following tasks:

- Background Review: We reviewed available, relevant geotechnical geologic maps and reports and aerial photographs available from our in-house library. This included a review of geotechnical reports previously prepared for the site.

- Utility Coordination: We contacted Underground Service Alert (USA) prior to excavating borings and test pits so that utility companies could mark utilities onsite. We also coordinated our work with you and the property representative.

- Field Exploration: Previous subsurface explorations have been performed on the site by Leighton in December of 2013. A total of 5 exploratory soil borings (LB-1 through LB-5) were logged and sampled onsite to evaluate subsurface conditions.

  - The borings were drilled to depths ranging from 21.5 to 51.5 feet below the existing ground surface (bgs) by a subcontracted drill rig operator. The borings were logged by our field representative during drilling. Relatively undisturbed soil samples were obtained at selected intervals within the borings using a California Ring Sampler. Standard Penetration Tests (SPT) were conducted at selected depths and samples were obtained. Representative bulk soil samples were also collected at shallow depths from the borings.

  - Well permeameter tests were conducted at the 5 boring locations on the site (LB-1 through LB-5) to evaluate general infiltration rates of the subsurface soils at the depths and locations tested. The well permeameter tests were conducted based on the USBR 7300-89 method. All tests were conducted at depths of about 5 to 6 feet bgs to estimate the infiltration rate for use of shallow infiltration trenches.

  All excavations were backfilled with the soil cuttings. Logs of the geotechnical borings and the well permeameter test results are presented in Appendix B. Approximate boring and well permeameter test locations are shown on the accompanying Test Location Map, Figure 2.

- Geotechnical Laboratory Testing: Geotechnical laboratory tests were conducted on selected relatively undisturbed and bulk soil samples obtained during our field investigation. This laboratory testing program was designed to evaluate engineering characteristics of site soils. Laboratory tests conducted during this investigation include:

  - In situ moisture content and dry density
  - Maximum dry density and optimum moisture content
  - Sieve analysis for grain-size distribution
  - Swell and collapse potential
  - Water-soluble sulfate concentration
  - Resistivity, chloride content and pH

  The in situ moisture content and dry density test results are shown on the boring logs, Appendix B. The other laboratory test results are presented in Appendix C.

- Engineering Analysis: Data obtained from our background review, previous field exploration and geotechnical laboratory testing was evaluated and analyzed to develop geotechnical conclusions and provide preliminary recommendations presented in this report.

- Report Preparation: Results of our preliminary geotechnical investigation have been summarized in this report, presenting our findings, conclusions and preliminary geotechnical recommendations for design and construction of the proposed residential development.

2.0 FINDINGS

2.1 Regional Geologic Conditions

The site is located within the Chino Basin in the northern portion of the Peninsular Range geomorphic province of California. Major structural features surround this region, including the Cucamonga fault and the San Gabriel Mountains to the north, the Chino fault and Puente/Chino Hills to the west, and the San Jacinto fault to the east. This is an area of large-scale crustal disturbance as the relatively northwestward-moving Peninsular Range Province collides with the Transverse Range Province (San Gabriel and San Bernardino Mountains) to the north. Several active or potentially active faults have been mapped in the region and are believed to accommodate compression associated with this collision. The site is underlain by younger alluvial soil deposits eroded from the mountains surrounding the basin and deposited in the site vicinity.

2.2 Subsurface Soil Conditions

Based upon our review of pertinent geotechnical literature and our subsurface exploration, the site is underlain by alluvial soil deposits mantled in areas of the site by minor amounts of goat manure. The manure was generally less than approximately one inch thick. The alluvial soil encountered within our excavations generally consisted of combinations of sand and silt, with some gravel interspersed. The soil was generally moist and medium dense. The in-situ moisture content within the upper approximately 15 feet generally ranged from 1 to 10 percent. More detailed descriptions of the subsurface soil are presented on the boring logs.

2.2.1 Compressible and Collapsible Soil

Soil compressibility refers to a soil's potential for settlement when subjected to increased loads as from a fill surcharge. Based on our investigation, the native soil encountered is generally considered slightly to moderately compressible. Partial removal and recompaction of this material under shallow foundations is recommended to reduce the potential for adverse total and differential settlement of the proposed improvements.

Collapse potential refers to the potential settlement of a soil under existing stresses upon being wetted. Test results indicate that the alluvial soil within the upper 10 feet onsite has a minor collapse potential.

2.2.2 Expansive Soils

Expansive soils contain significant amounts of clay particles that swell considerably when wetted and shrink when dried. Foundations constructed on these soils are subjected to large uplifting forces caused by the swelling. Without proper measures taken, heaving and cracking of both building foundations and slabs-on-grade could result.

The near surface soils consist of sands and silty sands. Based on our observations conditions and experience in the area, the near-surface soil is generally expected to have a very low expansion potential.

2.2.3 Sulfate Content

Water-soluble sulfates in soil can react adversely with concrete. However, concrete in contact with soil containing sulfate concentrations of less than 0.1 percent by weight is considered to have negligible sulfate exposure based on the American Concrete Institute (ACI) provisions, adopted by the 2010 CBC (CBC, 2010, Chapter 19, and ACI, 2005, Chapter 4).

A near-surface soil sample was tested during this investigation for soluble sulfate content. The results of this test indicate a sulfate content of less than 0.01 percent by weight, indicating negligible sulfate exposure. Recommendations for concrete in contact with the soil are provided in Section 3.11.

2.2.4 Resistivity, Chloride and pH

Soil corrosivity to ferrous metals can be estimated by the soil's electrical resistivity, chloride content and pH. In general, soil having a minimum resistivity less than 1,000 ohm-cm is considered severely corrosive. Soil with a chloride content of 500 parts-per-million (ppm) or more is considered corrosive to ferrous metals.

As a screening for potentially corrosive soil, representative soil samples were tested during this investigation to determine minimum resistivity, chloride content, and pH. The tests indicated a minimum resistivity of 8,100 ohm-cm, chloride content of 200 ppm, and pH of 6.9. Based on the chloride content, the onsite soil is considered moderately corrosive to ferrous metals.

2.3 Groundwater

Groundwater was not encountered in our borings excavated to a maximum depth of 51.5 feet below the existing ground surface (bgs). Historical groundwater mapping indicates that groundwater was approximately 150 feet bgs in 1933 (CDWR, 1970). Recent data from the California Department of Water Resources indicates groundwater levels no higher than 200 feet bgs in the area (CDWR, 2013). Based on this, groundwater has historically been deep, and shallow groundwater is not expected at the site.

2.4 Faulting and Seismicity

Our review of available in-house literature indicates that there are no known active faults traversing the site. The closest known active or potentially active fault is the Chino-Elsinore fault, located approximately 3 miles southwest of the site.

The principal seismic hazard that could affect the site is ground shaking resulting from an earthquake occurring along several major active or potentially active faults in southern California. The known regional active and potentially active faults that could produce the most significant ground shaking at the site include the Chino-Elsinore, San Jose, Cucamonga, Sierra Madre, Whittier, Elsinore-Glen Ivy, and Elysian Park Thrust faults.

The Peak Horizontal Ground Acceleration (PHGA) and hazard deaggregation were estimated using the United States Geological Survey's (USGS) 2008 Interactive Deaggregations utility. The results of this analysis indicate that the predominant modal earthquake has a PHGA of 0.76g with magnitude of approximately 6.6 (M_W) at a distance on the order of 7 kilometers for the Maximum Considered Earthquake (2% probability of exceedance in 50 years). Based on this, the corresponding PHGA for the design earthquake (2/3 of the MCE) is 0.51g.

We also estimated the design PHGA based on the 2013 California Building Code Section 1613. The calculated S_{DS} value at the site is 1.18g (see Section 3.4). Dividing this by a factor of 2.5 results in a design peak horizontal ground acceleration (PHGA) of 0.47g, per 2013 CBC, Section 1803.5.12(2).

Based on these results, we have selected a design PHGA of 0.51g for seismic analysis of the onsite soils (seismic settlement).

2.5 Secondary Seismic Hazards

In general, secondary seismic hazards for sites in the region could include soil liquefaction, earthquake-induced settlement, lateral displacement, landsliding, and earthquake-induced flooding. The potential for secondary seismic hazards at the site is discussed below.

2.5.1 Liquefaction Potential

Liquefaction is the loss of soil strength or stiffness due to a buildup of pore-water pressure during severe ground shaking. Liquefaction is associated primarily with loose (low density), saturated, fine-to-medium grained, cohesionless soils. As the shaking action of an earthquake progresses, the soil grains are rearranged and the soil densifies within a short period of time. Rapid densification of the soil results in a buildup of pore-water pressure. When the pore-water pressure approaches the total overburden pressure, the soil reduces greatly in strength and temporarily behaves similarly to a fluid. Effects of liquefaction can include sand boils, settlement, and bearing capacity failures below structural foundations.

The State of California has not prepared liquefaction hazard maps for this area. San Bernardino County (2010) does not show the site in a zone of susceptibility for liquefaction.

Based on our study, current groundwater levels are deeper than 51.5 feet bgs and historic high groundwater levels are deeper than 150 feet bgs. As such, the potential for liquefaction at the site is very low.

2.5.2 Seismically Induced Settlement

During a strong seismic event, seismically induced settlement can occur within loose to moderately dense, dry or saturated granular soil. Settlement caused by ground shaking is often nonuniformly distributed, which can result in differential settlement.

Considering our recommended overexcavation recommendations, the potential total settlement resulting from seismic loading is considered low (less than 1 inch) for this site. Differential settlement resulting from seismic loading is generally assumed to be one-half of the total seismically induced settlement over a distance of 40 feet. Seismic settlement analysis is provided in Appendix D.

2.5.3 Seismically Induced Landslides

The site is generally level without significant slopes. This site is not considered susceptible to static slope instability or seismically induced landslides.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based on this investigation, construction of the proposed residential development is feasible from a geotechnical standpoint. No severe geologic or soils related issues were identified that would preclude development of the site for the proposed improvements. The most significant geotechnical issues at the site are those related to the potential for strong seismic shaking and potentially compressible soils. Good planning and design of the project can limit the impact of these constraints. Remedial recommendations for these and other geotechnical issues are provided in the following sections.

The site is not expected to be prone to adverse effects of slope instability or adverse differential settlement from cut/fill transitions (significant cuts and fills are not proposed).

Although not identified during this investigation, abandoned septic tanks, seepage pits, or other buried structures, trash pits, or items related to past site uses may be present. If such items were encountered during grading, they would require further evaluation and special consideration.

3.1 General Earthwork and Grading

All grading should be performed in accordance with the General Earthwork and Grading Specifications presented in Appendix E, unless specifically revised or amended below or by future recommendations based on final development plans.

3.1.1 Site Preparation

Prior to construction, the site should be cleared of vegetation, trash and debris, which should be disposed of offsite. Any underground obstructions should be removed as should large tress and their root systems. Resulting cavities should be properly backfilled and compacted. Efforts should be made to locate existing utility lines. Those lines should be removed or rerouted if they interfere with the proposed construction, and the resulting cavities should be properly backfilled and compacted. Trees should be removed.

3.1.2 Removal of Manure, Organic-Rich Soil and Uncontrolled Artificial Fill

Prior to overexcavation and recompaction of the onsite alluvial soil, all manure should be cleared and removed from the site. Heavy concentrations of organic-rich soil (containing visible organic matter or containing an organic content of 2 percent by weight or more) should be removed.

Removal and disposal of manure and organic-rich soil should be observed by Leighton and Associates. Organic content testing should be performed during removal to guide disposal operations.

In addition to the above, prior to overexcavation and recompaction of the onsite alluvial soil, any clean uncontrolled artificial fill should be removed and may be used as compacted fill for the project.

If suitable open space areas are available without proposed structures, such as a park site, it may be possible to place organic-rich soil and minor amounts of manure as non-structural fill in those areas, provided this is acceptable to the local reviewing agency. If this is done, we suggest the manure and organic-rich soils be mixed with clean soil to reduce the overall organic content and a clean soil cap be provided above the organic-rich soil.

3.1.3 Overexcavation and Recompaction

To reduce the potential for adverse differential settlement of the proposed improvements, the underlying subgrade soil should be prepared in such a manner that a uniform response to the applied loads is achieved. For structures with shallow foundations, we recommend that onsite alluvial soils be overexcavated and recompacted to a minimum depth of 3 feet below the bottom of the proposed footings or 5 feet below existing grade, whichever is deeper. Overexcavation and recompaction should extend a minimum horizontal distance of 5 feet from perimeter edges of the proposed footings.

Local conditions may require that deeper overexcavation be performed; such areas should be evaluated by Leighton during grading.

Areas outside these overexcavation limits planned for asphalt or concrete pavement, flatwork, and site walls, and areas to receive fill should be overexcavated to a minimum depth of 24 inches below the existing ground surface or 12 inches below the proposed subgrade, whichever is deeper.

After completion of the overexcavation, and prior to fill placement, the exposed surfaces should be scarified to a minimum depth of 6 inches, moisture conditioned to or slightly above optimum moisture content, and recompacted to a minimum 90 percent relative compaction, relative to the ASTM D 1557 laboratory maximum density.

These recommendations should be reviewed once a grading plan is available.

3.1.4 Fill Placement and Compaction

Manure and organic-rich soil is considered unsuitable for support of the proposed improvements, and will require offsite disposal or placement in non-structural areas. All structural fill should be visibly free of organic matter or should have a total organic matter content of less than 2.0 percent.

Onsite soil to be used for compacted structural fill should also be free of debris and oversized material (greater than 8 inches in largest dimension). Any soil to be placed as fill, whether onsite or imported material, should be reviewed and possibly tested by Leighton.

All fill soil should be placed in thin, loose lifts, moisture conditioned, as necessary, and compacted to a minimum 90 percent relative compaction. Relative compaction should be determined in accordance with ASTM Test Method D1557. Aggregate base for pavement should be compacted to a minimum of 95 percent relative compaction.

3.1.5 Import Fill Soil

Import soil to be placed as fill should be geotechnically accepted by Leighton. Preferably at least 3 working days prior to proposed import to the site, the contractor should provide Leighton pertinent information of the proposed import soil, such as location of the soil, whether stockpiled or native in place, and pertinent geotechnical reports if available. We recommend that a Leighton representative visit the proposed import site to observe the soil conditions and obtain representative soil samples. Potential issues may include soil that is more expansive than onsite soil, soil that is too wet, soil that is too rocky or too dissimilar to onsite soils, oversize material, organics, debris, etc.

3.1.6 Shrinkage and Subsidence

The change in volume of excavated and recompacted soil varies according to soil type and location. This volume change is represented as a percentage increase (bulking) or decrease (shrinkage) in volume of fill after removal and recompaction. Subsidence occurs as in-place soil (e.g., natural ground) is moisture-conditioned and densified to receive fill, such as in processing an overexcavation bottom. Subsidence is in addition to shrinkage due to recompaction of fill soil. Field and laboratory data used in our calculations included laboratory-measured maximum dry densities for soil types encountered at the subject site, the measured in-place densities of soils encountered and our experience. We preliminarily estimate the following earth volume changes will occur during grading:

Shrinkage	Approximately 15 +/- 5 percent
Subsidence (overexcavation bottom processing)	Approximately 0.15 feet

It should be noted that these values do not account for removal of manure and organic-rich soil.

The level of fill compaction, variations in the dry density of the existing soils and other factors influence the amount of volume change. Some adjustments to earthwork volume should be anticipated during grading of the site.

3.1.7 Rippability and Oversized Material

Oversized material (rock or rock fragments greater than 8 inches in dimension) was not observed during our investigation. Oversized material should not be used within structural fill areas.

3.2 Shallow Foundation Recommendations

Overexcavation and recompaction of the footing subgrade soil should be performed as detailed in Section 3.1. The following recommendations are based on the onsite soil conditions and soils with a very low expansion potential.

3.2.1 Minimum Embedment and Width

Based on our preliminary investigation, footings should have a minimum embedment of 18 inches, with a minimum width of 24 and 12 inches for isolated and continuous footings, respectively.

3.2.2 Allowable Bearing

An allowable bearing pressure of 1,800 pounds-per-square-foot (psf) may be used, based on the minimum embedment depth and width above. This allowable bearing value may be increased by 250 psf per foot increase in depth or width to a maximum allowable bearing pressure of 2,500 psf. If higher bearing pressures are required, this should be reviewed on a case-by-case basis. These allowable bearing pressures are for total dead load and sustained live loads. Footing reinforcement should be designed by the structural engineer.

3.2.3 Lateral Load Resistance

Soil resistance available to withstand lateral loads on a shallow foundation is a function of the frictional resistance along the base of the footing and the passive resistance that may develop as the face of the structure tends to move into the soil. The frictional resistance between the base of the foundation and the subgrade soil may be computed using a coefficient of friction of 0.30. The passive resistance may be computed using an allowable equivalent fluid pressure of 240 pounds per cubic foot (pcf), assuming there is constant contact between the footing and undisturbed soil. The coefficient of friction and passive resistance may be combined without further reduction.

3.2.4 Increase in Bearing and Friction - Short Duration Loads

The allowable bearing pressure and coefficient of friction values may be increased by one-third when considering loads of short duration, such as those imposed by wind and seismic forces.

3.3 Recommendations for Slabs-On-Grade

Concrete slabs-on-grade should be designed by the structural engineer in accordance with the current CBC for a soil with a very low expansion potential. Where conventional light floor loading conditions exist, the following minimum recommendations should be used. More stringent requirements may be required by local agencies, the structural engineer, the architect, or the CBC. Laboratory testing should be conducted at finish grade to evaluate the Expansion Index (EI) of near-surface subgrade soils. Slabs-on-grade should have the following minimum recommended components:

Subgrade Moisture Conditioning: The subgrade soil should be moisture conditioned to at least 2 percent above optimum moisture content to a minimum depth of 18 inches prior to placing steel or concrete.

- Moisture Vapor Retarder: A minimum of a 10-mil vapor retarder should be placed below slabs where moisture-sensitive floor coverings or equipment is planned. Since moisture will otherwise be transmitted up from the soil through the concrete, it is important that an intact vapor retarder be installed. We recommend that the vapor retarder meet the requirements of ASTM E1745 and be installed per ASTM E1643. The structural engineer should specify pertinent concrete design parameters and moisture migration prevention measures, such as whether a sand blotter layer should be placed over the vapor retarder. Gravel or other protruding objects that could puncture the moisture retarder should be removed from the subgrade prior to placing the vapor retarder, or a stronger vapor retarder intended for the specific conditions present can be used.

- Concrete Thickness: Slabs-on-grade should be at least 4 inches thick. Reinforcing steel should be designed by the structural engineer, but as a minimum should be No. 4 rebar placed at 18 inches on center, each direction, mid-depth in the slab.

Minor cracking of the concrete as it cures, due to drying and shrinkage is normal and should be expected. However, cracking is often aggravated by a high water/cement ratio, high concrete temperature at the time of placement, small nominal aggregate size, and rapid moisture loss due to hot, dry, and/or windy weather conditions during placement and curing. Cracking due to temperature and moisture fluctuations can also be expected. Low slump concrete can reduce the potential for shrinkage cracking. Additionally, our experience indicates that reinforcement in slabs and foundations can generally reduce the potential for concrete cracking. The structural engineer should consider these components in slab design and specifications.

Moisture retarders can reduce, but not eliminate moisture vapor rise from the underlying soils up through the slab. Floor covering manufacturers should be consulted for specific recommendations.

Leighton does not practice in the field of moisture vapor transmission evaluation, since this is not specifically a geotechnical issue. Therefore, we recommend that a qualified person, such as the flooring subcontractor and/or structural engineer, be consulted with to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. That person should provide recommendations for mitigation of potential adverse impact of moisture vapor transmission on various components of the structures as deemed appropriate.

3.4 Seismic Design Parameters

Seismic parameters presented in this report should be considered during project design. In order to reduce the effects of ground shaking produced by regional seismic events, seismic design should be performed in accordance with the most recent edition of the California Building Code (CBC). The following data should be considered for the seismic analysis of the subject site:

2013 CBC Categorization/Coefficient	Design Value
Site Longitude (decimal degrees)	-117.704
Site Latitude (decimal degrees)	34.042
Site Class Definition (ASCE 7 Table 20.3-1)	D
Mapped Spectral Response Acceleration at 0.2s Period, S_s (Figure 1613.3.1(1))	1.771 g
Mapped Spectral Response Acceleration at 1s Period, S_1 (Figure 1613.3.1(2))	0.628 g
Short Period Site Coefficient at 0.2s Period, F_a (Table 1613.3.3(1))	1.0
Long Period Site Coefficient at 1s Period, F_v (Table 1613.3.3(2)	1.5
Adjusted Spectral Response Acceleration at 0.2s Period, S_{MS} (Eq. 16-37)	1.771 g
Adjusted Spectral Response Acceleration at 1s Period, S_{M1} (Eq. 16-38)	0.941 g
Design Spectral Response Acceleration at 0.2s Period, S_{DS} (Eq. 16-39)	1.181 g
Design Spectral Response Acceleration at 1s Period, S_{D1} (Eq. 16-40)	0.628 g

3.5 Retaining Walls

We recommend that retaining walls be backfilled with very low expansive soil and constructed with a backdrain in accordance with the recommendations provided on Figure 3 (rear of text). Using expansive soil as retaining wall backfill will result in higher lateral earth pressures exerted on the wall. Based on these recommendations, the following parameters may be used for the design of conventional retaining walls:

Static Equivalent Fluid Weight (pcf)	
Condition	Level Backfill
Active	35 pcf
At-Rest	55 pcf
Passive	240 pcf (allowable) (Maximum of 3,500 psf)

The above values do not contain an appreciable factor of safety unless noted, so the structural engineer should apply the applicable factors of safety and/or load factors during design, as specified by the California Building Code.

Cantilever walls that are designed to yield at least 0.001H, where H is equal to the wall height, may be designed using the active condition. Rigid walls and walls braced at the top should be designed using the at-rest condition.

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Passive pressure is used to compute soil resistance to lateral structural movement. In addition, for sliding resistance, a frictional resistance coefficient of 0.3 may be used at the concrete and soil interface. The lateral passive resistance should be taken into account only if it is ensured that the soil providing passive resistance, embedded against the foundation elements, will remain intact with time.

In addition to the above lateral forces due to retained earth, surcharge due to improvements, such as an adjacent structure or traffic loading, should be considered in the design of the retaining wall. Loads applied within a 1:1 projection from the surcharging structure on the stem of the wall should be considered in the design.

A soil unit weight of 120 pcf may be assumed for calculating the actual weight of the soil over the wall footing.

3.6 Infiltration Design

Five well permeameter tests (LB-1 through LB-5) were conducted to estimate the infiltration rate in various parts of the site. The well permeameter tests were conducted at depths between 4 and 6 feet below ground surface.

Well permeameter tests are useful for field measurements of soil infiltration rates, and is suited for testing when the design depth of the basin is deeper than current existing grades. The test consists of excavating a boring to the depth of the test (or deeper if it is partially backfilled with soil and a bentonite plug with a thin soil covering is placed just below the design test elevation). A layer of clean sand is placed in the boring bottom to support a float mechanism and temporary perforated well casing pipe. In addition, sand is poured around the outside of the well casing within the test zone to prevent the boring from caving/collapsing or eroding when water is added. The float mechanism, placed inside the casing, adds water stored in barrels at the top of the hole to the boring as water infiltrates into the soil, while maintaining a constant water head in the boring. The test was conducted based on the USBR 7300-89 test method. The incremental infiltration rate as measured during intervals of the test is defined as the incremental flow rate of water infiltrated, divided by the surface area of the infiltration interface.

Small-scale infiltration rates were measured at the 5 well permeameter locations and ranged from approximately 0.3 to 13 inches per hour (no factor of safety applied). Infiltration at three of the five locations was too rapid to measure for normal test procedures. One of these three locations was selected based on the boring geology as the probable fastest infiltration location, and a modified test procedure was used to test the infiltration rate using a lower water surface head. The result of this test indicated an infiltration rate of 13 inches per hour. Infiltration test results are provided in Appendix B. These are raw values, before applying an appropriate factor of safety or correction factor. Based on these results, the onsite silty soils or soils with a higher fines content are not considered feasible for infiltration. Sandy soils with a low fines content are anticipated to have higher infiltration rates; however, sandy soils underlain by finer-grained soils are not considered suitable. Specific infiltration design information should be made available so testing representative to the final design conditions can be conducted. The small-scale infiltration rate should be divided by a correction factor of at least 2 for buried chambers and at least 3 for open basins, but the correction/safety factor may be higher based on project-specific aspects, based on *San Bernardino County Stormwater Program Technical Guidance Document for Water Quality Management Plans (WQMP)*.

We recommend that further testing be conducted after a design has been selected for an infiltration facility, since infiltration rates varied significantly across the site.

The infiltration rates described herein are for a clean, unsilted infiltration surface in native, sandy alluvial soil. These values may be reduced over time as silting of the basin or chamber occurs. Furthermore, if the basin or chamber bottom is allowed to be compacted by heavy equipment, this value is expected to be significantly reduced. Infiltration of water through soil is highly dependent on such factors as grain size distribution of the soil particles, particle shape, fines content, clay content, and density. Small changes in soil conditions, including density, can cause large differences in observed infiltration rates. Infiltration is not suitable in compacted fill.

It should be noted that during periods of prolonged precipitation, the underlying soils tend to become saturated to greater and greater depths/extents. Therefore, infiltration rates tend to decrease with prolonged rainfall. It is difficult to extrapolate longer-term, full-scale infiltration rates from small-scale tests, and as such, this is a significant source of uncertainty in infiltration rates.

Additional Review and Evaluation:

Infiltration rates are anticipated to vary significantly based on the location and depth. Infiltration concepts should be discussed with Leighton as infiltration plans are being developed. Leighton should review all infiltration plans, including locations and depths of proposed facilities. Further testing should be conducted based on the design of infiltration facilities, particularly considering their type, depth and location.

General Design Considerations:

The periodic flow of water carrying sediments in the basin or chamber, plus the introduction of wind-blown sediments and sediments from erosion of the basin side walls, can eventually cause the bottom of the basin or chamber to accumulate a layer of silt, which has the potential of significantly reducing the overall infiltration rate of the basin or chamber. Therefore, we recommend that significant amounts of silt/sediment not be allowed to flow into the facility within storm water, especially during construction of the project and prior to achieving a mature landscape on site. We recommend that an easily maintained, robust silt/sediment removal system be installed to pretreat storm water before it enters the infiltration facility.

As infiltrating water can seep within the soil strata nearly horizontally for long distances, it is important to consider the impact that infiltration facilities can have on nearby subterranean structures, such as basement walls or open excavations, whether onsite or offsite, and whether existing or planned. Any such nearby features should be identified and evaluated as to whether infiltrating water can impact these. Such features should be brought to Leighton's attention as they are identified.

Infiltration facilities should not be constructed adjacent to or under buildings. Setbacks should be discussed with Leighton during the planning process.

Infiltration facilities should be constructed with spillways or other appropriate means that would cause overfilling to not be a concern to the facility or nearby improvements.

For buried chambers that allow interior standing water, control/access manhole covers should not contain holes or should be screened to prevent mosquitos from entering the cambers.

Additional Design Considerations (Particularly for Open Basins):

If open basins are planned, additional infiltration exploration and testing should be conducted, as the soils that will be exposed at the bottom of the basin are critical to the basin's success. Soils at the bottom of buried chambers are also important, but not as critical to their success, provided the infiltration chamber cuts through sufficiently granular soils.

In general, the rate of infiltration reduces as the head of water in the infiltration facility reduces, and it also reduces with prolonged periods of infiltration. As such, water typically infiltrates much faster near the beginning of and/or immediately after storm events than at times well after a storm when the water level in the facility has receded, since the infiltration rate is then slower due to both lower head and longer overall duration of infiltration. In open basins with compacted or silty bottoms, this could be problematic, in that, even if the basin had already infiltrated significant amounts of storm water, the lower several inches or feet of water could remain in the basin for an extended period of time, creating a prolonged open-water safety concern and potential for mosquitos. In a buried/covered infiltration chamber, these conditions would be of less concern.

Parks or play/recreation areas should not be constructed within basin bottoms or below the spillway level.

For open basins and swales, vegetation within the basin bottoms and sides is expected to help reduce erosion and help maintain infiltration rates.

Estimating infiltration rates, especially based on small-scale testing, is inexact and indefinite, and often involves known and unknown soil complexities, potentially resulting in a condition where actual infiltration rates of the completed facility are significantly less than design rates. In open infiltration basins, this could create nuisance water in the basin. As such, enhancements may be needed after completion of the basin if prolonged or frequent standing water is experienced. A potential basin enhancement, if needed, might be to install infiltration trenches or dry wells in the basin bottom to capture and infiltrate low flows and to help speed infiltration during/after storms; specific recommendations, such as minimum trench/dry well depth, would be developed based on conditions observed. Such a contingency should be anticipated for open basins.

Construction Considerations:
We recommend that Leighton evaluate the infiltration facility excavations, to confirm that granular, undisturbed alluvium is exposed in the bottoms and sides. Additional excavation or evaluation may be required if silty or clayey soils are exposed.

It is critical to infiltration that the basin or chamber bottom not be allowed to be compacted during construction or maintenance; rubber-tired equipment and vehicles should not be allowed to operate on the bottom. We recommend that at least the bottom 3 feet of the basins or chambers be excavated with an excavator or similar.

If fill material is needed to be placed in the basin, such as due to removal of uncontrolled artificial fill, the fill material should be select and free-draining sand, and should be observed and evaluated by Leighton.

Maintenance Considerations:
The infiltration facilities should be routinely monitored, especially before and during the rainy season, and corrective measures should be implemented as/when needed. Things to check for include proper upkeep, proper infiltration, absence of accumulated silt, and that de-silting filters/features are clean and functioning. Pretreatment desilting features should be cleaned and maintained per manufacturers' recommendations. Even with measures to prevent silt from flowing into the infiltration facility, accumulated silt may need to be removed occasionally as part of maintenance.

3.7 Pavement Design

Based on the design procedures outlined in the current Caltrans Highway Design Manual, and using an assumed design R-value of 50, flexible pavement sections may consist of the following for the Traffic Indices indicated. Final pavement design should be based on the Traffic Index determined by the project civil engineer and R-value testing provided near the end of grading.

Asphalt Pavement Section Thickness, Type I Subgrade Soil			
Traffic Index	Asphaltic Concrete (AC) Thickness (inches)	Class 2 Aggregate Base Thickness (inches)	Total Pavement Section Thickness (inches)
5 or less	3	4	7
6	3	4.5	7.5
7	4	4.5	8.5

All pavement construction should be performed in accordance with the Standard Specifications for Public Works Construction or Caltrans Specifications. Field observations and periodic testing, as needed during placement of the base course materials, should be undertaken to ensure that the requirements of the standard specifications are fulfilled.

Prior to placement of aggregate base, the subgrade soil should be processed to a minimum depth of 6 inches, moisture-conditioned, as necessary, and recompacted to a minimum of 90 percent relative compaction. Aggregate base should be moisture conditioned, as necessary, and compacted to a minimum of 95 percent relative compaction.

If the pavement is to be constructed prior to construction of the structures, we recommend that the full depth of the pavement section be placed in order to support heavy construction traffic.

3.8 Temporary Excavations

All temporary excavations, including utility trenches, retaining wall excavations and other excavations should be performed in accordance with project plans, specifications and all OSHA requirements.

No surcharge loads should be permitted within a horizontal distance equal to the height of cut or 5 feet, whichever is greater from the top of the slope, unless the cut is shored appropriately. Excavations that extend below an imaginary plane inclined at 45 degrees below the edge of any adjacent existing site foundation should be properly shored to maintain support of the adjacent structures.

Cantilever shoring should be designed based on an active equivalent fluid pressure of 35 pcf. If excavations are braced at the top and at specific design intervals, the active pressure may then be approximated by a rectangular soil pressure distribution with the pressure per foot of width equal to 25H, where H is equal to the depth of the excavation being shored.

During construction, the soil conditions should be regularly evaluated to verify that conditions are as anticipated. The contractor should be responsible for providing the "competent person" required by OSHA, standards to evaluate soil conditions. Close coordination between the competent person and the geotechnical engineer should be maintained to facilitate construction while providing safe excavations.

3.9 Trench Backfill

Utility-type trenches onsite can be backfilled with the onsite material, provided it is free of debris, significant organic material and oversized material. Prior to backfilling the trench, pipes should be bedded and shaded in a granular material that has a sand equivalent of 30 or greater. The sand should extend 12 inches above the top of the pipe. The bedding/shading sand should be densified in-place by mechanical means, or in accordance with Greenbook specifications. The native backfill should be placed in loose layers, moisture conditioned, as necessary, and mechanically compacted using a minimum standard of 90 percent relative compaction. The thickness of layers should be based on the compaction equipment used in accordance with the Standard Specifications for Public Works Construction (Greenbook, 2015).

3.10 Surface Drainage

Inadequate control of runoff water and/or poorly controlled irrigation can cause the onsite soils to expand and/or shrink, producing heaving and/or settlement of foundations, flatwork, walls, and other improvements. Maintaining adequate surface drainage, proper disposal of runoff water, and control of irrigation should help reduce the potential for future soil moisture problems.

Positive surface drainage should be designed to be directed away from foundations and toward approved drainage devices, such as gutters, paved drainage swales, or watertight area drains and collector pipes.

Surface drainage should be provided to prevent ponding of water adjacent to the structures. In general, the area around the buildings should slope away from the building. We recommend that unpaved landscaped areas adjacent to the buildings be avoided. Roof runoff should be carried to suitable drainage outlets by watertight drain pipes or over paved areas.

3.11 Sulfate Attack and Corrosion Protection

Based on the results of laboratory testing, concrete structures in contact with the onsite soil will have negligible exposure to water-soluble sulfates in the soil. Type II cement may be used for concrete construction. The concrete should be designed in accordance with Table 4.3.1 of the American Concrete Institute ACI 318-08 provisions (ACI, 2008).

Based on our laboratory testing, the onsite soil is considered severely corrosive to ferrous metals. Use of non-ferrous buried pipe may be prudent, or ferrous pipe can be protected by dielectric tape, polyethylene sleeves and/or other methods, with recommendations from a corrosion engineer. Corrosion information presented in this report should be provided to your underground utility subcontractors. Additional testing and evaluation by a corrosion engineer may be warranted if corrosion protection is considered critical to the project.

3.12 Additional Geotechnical Services

The preliminary geotechnical recommendations presented in this report are based on subsurface conditions as interpreted from limited subsurface explorations and limited laboratory testing. Our preliminary geotechnical recommendations provided in this report are based on information available at the time the report was prepared and may change as plans are developed. Additional geotechnical investigation and analysis may be required based on final improvement plans. Leighton should review the site and grading plans when available and comment further on the geotechnical aspects of the project. Geotechnical observation and testing should be conducted during excavation and all phases of grading operations. Our conclusions and preliminary recommendations should be reviewed and verified by Leighton during construction and revised accordingly if geotechnical conditions encountered vary from our preliminary findings and interpretations.

Geotechnical observation and testing should be provided:

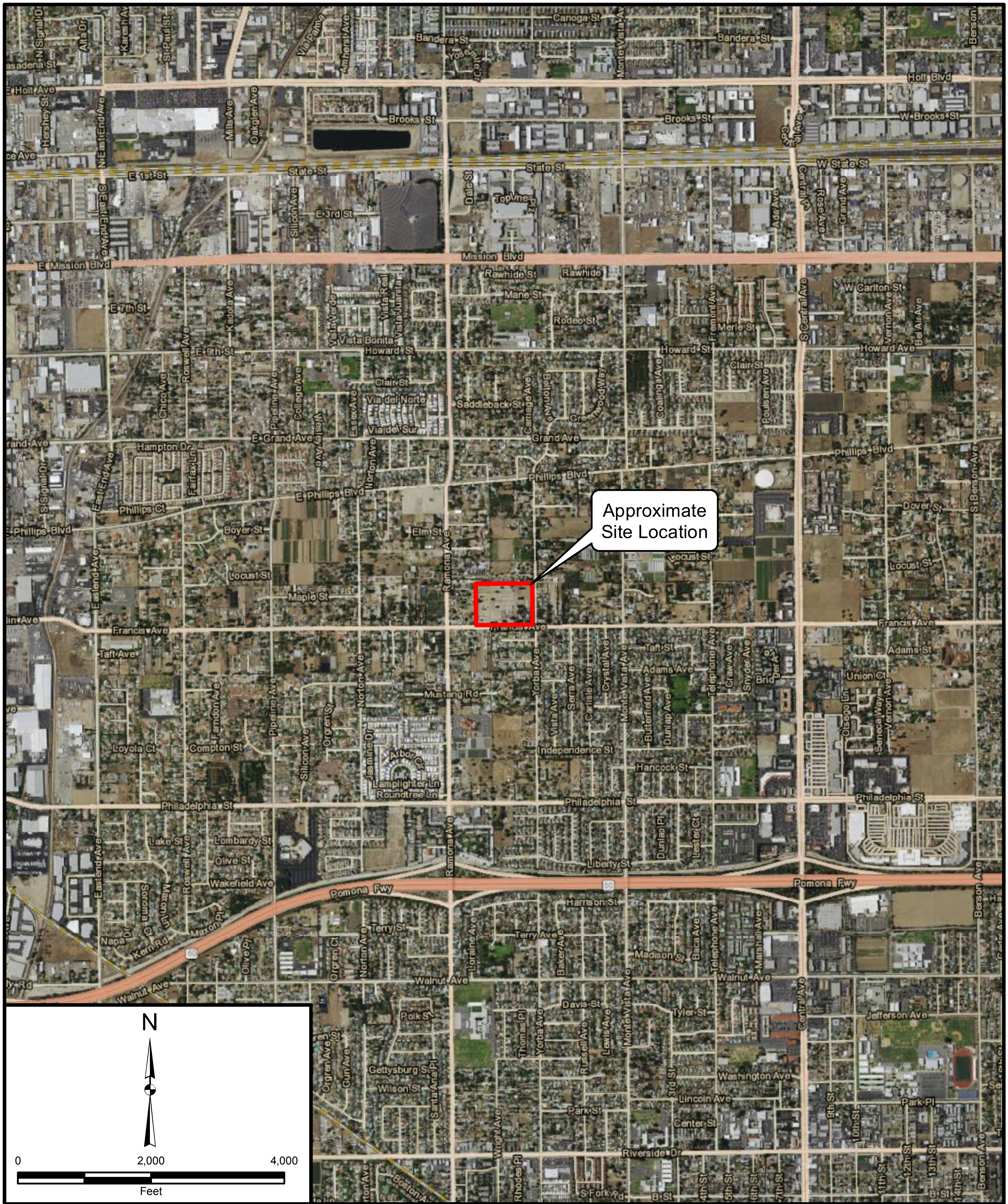
- After completion of site clearing.
- During overexcavation of compressible soil.
- During compaction of all fill materials.
- After excavation of all footings and prior to placement of concrete.
- During utility trench backfilling and compaction.
- During pavement subgrade and base preparation.
- When any unusual conditions are encountered.

4.0 LIMITATIONS

This report was based in part on data obtained from a limited number of observations, site visits, soil excavations, samples, and tests. Such information is, by necessity, incomplete. The nature of many sites is such that differing soil or geologic conditions can be present within small distances and under varying climatic conditions. Changes in subsurface conditions can and do occur over time. Therefore, our findings, conclusions, and recommendations presented in this report are based on the assumption that Leighton and Associates, Inc. will provide geotechnical observation and testing during construction.

This report was prepared for the sole use of Stratham Company for application to the design of the proposed residential development in accordance with generally accepted geotechnical engineering practices at this time in California.

See the GBA insert on the following page for important information about this geotechnical engineering report.



Project: 10557.004	Eng/Geol: JDH/PB
Scale: 1 " = 2,000 '	Date: August 2016

Base Map: ESRI ArcGIS Online 2016
Thematic Information: Leighton
Author: Leighton Geomatics (mmurphy)

SITE LOCATION MAP

Proposed Residential Development, Assessor Parcel Numbers 1013-211-21 and 1013-211-22, Northwest of Francis Avenue and Yorba Linda Avenue, City of Chino, California

Figure 1

Leighton

Map Saved as V:\Drafting\10557\004\Maps\10557-004_F01_SLM_2016-08-24.mxd on 8/24/2016 1:20:00 PM

Project: 10557.004

Eng/Geol: JDH/PB

Scale: 1 " = 150 '

Date: August 2016

Base Map: ESRI ArcGIS Online 2016
Thematic Information: Leighton
Author: Leighton Geomatics (mmurphy)

TEST LOCATION MAP

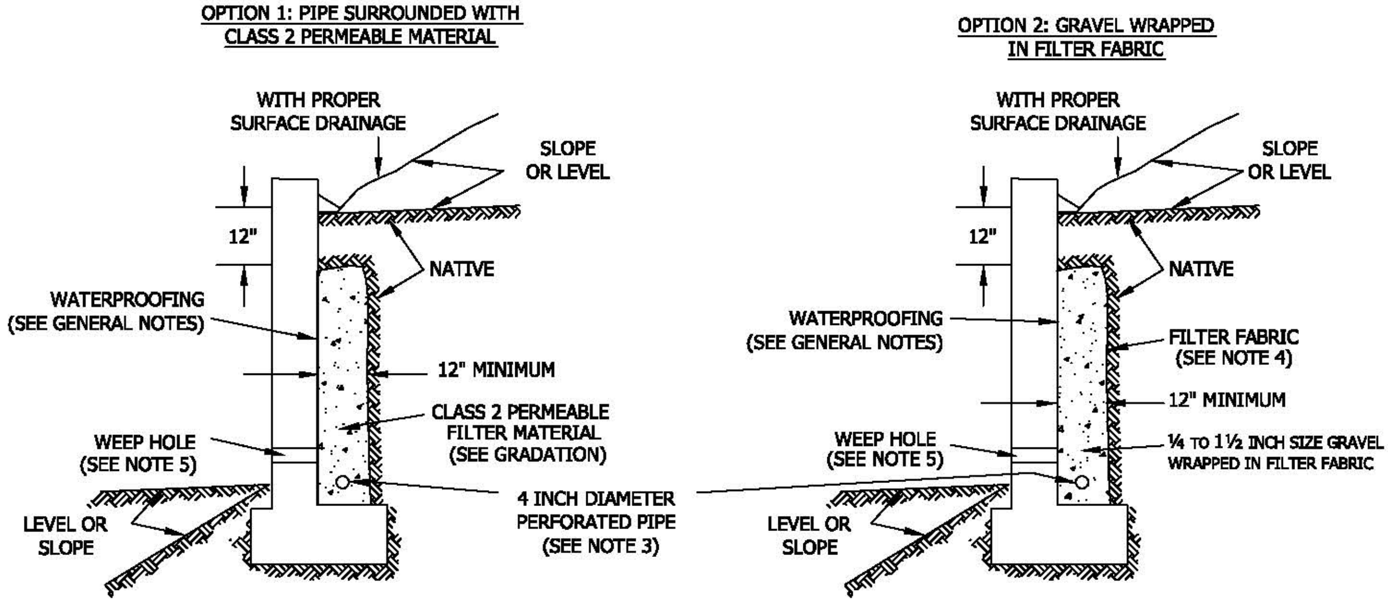
Proposed Residential Development, Assessor Parcel Numbers 1013-211-21 and 1013-211-22, Northwest of Francis Avenue and Yorba Linda Avenue, City of Chino, California

Figure 2

Leighton

Map Saved as V:\Drafting\10557\004\Maps\10557-004_F02_TLM_2016-08-24.mxd on 8/24/2016 1:17:20 PM

SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50



Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

Sieve Size	Percent 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

GENERAL NOTES:

* Waterproofing should be provided where moisture nuisance problem through the wall is undesirable.
* Water proofing of the walls is not under purview of the geotechnical engineer
* All drains should have a gradient of 1 percent minimum
*Outlet portion of the subdrain should have a 4-inch diameter solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding)
*Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

Notes:
1) Sand should have a sand equivalent of 30 or greater and may be densified by water jetting.
2) 1 Cu. ft. per ft. of 1/4- to 1 1/2-inch size gravel wrapped in filter fabric
3) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down. Perforations should be 3/8 inch in diameter placed at the ends of a 120-degree arc in two rows at 3-inch on center (staggered)
4) Filter fabric should be Mirafi 140NC or approved equivalent.
5) Weephole should be 3-inch minimum diameter and provided at 10-foot maximum intervals. If exposure is permitted, weepholes should be located 12 inches above finished grade. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to be discharged through the curb face or equivalent should be provided. For a basement-type wall, a proper subdrain outlet system should be provided.
6) Retaining wall plans should be reviewed and approved by the geotechnical engineer.
7) Walls over six feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements.

RETAINING WALL BACKFILL AND SUBDRAIN DETAIL FOR WALLS 6 FEET OR LESS IN HEIGHT

WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

Leighton

Figure 3

P:Drafting\templates\details\retain-wall-backfill-and subdrain.dwg (7/00)

APPENDIX A

REFERENCES

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APPENDIX A

References

American Concrete Institute (ACI), 2008, Building Code Requirements for Structural Concrete (ACI 318-08) and Commentary (ACI 318R-08), an ACI Standard, 2008.

American Society of Civil Engineers (ASCE), ASCE Standard/SEI 7-10, an ASCE Standard, 2010.

Bryant, W.A., Hart, E.W., 2007, Fault Rupture Hazard Zones in California, Interim Revision 2007, CGS Special Publication 42, Interim Revision 2007

California Building Standards Commission, 2013, 2013 California Building Code, California Code of Regulations, Title 24, Part 2, Volume 2 of 2, Based on 2012 International Building Code, Effective January 1, 2014.

California Department of Water Resources (CDWR) of California, 1970, Meeting Water Demands in Chino-Riverside Area, Bulletin No. 104-3, September 1970.

______, 2013, Water Data Library, <http://www.water.ca.gov/waterdatalibrary/>

California Geological Survey (formerly California Division of Mines and Geology), 2000, CD-ROM containing digital images of Official Maps of Alquist-Priolo Earthquake Fault Zones that affect the Southern Region, DMG CD 2000-003 2000.

CivilTech Software, 2008, LiquefyPro, Version 5.5j

Martin, G. R., and Lew, M., ed., 1999, "Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction Hazards in California," Southern California Earthquake Center, dated March 1999.

Public Works Standard, Inc., 2015, Greenbook, Standard Specifications for Public Works Construction: BNI Building News, Anaheim, California.

San Bernardino County, 2010, Geologic Hazard Overlays – FH27 C, Ontario, <http://www.sbcounty.gov/Uploads/lus/GeoHazMaps/FH27C_20100309.pdf>.

United States Geological Survey (USGS), 2011, Ground Motion Parameter Calculator, Seismic Hazard Curves and Uniform Hazard Response Spectrum, Java Application, Version 5.1.0, February 10, 2011, downloaded from http://earthquake.usgs.gov /hazards/designmaps/ javacalc.php

Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J.T., Dobry, R., Finn, L., Harder, L.F., Hynes, M.E., Ishihara, K., Koester, J.P., Liao, S.C., Marcuson, W.F. III, Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R.B., Stokoe, K.H. II, 2001, "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils", Journal of Geotechnical and Geoenvironmental Engineering, Vol. 127, No. 10, October 2001.

APPENDIX B

GEOTECHNICAL BORING LOGS

GEOTECHNICAL BORING LOG LB-1

Project No.	10557.004	**Date Drilled**	12-13-13
Project	Coastal Commerce Chino	**Logged By**	JMD
Drilling Co.	2R Drilling	**Hole Diameter**	9.5"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	849'
Location	See Figure 2	**Sampled By**	JMD

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0			BULK					@Surface: dirt with some straw	
				R-1	4 6 11	111	2	SM	@2.5' SILTY SAND, loose, light olive brown, dry to moist, fine sand, 30% fines (field estimate), trace rootlets, trace fine gravel	
845										
	5			R-2	7 10 14	119	1	SP	@5' SAND, medium dense, light brown, dry, medium to coarse sand, trace fines, trace fine gravel, larger piece of gravel in ring sample	
840										
	10			R-3	10 15 21	121	2	SP	@10' SAND, medium dense, gray to brown, dry, medium sand, some gravel, 1.25" maximum gravel size	
835										
	15			R-4	7 12 17	108	10	ML	@15' SANDY SILT, very stiff, yellowish brown, dry to moist, homogenous	-200
830										
	20			S-5	6 8 10			ML SP	@20' SANDY SILT, very stiff, dark gray, dry to moist, fine sand @20.7' SAND, gray, dry to moist, fine to medium sand	
									Total depth of 21.5' No groundwater encountered Backfilled with soil cuttings	
825										
	25									
820										
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-2

Project No.	10557.004	**Date Drilled**	12-13-13
Project	Coastal Commerce Chino	**Logged By**	JMD
Drilling Co.	2R Drilling	**Hole Diameter**	9.5"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	844'
Location	See Figure 2	**Sampled By**	JMD

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0			BULK					@Surface: dirt with some grass	
840				R-1	3 5 7	106	2	SM	@2.5' SILTY SAND, loose, light gray brown, dry, fine sand, 30% fines (field estimate), trace fine gravel	
	5			R-2	7 9 10			SP	@5' SAND, medium dense, reddish brown, dry, medium to coarse sand, trace fines, some gravel, 1.25" maximum gravel size	
835	10			R-3	20 24 25	126	2	SP	@10' SAND, medium dense, light gray brown, dry, medium to coarse sand, angular, broken rocks up to 2.25" in sample	
830	15			S-4	7 8 9			SP	@15' SAND, medium dense, gray, dry to moist, medium sand	
825	20			R-5	17 23 45	111	15	ML	@20' SANDY SILT, very dense, olive, moist, some FeO2 staining	
820	25			S-6	7 12 11			ML-CL	@25' SILT to CLAY, very stiff, gray, dry to moist, with FeO2 staining @25.4' SAND, dry, fine to medium sand @25.6' SILT, gray, moist @25.9' CLAY, gray, moist	
815	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-2

Project No.	10557.004	**Date Drilled**	12-13-13
Project	Coastal Commerce Chino	**Logged By**	JMD
Drilling Co.	2R Drilling	**Hole Diameter**	9.5"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	844'
Location	See Figure 2	**Sampled By**	JMD

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	30			S-7	8 16 21			ML	@30' SILT, hard, olive brown, dry to moist, FeO2 staining, with some clay @30.5' SILT, olive brown, dry to moist, FeO2 staining @31' SAND, dark reddish brown to light gray, dry, fine to medium sand	
810										
	35			S-8	18 24 21			SP	@35' SAND, light brown, dry to moist, with large amounts of FeO2 staining, trace fine gravel, a 1.25" piece of gravel in the sampler tip	
805										
	40			S-9	12 10 20			CL	@40' CLAY with gravel, hard, reddish brown to olive brown, gravel up to 2" large, with some silt, some FeO2 staining @41.3' SAND with gravel, dry to moist, medium to coarse sand, gravel up to 2" large	
800										
	45			S-10	15 35 24			SM	@45' SILTY SAND, very dense, reddish brown, moist, angular, 20% fines (field estimate), with some gravel, 1" maximum gravel size	
795										
	50			S-11	9 11 16			ML	@50' SILT, very stiff, olive brown, moist, with FeO2 staining, homogenous	
									Total depth of 51.5' No groundwater encountered Bakfilled with soil cuttings	
790										
	55									
785										
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

GEOTECHNICAL BORING LOG LB-3

Project No.	10557.004	**Date Drilled**	12-13-13
Project	Coastal Commerce Chino	**Logged By**	JMD
Drilling Co.	2R Drilling	**Hole Diameter**	9.5"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	852'
Location	See Figure 2	**Sampled By**	JMD

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	**SOIL DESCRIPTION** *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0			BULK					@Surface: dry grass	
850										
				R-1	2 4 6	104	4	SM	@2.5' SILTY SAND, loose, light brown, dry, fine sand, 40% fines (field estimate), trace rootlets	
	5			R-2	8 11 14	111	5	SM	@5' SILTY SAND, medium dense, brown, moist, fine sand, 30% fines (field estimate)	
845										
	10			R-3	11 7 13	111	4	SM	@10' SILTY SAND, medium dense, light gray brown, moist, fine sand, 30% fines (field estimate), trace fine gravel	CO
840										
	15			R-4	11 17 19	93	9	ML	@15' SILT, very stiff, gray, moist, FeO2 staining, homongenous	AL
835										
	20			S-5	5 7 9			CL ML	@20' CLAY, very stiff, gray, moist, FeO2 staining @20.5' SILT, gray, moist, FeO2 staining	
830										
	25			S-6	5 5 11			ML		
825										
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

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GEOTECHNICAL BORING LOG LB-3

Project No.	10557.004	**Date Drilled**	12-13-13
Project	Coastal Commerce Chino	**Logged By**	JMD
Drilling Co.	2R Drilling	**Hole Diameter**	9.5"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	852'
Location	See Figure 2	**Sampled By**	JMD

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	30			S-7	12 14 16			ML	@30' SANDY SILT, very stiff, gray, moist	
820								SM	@31.1' SILTY SAND, gray, dry, fine sand, 20% fines (field estimate),	
	35			S-8	17 13 8			SP	@35' SAND, medium dense, reddish brown, medium to coarse sand	
815								CL	@36.3' CLAY, olive brown, moist, large amount of FeO2 staining	
	40			S-9	9 14 26			ML	@40' SANDY SILT, hard, olive brown, moist, large amount of FeO2 staining	
810										
	45			S-10	6 8 9			ML	@45' SILT, very stiff, light brown, large amount of FeO2 staining, homogenous	
805										
	50			S-11	14 14 20			SP	@50' SAND, dense, light gray brown, dry to moist, fine sand, trace fines	
800								ML	@51.2' SILT, light brown, large amount of FeO2 staining	
									Total depth of 51.5' No groundwater encountered Backfilled with soil cuttings	
	55									
795										
	60									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-4

Project No.	10557.004	**Date Drilled**	12-13-13
Project	Coastal Commerce Chino	**Logged By**	JMD
Drilling Co.	2R Drilling	**Hole Diameter**	9.5"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	850'
Location	See Figure 2	**Sampled By**	JMD

SOIL DESCRIPTION

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Soil Description	Type of Tests
850	0			BULK					@Surface: dirt	MD, CR
				R-1	5 8 8			SM	@2.5' SILTY SAND, loose, light brown to brown, dry, 20% fines (field estimate), with some gravel, 2" maximum gravel size	
845	5			R-2	6 11 10	121	2	SP-SM	@5' SAND to SILTY SAND, medium dense, light brown, dry to moist, 10% fines (field estimate), with some gravel, 1.25" maximum gravel size	-200
840	10			R-3	20 30 40			SP	@10' SAND, dense, gray, dry to moist, trace fines, some fine and medium sand, some gravel, 1.5" maximum gravel size	
835	15			S-4	6 7 7			SM	@15' SILTY SAND, medium dense, olive, moist, fine sand, 40% fines (field estimate), trace coarse sand	
830	20			R-5	10 19 26	100	19	CL	@20' CLAY, very stiff, olive, moist, with FeO2 staining. homogenous	
									Total depth of 21.5' No groundwater encountered Backfilled with soil cuttings	
825	25									
820	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-5

Project No.	10557.004	**Date Drilled**	12-13-13
Project	Coastal Commerce Chino	**Logged By**	JMD
Drilling Co.	2R Drilling	**Hole Diameter**	10"
Drilling Method	Hollow Stem Auger - 140lb - Autohammer - 30" Drop	**Ground Elevation**	848'
Location	See Figure 2	**Sampled By**	JMD

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION *This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	Type of Tests
	0			BULK					@Surface: dirt	
845										
	5			R-2	12 28 34	117	3	SP	@5' SAND, dense, gray brown, moist, medium sand, with some gravel, 1" maximum gravel size	
840										
	10			R-3	12 16 18	106	3	SP	@10' SAND, medium dense, gray to reddish brown, moist, medium sand, trace gravel, 2" maximum gravel size	
835										
	15			R-4	17 14 17	105	2	SP	@15' SAND, medium dense, olive, moist, trace fines, trace fine gravel, trace FeO2 staining	
830										
	20			S-5	7 6 6			SM	@20' SILTY SAND, medium dense, olive, dry to moist, fine sand, 40% fines (field estimate), some FeO2 staining	
									Total depth of 21.5' No groundwater encountered Backfilled with soil cuttings	
825										
	25									
820										
	30									

SAMPLE TYPES:
- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

General Test Setup Data of Well Permeameter, from USBR 7300-89 Method.

Project: Coastal Commercial Chino, Project No. 10557.004

			LB-1		LB-2		LB-3		LB-4		LB-5			
	Exploration #/Location:		LB-1		LB-2		LB-3		LB-4		LB-5			
	Approx. Test Depth (ft):		6		4		6		6		5			
	Date Tested, start/finish:		12/16/2013		12/16/2013		12/16/2013		12/16/2013		12/16/2013			
	Tested by:		JMD		JMD		JMD		JMD		JMD			
	USCS Soil Type:													
	Weather (start to finish)		Warm, clear											
	Liquid Used/pH:		water from garden hose											
	Well Prep:		straight drill, tamp											
a.	**Diameter of barrel (in.):**		22.5		22.5		22.5		22.5		22.5		22.5	
b.	**No. of Supply barrels:**		1		1		1		1		1		1	
c.	**Measured boring diameter**	inches	9.5		9.5		9.5		9.5		10		13	
d.	Approx Depth to groundwater below GS	feet	200		200		200		200		200		200	
	Depths from string line (or top of ex. pavement):													
f.	to ground surface (=0 if no string line used)	ft/in.	0. ft		0. ft		0. ft		0. ft		0. ft			
g.	**to Bot of Boring** (or top of soil over Bentonite)	ft/in.	6. ft	1. in.	4. ft	3. in.	5. ft	7. in.	5. ft	8. in.	4. ft	10. in.		
i	to Top of Sand (bot of float assbly) (dry)	ft/in.	5. ft	10. in.	4. ft	2. in.	5. ft	4.5 in.	5. ft	5. in.	4. ft	6. in.		
k	to Top of casing after adding water (negative is above string line)	ft/in.	0. ft	-3. in.			0. ft	-0.75 in.			0. ft	-1. in.		
m	Top of Float assembly Rod, when pushed to bottom	ft/in.		34.75 in.				33.5 in.				14.88 in.		
n	**top of float assembly rod, floating, water level stable**	ft/in.		30.5 in.				25.13 in.				26.5 in.		
p	**Float Assembly (choose one)**		Long body				Long body				Long body			
q	Float Assembly extension (0=none)	inches	12				12				0			
s	free play in float assembly (water level stablized)	inches	2.5				1.25				2.5			
t	Length of float assembly (=lookup p)	inches	23		#N/A		23		#N/A		23		#N/A	
u	Length of float assembly plus extension (=q+t)	inches	35		#N/A		35		#N/A		35		#N/A	
v	**Ht from water surface to top of float rod (=lookup p)**	inches	16.75		#N/A		16.75		#N/A		16.75		#N/A	
w	range of float movement (=lookup p)	inches	6.75		#N/A		6.75		#N/A		6.75		#N/A	
x	Depth to Water Surface (=n+v)		47.3	in.	#N/A	in.	41.9	in.	#N/A	in.	43.3	in.	#N/A	in.
h	**Depth of water in Well, "h" (=g-x)**		**25.8 in=**	2.15 ft	**#N/A**	#N/A	**25.1 in=**	2.09 ft	**#N/A**	#N/A	**14.8 in=**	1.23 ft	**#N/A**	#N/A
y	Total Area of barrels (in.^2):		397		397		397		397		397		397	
r	**Well Radius, "r" (=c/2)**		**4.8**	in.	**4.8**	in.	**4.8**	in.	**4.8**	in.	**5.0**	in.	**6.5**	in.

Results of Well Permeameter Test, from USBR 7300-89 Method.

Leighton

Project: Coastal Commercial Chino, Project No. 10557.004

Exploration #/Location: ***LB-1***   Initial Depth to top of float rod (in.) 30.5

Field Data / **Calculations**

Date (and comments)	Time	**Water Level in Supply Barrel (in.)**	Depth to top of float rod (when changed)		Water Temp in Barrel (deg F)	DL Interpre-tation? ("Y")	DL -- Head of Water in Barrel (in.)	h, Height of Water in Well (in.)	h/r	Total Elapsed Time (minutes)	Δt (min)	Vol Change (in.^3)	Flow (in^3/min)	q, Flow (in^3/hr)	V (Fig 9)	K20, Coef. Of Permeability at 20 deg C (in./hr)	**Infiltration Rate [flow/surf area] (in./hr) (FS=1)**
Start Date	Start time:																
12/16/2013	12:52:00 PM		**ft**	**in.**						E	G	H					
12/16/13	12:52	29.25			**74**			25.75	5.4	0					0.9		
12/16/13	12:53	28						25.75	5.4	0	1	497	497	29805	0.9	10.01	**14.65**
12/16/13	12:54	27						25.75	5.4	0	1	397	397	23844	0.9	8.00	**11.72**
12/16/13	12:55	26.625						25.75	5.4	0	1	149	149	8942	0.9	3.00	**4.39**
12/16/13	12:57	25.875						25.75	5.4	0	2	298	149	8942	0.9	3.00	**4.39**
12/16/13	13:05	20.25						25.75	5.4	0	8	2235	279	16766	0.9	5.63	**8.24**
12/16/13	13:23	10.75			76			25.75	5.4	0	18	3775	210	12585	0.9	4.11	**6.02**
										0							
12/16/13	13:27	31.125			76			25.75	5.4	0					0.9		
12/16/13	13:49	20.25						25.75	5.4	0	22	4322	196	11787	0.9	3.85	**5.64**
12/16/13	14:01	14.25			77			25.75	5.4	0	12	2384	199	11922	0.9	3.85	**5.63**
										0							
12/16/13	14:06	31.375			77			25.75	5.4	0					0.9		
12/16/13	14:37	18.5			77			25.75	5.4	0	31	5117	165	9903	0.9	3.20	**4.68**
12/16/13	15:07	7.25			77			25.75	5.4	0	30	4471	149	8942	0.9	2.89	**4.22**
12/16/13	15:20	3						25.75	5.4	0	13	1689	130	7795	0.9	2.52	**3.68**
										0							

Results of Well Permeameter Test, from USBR 7300-89 Method.

Leighton

Project: **Coastal Commercial Chino, Project No. 10557.004**

Exploration #/Location: ***LB-3***

Initial Depth to top of float rod (in.) 25.125

Field Data **Calculations**

Date (and comments)	Time	**Water Level in Supply Barrel (in.)**	Depth to top of float rod (when changed) ft	in.	Water Temp in Barrel (deg F)	DL Interpre-tation? ("Y")	DL -- Head of Water in Barrel (in.)	h, Height of Water in Well (in.)	h/r	Total Elapsed Time (minutes)	Δt (min)	Vol Change (in.^3)	Flow (in^3/min)	q, Flow (in^3/hr)	Cumulative Vol (gal)	V (Fig 9)	K20, Coef. Of Permeability at 20 deg C (in./hr)	**Infiltration Rate [flow/surf area] (in./hr) (FS=1)**
Start Date	Start time:																	
12/16/2013	10:25:00 AM																	
12/16/13	10:25	30.25			**69**			25.125	5.3	0					0	1.0		
12/16/13	11:04	28.375			74			25.125	5.3		39	745	19	1146		0.9	0.40	**0.58**
12/16/13	11:35	27.375			77			25.125	5.3		31	397	13	769		0.9	0.26	**0.37**
12/16/13	12:27	25.75			79			25.125	5.3		52	646	12	745		0.8	0.24	**0.35**
12/16/13	13:09	24.5			81			25.125	5.3		42	497	12	710		0.8	0.23	**0.33**
12/16/13	13:53	23.25			81			25.125	5.3		44	497	11	677		0.8	0.22	**0.31**
12/16/13	14:49	20.75			82			25.125	5.3		56	994	18	1064		0.8	0.34	**0.49**
12/16/13	15:45	19.125			83			25.125	5.3		56	646	12	692		0.8	0.22	**0.31**

Results of Well Permeameter Test, from USBR 7300-89 Method.

Project: **Coastal Commercial Chino, Project No. 10557.004**

Exploration #/Location: ***LB-5*** Initial Depth to top of float rod (in.) 26.5

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Field Data **Calculations**

Date (and comments)	Time	**Water Level in Supply Barrel (in.)**	Depth to top of float rod (when changed)		Water Temp in Barrel (deg F)	DL Interpre-tation? ("Y")	DL -- Head of Water in Barrel (in.)	h, Height of Water in Well (in.)	h/r	Total Elapsed Time (minutes)	Δt (min)	Vol Change (in.^3)	Flow (in^3/min)	q, Flow (in^3/hr)	Cumulative Vol (gal)	V (Fig 9)	K20, Coef. Of Permeability at 20 deg C (in./hr)	**Infiltration Rate [flow/surf area] (in./hr) (FS=1)**
Start Date	Start time:																	
12/16/2013	2:25:00 PM		**ft**	**in.**														
12/16/13	14:25	31			**77**			14.75	3.0	0					0	0.9		
12/16/13	14:26	30						14.75	3.0		1	397	397	23844		0.9	16.33	**17.75**
12/16/13	14:27	29.125						14.75	3.0		1	348	348	20864		0.9	14.29	**15.53**
12/16/13	14:28	28.125						14.75	3.0		1	397	397	23844		0.9	16.33	**17.75**
12/16/13	14:29	27.25						14.75	3.0		1	348	348	20864		0.9	14.29	**15.53**
12/16/13	14:30	26.25						14.75	3.0		1	397	397	23844		0.9	16.33	**17.75**
12/16/13	14:32	24.375						14.75	3.0		2	745	373	22354		0.9	15.31	**16.64**
12/16/13	14:42	15.375			77			14.75	3.0		10	3577	358	21460		0.9	14.70	**15.97**
12/16/13	14:53	6						14.75	3.0		11	3726	339	20322		0.9	13.92	**15.13**
12/16/13	15:01	25.125			79			14.75	3.0							0.8		
12/16/13	15:02	24.5						14.75	3.0		1	248	248	14903		0.8	9.96	**10.82**
12/16/13	15:24	7.75			79			14.75	3.0	0	22	6657	303	18154	0	0.8	12.13	**13.18**
12/16/13	15:31	2.375						14.75	3.0	0	7	2136	305	18309	0	0.8	12.23	**13.30**
										0					0			

APPENDIX C

LABORATORY TEST RESULTS

Leighton

TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: Coastal Commercial Chino   Tested By : G. Berdy   Date: 12/26/13

Project No. : 10557.004   Data Input By: J. Ward   Date: 01/03/14

Boring No.	LB-4			
Sample No.	B-4			
Sample Depth (ft)	0-5			
Soil Identification:	Olive brown (SP-SM)g			
Wet Weight of Soil + Container (g)	301.40			
Dry Weight of Soil + Container (g)	299.00			
Weight of Container (g)	64.80			
Moisture Content (%)	1.02			
Weight of Soaked Soil (g)	100.50			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	31			
Crucible No.	28			
Furnace Temperature (°C)	820			
Time In / Time Out	8:50/9:35			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	21.1490			
Wt. of Crucible (g)	21.1467			
Wt. of Residue (g) (A)	0.0023			
PPM of Sulfate (A) x 41150	94.65			
PPM of Sulfate, Dry Weight Basis	96			

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)	15			
ml of AgNO3 Soln. Used in Titration (C)	1.2			
PPM of Chloride (C -0.2) * 100 * 30 / B	200			
PPM of Chloride, Dry Wt. Basis	202			

pH TEST, DOT California Test 532/643

pH Value	6.94			
Temperature °C	21.0			

SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

Project Name: Coastal Commercial Chino
Tested By : G. Berdy Date: 12/31/13

Project No. : 10557.004
Data Input By: J. Ward Date: 01/03/14

Boring No.: LB-4
Depth (ft.) : 0-5

Sample No. : B-4

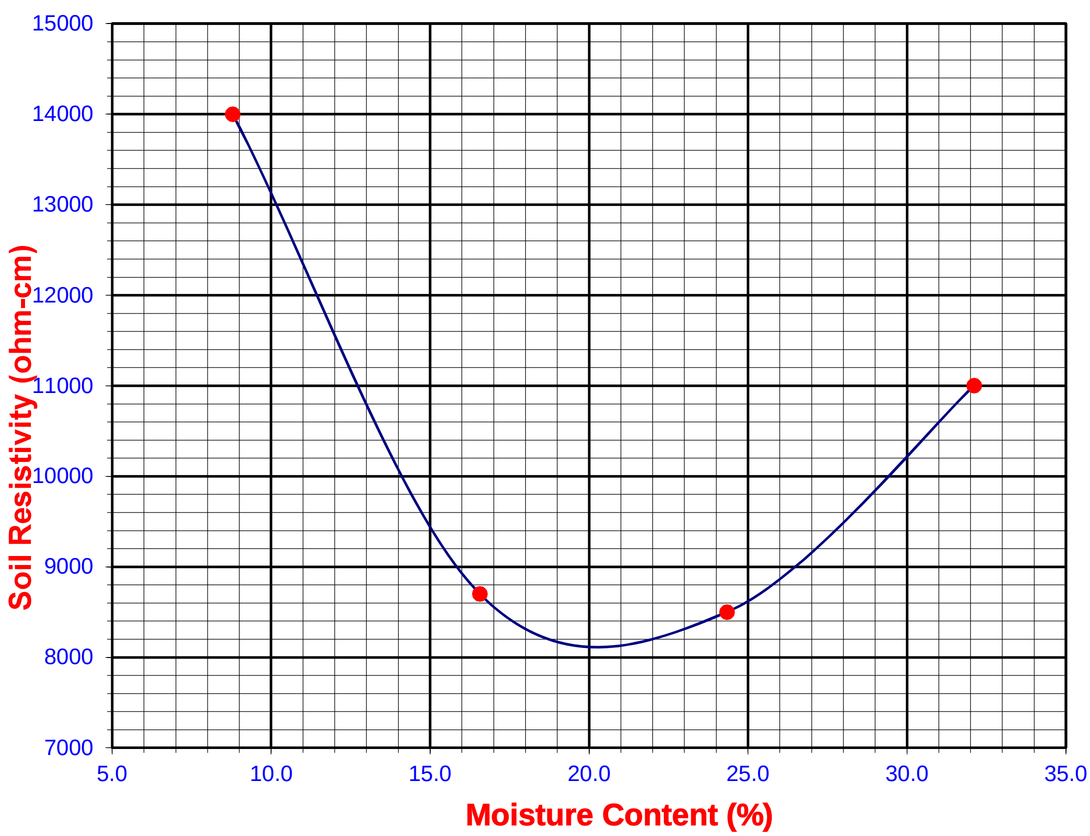
Soil Identification:* Olive brown (SP-SM)g

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	10	8.80	14000	14000
2	20	16.57	8700	8700
3	30	24.34	8500	8500
4	40	32.11	11000	11000
5				

Moisture Content (%) (MCi)	1.02
Wet Wt. of Soil + Cont. (g)	301.40
Dry Wt. of Soil + Cont. (g)	299.00
Wt. of Container (g)	64.80
Container No.	
Initial Soil Wt. (g) (Wt)	130.00
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
8100	20.3	96	202	6.94	21.0



TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Leighton

Project Name: Coastal Commercial Chino | Tested By : G. Berdy | Date: 12/26/13

Project No. : 10557.004 | Data Input By: J. Ward | Date: 01/03/14

Boring No.	LB-4			
Sample No.	B-4			
Sample Depth (ft)	0-5			
Soil Identification:	Olive brown (SP-SM)g			
Wet Weight of Soil + Container (g)	301.40			
Dry Weight of Soil + Container (g)	299.00			
Weight of Container (g)	64.80			
Moisture Content (%)	1.02			
Weight of Soaked Soil (g)	100.50			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	31			
Crucible No.	28			
Furnace Temperature (°C)	820			
Time In / Time Out	8:50/9:35			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	21.1490			
Wt. of Crucible (g)	21.1467			
Wt. of Residue (g) (A)	0.0023			
PPM of Sulfate (A) x 41150	94.65			
PPM of Sulfate, Dry Weight Basis	96			

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)	15			
ml of AgNO3 Soln. Used in Titration (C)	1.2			
PPM of Chloride (C -0.2) * 100 * 30 / B	200			
PPM of Chloride, Dry Wt. Basis	202			

pH TEST, DOT California Test 532/643

pH Value	6.94			
Temperature °C	21.0			

SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

Project Name: Coastal Commercial Chino

Project No. : 10557.004

Boring No.: LB-4

Sample No. : B-4

Tested By : G. Berdy Date: 12/31/13

Data Input By: J. Ward Date: 01/03/14

Depth (ft.) : 0-5

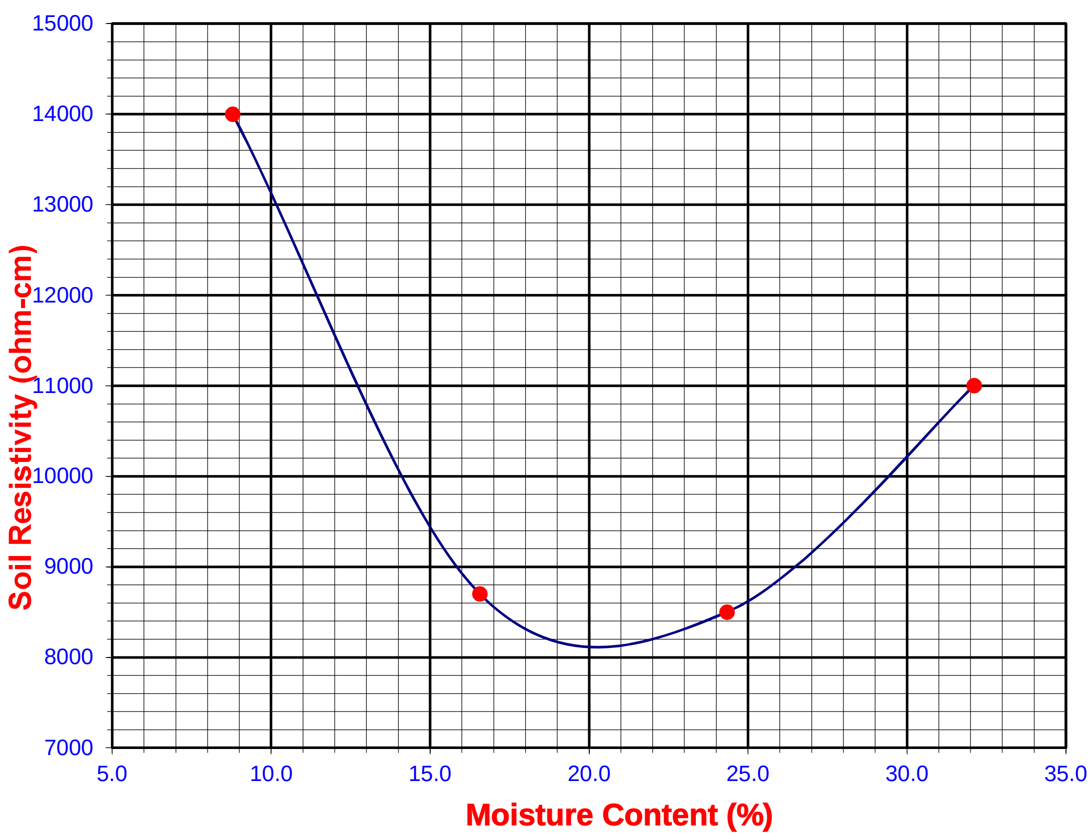
Soil Identification:* Olive brown (SP-SM)g

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	10	8.80	14000	14000
2	20	16.57	8700	8700
3	30	24.34	8500	8500
4	40	32.11	11000	11000
5				

Moisture Content (%) (MCi)	1.02
Wet Wt. of Soil + Cont. (g)	301.40
Dry Wt. of Soil + Cont. (g)	299.00
Wt. of Container (g)	64.80
Container No.	
Initial Soil Wt. (g) (Wt)	130.00
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
8100	20.3	96	202	6.94	21.0



Leighton

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Coastal Commercial Chino	Tested By:	O. Figueroa	Date:	12/27/13
Project No.:	10557.004	Input By:	J. Ward	Date:	01/03/14
Boring No.:	LB-4	Depth (ft.):	0-5		
Sample No.:	B-4				
Soil Identification:	Olive brown poorly-graded sand with silt and gravel (SP-SM)g				

Preparation Method:	X	Moist
		Dry
Compaction Method	X	Mechanical Ram
		Manual Ram

Scalp Fraction (%)	
#3/4	
#3/8	
#4	15.4

Rammer Weight (lb.) = 10.0

Height of Drop (in.) = 18.0

Mold Volume (ft³) 0.03310

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3773.0	3834.0	3898.0	3899.0		
Weight of Mold (g)	1859.0	1859.0	1859.0	1859.0		
Net Weight of Soil (g)	1914.0	1975.0	2039.0	2040.0		
Wet Weight of Soil + Cont. (g)	475.80	450.50	423.80	506.90		
Dry Weight of Soil + Cont. (g)	462.20	428.90	395.80	463.60		
Weight of Container (g)	48.50	51.30	54.80	52.70		
Moisture Content (%)	3.29	5.72	8.21	10.54		
Wet Density (pcf)	127.5	131.5	135.8	135.9		
Dry Density (pcf)	123.4	124.4	125.5	122.9		

Maximum Dry Density (pcf)	125.5	Optimum Moisture Content (%)	8.0
Corrected Dry Density (pcf)	130.5	Corrected Moisture Content (%)	7.0

[X] Procedure A
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

[ ] Procedure B
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

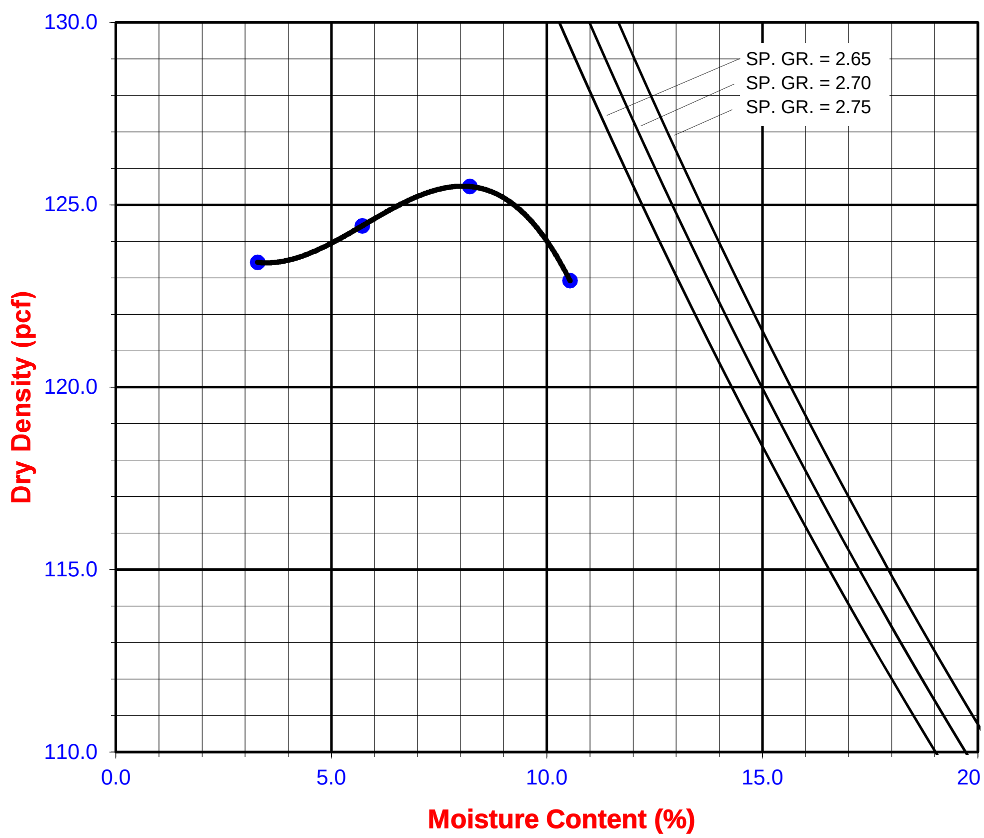
[ ] Procedure C
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



MX LB-4, B-4 @ 0-5

Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	Coastal Commercial Chino	Tested By:	G. Bathala	Date:	12/30/13
Project No. :	10557.004	Input By:	J. Ward	Date:	01/03/13
Boring No.:	LB-3	Checked By:	J. Ward		
Sample No.:	R-4	Depth (ft.)	15.0		
Soil Identification:	Olive sandy silt s(ML)				

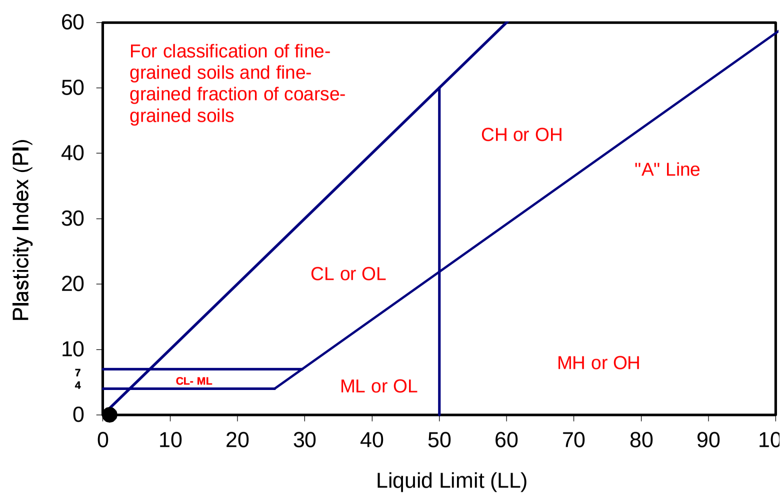
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			5			
Wet Wt. of Soil + Cont. (g)	18.01	16.94	35.69	Cannot get more than 5 blows:		
Dry Wt. of Soil + Cont. (g)	17.10	16.27	30.12	NonPlastic		
Wt. of Container (g)	13.51	13.61	13.51			
Moisture Content (%) [Wn]	25.35	25.19	33.53			

Liquid Limit	NP
Plastic Limit	25
Plasticity Index	NP
Classification	NP

PI at "A" - Line = 0.73(LL-20) =

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



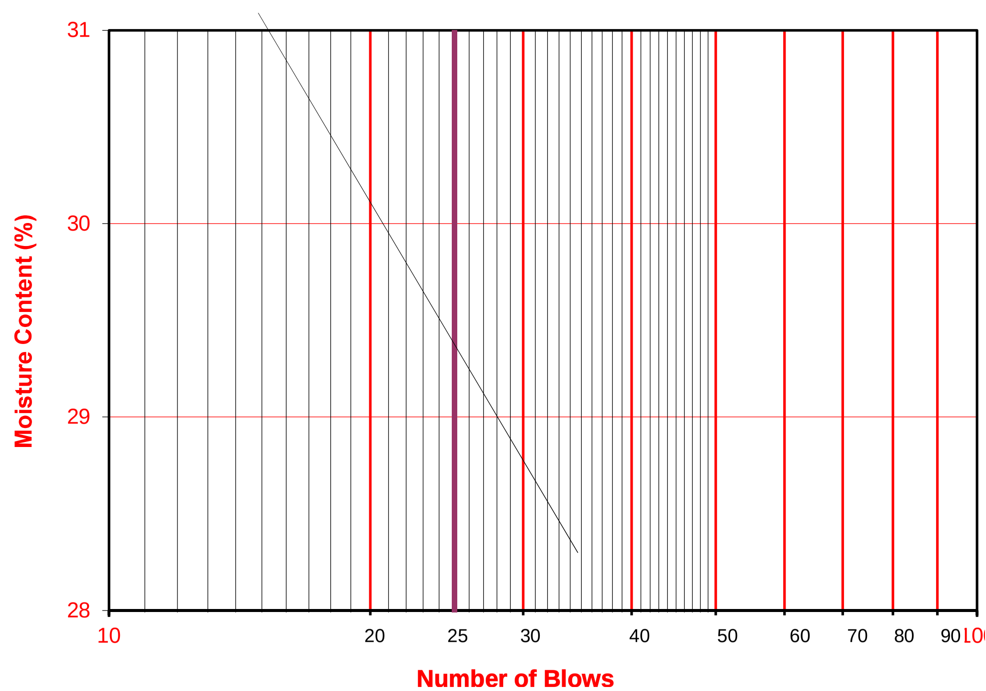
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



Leighton

ONE-DIMENSIONAL SWELL OR SETTLEMENT POTENTIAL OF COHESIVE SOILS
(ASTM D 4546)

Project Name:	Coastal Commercial Chino	Tested By:	G. Bathala	Date:	12/20/13
Project No.:	10557.004	Checked By:	J. Ward	Date:	01/03/14
Boring No.:	LB-3	Sample Type:	Ring		
Sample No.:	R-3	Depth (ft.)	10.0		
Sample Description:	Olive silty sand (SM)				

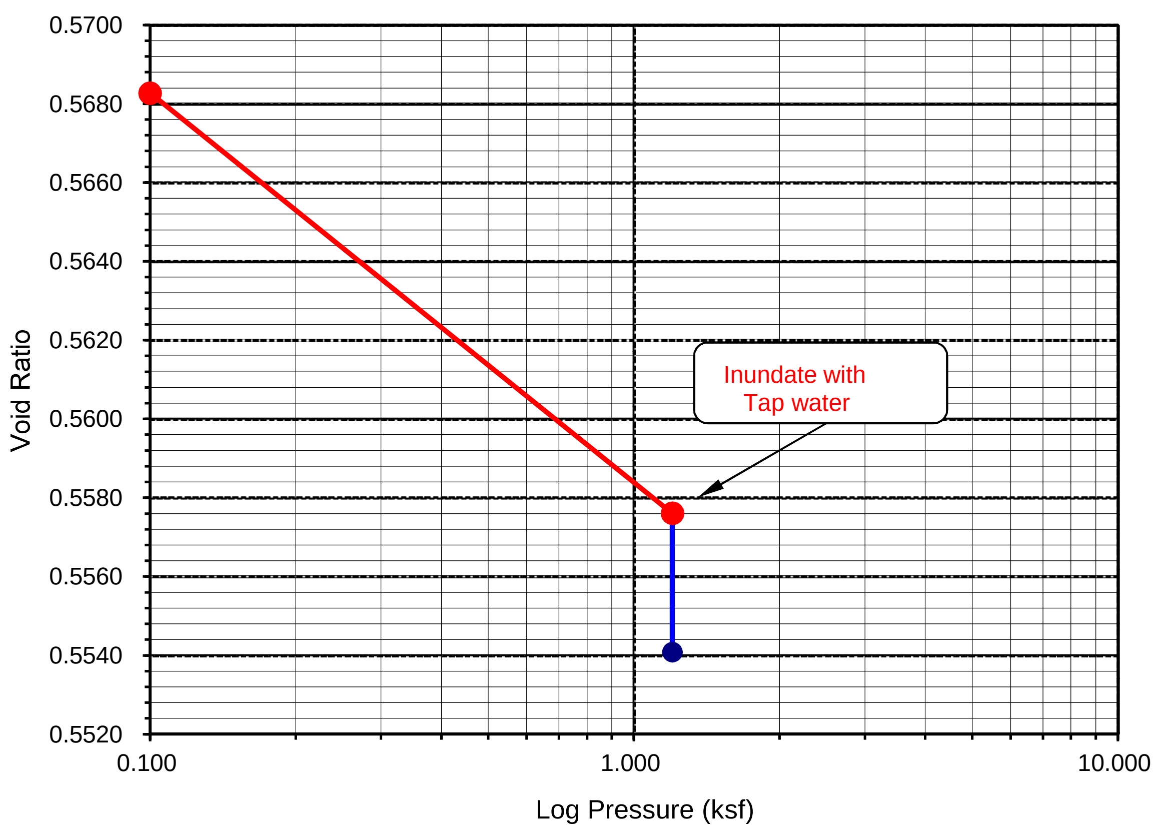
Initial Dry Density (pcf):	107.5
Initial Moisture (%):	3.61
Initial Length (in.):	1.0000
Initial Dial Reading:	0.3063
Diameter(in):	2.416

Final Dry Density (pcf):	108.5
Final Moisture (%) :	17.2
Initial Void Ratio:	0.5683
Specific Gravity(assumed):	2.70
Initial Saturation (%)	17.2

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.100	0.3063	1.0000	0.00	0.00	0.5683	0.00
1.200	0.2983	0.9920	0.12	-0.80	0.5576	-0.68
H2O	0.2961	0.9898	0.12	-1.03	0.5541	-0.91

Percent Swell (+) / Settlement (-) After Inundation = -0.23

Void Ratio - Log Pressure Curve



Boring No.	LB-1	LB-4						
Sample No.	R-4	R-2						
Depth (ft.)	15.0	5.0						
Sample Type	Ring	Ring						
Soil Identification	Brown poorly-graded sand with silt and gravel (SP-SM)g	Olive brown sandy silt s(ML)						
Moisture Correction								
Wet Weight of Soil + Container (g)	0.0	0.0						
Dry Weight of Soil + Container (g)	0.0	0.0						
Weight of Container (g)	1.0	1.0						
Moisture Content (%)	0.00	0.00						
Sample Dry Weight Determination								
Weight of Sample + Container (g)	822.7	915.4						
Weight of Container (g)	250.0	252.4						
Weight of Dry Sample (g)	572.7	663.0						
Container No.:								
After Wash								
Method (A or B)	B	B						
Dry Weight of Sample + Cont. (g)	782.9	519.1						
Weight of Container (g)	250.0	252.4						
Dry Weight of Sample (g)	532.9	266.7						
% Passing No. 200 Sieve	**6.9**	**59.8**						
% Retained No. 200 Sieve	93.1	40.2						

Leighton

PERCENT PASSING
No. 200 SIEVE
ASTM D 1140

Project Name: Coastal Commercial Chino
Project No.: 10557.004
Client Name: L&A/Rancho Cucamonga
Tested By: S. Felter Date: 12/23/13

APPENDIX D

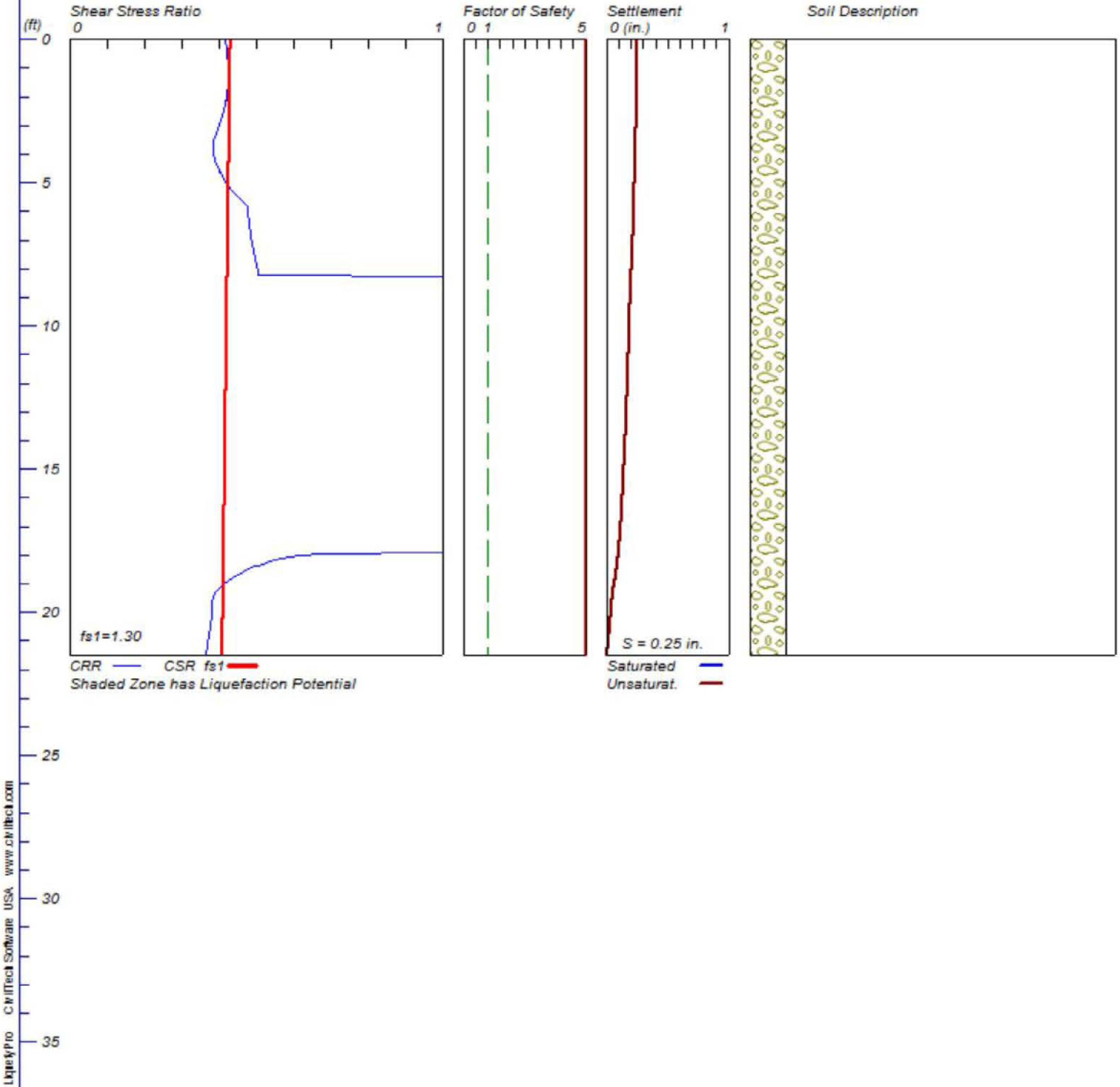
SUMMARY OF SECONDARY SEISMIC HAZARD ANALYSIS

SEISMIC SETTLEMENT ANALYSIS

Coastal Commerce Chino

Hole No.=LB-1 Water Depth=100 ft Surface Elev.=849

Magnitude=6.57
Acceleration=0.51g

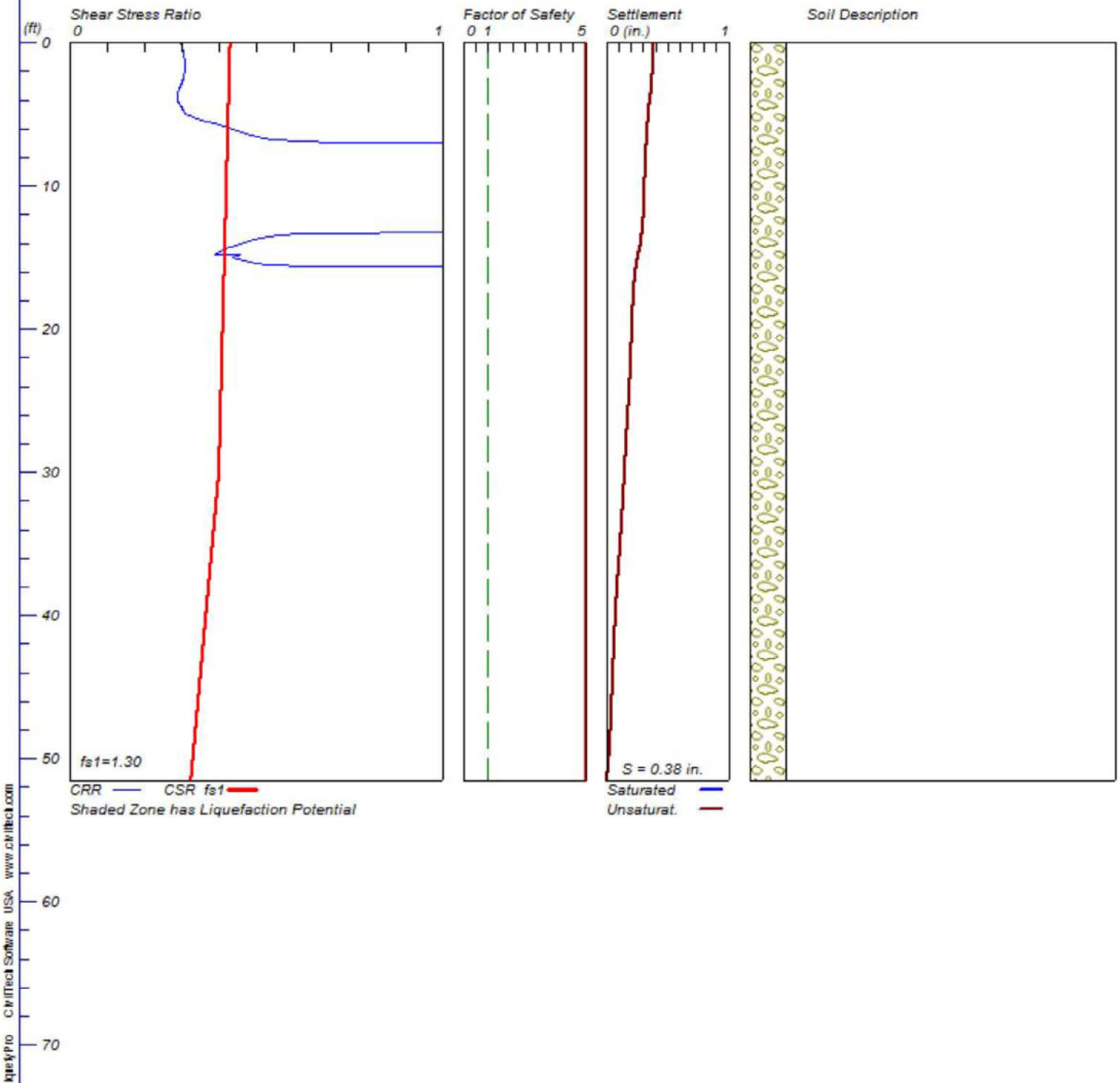


SEISMIC SETTLEMENT ANALYSIS

Coastal Commerce Chino

Hole No.=LB-2 Water Depth=100 ft Surface Elev.=844

Magnitude=6.57
Acceleration=0.51g

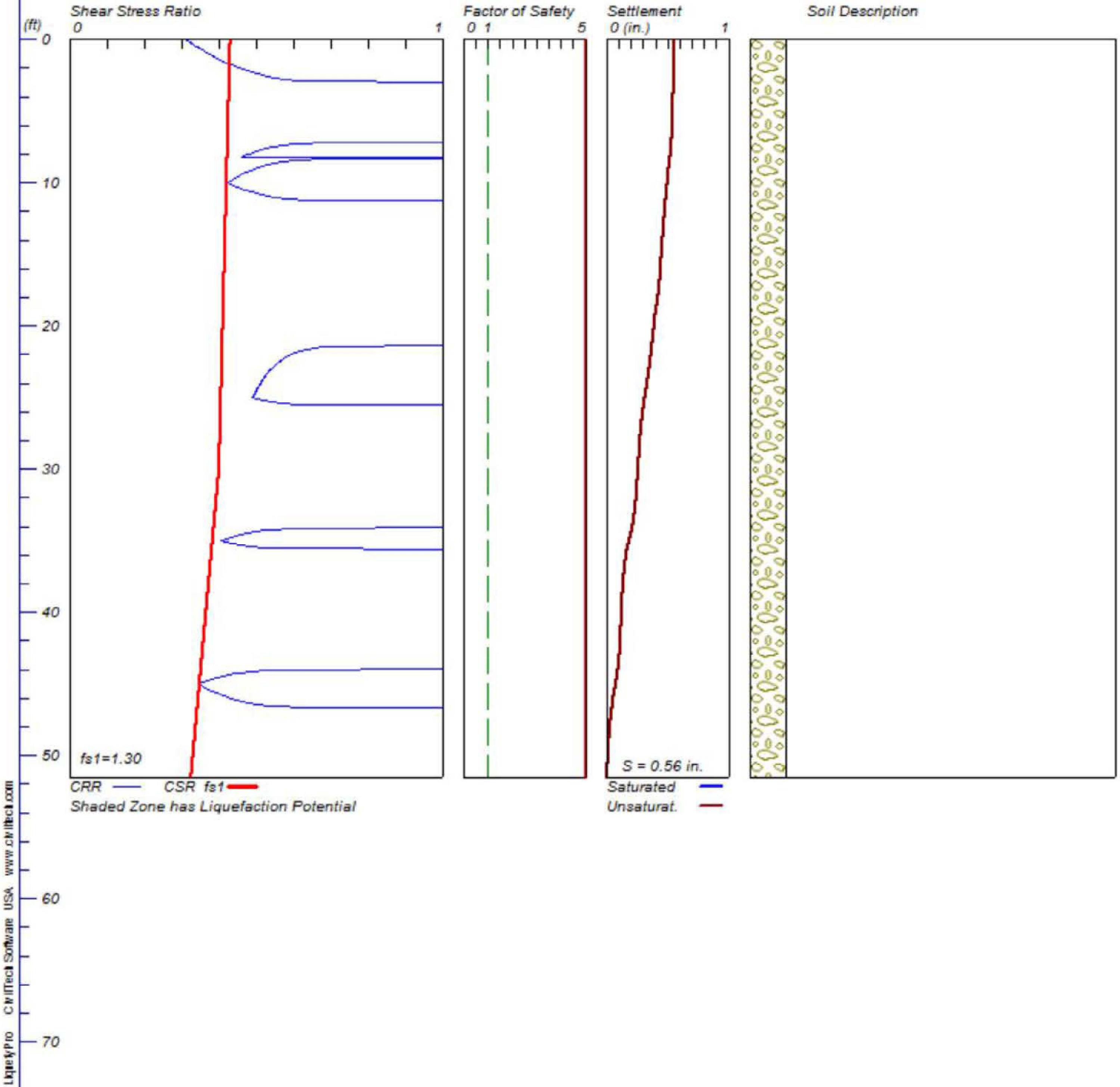


SEISMIC SETTLEMENT ANALYSIS

Coastal Commerce Chino

Hole No.=LB-3 Water Depth=100 ft Surface Elev.=852

Magnitude=6.57
Acceleration=0.51g

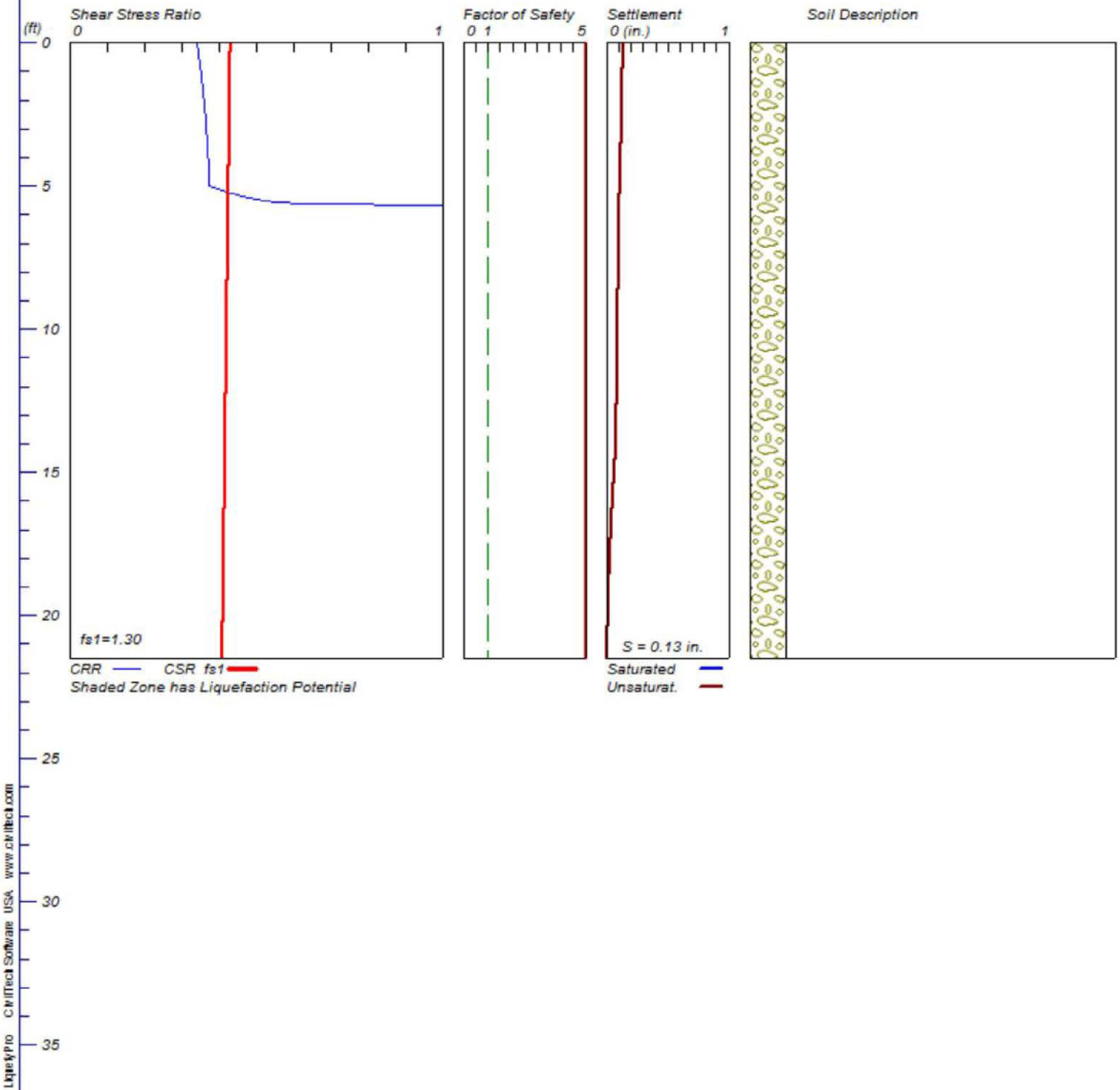


SEISMIC SETTLEMENT ANALYSIS

Coastal Commerce Chino

Hole No.=LB-4   Water Depth=100 ft   Surface Elev.=850

Magnitude=6.57
Acceleration=0.51g



LEIGHTON

10557.004

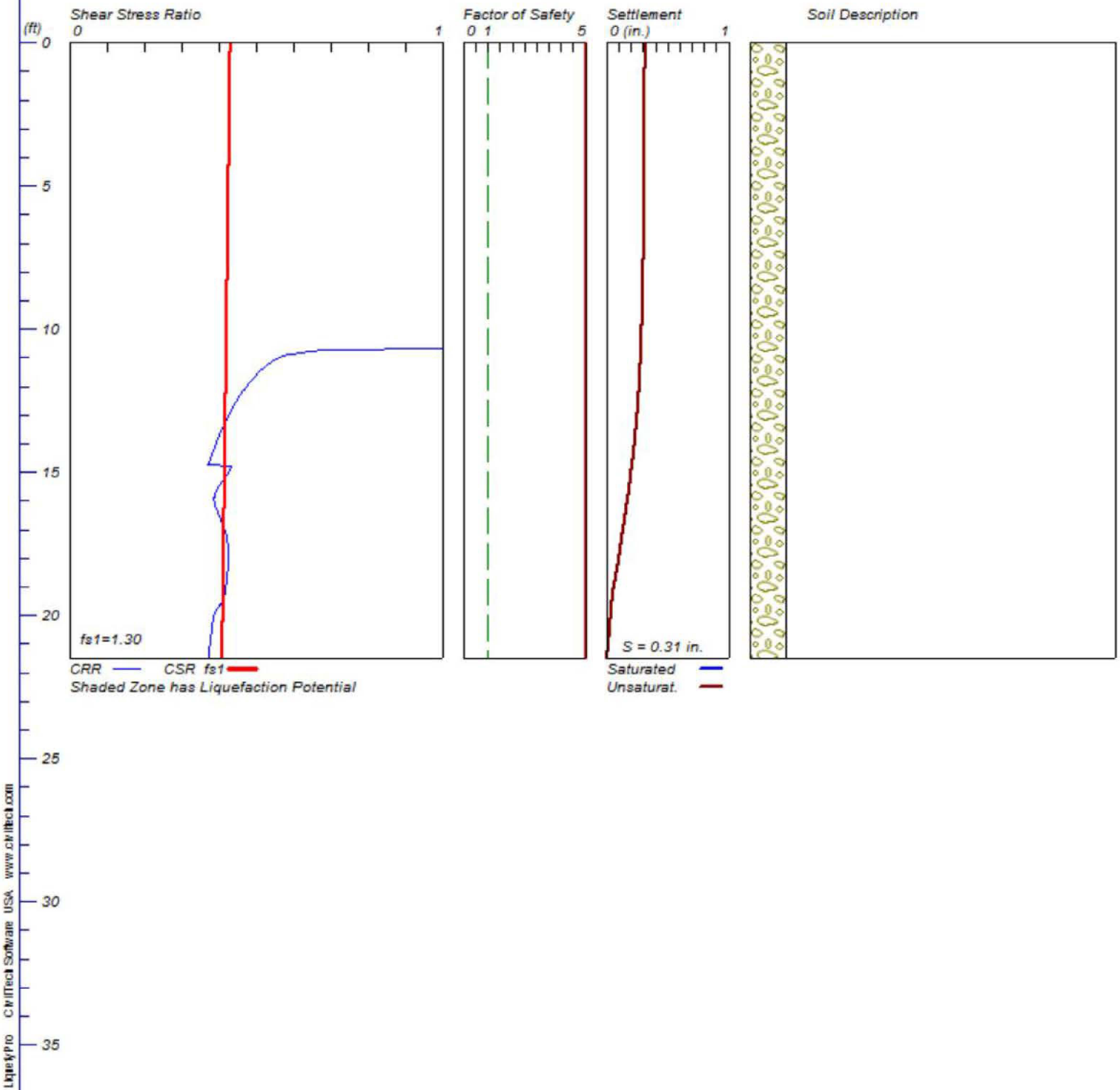
Plate A-4

SEISMIC SETTLEMENT ANALYSIS

Coastal Commerce Chino

Hole No.=LB-5 Water Depth=100 ft Surface Elev.=848

Magnitude=6.57
Acceleration=0.51g



APPENDIX E

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

Leighton

LEIGHTON AND ASSOCIATES, INC.

GENERAL EARTHWORK AND GRADING SPECIFICATIONS FOR ROUGH GRADING

Table of Contents

1.0 General

1.1 Intent: These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 The Geotechnical Consultant of Record: Prior to commencement of work, the owner shall employ the Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultants shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor: The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The

Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing: Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

2.2 Processing: Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation: In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching: Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas: All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General: Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize: Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import: If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers: Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill Moisture Conditioning: Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557-91).

4.3 Compaction of Fill: After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557-91). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes: In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557-91.

4.5 Compaction Testing: Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Frequency of Compaction Testing: Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations: The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 Safety: The Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and Backfill: All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of maximum from 1 foot above the top of the conduit to the surface.

The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

7.3 Lift Thickness: Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

7.4 Observation and Testing: The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

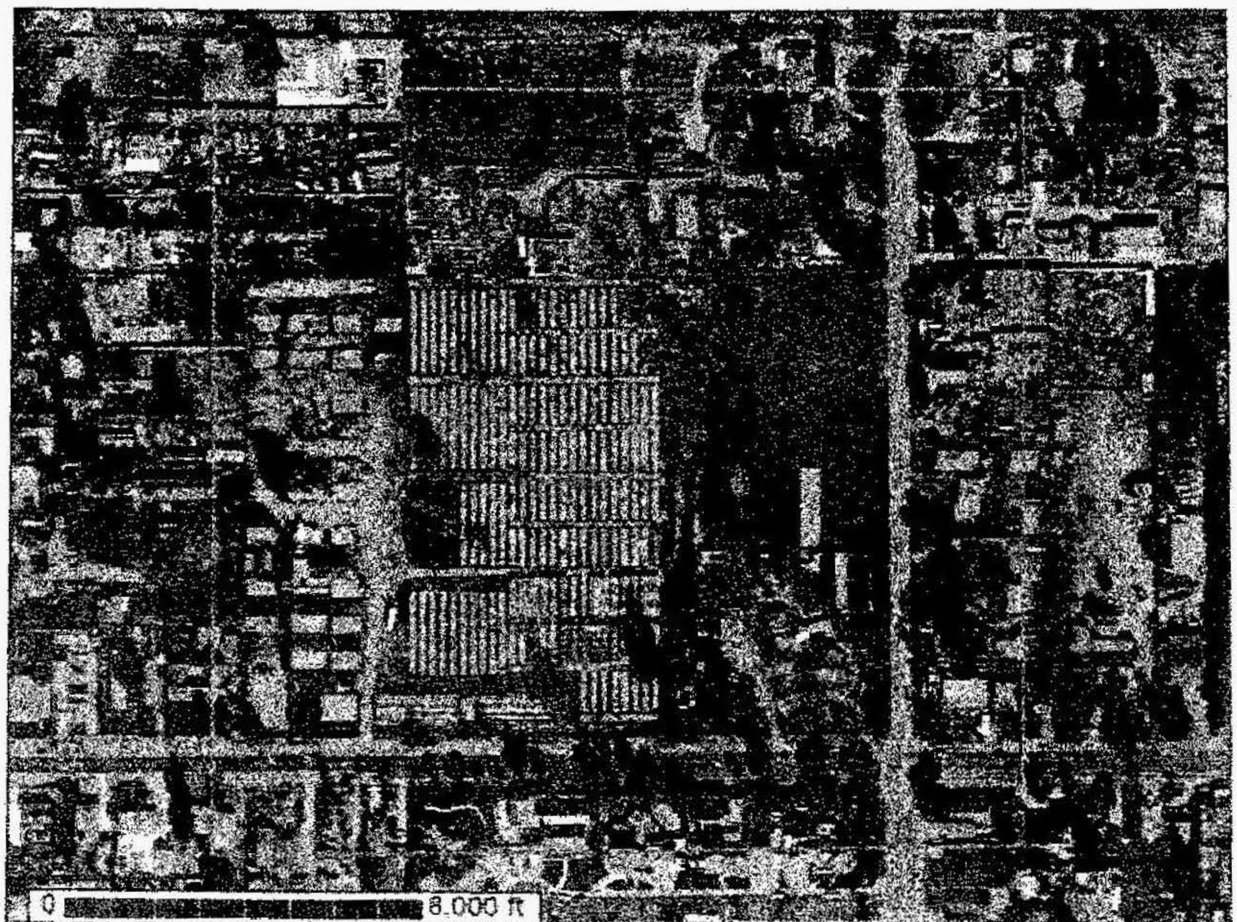
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for San Bernardino County Southwestern Part, California



October 21, 2016

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

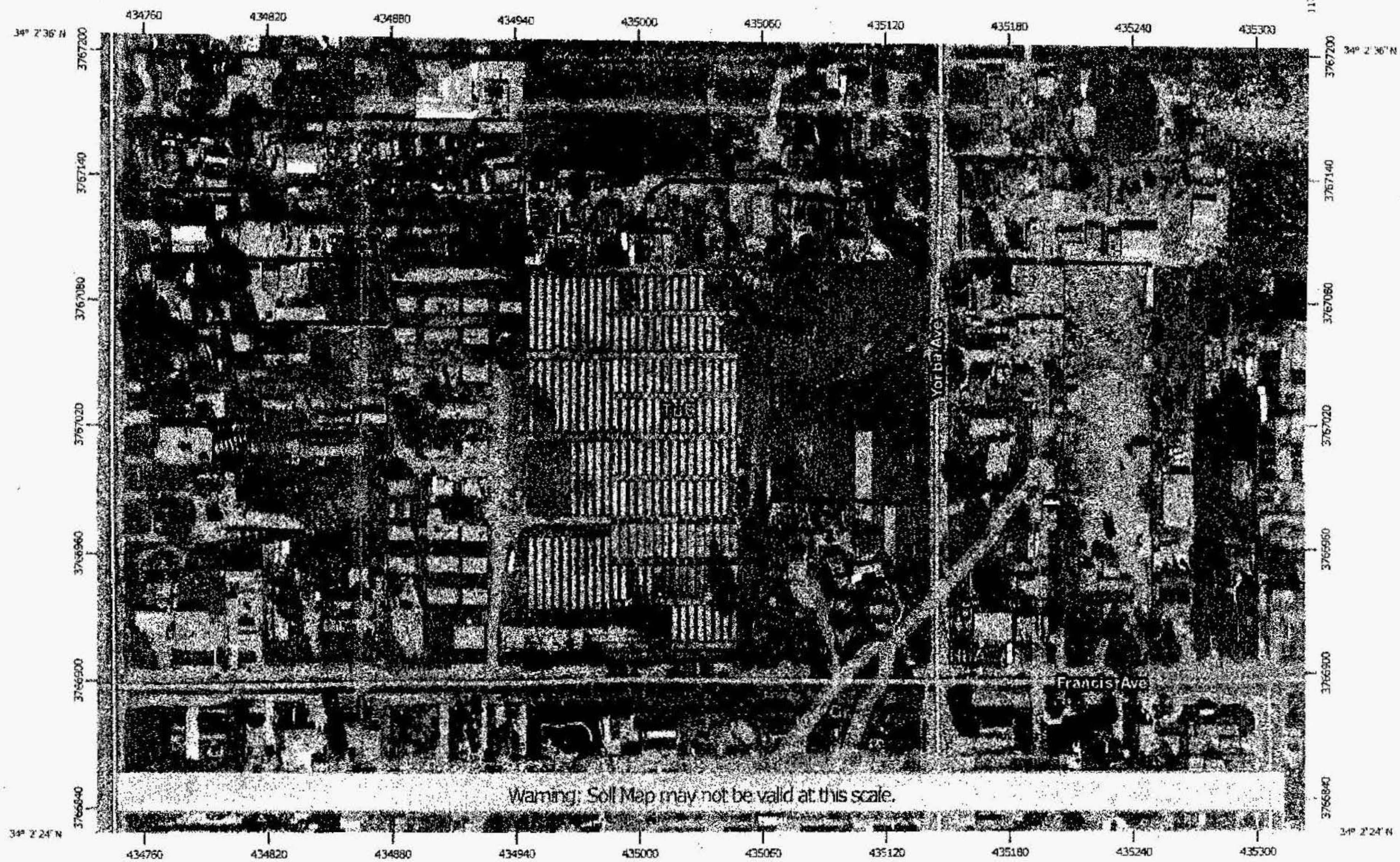
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



N

Map Scale: 1:2,680 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: San Bernardino County Southwestern Part, California
Survey Area Data: Version 7, Sep 3, 2015

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

Date(s) aerial images were photographed: Jan 5, 2015—Jan 18, 2015

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

Map Unit Legend

San Bernardino County Southwestern Part, California (CA677)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
Gr	Grangeville fine sandy loam	0.3	1.1%
HbA	Hanford sandy loam, 0 to 2 percent slopes	1.8	7.1%
TuB	Tujunga loamy sand, 0 to 5 percent slopes	23.6	91.8%
Totals for Area of Interest		**25.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Bernardino County Southwestern Part, California

Gr—Grangeville fine sandy loam

Map Unit Setting

National map unit symbol: hcjy
Elevation: 0 to 1,800 feet
Mean annual precipitation: 7 to 16 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 200 to 300 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Grangeville and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Grangeville

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

H1 - 0 to 12 inches: fine sandy loam
H2 - 12 to 60 inches: sandy loam, fine sandy loam, loam
H2 - 12 to 60 inches:
H2 - 12 to 60 inches:

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Salinity, maximum in profile: Very slightly saline to slightly saline (2.0 to 4.0 mmhos/cm)
Available water storage in profile: Very high (about 21.4 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 5 percent

Landform: Depressions
Hydric soil rating: Yes

San emigdio, fine sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

Chino

Percent of map unit: 5 percent
Hydric soil rating: No

HbA—Hanford sandy loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: hck5
Elevation: 150 to 900 feet
Mean annual precipitation: 10 to 20 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 250 to 280 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Hanford and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hanford

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

H1 - 0 to 12 inches: sandy loam
H2 - 12 to 60 inches: fine sandy loam, sandy loam, coarse sandy loam
H2 - 12 to 60 inches:
H2 - 12 to 60 inches:

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None

Available water storage in profile: Very high (about 20.3 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Greenfield, sandy loam

Percent of map unit: 5 percent
Hydric soil rating: No

Hanford, steeper slopes

Percent of map unit: 5 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 5 percent
Hydric soil rating: No

TuB—Tujunga loamy sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: hcl1
Elevation: 10 to 2,500 feet
Mean annual precipitation: 10 to 25 inches
Mean annual air temperature: 59 to 64 degrees F
Frost-free period: 250 to 350 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Tujunga, loamy sand, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Tujunga, Loamy Sand

Setting

Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from granite

Typical profile

A - 0 to 6 inches: loamy sand
C1 - 6 to 18 inches: loamy sand
C2 - 18 to 60 inches: loamy sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Tujunga, gravelly loamy sand

Percent of map unit: 10 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Hanford, sandy loam

Percent of map unit: 5 percent
Landform: Alluvial fans
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

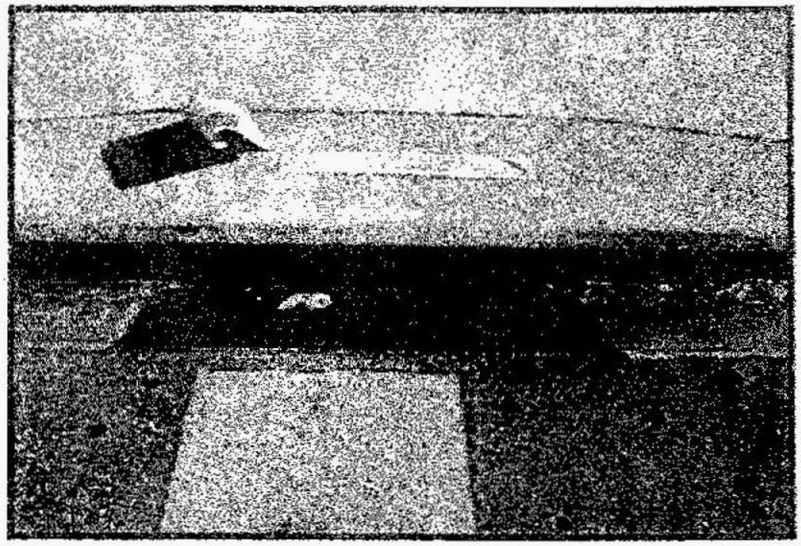
United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf



Design Objectives

Maximize Infiltration

Provide Retention

Slow Runoff

Minimize Impervious Land Coverage

☑ Prohibit Dumping of Improper Materials

Contain Pollutants

Collect and Convey

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Placement

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

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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

Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

Targeted Constituents

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

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

Description

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

California Experience

Infiltration basins have a long history of use in California, especially in the Central Valley. Basins located in Fresno were among those initially evaluated in the National Urban Runoff Program and were found to be effective at reducing the volume of runoff, while posing little long-term threat to groundwater quality (EPA, 1983; Schroeder, 1995). Proper siting of these devices is crucial as underscored by the experience of Caltrans in siting two basins in Southern California. The basin with marginal separation from groundwater and soil permeability failed immediately and could never be rehabilitated.

Advantages

- Provides 100% reduction in the load discharged to surface waters.
- The principal benefit of infiltration basins is the approximation of pre-development hydrology during which a

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

significant portion of the average annual rainfall runoff is infiltrated and evaporated rather than flushed directly to creeks.

- If the water quality volume is adequately sized, infiltration basins can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

Limitations

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

Design and Sizing Guidelines

- Water quality volume determined by local requirements or sized so that 85% of the annual runoff volume is captured.
- Basin sized so that the entire water quality volume is infiltrated within 48 hours.
- Vegetation establishment on the basin floor may help reduce the clogging rate.

Construction/Inspection Considerations

- Before construction begins, stabilize the entire area draining to the facility. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction or remove the top 2 inches of soil after the site is stabilized. Stabilize the entire contributing drainage area, including the side slopes, before allowing any runoff to enter once construction is complete.
- Place excavated material such that it can not be washed back into the basin if a storm occurs during construction of the facility.
- Build the basin without driving heavy equipment over the infiltration surface. Any equipment driven on the surface should have extra-wide ("low pressure") tires. Prior to any construction, rope off the infiltration area to stop entrance by unwanted equipment.
- After final grading, till the infiltration surface deeply.
- Use appropriate erosion control seed mix for the specific project and location.

Performance

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

There remain some concerns about the potential for groundwater contamination despite the findings of the NURP and Nightingale (1975; 1987a,b,c; 1989). For instance, a report by Pitt et al. (1994) highlighted the potential for groundwater contamination from intentional and unintentional stormwater infiltration. That report recommends that infiltration facilities not be sited in areas where high concentrations are present or where there is a potential for spills of toxic material. Conversely, Schroeder (1995) reported that there was no evidence of groundwater impacts from an infiltration basin serving a large industrial catchment in Fresno, CA.

Siting Criteria

The key element in siting infiltration basins is identifying sites with appropriate soil and hydrogeologic properties, which is critical for long term performance. In one study conducted in Prince George's County, Maryland (Galli, 1992), all of the infiltration basins investigated clogged within 2 years. It is believed that these failures were for the most part due to allowing infiltration at sites with rates of less than 0.5 in/hr, basing siting on soil type rather than field infiltration tests, and poor construction practices that resulted in soil compaction of the basin invert.

A study of 23 infiltration basins in the Pacific Northwest showed better long-term performance in an area with highly permeable soils (Hilding, 1996). In this study, few of the infiltration basins had failed after 10 years. Consequently, the following guidelines for identifying appropriate soil and subsurface conditions should be rigorously adhered to.

- Determine soil type (consider RCS soil type 'A, B or C' only) from mapping and consult USDA soil survey tables to review other parameters such as the amount of silt and clay, presence of a restrictive layer or seasonal high water table, and estimated permeability. The soil should not have more than 30% clay or more than 40% of clay and silt combined. Eliminate sites that are clearly unsuitable for infiltration.

- Groundwater separation should be at least 3 m from the basin invert to the measured ground water elevation. There is concern at the state and regional levels of the impact on groundwater quality from infiltrated runoff, especially when the separation between groundwater and the surface is small.

- Location away from buildings, slopes and highway pavement (greater than 6 m) and wells and bridge structures (greater than 30 m). Sites constructed of fill, having a base flow or with a slope greater than 15% should not be considered.

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

- Base flow should not be present in the tributary watershed.

Secondary Screening Based on Site Geotechnical Investigation

- At least three in-hole conductivity tests shall be performed using USBR 7300-89 or Bouwer-Rice procedures (the latter if groundwater is encountered within the boring), two tests at different locations within the proposed basin and the third down gradient by no more than approximately 10 m. The tests shall measure permeability in the side slopes and the bed within a depth of 3 m of the invert.

- The minimum acceptable hydraulic conductivity as measured in any of the three required test holes is 13 mm/hr. If any test hole shows less than the minimum value, the site should be disqualified from further consideration.

- Exclude from consideration sites constructed in fill or partially in fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.

- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Additional Design Guidelines

(1) Basin Sizing - The required water quality volume is determined by local regulations or sufficient to capture 85% of the annual runoff.

(2) Provide pretreatment if sediment loading is a maintenance concern for the basin.

(3) Include energy dissipation in the inlet design for the basins. Avoid designs that include a permanent pool to reduce opportunity for standing water and associated vector problems.

(4) Basin invert area should be determined by the equation:

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

where A = Basin invert area (m^2)

WQV = water quality volume (m^3)

k = 0.5 times the lowest field-measured hydraulic conductivity (m/hr)

t = drawdown time (48 hr)

(5) The use of vertical piping, either for distribution or infiltration enhancement shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).

Maintenance

Regular maintenance is critical to the successful operation of infiltration basins. Recommended operation and maintenance guidelines include:

- Inspections and maintenance to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.
- Observe drain time for the design storm after completion or modification of the facility to confirm that the desired drain time has been obtained.
- Schedule semiannual inspections for beginning and end of the wet season to identify potential problems such as erosion of the basin side slopes and invert, standing water, trash and debris, and sediment accumulation.
- Remove accumulated trash and debris in the basin at the start and end of the wet season.
- Inspect for standing water at the end of the wet season.
- Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10% of the basin.
- If erosion is occurring within the basin, revegetate immediately and stabilize with an erosion control mulch or mat until vegetation cover is established.
- To avoid reversing soil development, scarification or other disturbance should only be performed when there are actual signs of clogging, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a very light tractor.

Cost

Infiltration basins are relatively cost-effective practices because little infrastructure is needed when constructing them. One study estimated the total construction cost at about $2 per ft (adjusted for inflation) of storage for a 0.25-acre basin (SWRPC, 1991). As with other BMPs, these published cost estimates may deviate greatly from what might be incurred at a specific site. For instance, Caltrans spent about $18/ft^3 for the two infiltration basins constructed in southern California, each of which had a water quality volume of about 0.34 ac.-ft. Much of the higher cost can be attributed to changes in the storm drain system necessary to route the runoff to the basin locations.

Infiltration basins typically consume about 2 to 3% of the site draining to them, which is relatively small. Additional space may be required for buffer, landscaping, access road, and fencing. Maintenance costs are estimated at 5 to 10% of construction costs.

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time.

References and Sources of Additional Information

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

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

Hilding, K. 1996. Longevity of infiltration basins assessed in Puget Sound. *Watershed Protection Techniques* 1(3):124–125.

Maryland Department of the Environment (MDE). 2000. *Maryland Stormwater Design Manual*. http://www.mde.state.md.us/environment/wma/stormwatermanual. Accessed May 22, 2002.

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

Nightingale, H.I., 1975, "Lead, Zinc, and Copper in Soils of Urban Storm-Runoff Retention Basins," American Water Works Assoc. Journal. Vol. 67, p. 443-446.

Nightingale, H.I., 1987a, "Water Quality beneath Urban Runoff Water Management Basins," Water Resources Bulletin, Vol. 23, p. 197-205.

Nightingale, H.I., 1987b, "Accumulation of As, Ni, Cu, and Pb in Retention and Recharge Basin Soils from Urban Runoff," Water Resources Bulletin, Vol. 23, p. 663-672.

Nightingale, H.I., 1987c, "Organic Pollutants in Soils of Retention/Recharge Basins Receiving Urban Runoff Water," Soil Science Vol. 148, pp. 39-45.

Nightingale, H.I., Harrison, D., and Salo, J.E., 1985, "An Evaluation Technique for Ground-water Quality Beneath Urban Runoff Retention and Percolation Basins," Ground Water Monitoring Review, Vol. 5, No. 1, pp. 43-50.

Oberts, G. 1994. Performance of Stormwater Ponds and Wetlands in Winter. *Watershed Protection Techniques* 1(2): 64–68.

Pitt, R., et al. 1994, *Potential Groundwater Contamination from Intentional and Nonintentional Stormwater Infiltration*, EPA/600/R-94/051, Risk Reduction Engineering Laboratory, U.S. EPA, Cincinnati, OH.

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

Schroeder, R.A., 1995, *Potential For Chemical Transport Beneath a Storm-Runoff Recharge (Retention) Basin for an Industrial Catchment in Fresno, CA*, USGS Water-Resource Investigations Report 93-4140.

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

U.S. EPA, 1983, *Results of the Nationwide Urban Runoff Program: Volume 1 – Final Report*, WH-554, Water Planning Division, Washington, DC.

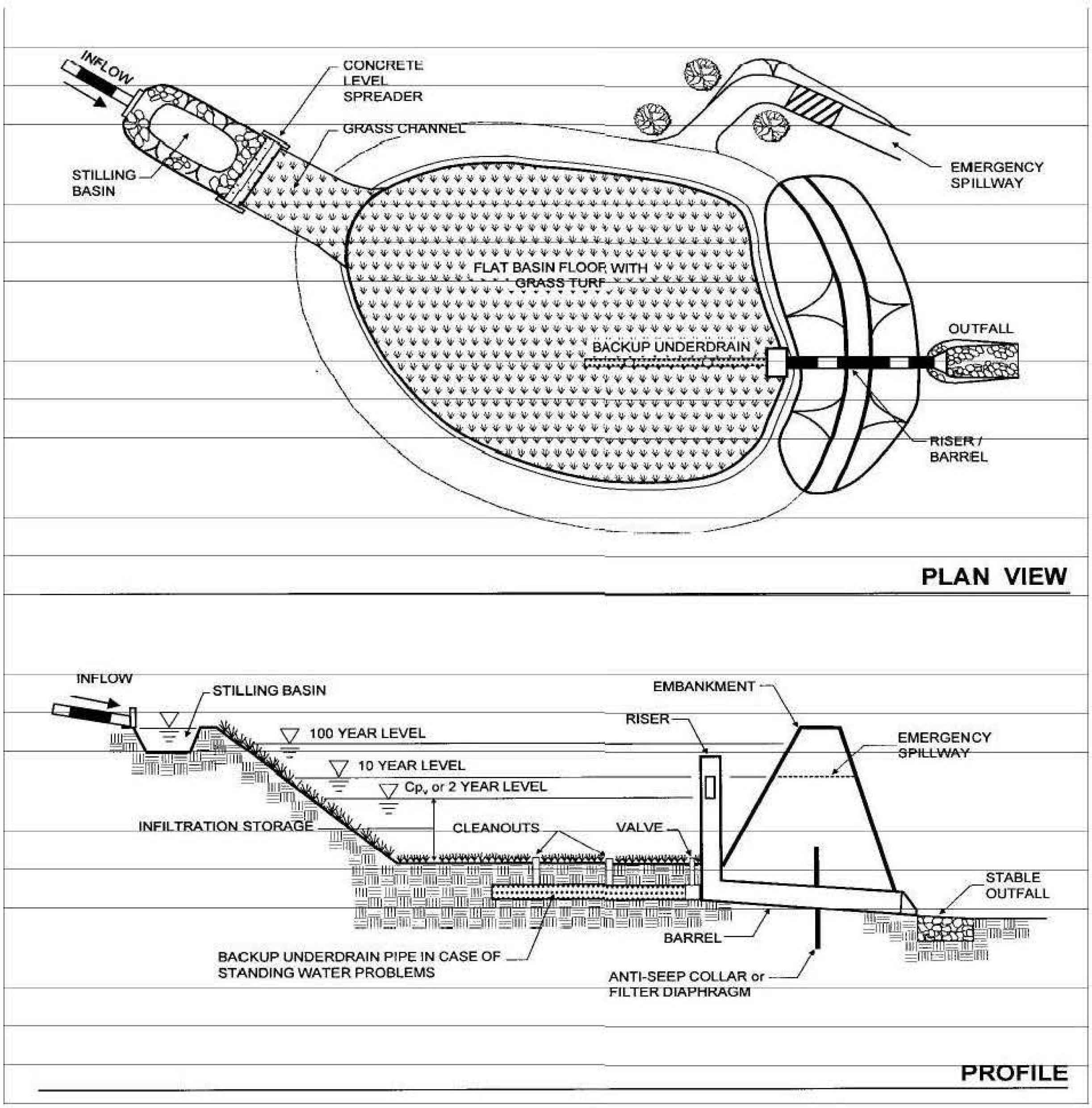
Watershed Management Institute (WMI). 1997. *Operation, Maintenance, and Management of Stormwater Management Systems*. Prepared for U.S. Environmental Protection Agency Office of Water, Washington, DC.

Information Resources

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

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

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


INFLOW
CONCRETE LEVEL SPREADER
GRASS CHANNEL
STILLING BASIN
EMERGENCY SPILLWAY
FLAT BASIN FLOOR WITH GRASS TURF
OUTFALL
BACKUP UNDERDRAIN
RISER / BARREL
PLAN VIEW
INFLOW
STILLING BASIN
EMBANKMENT
RISER
100 YEAR LEVEL
EMERGENCY SPILLWAY
10 YEAR LEVEL
Cpv or 2 YEAR LEVEL
INFILTRATION STORAGE
CLEANOUTS
VALVE
STABLE OUTFALL
BARREL
BACKUP UNDERDRAIN PIPE IN CASE OF STANDING WATER PROBLEMS
ANTI-SEEP COLLAR or FILTER DIAPHRAGM
PROFILE

Stormwater Pollution Prevention

Best Management Practices for Homeowner's Associations, Property Managers and Property Owners

Your Guide To Maintaining Water Friendly Standards In Your Community

sbcountystormwater.org

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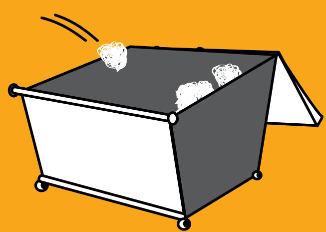
COMMERCIAL TRASH ENCLOSURES

FOLLOW THESE **REQUIREMENTS** TO **KEEP OUR WATERWAYS CLEAN**

Trash enclosures, such as those found in commercial and apartment complexes, typically contain materials that are intended to find their way to a landfill or a recycling facility. **These materials are NOT meant to go into our local lakes and rivers.**

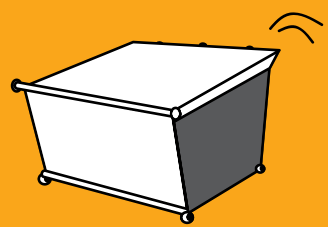
PROTECT WATER QUALITY BY FOLLOWING THESE SIMPLE STEPS

PUT TRASH INSIDE



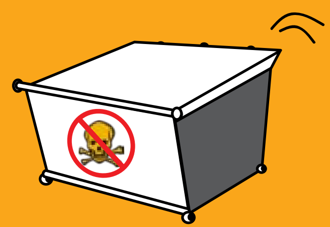
Place trash inside the bin (preferably in sealed bags)

CLOSE THE LID



Prevent rain from entering the bin in order to avoid leakage of polluted water runoff

KEEP TOXICS OUT



- Paint
- Grease, fats and used oils
- Batteries, electronics and fluorescent lights

SOME ADDITIONAL GUIDELINES, INCLUDE

✓ **SWEEP FREQUENTLY**
Sweep trash enclosure areas frequently, instead of hosing them down, to prevent polluted water from flowing into the streets and storm drains.

✓ **FIX LEAKS**
Address trash bin leaks immediately by using dry clean up methods and report to your waste hauler to receive a replacement.

✓ **CONSTRUCT ROOF**
Construct a solid cover roof over the existing trash enclosure structure to prevent rainwater from coming into contact with trash and garbage. Check with your local City/County for Building Codes.

In San Bernardino County, stormwater pollution is caused by food waste, landscape waste, chemicals and other debris that are washed into storm drains and end up in our waterways - untreated! You can be part of the solution by maintaining a water-friendly trash enclosure.

THANK YOU FOR HELPING TO KEEP SAN BERNARDINO COUNTY CLEAN AND HEALTHY!

In the event of a spill or discharge to a storm drain or waterway, contact San Bernardino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

sbcountystormwater.org

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CESQG PROGRAM

Conditionally Exempt Small Quantity Generator

WHAT IS A CESQG?

Businesses that generate 27 gallons or 220 lbs. of hazardous waste, or 2.2 lbs. of extremely hazardous waste per month are called "Conditionally Exempt Small Quantity Generators," or CESQGs. San Bernardino County Household Hazardous Program provides waste management services to CESQG businesses. The most common CESQGs in San Bernardino County are painters, print shops, auto shops, builders, agricultural operators and property managers, but there are many others. When you call, be ready to describe the types and amounts of waste your business generates in a typical month. If you generate hazardous waste on a regular basis, you must:

- Register with San Bernardino County Fire Department (909) 386-8400 as a hazardous waste generator.
- To obtain an EPA ID# and application form from the State visit www.dtsc.ca.gov.
- Manage hazardous waste in accordance with all applicable local, state and federal laws and regulations.

HOW DO I GET SERVICE?

To arrange an appointment for the CESQG Program, call 1-800-OILY CAT or 909-382-5401. Be ready to describe the type and amount of hazardous waste your business is ready to dispose of, and the types and size(s) of containers that the waste is in.

Waste Type and Cost

There is a small handling fee involved in the collection of hazardous waste from your business. Disposal costs depend on the type of waste.

Aerosols	$1.29/lb.
Automobile motor oil	$.73/gal.
Anti-freeze	$1.57/gal.
Contaminated oil	$4.48/gal.
Car batteries	$.62/ea.
Corrosive liquids, solids	$2.80/lb.
Flammable solids, liquids	$1.57/lb.
Latex Paint	$.73/lb.
Mercury	$10.08/lb.
NiCad/Alkaline Batteries	$2.13/lb.
Oil Base Paints	$1.00/lb.
Oil Filters	$.56/ea.
Oxidizers	$9.63/lb.
PCB Ballasts	$5.94/lb.
Pesticides (most)	$2.91/lb.
Photofixer, developer	$4.31/gal.
Television & Monitors	$11.20/ea.
Additional Handling	$138.00/hr.

Rates subject to change without notice

WE CANNOT ACCEPT

- Radioactives
- Water reactives
- Explosives
- Compressed gas cylinders
- Medical or biohazardous waste
- Asbestos
- Remediation wastes

HAZARDOUS WASTE

WHY IS THE FIRE DEPARTMENT COLLECTING HAZARDOUS WASTE?

Small Quantity Generators often have difficulty disposing of small quantities of hazardous waste. Hazardous waste companies usually have a minimum amount of waste that they will pick up, or charge a minimum fee for service. Typically, the minimum fee exceeds the cost of disposal for the hazardous waste. This leaves the small quantity generator in a difficult situation. Some respond by storing hazardous waste until it becomes economical for the hazardous waste transporter to pick it up, putting the business out of compliance by exceeding regulatory accumulation time limits. Other businesses simply store their hazardous wastes indefinitely, creating an unsafe work environment and exceeding accumulation time limits. Yet other businesses attempt to illegally dispose of their waste at household hazardous waste collection facilities. These facilities are not legally permitted to accept commercial wastes, nor are prepared to provide legal documentation for commercial hazardous waste disposal. In answer to the problems identified above, the San Bernardino County Fire Department Household Hazardous Program instituted the Conditionally Exempt Small Quantity Generator Program.

PAYMENT FOR SERVICES

The CESQG Program will prepare an invoice for your business at the time of service. You can pay at the time of service with cash or a check, or you can mail your payment to the Fire Department within 30 days. Please note that we do not accept credit card payments. The preferred method of payment is to handle payment at time of service. Additional charges may apply for accounts not paid within 30 days.

ARE THERE ANY OTHER WAYS THAT I CAN SAVE MONEY ON HAZARDOUS WASTE DISPOSAL?

Yes! First, start by reducing the amount of waste that you produce by changing processes or process chemicals, at your business. Next, examine if there is a way that you can recycle your waste back into your processes. Network with similar businesses or trade associations for waste minimization and pollution prevention solutions.

WHAT IF YOUR BUSINESS DOES NOT QUALIFY?

Call the San Bernardino County Fire Department Field Services Division for assistance with hazardous waste management at 909-386-8400.

If you reduce the amount of waste you generate each month to 27 gallons or less, you may qualify in the future.

WHAT HAPPENS TO YOUR HAZARDOUS WASTE?

Hazardous waste collected by the CESQG Program is transported to a state permitted processing facility in San Bernardino. The waste is further processed at this point and packaged for off-site recycling (oil filters, oil, latex paint, antifreeze, and batteries) or destructive incineration (pesticides, corrosives, flammables, oil based paint).

San Bernardino County Fire Department
CESQG Program
2824 East "W" Street
San Bernardino, CA 92415-0799
Phone: 909-382-5401
Fax: 909-382-5413
www.sbcfire.org/ofm/hhw/HouseholdHazardousWaste.aspx
Email: mvangese@sbcfire.org

WHEN WORKING OUTDOORS USE THE 3Cs

CUANDO TRABAJE AL AIRE LIBRE UTILICE LAS 3Cs

CONTROL | CONTROL

Locate the nearest storm drain and ensure nothing can enter or be discharged into it.

Ubique el desagüe de aguas pluviales más cercano y asegúrese de que nada pueda ingresar a éste ni descargarse en él.

CONTAIN | CONTENER

Isolate your area to prevent material from potentially flowing or being blown away.

Aísle su área para evitar que el material pueda discurrirse o ser llevado por el viento.

CAPTURE | CAPTURAR

Sweep up debris and place it in the trash. Clean up spills with an absorbent material (e.g. kitty litter) or vacuum with a Wet-Vac and dispose of properly.

Recoja los restos y colóquelos en la basura. Limpie los derrames con un material absorbente (como la arena para gatos) o aspírelos con una Wet-Vac (aspiradora de humedad) y deséchelos correctamente.

COMMERCIAL LANDSCAPE

DISCHARGE TO THE STORM DRAIN, ACCIDENTAL OR NOT, COULD LEAD TO ENFORCEMENT ACTIONS, WHICH COULD INCLUDE FINES.

Follow the best practices below to **prevent water pollution from landscaping activities.**

RECYCLE YARD WASTE

- Recycle leaves, grass clippings and other yard waste.
- Do not blow, sweep, rake or hose yard waste into the street or catch basin.
- **Try grasscycling:** the natural recycling of grass by leaving clippings on the lawn when mowing.

For more information, please visit: **www.calrecycle.ca.gov/organics/grasscycling**

USE FERTILIZERS, HERBICIDES AND PESTICIDES SAFELY

- Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use natural and non-toxic alternatives as often as possible.
- If you must use chemical fertilizers, herbicides or pesticides:
  - Spot apply, rather than blanketing entire areas.
  - Avoid applying near curbs and driveways, and **never** before a rain.
  - Apply fertilizers as needed: when plants could best use it and when the potential runoff would be low.
  - Follow the manufacturer's instructions carefully—this will not only give the best results, but will save money.

USE WATER WISELY

- Control the amount of water and direction of sprinklers. Sprinklers should only be on long enough to allow water to soak into the ground, but not so long as to cause runoff.
- Periodically inspect, fix leaks and realign sprinkler heads.
- Plant native vegetation to reduce the need of water, fertilizers, herbicides and pesticides.

HOMEOWNERS

KEEP THESE TIPS IN MIND WHEN HIRING PROFESSIONAL LANDSCAPERS AND REMIND AS NECESSARY.

Leftover pesticides, fertilizers, and herbicides contaminate landfills and should be disposed of through a Hazardous Waste Facility.

For more information on proper disposal call,

(909) 382-5401 or 1-800-OILY CAT.

San Bernardino County STORMWATER PROGRAM

In the event of a spill or discharge to a storm drain or waterway, contact San Bernardino County Stormwater immediately: (877) WASTE18 | sbcountystormwater.org/report

sbcountystormwater.org

Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga
Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

Pollutants on sidewalks and other pedestrian traffic areas and plazas are typically due to littering and vehicle use. Fountain water containing chlorine and copperbased algaecides is toxic to aquatic life. Proper inspection, cleaning, and repair of pedestrian areas and HOA owned surfaces and structures can reduce pollutant runoff from these areas. Maintaining these areas may involve one or more of the following activities:

1. **Surface Cleaning**
2. **Graffiti Cleaning**
3. **Sidewalk Repair**
4. **Controlling Litter**
5. **Fountain Maintenance**

POLLUTION PREVENTION:

Pollution prevention measures have been considered and incorporated in the model procedures. Implementation of these measures may be more effective and reduce or eliminate the need to implement other more complicated or costly procedures. Possible pollution prevention measures for sidewalk, plaza, and fountain maintenance and cleaning include:

- Use dry cleaning methods whenever practical for surface cleaning activities.
- Use the least toxic materials available (e.g. water based paints, gels or sprays for graffiti removal).
- Once per year, educate HOA staff and tenants on pollution prevention measures.

MODEL PROCEDURES:

1. Surface Cleaning

Discharges of wash water to the storm water drainage system from cleaning or hosing of impervious surfaces is prohibited.
Sidewalks, Plazas

✓ Use dry methods (e.g. sweeping, backpack blowers, vacuuming) whenever practical to clean sidewalks and plazas rather than hosing, pressure washing, or steam cleaning. DO NOT sweep or blow material into curb; use devices that contain the materials.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

Parking Areas, Driveways, Drive-thru

✓ Parking facilities should be swept/vacuumed on a regular basis. Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

✓ Sweep all parking lots at least once before the onset of the wet season.

✓ Use absorbents to pick up oil; then dry sweep.

✓ Appropriately dispose of spilled materials and absorbents.

OPTIONAL:

- Consider increasing sweeping frequency based on factors such as traffic volume, land use, field observations of sediment and trash accumulation, proximity to water courses, etc.

Building Surfaces, Decks, etc., without loose paint

✓ Use high-pressure water, no soap.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

Unpainted Building Surfaces, Wood Decks, etc.

✓ If water must be used, block storm drain inlets and contain runoff. Discharge wash water to landscaping or contain and dispose of properly.

✓ If using a biodegradable or other cleaning agent to remove deposits contain and dispose of properly.

2. Graffiti Cleaning

Graffiti Removal

✓ Avoid graffiti abatement activities during rain events.

✓ When graffiti is removed by painting over, implement the procedures under Painting and Paint Removal in the Roads, Streets, and Highway Operation and Maintenance procedure sheet.

✓ Protect nearby storm drain inlets prior to removing graffiti from walls, signs, sidewalks, or other structures needing graffiti abatement. Clean up afterwards by sweeping or vacuuming thoroughly, and/or by using absorbent and properly disposing of the absorbent.

✓ Note that care should be taken when disposing of waste since it may need to be disposed of as hazardous waste.

OPTIONAL:

• Consider using a waterless and non-toxic chemical cleaning method for graffiti removal (e.g. gels or spray compounds).

3. Sidewalk Repair

Surface Removal and Repair

✓ Schedule surface removal activities for dry weather if possible.

✓ Avoid creating excess dust when breaking asphalt or concrete.

✓ Take measures to protect nearby storm drain inlets prior to breaking up asphalt or concrete (e.g. place hay bales or sand bags around inlets). Clean afterwards by sweeping up material.

✓ Designate an area for clean up and proper disposal of excess materials.

✓ Remove and recycle as much of the broken pavement as possible.

✓ When making saw cuts in pavement, use as little water as possible. Cover each storm drain inlet with filter fabric during the sawing operation and contain the slurry by placing straw bales, sandbags, or gravel dams around the inlets. After the liquid drains shovel or vacuum the slurry, remove from site and dispose of properly.

✓ Always dry sweep first to clean up tracked dirt. Use a street sweeper or vacuum truck. Do not dump vacuumed liquid in storm drains. Once dry sweeping is complete, the area may be hosed down if needed. Discharge wash water to landscaping, pump to the sanitary sewer if permitted to do so or contain and dispose of properly.

Concrete Installation and Repair

✓ Avoid mixing excess amounts of fresh concrete or cement mortar on-site. Only mix what is needed for the job.

✓ Wash concrete trucks off-site or in designated areas on-site, such that there is no discharge of concrete wash water into storm drain inlets, open ditches, streets, or other storm water conveyance structures. (See Concrete Waste Management BMP WM – 8)

SIDEWALK, PLAZA, ENTRY MONUMENT & FOUNTAIN MAINTENANCE

✓ Store dry and wet concrete materials under cover, protected from rainfall and runoff and away from drainage areas. After job is complete remove temporary stockpiles (asphalt materials, sand, etc.) and other materials as soon as possible.

✓ Return leftover materials to the transit mixer. Dispose of small amounts of excess concrete, grout, and mortar in the trash.

✓ When washing concrete to remove fine particles and expose the aggregate, contain the wash water for proper disposal.

✓ Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stock pile, or dispose in the trash.

✓ Protect applications of fresh concrete from rainfall and runoff until the material has hardened.

4. Litter Control

✓ Enforce anti-litter laws.

✓ Provide litter receptacles in busy, high pedestrian traffic areas of the community, at recreational facilities, and at community events.

✓ Cover litter receptacles and clean out frequently to prevent leaking/spillage or overflow.

OPTIONAL:

• Post "No Littering" signs.

5. Fountain Maintenance

✓ Do not use copper-based algaecides. Control algae with chlorine or other alternatives, such as sodium bromide.

✓ Allow chlorine to dissipate for a few days and then recycle/reuse water by draining it gradually onto a landscaped area. Water must be tested prior to discharge to ensure that chlorine is not present (concentration must be less than 0.1 ppm).

✓ Contact local agency for approval to drain into sewer or storm drain.

✓ Avoid mixing excess amounts of fresh concrete or cement mortar on-site. Only mix what is needed for the job.

EQUIPMENT MAINTENANCE & REPAIR

Vehicle or equipment maintenance has the potential to be a significant source of stormwater pollution. Engine repair and service (parts cleaning, spilled fuel, oil, etc.), replacement of fluids, and outdoor equipment storage and parking (dripping engines) can all contaminate stormwater. Conducting the following activities in a controlled manner will reduce the potential for stormwater contamination:

1. **General Maintenance and Repair**
2. **Vehicle and Machine Repair**
3. **Waste Handling/Disposal**

Related vehicle maintenance activities are covered under the following program headings in this manual: "Vehicle and Equipment Cleaning", "Vehicle and Equipment Storage", and "Vehicle Fueling".

POLLUTION PREVENTION:

Pollution prevention measures have been considered and incorporated in the model procedures. Implementation of these measures may be more effective and reduce or eliminate the need to implement other more complicated or costly procedures. Possible pollution prevention measures for equipment maintenance and repair include:

- Review maintenance activities to verify that they minimize the amount of pollutants discharged to receiving waters. Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Minimize use of solvents. Clean parts without using solvents whenever possible. Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.
- Once per year, educate HOA staff and tenants on pollution prevention measures.

MODEL PROCEDURES:

1. General Maintenance and Repair

General Guidelines

> ➔ *Note: Permission must be obtained for any discharge of wash water to the sanitary sewer from the local sewering agency.*

- ✓ Review maintenance activities to verify that they minimize the amount of pollutants discharged to receiving waters. Keep accurate maintenance logs to evaluate materials removed and improvements made.
- ✓ Regularly inspect vehicles and equipment for leaks.
- ✓ Move activity indoors or cover repair area with a permanent roof if feasible.
- ✓ Minimize contact of stormwater with outside operations through berming the local sewering and drainage routing.
- ✓ Place curbs around the immediate boundaries of the process equipment.
- ✓ Clean yard storm drain inlets regularly and stencil them.

Good Housekeeping

- ✓ Avoid hosing down work areas. If work areas are washed and if discharge to the sanitary sewer is allowed, treat water with an appropriate treatment device (e.g. clarifier) before discharging. If discharge to the sanitary sewer is not permitted, pump water to a tank and dispose of properly.
- ✓ Collect leaking or dripping fluids in drip pans or container. Fluids are easier to recycle or dispose of properly if kept separate.
- ✓ Keep a drip pan under the vehicle while you unclip hoses, unscrew filters, any discharge of or remove other parts. Place a drip pan under any vehicle that might leak while you work on it to keep splatters or drips off the shop floor.
- ✓ Educate employees on proper handling and disposal of engine fluids.
- ✓ Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.
- ✓ Do not pour liquid waste to floor drains, sinks, outdoor storm drain inlets, or other storm drains or sewer connections.
- ✓ Post signs at sinks and stencil outdoor storm drain inlets.

2. Vehicle Repair

General Guidelines

- ✓ Perform vehicle fluid removal or changing inside of a building or in a contained covered area, where feasible, to prevent the run-on of stormwater and the runoff of spills.
- ✓ Regularly inspect vehicles and equipment for leaks, and repair as needed.

✓ Use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.

✓ Immediately drain all fluids from wrecked vehicles. Ensure that the drain pan or drip pan is large enough to contain drained fluids (e.g. larger pans are needed to contain antifreeze, which may gush from some vehicles).

✓ Promptly transfer used fluids to the proper waste or recycling drums. Don't leave full drip pans or other open containers lying around.

✓ Recycle used motor oil, diesel oil, and other vehicle fluids and parts whenever possible.

✓ Oil filters disposed of in trash cans or dumpsters can leak oil. Place the oil filter in a funnel over a waste oil recycling drum to drain excess oil before disposal. Oil filters can also be recycled. Ask your oil supplier or recycler about recycling oil filters.

✓ Store cracked batteries in a non-leaking secondary container and dispose of properly at recycling facilities or at County hazardous waste disposal site.

Vehicle Leak and Spill Control

✓ Use absorbent materials on small spills. Remove the absorbent materials promptly and dispose of properly.

✓ Place a stockpile of spill cleanup materials where it will be readily accessible.

✓ Sweep floor using dry absorbent material.

3. Machine Repair

✓ Keep equipment clean; don't allow excessive build-up of oil or grease.

✓ Minimize use of solvents.

✓ Use secondary containment, such as a drain pan or drop cloth, to catch spills or leaks when removing or changing fluids.

✓ Perform major equipment repairs at the corporation yard, when practical.

✓ Following good housekeeping measures in Vehicle Repair section.

4. Waste Handling/Disposal

Waste Reduction

✓ Prevent spills and drips of solvents and cleansers to the shop floor.

✓ Do liquid cleaning at a centralized station so the solvents and residues stay in one area. Recycle liquid cleaners when feasible.

✓ Locate drip pans, drain boards, and drying racks to direct drips back into a solvent sink or fluid holding tank for reuse.

OPTIONAL:

- If possible, eliminate or reduce the amount of hazardous materials and waste by substituting non-hazardous or less hazardous material:

  -Use non-caustic detergents instead of caustic cleaning for parts cleaning.

  -Use a water-based cleaning service and have tank cleaned. Use detergent-based or water-based cleaning systems in place of organic solvent degreasers.

  -Replace chlorinated organic solvents with non-chlorinated solvents. Non-chlorinated solvents like kerosene or mineral spirits are less toxic and less expensive to dispose of properly. Check list of active ingredients to see whether it contains chlorinated solvents.

  -Choose cleaning agents that can be recycled.

Recycling

OPTIONAL:

- Separate wastes for easier recycling. Keep hazardous and non-hazardous wastes separate, do not mix used oil and solvents, and keep chlorinated solvents separate from non-chlorinated solvents.
- Label and track the recycling of waste material (e.g. used oil, spent solvents, batteries).
- Purchase recycled products to support the market for recycled materials.

LIMITATIONS:

Space and time limitations may preclude all work being conducted indoors. It may not be possible to contain and clean up spills from vehicles/equipment brought on-site after working hours. Dry floor cleaning methods may not be sufficient for some spills – see spill prevention and control procedures sheet. Identification of engine leaks may require some use of solvents.

POOL MAINTENANCE

Pool chemicals and filter solids, when discharged to the City streets, gutters or storm drans, DO NOT GET TREATED before reaching the Santa Ana River. Chlorine, acid cleaning chemicals and metal-based algaecides used in pools can kill beneficial organisms in the food chain and pollute our drinking water.

When emptying your swimming pool, spa or fountain, please use one of the following best management practices to prevent water pollution:

- Reuse the water as landscape irrigation
- Empty the water into the sewer between midnight and 6:00 am
- Remove solids and floating debris and dispose of in the trash, de-chlorinate the water to a chlorine residual = 0, wait 24 hours, then discharge the water to the street or storm drain
- Try not to use metal-based algaecides (i.e. copper sulfate) in your pool or spa. If you have, empty your pool or spa into the sewer. *Prior to discharging pool water into the sanitary sewer system, contact your local agency.*
- If the pool contains algae and mosquito larvae, discharge the water to the sewer

When acid cleaning or other chemical cleaning:

- Neutralize the pool water to pH of 6.5 to 8.5, then discharge to the sewer

For swimming pool and spa filter backwash:

- Dispose of solids into trash bag, then wash filter into a landscape area
- Settle, dispose of solids in trash and discharge water to the sewer, never to the storm drain

» For Residents

The following is a preview of the information we have available to residents. For more fact sheets, visit ***sbcountystormwater.org***

Household Hazardous Waste Center Locations

DO YOU HAVE THE FOLLOWING ITEMS IN YOUR HOME?

Automotive Fluids
Batteries
Cooking Oil
Fertilizers & Pesticides
Fluorescent Bulbs
Household Cleaners
Medicine
Motor Oil & Filters
Paint Products
Pool Chemicals

PROTECT YOUR COMMUNITY!
Take your toxic products to a local waste collection center:

Big Bear Lake
Chino
Fontana
Ontario
Rancho Cucamonga
Redlands
Rialto
San Bernardino
Upland

**No business waste accepted. Must be a San Bernardino County resident.*

Find locations and a full list of items, visit
tootoxictotrash.com

SAN BERNARDINO COUNTY STORMWATER PROGRAM
WHERE WATER MEETS COMMUNITY

WE DID IT OURSELVES AND WE DID IT RIGHT

When painting your home, protect your family and community.

- **PAINTS** that are water-based are less toxic and should be used whenever possible.
- **BRUSHES** with water-based paint should be washed in the sink. Those with oil-based paint should be cleaned with paint thinner.
- **SAFELY** dispose of unwanted paint and paint thinner. The County of San Bernardino offers 9 HHW Centers that accept paint and other household hazardous waste from residents FREE of charge. For a list of acceptable materials, location information, and hours of operation visit TooToxicToTrash.com.

VEHICLE MAINTENANCE

Oil, grease, anti-freeze and other toxic automotive fluids often make their way into the San Bernardino County storm drain system, and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

Cleaning Auto Parts
Scrape parts with a wire brush or use a bake oven rather than liquid cleaners. Arrange drip pans, drying racks and drain boards so that fluids are directed back into the parts washer or the fluid holding tank. Do not wash parts or equipment in a sink, parking lot, driveway or street.

Storing Hazardous Waste
Keep your liquid waste segregated. Many fluids can be recycled via hazardous waste disposal companies if they are not mixed. Store all materials under cover with spill containment or inside to prevent contamination of rainwater runoff.

Preventing Leaks and Spills
Conduct all vehicle maintenance inside of a garage. Place drip pans underneath vehicle to capture fluids. Use absorbent materials instead of water to clean work areas.

Cleaning Spills
Use dry methods for spill cleanup (sweeping, absorbent materials). To report accidental spills into the street or storm drain call (877) WASTE18 or 911.

Proper Disposal of Hazardous Waste
Dispose of household hazardous waste by taking it to your nearest household hazardous waste center. For more information, call 1-800-OILY CAT or check out TooToxicToTrash.com.


GET A
FREE DOGGIE WASTE BAG
FOR YOU AND YOUR FRIEND
Step 1 Visit **FreeDoggieBags.com**
Step 2 Request a **FREE** canister from us
Step 3 Send a **FREE** canister to a friend
Step 4 Use your canister to pick up after your dog anytime, anyplace!
Thanks for being a responsible pet owner and contributing to a beautiful San Bernardino County.
SAN BERNARDINO COUNTY STORMWATER PROGRAM
WHERE WATER
MEETS COMMUNITY


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SAN BERNARDINO COUNTY STORMWATER PROGRAM
WHERE WATER
MEETS COMMUNITY

» Get In Touch With Us Online!

» Website
sbcountystormwater.org

» eUpdates
sbcountystormwater.org/newsletter

» Facebook
facebook.com/sbcountystormwater

» YouTube
youtube.com/sbcountystormwater

» Report Pollution Violations
sbcountystormwater.org/report

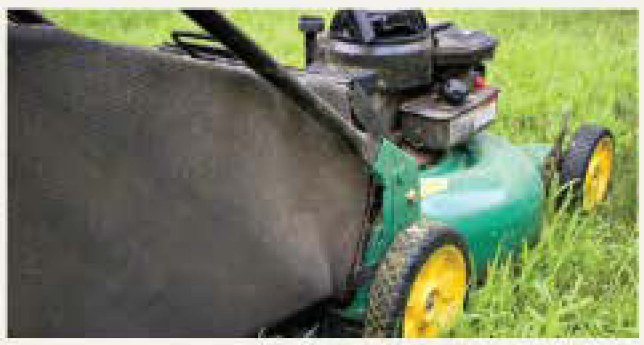
» Email
info@sbcountystormwater.org

LANDSCAPE MAINTENANCE

DISCHARGE TO THE STORM DRAIN, **ACCIDENTAL OR NOT**, COULD LEAD TO ENFORCEMENT ACTIONS, WHICH COULD INCLUDE FINES.

Follow the best practices below to **prevent water pollution from landscaping activities.**

RECYCLE YARD WASTE



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HOMEOWNERS

KEEP THESE TIPS IN MIND WHEN HIRING PROFESSIONAL LANDSCAPERS AND REMIND AS NECESSARY.

Leftover pesticides, fertilizers, and herbicides contaminate landfills and should be disposed of through a Hazardous Waste Facility.

For more information on proper disposal call,

(909) 382-5401 or 1-800-OILY CAT.

*FREE for San Bernardino County residents only. Businesses can call for cost inquiries and to schedule an appointment.

To report illegal dumping, call (877) WASTE18 or visit sbcountystormwater.org
To report toxic spills, call 1(800) 33 TOXIC
To dispose of hazardous waste, call 1(800) OILY CAT

sbcountystormwater.org

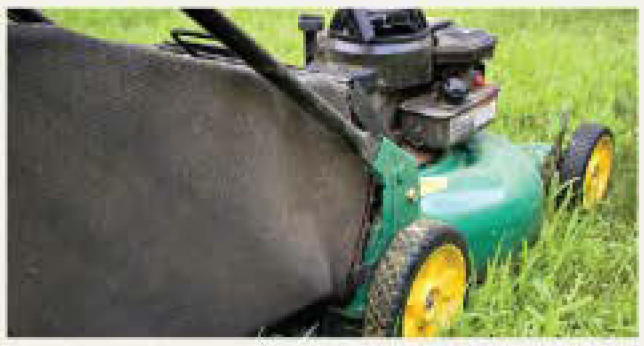
Big Bear • Chino • Chino Hills • Colton • Fontana • Grand Terrace • Highland • Loma Linda • Montclair • Ontario • Rancho Cucamonga
Redlands • Rialto • San Bernardino • San Bernardino County • San Bernardino County Flood Control District • Upland • Yucaipa

MANTENIMIENTO DE JARDINERÍA

LAS DESCARGAS A LOS DESAGUES PLUVIALES, DE MANERA ACCIDENTAL O NO, PUEDEN INDUCIR A LA APLICACIÓN DE MULTAS Y OTRAS MEDIDAS.

Siga las mejores prácticas descritas debajo para evitar la contaminación del agua por actividades de jardinería.

RECICLAJE DE LOS DESECHOS DE JARDÍN



- Reciclar las hojas, recortes de césped y otros desechos de jardín.
- No soplar, barrer, o usar la manguera para empujar los desechos de jardín a la calle.
- **Poner a prueba el reciclaje de césped (grasscycling): la manera natural de reciclar el césped dejando los recortes sobre el césped cuando son cortados. Para más información, visite la página web: www.calrecycle.ca.gov/organics/grasscycling**

USAR FERTILIZANTES, HERBICIDAS Y PESTICIDAS DE MANERA SEGURA

- Los fertilizantes, herbicidas y pesticidas son arrastrados con frecuencia hacia el sistema de desagüe pluvial mediante el escurrimiento de los rociadores. Use alternativas naturales no tóxicas siempre que sea posible.
- Si tiene que usar fertilizantes, herbicidas o pesticidas químicos:
  Aplicar solo en el sitio necesario, en lugar de cubrir todas las áreas.
  Evitar aplicar cerca de los bordillos y las calzadas, y nunca antes de que llueva.
  Aplicar los fertilizantes cuando sea necesario: esto es, cuando las plantas mejor podrían usarlo y el posible escurrimiento sea bajo.
  Seguir las instrucciones del fabricante cuidadosamente – esto no solo le proporcionará los mejores resultados, pero le permitirá ahorrar dinero.

USAR EL AGUA DE MANERA PRUDENTE

- Controlar la cantidad de agua y la orientación de los rociadores. Los rociadores deben ser **solo lo suficientemente largos como para** permitir que el agua remoje el suelo, pero no tan largos que causen un escurrimiento.
- Inspeccione, repare los escapes y alinee los aspersores periódicamente.
- Siembre plantas nativas para reducir el uso de agua, fertilizantes, herbicidas y pesticidas.

PROPIETARIOS DE HOGARES

Tengan en cuenta estos consejos cuando contraten a paisajistas profesionales y recuérdenselos según sea necesario.

Los sobrantes de pesticidas, fertilizantes y herbicidas contaminan los vertederos y deben ser desechados a través de Plantas de Tratamiento para Residuos Peligrosos.

Para más información sobre el manejo adecuado de residuos peligrosos, llame a **(909) 382-5401 o 1-800-OILY CAT.**

*GRATIS únicamente para los residentes del Condado de San Bernardino. Las empresas pueden llamar para indagar sobre los costos y concertar una cita

Para denunciar el vertido ilegal de basura, llame al (877) WASTE18 o visite sbcountystormwater.org
Para denunciar derrames tóxicos, llame al 1(800) 33 TOXIC
Para desechar residuos peligrosos, llame al 1(800) OILY CAT

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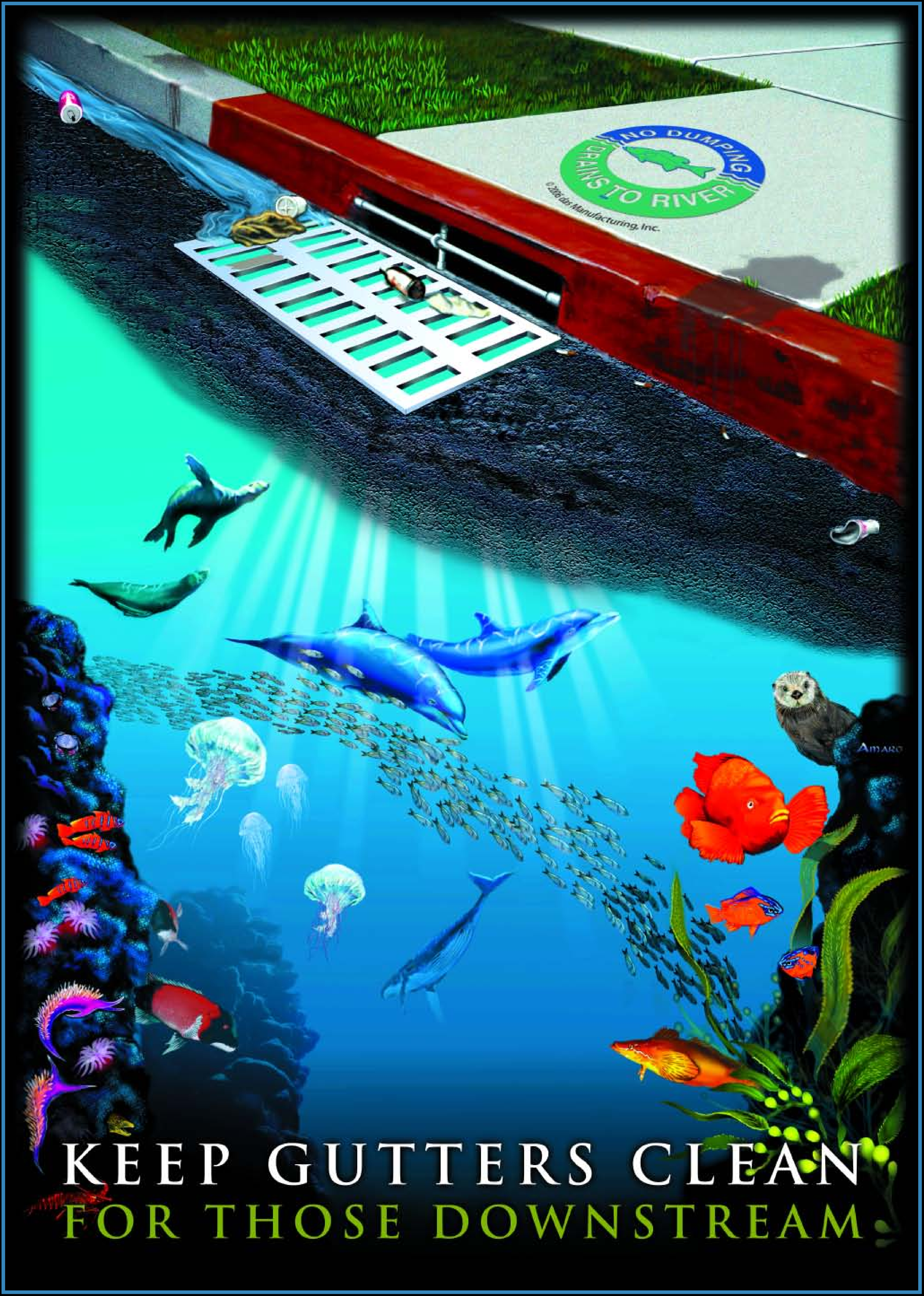
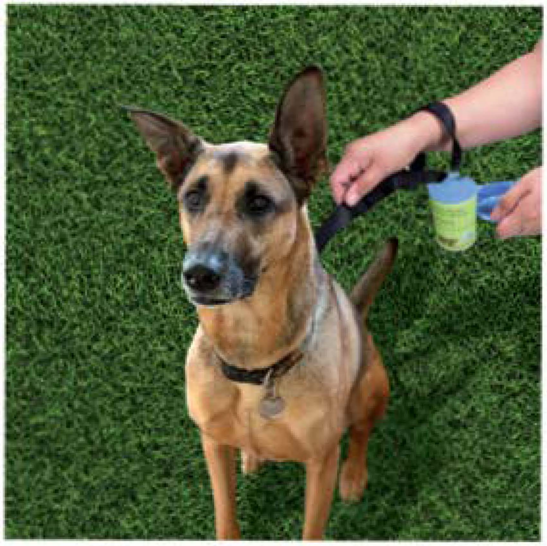


FOR MORE INFORMATION ON PREVENTING STORMWATER POLLUTION

CALL 1(800) CLEANUP OR VISIT WWW.SBCOUNTY.GOV/STORMWATER

The San Bernardino County Stormwater Program is a cooperative effort including the Flood Control District, the County of San Bernardino, and the cities of Big Bear Lake, Chino, Chino Hills, Colton, Fontana, Grand Terrace, Highland, Loma Linda, Montclair, Ontario, Rancho Cucamonga, Redlands, Rialto, San Bernardino, Upland, and Yucaipa.



PICK UP
After Your Pet!

Protect the health of your pet and the environment

For more information about current campaigns visit
sbcountystormwater.org/dog

facebook.com/sbcountystormwater

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San Bernardino County Stormwater Program

WHY IT MATTERS

PROTECT YOUR FAMILY AND YOUR PET

- Dog waste can infect children and adults with disease-causing bacteria and parasites.
- Your dog can get infected from the waste of other dogs.

PROTECT OUR ENVIRONMENT

Leaving dog waste on the streets or on your property can have a negative impact on water quality. Pet waste that's not disposed of properly flows untreated through the storm drain system and directly into our local water bodies. Pet waste is a pollutant that contains nutrients, parasites and bacteria that can affect the quality of our rivers and the ocean and make the water unsafe for swimming, drinking or fishing.

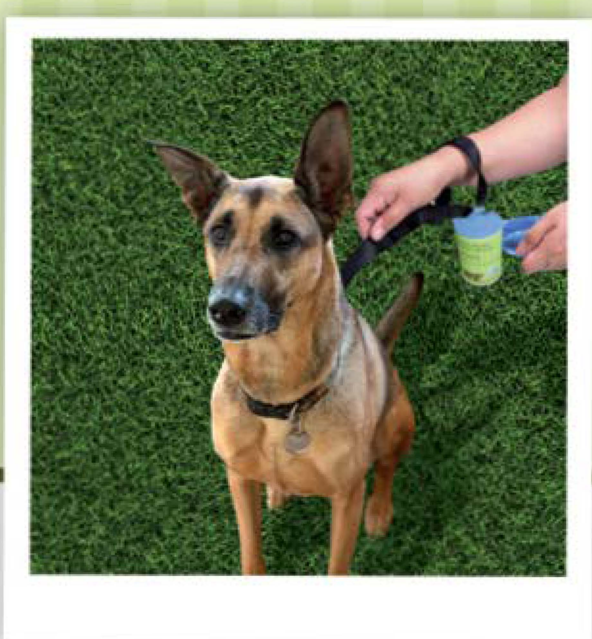
BAG IT AND TRASH IT

It's that simple to protect our health and the environment!

- Keep a supply of bags near your dog leash or tie them to the leash
- Use a poop scooper
- Bring several plastic bags with you
- Reuse plastic grocery bags or purchase special doggie waste bags at pet supplies stores
- Make sure your pet's waste gets into a trash can

Encourage your neighbors and other pet owners to do the right thing and pick up after their pets.



¡RECOJA los desechos de sus mascotas!

Proteja la salud de su mascota y el medio ambiente

Si desea más información, visite
sbcountystormwater.org/dog

facebook.com/sbcountystormwater

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San Bernardino County Stormwater Program

POR QUÉ ES IMPORTANTE

PROTEJA A SU FAMILIA Y A SU MASCOTA

- Los desechos de los perros pueden infectar a niños y adultos con enfermedades causadas por bacterias y parásitos.
- Su perro puede contraer una infección de los desechos de otros perros.

PROTEJA EL MEDIO AMBIENTE

Dejar desechos de perros en la calle o en su propiedad puede tener un impacto negativo en la calidad del agua. Los desechos de mascotas que no se eliminan de la propiedad fluyen sin tratamiento por el sistema de drenaje de tormentas y llegan directamente a las masas de agua locales. Los desechos de mascotas son agentes contaminantes que contienen nutrientes, parásitos y bacterias que pueden afectar la calidad de nuestros ríos y océanos, y hacer que el agua no sea segura para nadar, beber o pescar.

COLÓQUELA EN UNA BOLSA Y TÍRELA EN LA BASURA

Así de simple es proteger nuestra salud y el medio ambiente.

- Guarde algunas bolsas cerca de la correa de su perro o átelas a la correa;
- Use una cuchara para recojer el desecho;
- Lleve varias bolsas plásticas;
- Reutilice bolsas plásticas de comestibles o compre bolsas especiales para desechos de perros en las tiendas para mascotas;
- Asegúrese de tirar los desechos de su perro en un cesto de basura.

Aliente a sus vecinos y otros dueños de mascotas a hacer lo correcto y levantar los desechos de sus mascotas.




Mobile vehicle maintenance

Wash in a designated area that has been bermed up to contain the wash water.

Common water control devices are: recycling systems; pretreatment or sewer discharge systems; limited recycling systems; wash pits(portable vinyl wash pads), vacuum sludge filtering systems; wet-dry vacuums, sump pumps; drain covers; portable dams; vacu-brooms; oil absorbent pads, booms, pillows, and tubes; plastic sheeting; filter tubs; buckets; pans; and squeegees.

When cleaning engines using chemical additives like soaps, solvents or degreasers, the cleaning must be performed at a facility that has the equipment to properly process the contaminated wastewater runoff, or using a leak-proof ground cover device that will catch and contain all contaminated wastewater runoff for later disposal in a manner that complies with city, county, state and federal codes.

Wastewater from cleaning equipment must be discharged into a sink, toilet, or other drain connected to the sanitary sewer

WASH YOUR CAR THE ECO-FRIENDLY WAY!

When possible, wash in a professional car wash.

1. **Locate** the nearest storm drain and ensure that wash water does not flow into it.

2. **Wash** in a contained area or on grass*, gravel or other permeable surface. Dispose of excess soapy water into the sanitary sewer *(ie. sink or toilet)* or onto grass.

3. **Use** eco-friendly cleaning products (*non-toxic, phosphate free or biodegradable*). Use as little soap as possible and wipe brake dust off tires with a rag before washing.

4. **Conserve** water by using a high pressure hose and turn off the water when not in use.

**Some local ordinances may not allow a car to be parked on the front lawn. Check with your City's Building and Code department if you are unsure.*

How Does Eco Car Washing Help Local Waterways?

When excess wash water travels through the street it has the potential to pick up oil, grease and other chemicals along the way before it ends up in the curb, gutter and the storm drain system. **This contaminated water then travels to our creeks and the Santa Ana River making it unsafe for people and wildlife.**

To report illegal dumping, call **(877) WASTE18** or visit **sbcountystormwater.org**
To find a Hazardous Waste Facility, call **(800) OILY CAT**

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¡LAVE SU AUTO DE MANERA ECOLÓGICA!

Cuando sea posible, lávelo en un lavadero profesional de autos.

1. **Ubique** el desagüe pluvial más cercano y asegúrese de que nada pueda entrar en él o que pueda descargarse allí.

2. **Lave** su auto sobre el cesped, grava u otras superficies permeables. Elimine el exceso de agua jabonosa en un drenaje sanitario *(por ejemplo, lavamanos o inodoro)* o en el césped.

3. **Use** productos de limpieza ecológicos *(no tóxicos, sin fosfato o biodegradables)*. Use la menor cantidad de jabón posible y limpie el polvo de frenos de los neumáticos con un trapo antes de lavar.

4. **Conserve** agua usando una manguera de alta presión y cierre el agua cuando no la use.

** Es posible que algunas ordenanzas locales no permitan estacionar sobre el césped en el frente de la casa. Consulte con el departamento de Código Urbano y Edificación de su ciudad si no está seguro.*

¿De qué Manera el Lavado de Autos Ecológico Ayuda a Proteger los Canales Fluviales Locales?

Cuando el exceso de agua de lavado viaja por la calle, es posible que recoja aceite, grasa y otros elementos químicos en el camino antes de que llegue en el desagüe pluvial y el sistema de la boca de tormenta. **Esa agua contaminada luego viaja hacia nuestros arroyos y al Río Santa Ana, haciendo que sea inseguro para la gente y los animales.**

Para reportar actividades ilegales, llame a **(877) WASTE18** o visite **sbcountystormwater.org**. Para encontrar un establecimiento de Desechos Peligrosos, llame al **(800) OILY CAT**

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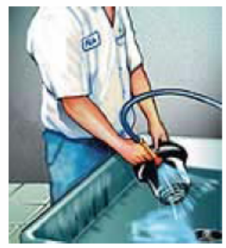
SAN BERNARDINO COUNTY
STORMWATER POLLUTION PREVENTION

Automotive services

Oil, grease, anti-freeze and other toxic automotive fluids often make their way into the San Bernardino County storm drain system, and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution, protect public health and avoid fines or legal action.

- **Storing Hazardous Waste:** Keep your liquid waste segregated. Many fluids can be recycled via hazardous waste disposal companies if they are not mixed. Store all materials under cover with spill containment or inside to prevent contamination of rainwater runoff.
- **Proper Disposal of Hazardous Waste**: Recycle used motor oil and oil filters, anti-freeze and other hazardous automotive fluids, batteries, tires and metal filings collected from grinding/polishing auto parts. Contact a licensed hazardous waste hauler. For more recycling information, call (909) 386-8401.



- **Cleaning Auto Parts:** Scrape parts with a wire brush or use a bake oven rather than liquid cleaners. Arrange drip pans, drying racks and drain boards so that fluids are directed back into the sink or the fluid holding tank. Do not wash parts or equipment in a parking lot, driveway or street.
- **Preventing Leaks and Spills:** Place drip pans underneath to capture fluids. Use absorbent cleaning agents instead of water to clean work areas.
- **Metal Grinding & Polishing:** Keep a bin under your lathe or grinder to capture metal filings. Send uncontaminated filings to a scrap metal recycler for reclamation. Store metal filings in a covered container or indoors.
- **Cleaning Spills:** Follow your hazardous materials response plan, as filed with your local fire department or other hazardous materials authority. Be sure that all employees are aware of the plan and are capable of implementing each phase of the plan. Use dry methods for spill cleanup (sweeping, absorbent materials, etc.). To report serious spills, call 911.
- **Washing vehicles:** Wash vehicles where the wash water can soak into grass, gravel or be diverted to nearby landscaping, away from the street and storm drains. Wash vehicles at a designated wash rack that is connected to the sanitary sewer or take vehicles to a professional car wash. Use soaps, cleaners and detergents that are labeled phosphate free or biodegradable. The safest products for the environment are vegetable based or citrus-based soaps.

For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

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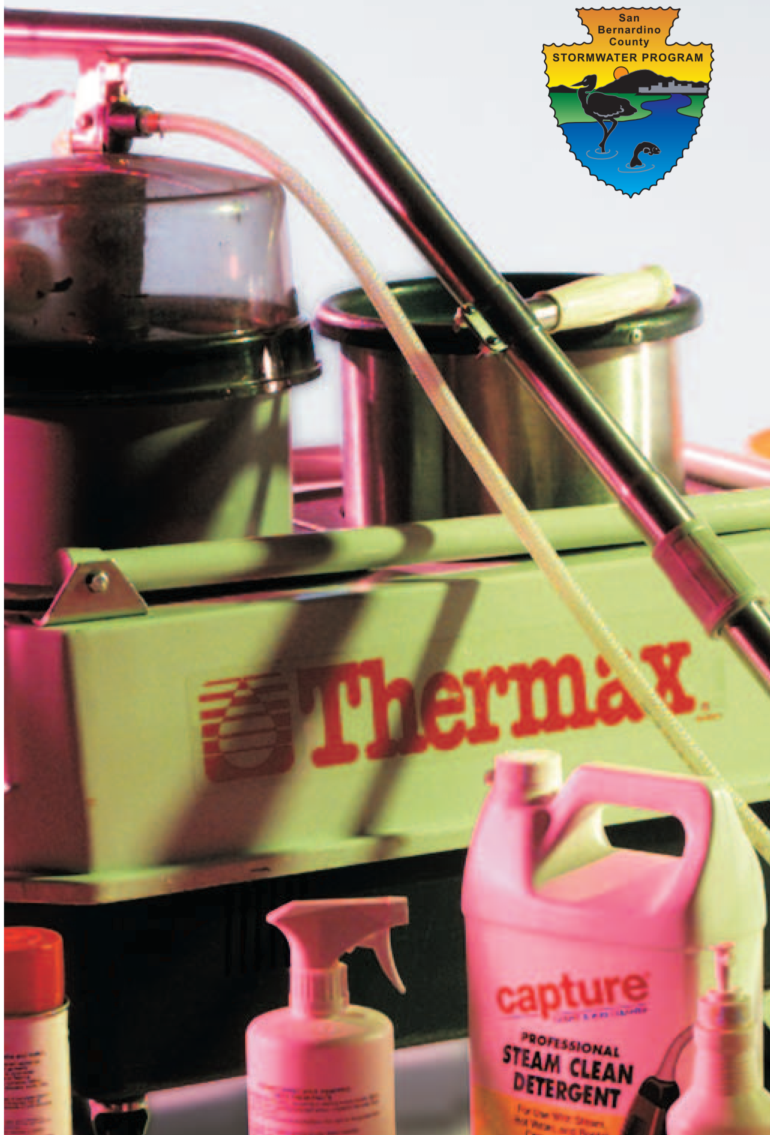
San Bernardino County STORMWATER PROGRAM

STORMWATER Pollution Prevention

CARPET CLEANING ACTIVITIES

San Bernardino County STORMWATER PROGRAM



Pollution Prevention

Stormwater Management Practices for Carpet Cleaning Activities

Toxic chemicals and discharged waste water from carpet, drapery, furniture and window cleaning often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates local waterways, making them unsafe for people and wildlife. Following these best management practices will prevent pollution, comply with regulations and protect public health.

These guidelines apply even if the cleaning products are labeled "nontoxic" or "biodegradable". Although these products may be less harmful to the environment, they can still have harmful effects if they enter the storm drain untreated.

Dispose of Wastewater Properly

Wastewater from cleaning equipment must be discharged into a sink, toilet, or other drain connected to the sanitary sewer system within sanitary sewer discharge limits, hauled off and disposed of properly, or may be discharged to a pervious area, for example, a lawn area, as long as it does not overflow into the street, gutter, parking lot or storm drain. Wastewater should never be discharged into a street, gutter, parking lot or storm drain.

Filter Wastewater

Carpet cleaning wastewater should be filtered before discharging it to the sanitary sewer since fibers and other debris in the wastewater can clog pipes. The filtered material can be disposed of in the garbage, provided that the waste is not contaminated with hazardous pollutants.

To report illegal dumping call
(877) WASTE18
or visit our website:
sbcountystormwater.org

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STORMWATER
Pollution Prevention

LANDSCAPE MAINTENANCE

San Bernardino County
STORMWATER PROGRAM

STORMWATER

Pollution Prevention

Stormwater Management Practices for Commercial Landscape Maintenance

Yard waste, sediments, and toxic lawn/garden chemicals used in commercial landscape maintenance often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates local waterways, making them unsafe for people and wildlife. Following these best management practices will prevent pollution, comply with regulations and protect public health.

Recycle Yard Waste

Recycle leaves, grass clippings and other yard waste. Do not blow, sweep, rake or hose yard waste into the street. Try grasscycling – the natural recycling of grass by leaving clippings on the lawn when mowing. Grass clippings will quickly decompose, returning valuable nutrients to the soil. Further information can be obtained at www.ciwmb.ca.gov/Organics.

Use Fertilizers, Herbicides and Pesticides Safely

Fertilizers, herbicides and pesticides are often carried into the storm drain system by sprinkler runoff. Use of natural, non-toxic alternatives to the traditional fertilizers, herbicides and pesticides is highly recommended. If you must use chemical fertilizers, herbicides, or pesticides:

- Spot apply pesticides and herbicides, rather than blanketing entire areas.
- Avoid applying near curbs and driveways, and never apply before a rain.
- Apply fertilizers as needed, when plants can best use it, and when the potential for it being carried away by runoff is low.

Recycle Hazardous Waste

Pesticides, fertilizers, herbicides and motor oil contaminate landfills and should be disposed of through a Hazardous Waste Facility, which accepts these types of materials. For information on proper disposal call, (909) 386-8401.

Use Water Wisely

Conserve water and prevent runoff by controlling the amount of water and direction of sprinklers. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff. Periodically inspect, fix leaks and realign sprinkler heads. Plant native vegetation to reduce the need of water, fertilizers, herbicides, and pesticides.

Prevent Erosion

Erosion washes sediments, debris and toxic runoff into the storm drain system, polluting waterways.

- Prevent erosion and sediment runoff by using ground cover, berms and vegetation down-slope to capture runoff.
- Avoid excavation or grading during wet weather.

Store Materials Safely

Keep landscaping materials and debris away from the street, gutter and storm drains. On-site stockpiles of materials must be covered with plastic sheeting to protect from rain, wind and runoff.

To report illegal dumping call

(877) WASTE18

or visit our website:

sbcountystormwater.org

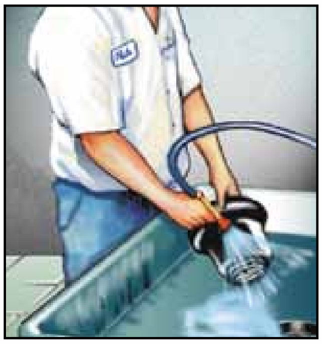
San Bernardino County STORMWATER PROGRAM

STORMWATER

Pollution Prevention

AUTO MAINTENANCE

Oil, grease, anti-freeze and other toxic automotive fluids often make their way into the San Bernardino County storm drain system, and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these best management practices to prevent pollution and protect public health.

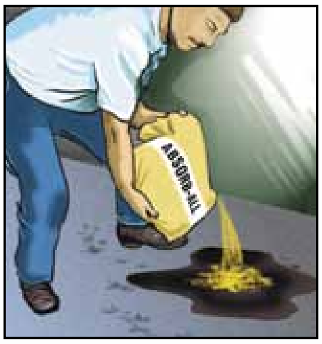


Cleaning Auto Parts
Scrape parts with a wire brush or use a bake oven rather than liquid cleaners. Arrange drip pans, drying racks and drain boards so that fluids are directed back into the parts washer or the fluid holding tank. Do not wash parts or equipment in a shop sink, parking lot, driveway or street.

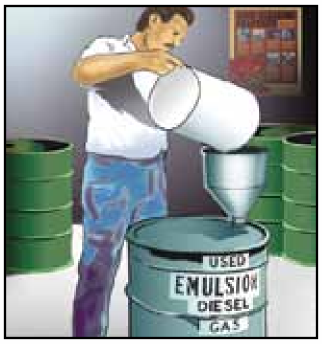
Storing Hazardous Waste
Keep your liquid waste segregated. Many fluids can be recycled via hazardous waste disposal companies if they are not mixed. Store all materials under cover with spill containment or inside to prevent contamination of rainwater runoff.

Metal Grinding and Polishing
Keep a bin under your lathe or grinder to capture metal filings. Send uncontaminated filings to a scrap metal recycler for reclamation. Store metal filings in a covered container or indoors.

Preventing Leaks and Spills
Place drip pans underneath to capture fluids. Use absorbent cleaning agents instead of water to clean work areas.



Cleaning Spills
Use dry methods for spill cleanup (sweeping, absorbent materials). Follow your hazardous materials response plan, as filed with your local fire department or other hazardous materials authority. Be sure that all employees are aware of the plan and are capable of implementing each phase. To report serious toxic spills, call 911.



Proper Disposal of Hazardous Waste
Recycle used motor oil and oil filters, anti-freeze and other hazardous automotive fluids, batteries, tires and metal filings collected from grinding or polishing auto parts. Contact a licensed hazardous waste hauler. For more recycling information, call (909) 386-8401.

To report illegal dumping call

(877) WASTE18

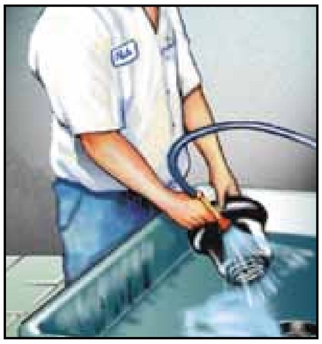
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación del Desagüe

MANTENIMIENTO DE AUTO

Aceite, grasa, anti-congelantes y otros liquidos toxicos para el auto acaban por llegar a los drenajes del Condado de San Bernardino y terminando en el Rio de Santa Ana. Esto contamina el agua que tomamos, haciendola peligorsa para la gente y la vida salvaje. Sigue estas practicas para prevenir la contaminación y protejer la salud publica.

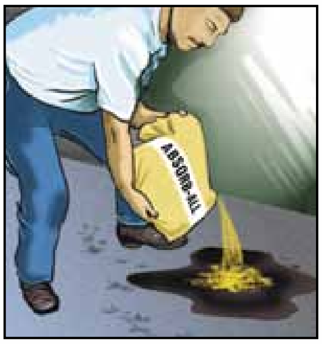


Limpiar Partes De Autos
Limpia las partes de auto con un cepillo de alambres o usa un limpiador de hornos en vez de usar limpiadores líquidos. Arregla las graseras, perchas para secar y tablas de escurrir para que los líquidos sean dirigidos al lavadero o recipientes para guardar líquidos. No laves las partes de auto o herramientas en el estacionamiento, la cochera o la calle.

Almacenando Desechos Peligrosos
Manten los desechos líquidos separados. Varios líquidos pueden ser reciclados por compañias que se especializan en desechos tóxicos si aun no estan mezclados. Guarda y cubre todos los materiales dentro de un lugar para prevenir la contaminación del desagüe.

Desechos de Metal & Pulidos
Manten un recipiente debajo de las maquinas de tornos o amoladoras para colectar desechos de metal. Manda los desechos de metal a un centro de reciclaje de metales. Guarda los desechos de metal en un recipiente cuvierto o dentro del local.

Prevenir Goteaduras & Derrames
Utilisa caserolas para el goteo de líquidos. Use limpiadores absorbentes en lugar de agua para limpiar el área de trabajo.



Limpiando Derrames
Sigue tu plan de como actuar sobre los materiales tóxicos, como esta indicado en el departamento de bomberos local u otras autoridades de materiales tóxicos. Asegurate que todos los empleados estén informados y capaz de aplicar cada fase del plan. Usa métodos secos para limpiar derramamientos (barriendo, materiales absorbentes, etc.).

Manera Correcta de Depositar los Desechos Peligrosos
Recicla el aceite de motor y filtros de aceite usados, anti-congelante, baterias, lubricantes, y desechos de metal y partes de auto pulidas. Llama a un colector de desechos tóxicos para disponer de absorbentes saturados. Mas iformación sobre reciclaje, llama al (909) 386-8401.

Para reportar actividades ilegales llamar al:

(877) WASTE18

sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

SAN BERNARDINO COUNTY
STORMWATER POLLUTION PREVENTION

Construction & development:

Soil, cement wash, asphalt, oil and other hazardous debris from construction sites often make their way into the San Bernardino County storm drain system, and flow untreated into local waterways. Follow these best management practices to prevent pollution, protect public health and avoid fines or legal action.

- **Store Materials Safely:** Keep construction materials and debris away from the street, gutter and storm drains. Cover exposed stockpiles of soil, sand or gravel and excavated material with plastic sheeting, protected from rain, wind and runoff.
- **Preventing Erosion:** Avoid excavation or grading during wet weather. Plant temporary vegetation or add hydro mulch on slopes where construction is not immediately planned, and permanent vegetation once excavation and grading are complete. Construct diversion dikes to channel runoff to a detention basin and around the construction site. Use gravel approaches where truck traffic is frequent to reduce soil compaction and limit the tracking of sediment into the streets. For more information on erosion control, call (909) 799-7407.

- **Cleaning & Preventing Spills:** Use a drip pan and funnel when draining or pouring fluids. Sweep up dry spills, instead of hosing. Be ready for spills by preparing and using spill containment and cleanup kits that include safety equipment and dry cleanup materials such as kitty litter or sawdust. To report serious spills, call 911.
- **Maintaining Vehicles & Equipment:** Maintain and refuel vehicles and equipment at a single location on-site, away from the street, gutter and storm drains. Perform major equipment repairs and washings off-site. Inspect vehicles and equipment frequently for leaks, and prevent leaks from stored vehicles by draining gas, hydraulic oil, transmission, and brake and radiator fluids.
- **Ordering Materials & Recycling Waste:** Reduce waste by ordering only the amounts of materials needed for the job. Use recycled or recyclable materials whenever possible. You can recycle broken asphalt, concrete, wood, and cleared vegetation. Dispose of hazardous materials through a hazardous waste hauler or other means in accordance with the construction permit. Non-recyclable materials should be taken to a landfill or disposed of as hazardous waste. For recycling and disposal information, call (909) 386-8401.
- **Concrete and mortar application:** Never dispose of cement washout into driveways, streets, gutters or drainage ditches. Wash concrete mixers and equipment only in specified washout areas, where the water flows into lined containment ponds. Cement wash water can be recycled by pumping it back into cement mixers for reuse.

For more information about how you can prevent stormwater pollution:

www.sbcountystormwater.org

GOT COOKING OIL? RECYCLE IT!

RECYCLE YOUR LEFTOVER LIQUID COOKING OIL TO AVOID THE HASSLE OF DEALING WITH CLOGGED PIPES AND OTHER SEWER PROBLEMS.

FOLLOW THESE SIMPLE STEPS TO RECYCLE YOUR COOKING OIL:

1. Let oil cool to a safe temperature and filter it to remove leftover food
2. Pour oil into a jar or plastic container with a tight-fitting lid
3. Take the oil to your nearest HHW collection center

DID YOU KNOW?

Recycled cooking oil is used to produce alternative fuels such as *biodiesel*, which is better for the environment.

For more information and a list of HHW collection centers near you, visit **sbcountystormwater.org/cookingoil** or call **1.800.OILY CAT (645.9228).**

STORMWATER Pollution Prevention

HOME & GARDEN

Yard waste and household toxics like paints and pesticides often make their way into the San Bernardino County storm drain system and do not get treated before reaching the Santa Ana River. This pollutes our drinking water and contaminates waterways, making them unsafe for people and wildlife. Follow these simple tips to prevent pollution and protect your health.

Recycle Household Hazardous Waste
Household products like paint, pesticides, solvents and cleaners are too dangerous to dump and too toxic to trash. Take them to be recycled at a convenient household hazardous waste collection facility. Call (800) CLEANUP for the facility in your area.

Disposing of Yard Waste
Recycle leaves, grass clippings and other yard waste, instead of blowing, sweeping or hosing into the street. Try grasscycling, leaving grass clippings on your lawn instead of using a grass catcher. The clippings act as a natural fertilizer, and because grass is mostly water, it also irrigates your lawn, conserving water.

Use Fertilizers & Pesticides Safely
Fertilizers and pesticides are often carried into the storm drain system by sprinkler runoff. Try using organic or non-toxic alternatives. If you use chemical fertilizers or pesticides, avoid applying near curbs and driveways and never apply before a rain.

Planting in the Yard
Produce less yard waste and save water by planting low maintenance, drought-tolerant trees and shrubs. Using drip irrigation, soaker hoses or micro-spray systems for flower beds and vegetation can also help reduce your water bill and prevent runoff.

Use Water Wisely
Cut your water costs and prevent runoff by controlling the amount of water and direction of sprinklers. The average lawn needs about an inch of water a week, including rainfall, or 10 to 20 minutes of watering. A half-inch per week is enough for fall and spring. Sprinklers should be on long enough to allow water to soak into the ground but not so long as to cause runoff.

To report illegal dumping call

(877) WASTE18

sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación del Desagüe

JARDIN

Basura del jardín y otros toxicos caseros como pintura, pesticidas y otros mas acaban por llegar a los drenajes del Condado de San Bernardino y terminando en el Rio de Santa Ana. Esto contamina el agua que tomamos, haciendola peligorsa para la gente y la vida salvaje. Sigue estas practicas para prevenir la contaminación y protejer la salud publica.

Disponiendo Desechos del Jardin
Recicla hojas, pasto y otras basuras del jardín en ves de soplarlas, barrerlas hacia la calle. El pasto sirve como fertilizante, y como el pasta es la mayoria agua tambien riega tu jardín, ahorrandote agua.

Reciclando Materiales del Hogar Peligrosos
Limpiadores del hogar como pintura, pesticidas, solventes y limpiadores son demasiado toxicos para tirarlos en la basura. Desechalos en unlugar de colección de desechos peligrosos. Llama al (800) CLEANUP para un lugar en tu area.

Usando Fertilizantes & Pesticidas Adecuadamente
Fertilizantes y pesticidas muchas veces terminan en los drenajes. Usa alternativas que no sean toxicas. Si tu usas fertilizantes y pesticidas con quimicos, no los uses cerca de las banquetas y cocheras y nunca los uses en tiempos de lluvia.

Cembrando en el Jardin
Reduce la basura del jardín y ahorra agua plantando arboles y plantas de bajo mantenimiento. Riega moderadamente con mangueras u otros metodos para las flores o vegetacion asi reduciras tu pago del mes y previenes el desagüe.

Usando el Agua Adecuadamente
Reduce el pago del agua y previene el desagüe controlando la cantidad y direccion de tus regaderas para el jardin. Solo necesitas regar de 10 a 20 minutos a la semana. Durante la primavera y otoño es la mitad. Las regaderas del jardin deverian estar ajustadas a que rieguen lo suficinete y evitar el desagüe.

Para reportar actividades ilegales llamar al:

(877) WASTE18
sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

A SAFE GARDEN: A LOT DEPENDS ON IT.

Protect your family and community when using pesticides and fertilizers.

- **STRATEGICALLY** apply products on your lawn only when rain is not expected.
- **SPOT-APPLY** directly on the problem instead of the whole area.
- **SAFELY** dispose of unwanted products. The County of San Bernardino offers 9 HHW Centers that accept pesticides, fertilizers and other toxic waste FREE of charge.

To report illegal dumping, call

(877) WASTE18 or visit

sbcountystormwater.org

San Bernardino County STORMWATER PROGRAM

Artwork Courtesy of the City of Los Angeles Stormwater Program. Printed on recycled paper.

UN JARDÍN SANO:
MUCHO DEPENDE DE ÉL.

Proteja a su familia y a su comunidad cuando utilice pesticidas y fertilizantes.

- **ESTRATÉGICAMENTE** aplique productos en su césped solamente cuando no se espera lluvia.
- **ESCASAMENTE** aplique los productos directamente en el área en donde exista el problema en lugar de distribuirlo en todo el jardín.
- **ELIMINE** productos tóxicos sanamente. El Condado de San Bernardino ofrece 9 centros de recolección que aceptan pesticidas, fertilizantes y otros desechos tóxicos GRATUITAMENTE.

Para reportar actividades ilegales llamar al
(877) WASTE18 **o visite**
sbcountystormwater.org

San Bernardino County
STORMWATER PROGRAM

Arte Cortesía del Programa de Agua Pluvial de la Ciudad de Los Angeles. Impreso en papel reciclado.

SPOT-APPLY

pesticides directly on the problem rather than blanketing the whole area.

sbcountystormwater.org

A SAFE GARDEN:
A LOT DEPENDS ON IT.

San Bernardino County
STORMWATER PROGRAM

(877) WASTE18

ESCASAMENTE

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sbcountystormwater.org

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San Bernardino County
STORMWATER PROGRAM

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San Bernardino County STORMWATER PROGRAM

Arte Cortesía del Programa de Agua Pluvial de la Ciudad de Los Angeles. Impreso en papel reciclado.

TRÁIGANOS SUS RESIDUOS TÓXICOS

Lleve sus productos tóxicos domésticos a un centro de recolección cerca de usted.

ES FÁCIL

1. Asegúrese que los productos estén **correctamente sellados, etiquetados**, y **protegidos contra derrames.***

2. Llévelos GRATIS a un centro de recolección en:

   - Big Bear Lake
   - Chino
   - Fontana
   - Ontario
   - Rancho Cucamonga
   - Redlands
   - Rialto
   - San Bernardino
   - Upland

PRODUCTOS DOMÉSTICOS TÓXICOS INCLUYEN:

- Líquidos Automotrices
- Baterías
- Aceite de Cocina
- Fertilizantes y Pesticidas
- Bombillas Fluorescentes
- Productos de Limpieza
- Medicina
- Aceite de Motor y Filtros
- Productos de Pintura
- Productos Químicos para Piscinas

¿POR QUÉ NO PUEDO ECHAR ESTOS ARTÍCULOS EN LA BASURA?

Es ilegal y representa riesgos para la salud de los seres humanos, mascotas, medioambiente y nuestras fuentes de agua.

Para obtener más información y una lista completa de los centros y productos, visite

tootoxictotrash.com

* *Por visita, usted puede traer 15 galones o 125 libras en contenedores no más grandes que 5 galones. No se aceptan desechos comerciales. Debe ser un residente del Condado de San Bernardino.*

SAN BERNARDINO COUNTY STORMWATER PROGRAM
WHERE WATER MEETS COMMUNITY

BRING US YOUR TOXIC WASTE

Take toxic household products to your local household hazardous waste collection center.

IT'S EASY!

1. Make sure products are **properly sealed**, **labeled**, and **spill-proof**.*

2. Take them to a **FREE** collection center in:

Big Bear Lake
Chino
Fontana
Ontario
Rancho Cucamonga
Redlands
Rialto
San Bernardino
Upland

TOXIC HOUSEHOLD PRODUCTS INCLUDE:

Automotive Fluids
Batteries
Cooking Oil
Fertilizers & Pesticides
Fluorescent Bulbs
Household Cleaners
Medicine
Motor Oil & Filters
Paint Products
Pool Chemicals

WHY CAN'T I THROW THESE ITEMS IN THE TRASH?

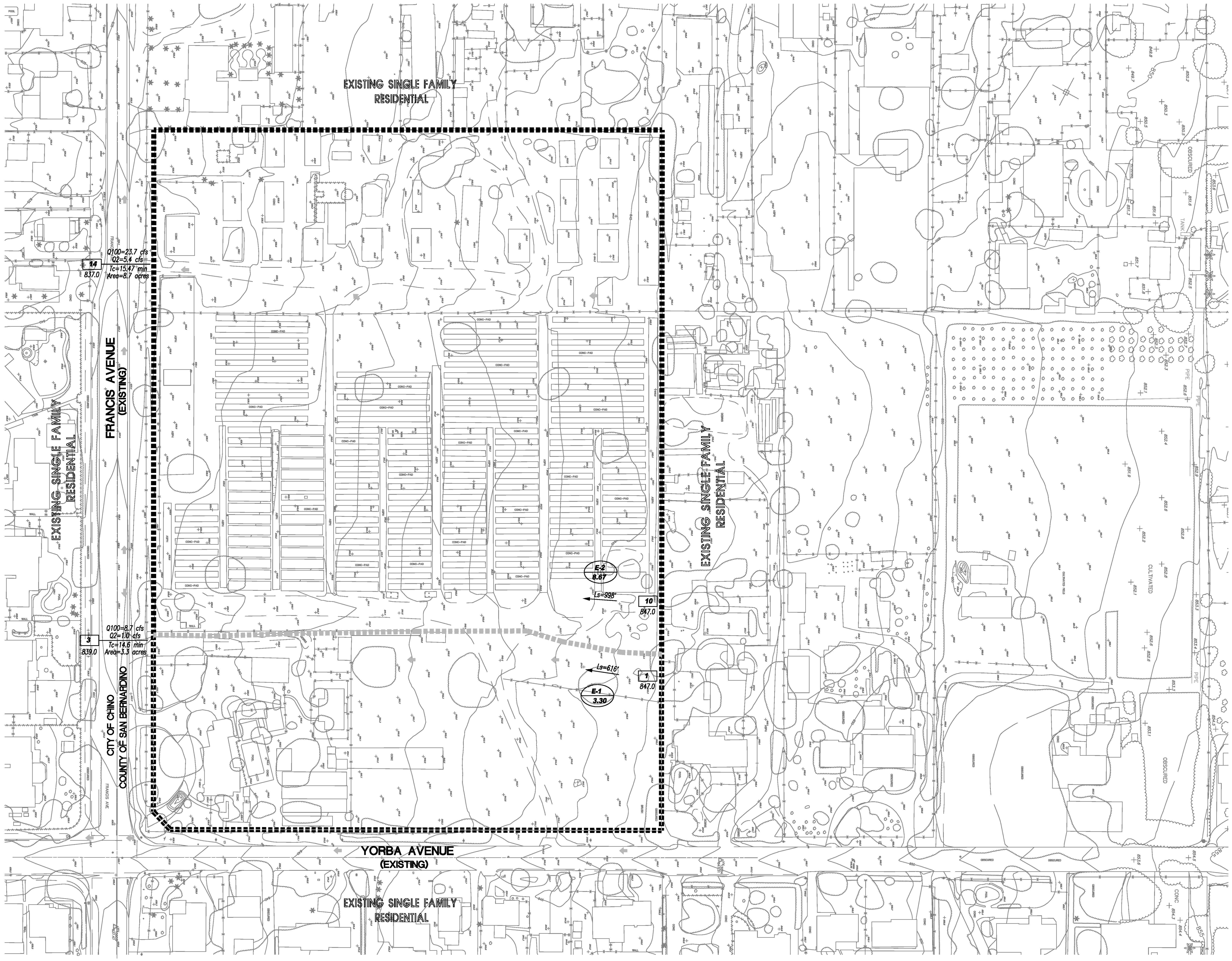
It is illegal and poses health risks to humans, pets, the environment, and our waterways.

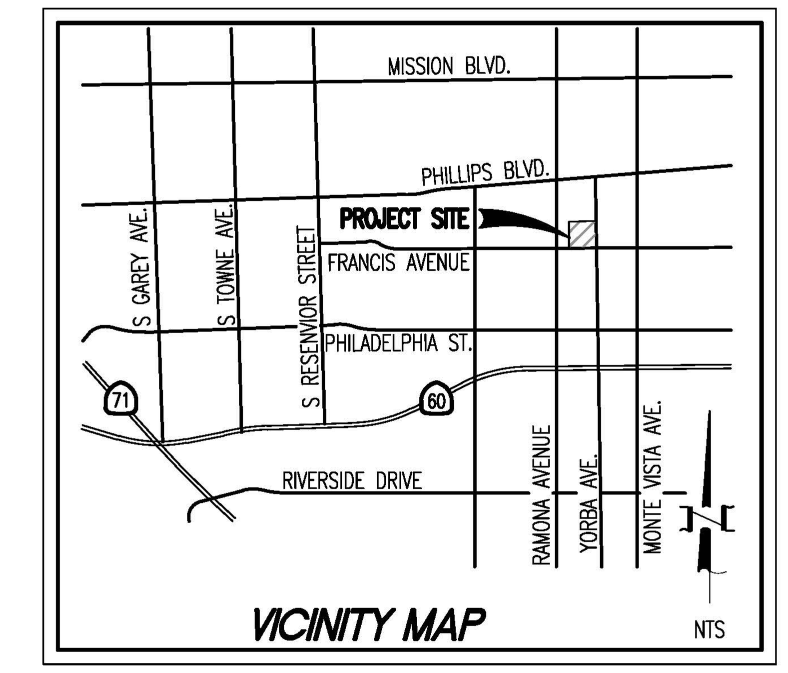
For more information, locations and a full list of items, visit

tootoxictotrash.com

** You can bring 15 gallons or 125 pounds in containers no larger than 5 gallons per visit. No business waste accepted. Must be a San Bernardino County resident.*

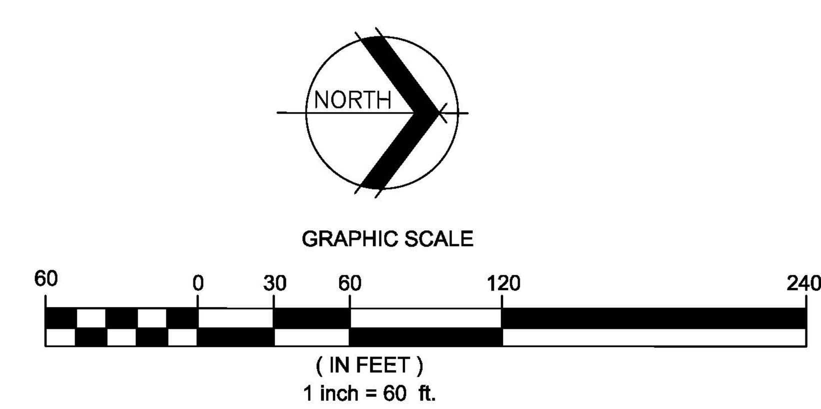
SAN BERNARDINO COUNTY STORMWATER PROGRAM
WHERE WATER MEETS COMMUNITY





SUMMARY:

TOTAL Q2 = 6.4 CFS
TOTAL Q100 = 32.4 CFS **0.8 x 32.4 CFS = 26.0 CFS = Q OUT ALLOWED**



TENTATIVE TRACT NO. 20394

EXISTING CONDITION

COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

Prepared: January 2021

PREPARED FOR:

BORSTEIN ENTERPRISES

YORBA VILLAS, LLC
C/O BORSTEIN ENTERPRISES
11766 WILSHIRE BOULEVARD, SUITE 820
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CONTACT PERSON: ERIK PFAHLER
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FAX: (310) 582-1999

PREPARED BY:

MDS CONSULTING
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FAX: 949-251-0516
PLANNERS ENGINEERS SURVEYORS

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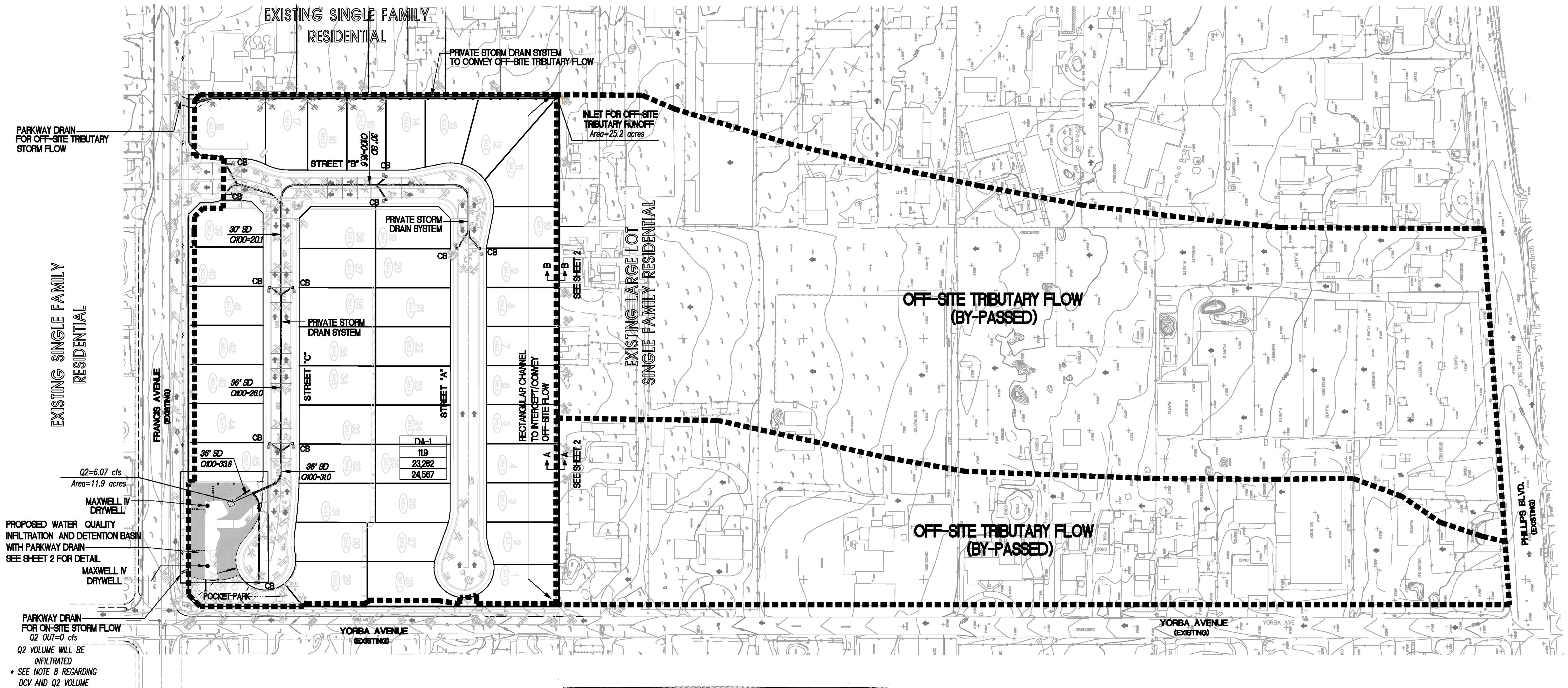
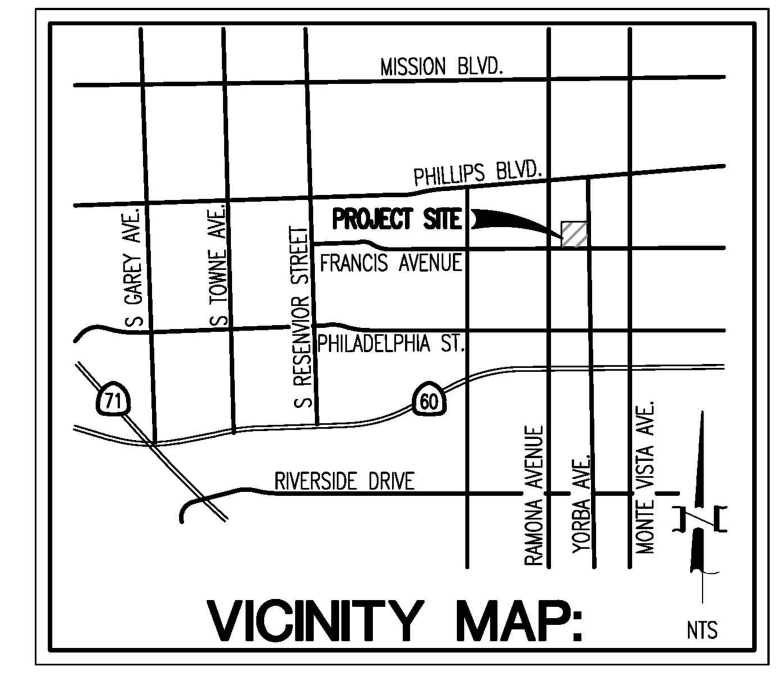




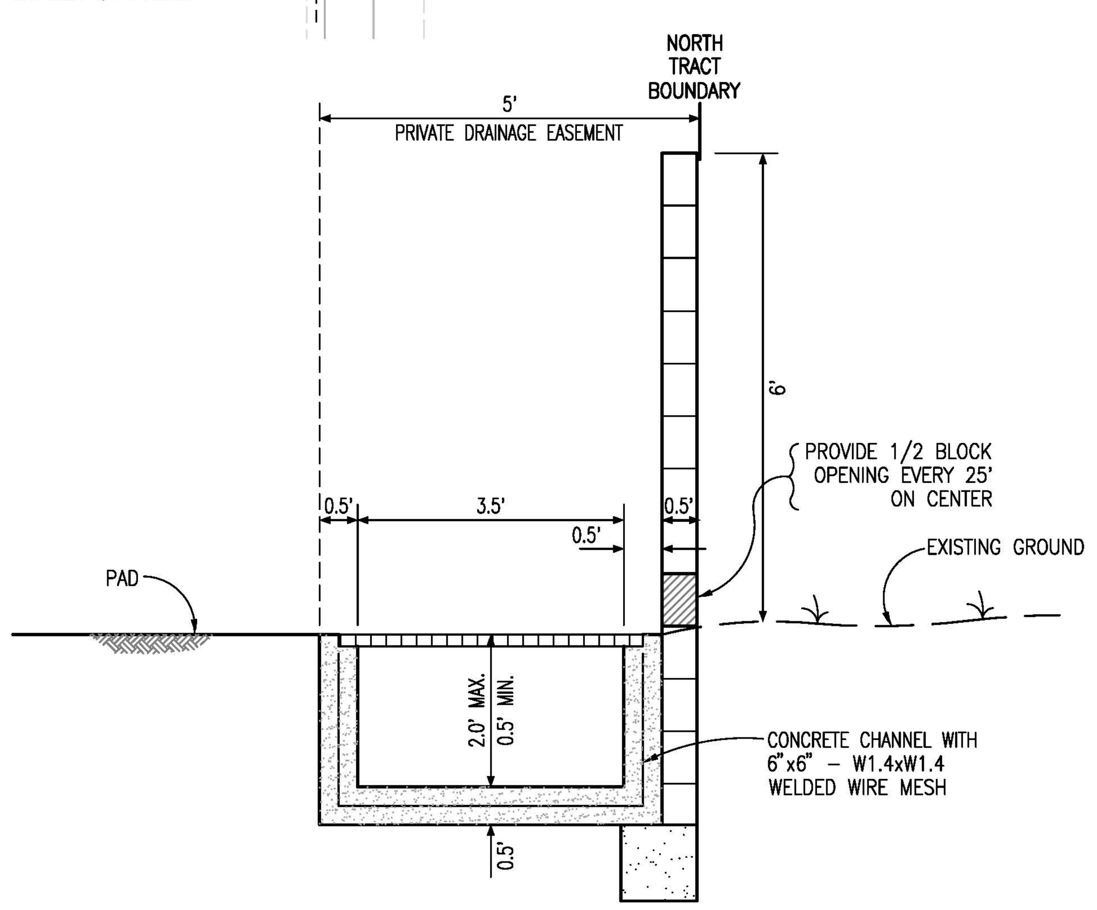
VICINITY MAP:

LEGEND:

C.B.	CATCH BASIN WITH STENCIL
	TRACT BOUNDARY
	DRAINAGE AREA BOUNDARY
CB	PROPOSED STORM DRAIN PROPOSED CATCH BASIN WITH BMP SD-13 CATCH BASIN STENCILING
Q2=X.X	2-year STORM PEAK FLOW (cfs)
	DIRECTION OF SURFACE FLOW
DA-1	DRAINAGE AREA
11.9±	AREA (acres)
23,282	DESIGN CAPTURE VOLUME (cu.ft.)
24,567	VOLUME PROVIDED (cu.ft.)
•	MAXWELL IV DRYWELL

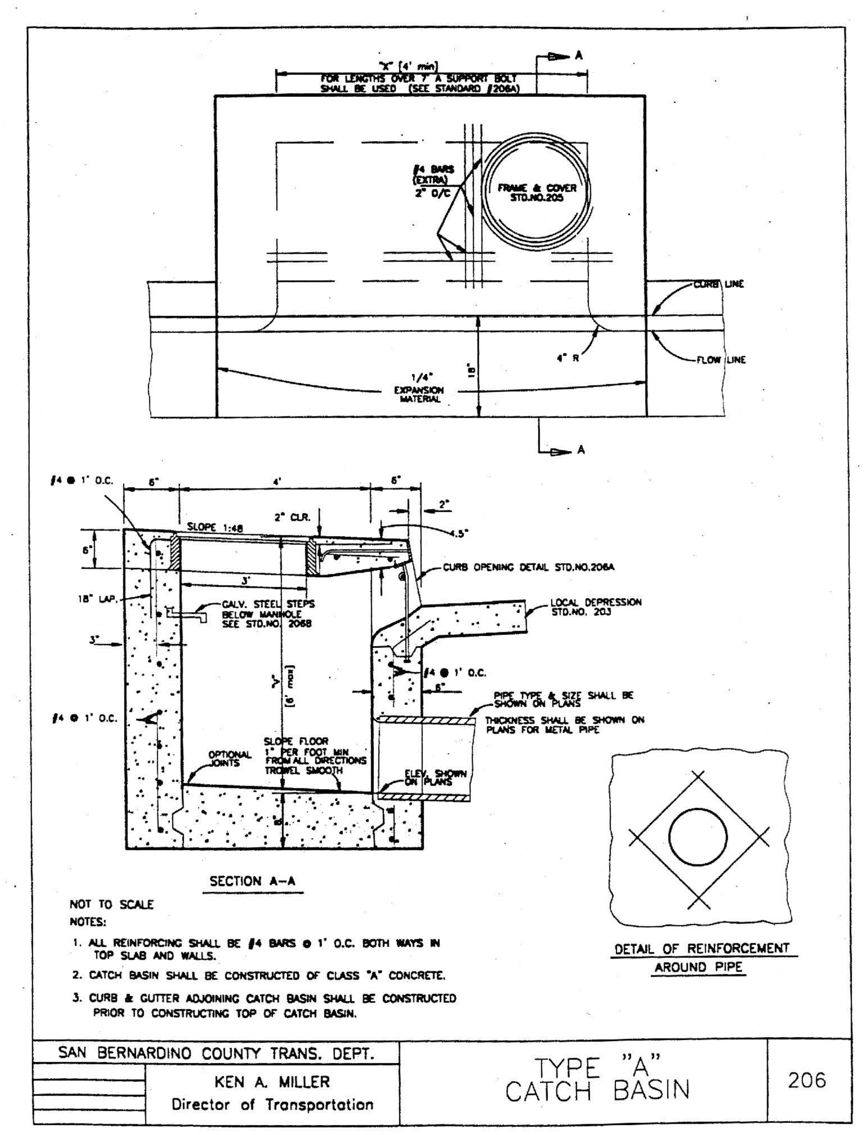
NOTES:

1. SOILS TYPE "A"
2. HYDROLOGIC CONDITIONS OF CONCERN (HCOC) CALCULATIONS PER PWQMP REPORT, POST DEVELOPED 2-YEAR STORM TO BE MITIGATED AND 100-YEAR STORM MITIGATED TO 80% OF PRE-DEVELOPED CONDITION STORM
3. EXISTING SITE: AGRICULTURE USE, 40% IMPERVIOUS
4. THE PROPERTY LIES WITHIN FLOOD ZONE 'X' UNSHADED PER FEMA FLOOD MAP 0671C8615H, DATED AUGUST 28, 2008.
5. OFFSITE TRIBUTARY RUNOFF TO BYPASS ONSITE WATER QUALITY INFITRATION BASIN
6. PEAK FLOW SHOWN ARE FOR 100-YEAR STORM UNLESS NOTED OTHERWISE
7. DEVELOPED CONDITION PEAK FLOW TO BE DETAINED TO 80% OF PRE-DEVELOPED CONDITION PEAK FLOW
8. DCV VOLUME AND 2-YR 24-HR VOLUME WILL BE INFILTRATED ON-SITE.



RECTANGULAR CHANNEL DETAIL

NOT TO SCALE

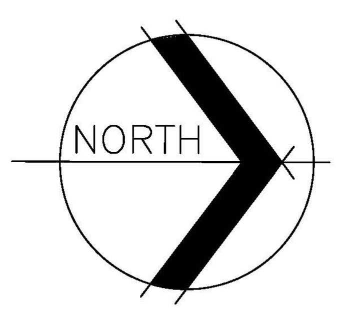


TYPICAL CATCH BASIN DETAIL

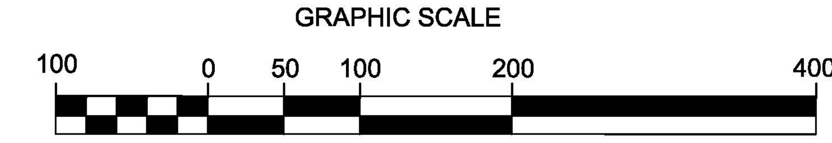
NOT TO SCALE

CATCH BASIN STENCIL DETAIL

NOT TO SCALE



GRAPHIC SCALE



(IN FEET)
1 inch = 100 ft.

VESTING TENTATIVE TRACT NO. 20394

PRELIMINARY WATER QUALITY MANAGEMENT PLAN SHEET 1 OF 2

COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

Prepared: November 2021

PREPARED FOR:

BORSTEIN ENTERPRISES

YORBA VILLAS, LLC
C/O BORSTEIN ENTERPRISES
11766 WILSHIRE BOULEVARD, SUITE 820
LOS ANGELES, CA 90025
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TELEPHONE: (310) 582-1991 EXT. 203
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PREPARED BY:

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Voice: 949-251-8821
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PLANNERS ENGINEERS SURVEYORS

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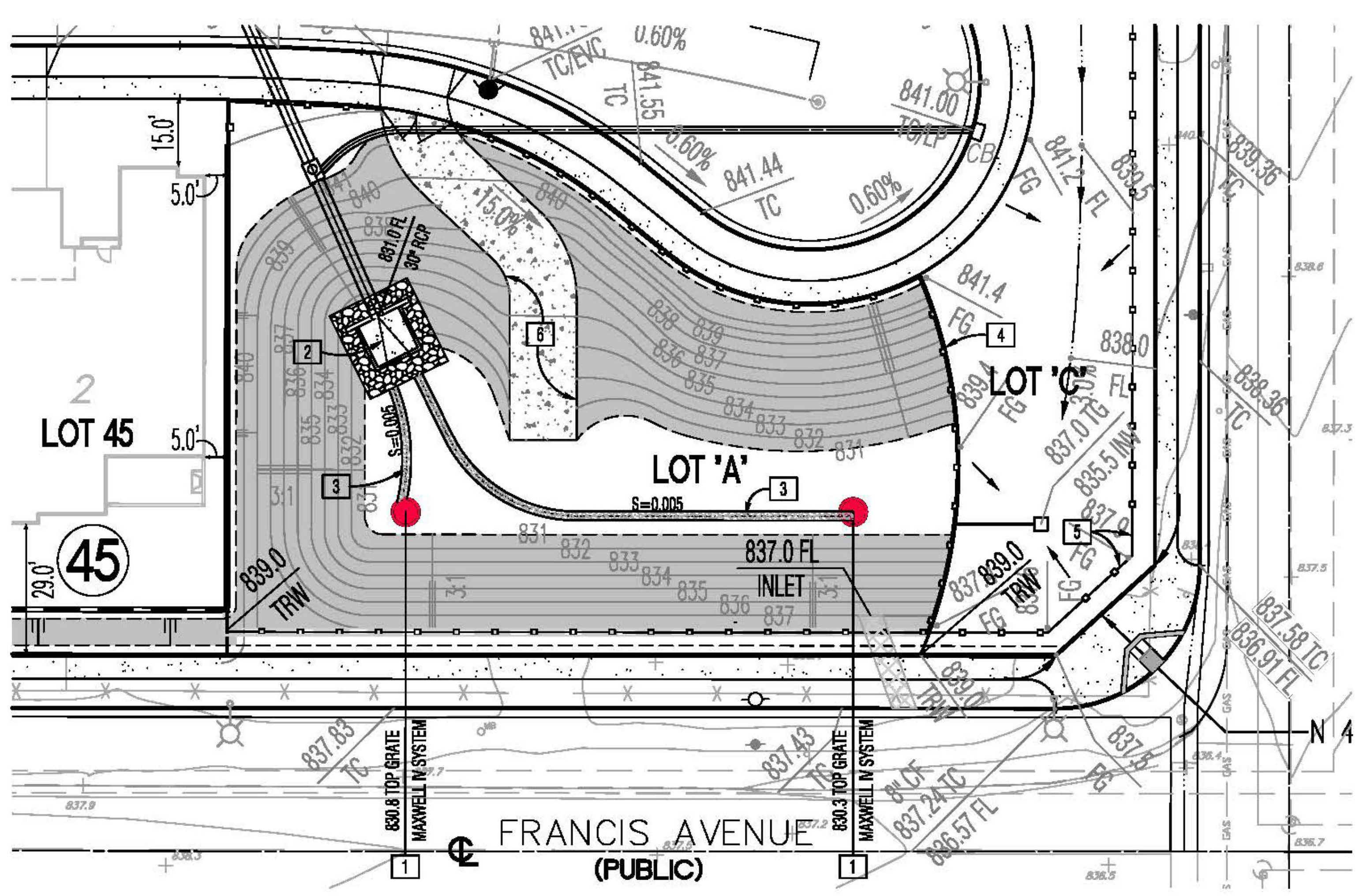


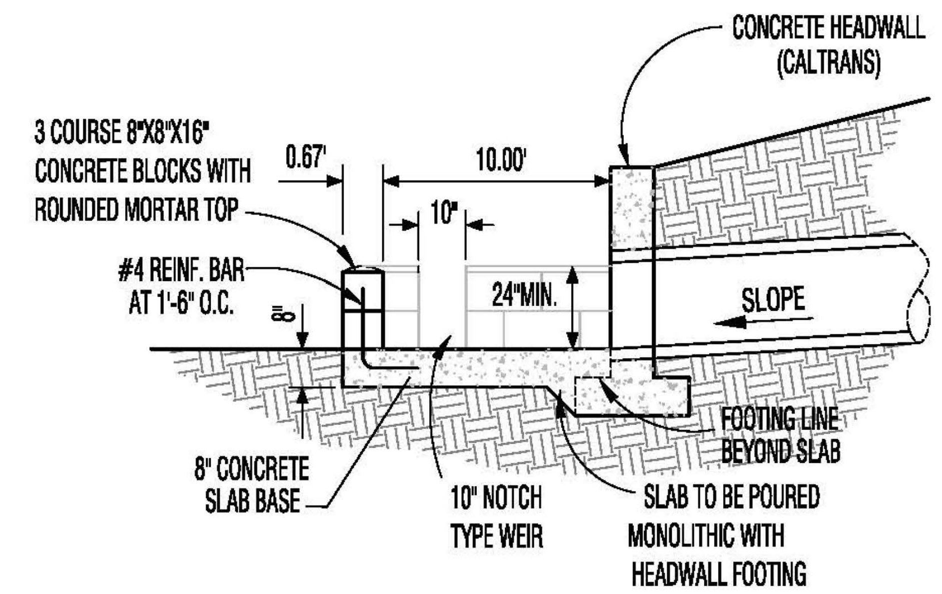
INFILTRATION AND DETENTION BASIN DETAIL

NORTH

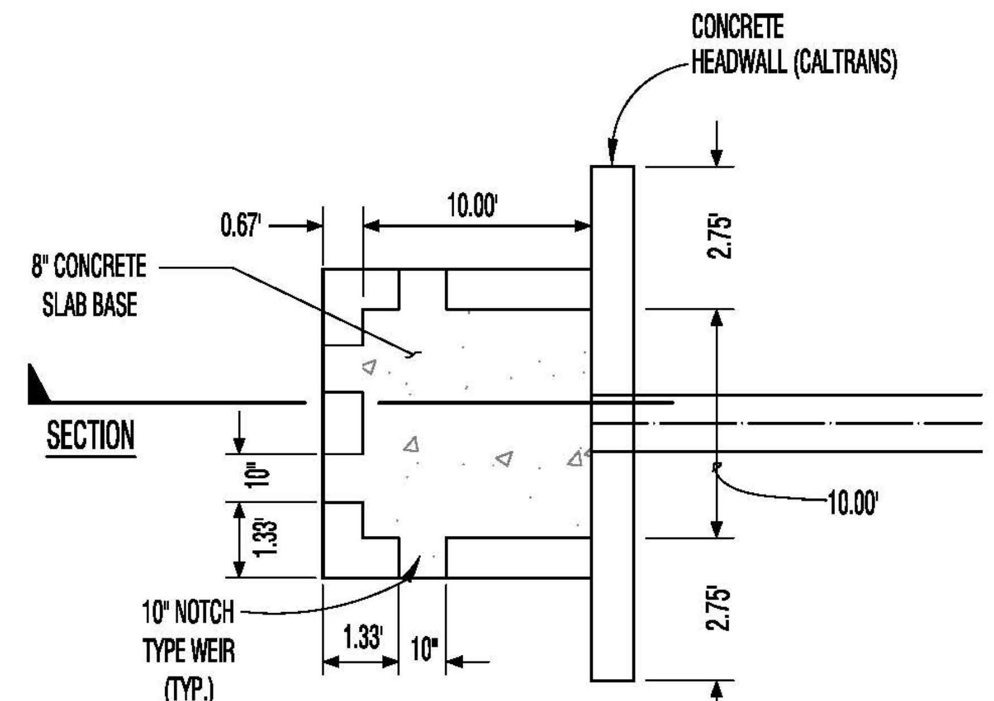
SCALE: 1" = 30'

ADVISORY NOTES:

1. MAXWELL IV DRAINAGE SYSTEM
2. CONCRETE FOREBAY
3. PILOT CHANNEL
4. RETAINING WALL WITH TUBULAR STEEL FENCE
5. TUBULAR STEEL FENCE
6. ACCESS RAMP (15% MAX. SLOPE), HEAVY BROOM FINISH



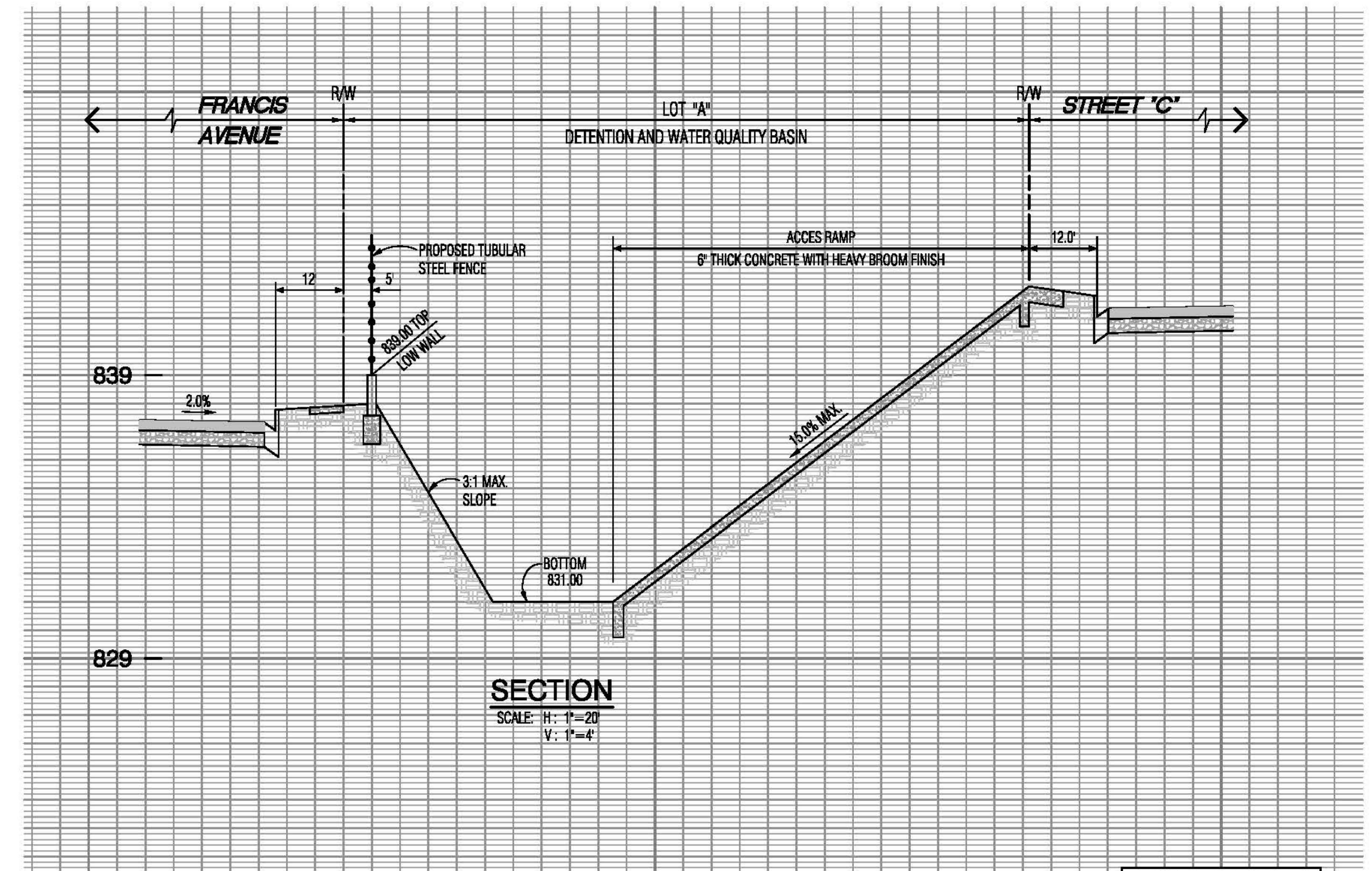
SECTION



PLAN

2 CONCRETE FOREBAY DETAIL

NOT TO SCALE

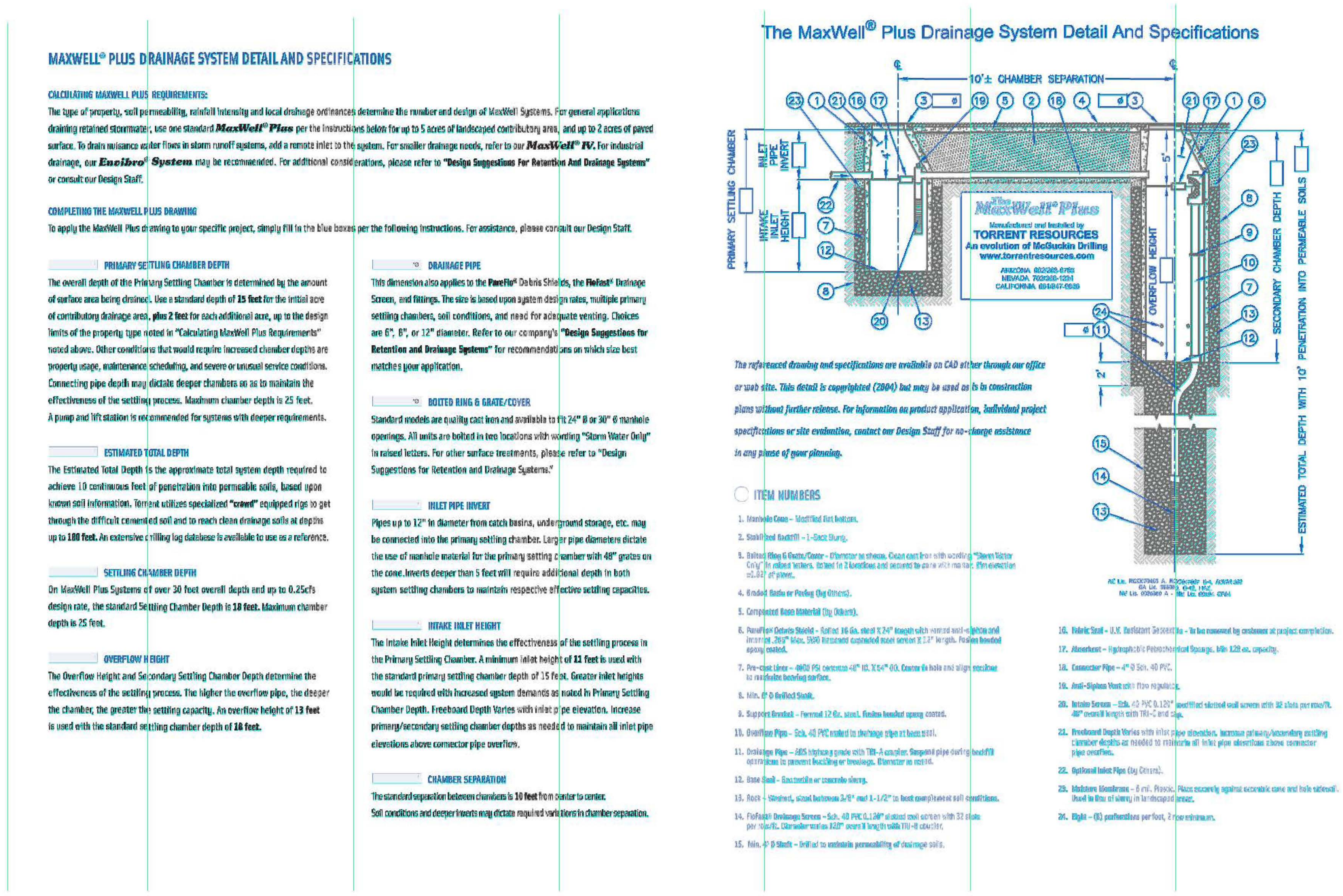


SECTION

SCALE: H: 1"=20' V: 1"=4'

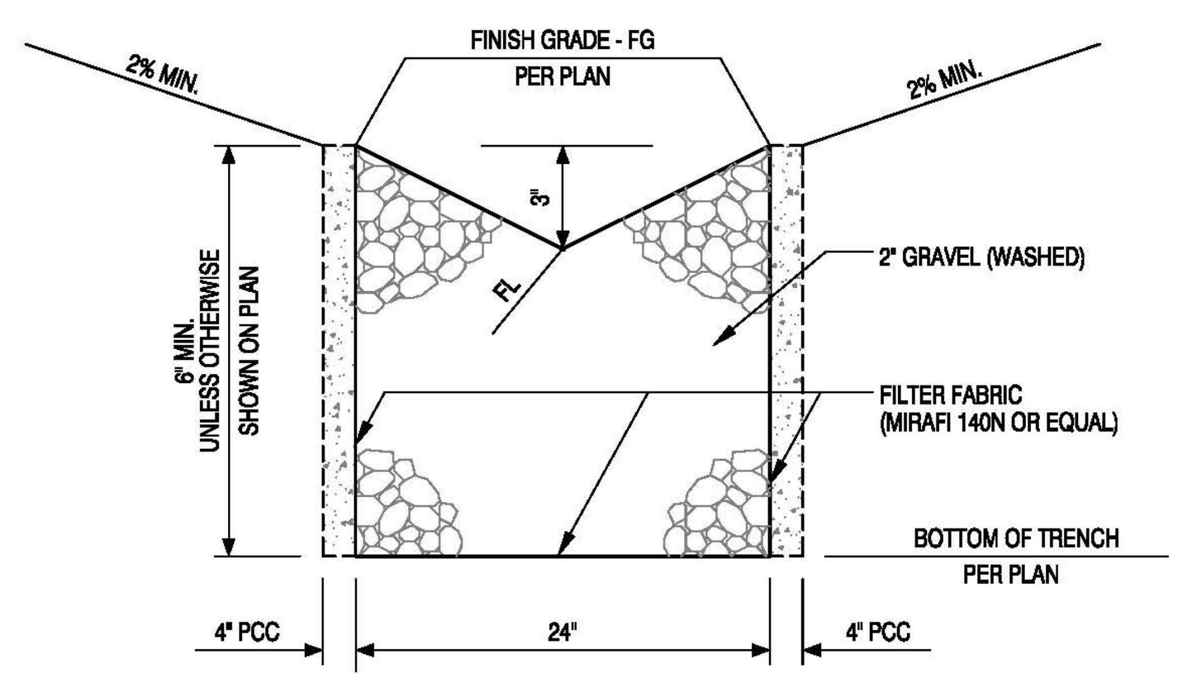
INFILTRATION AND DETENTION BASIN

PROFILE SCALES
HORIZ. 1"=20'
VERT. 1"=4'



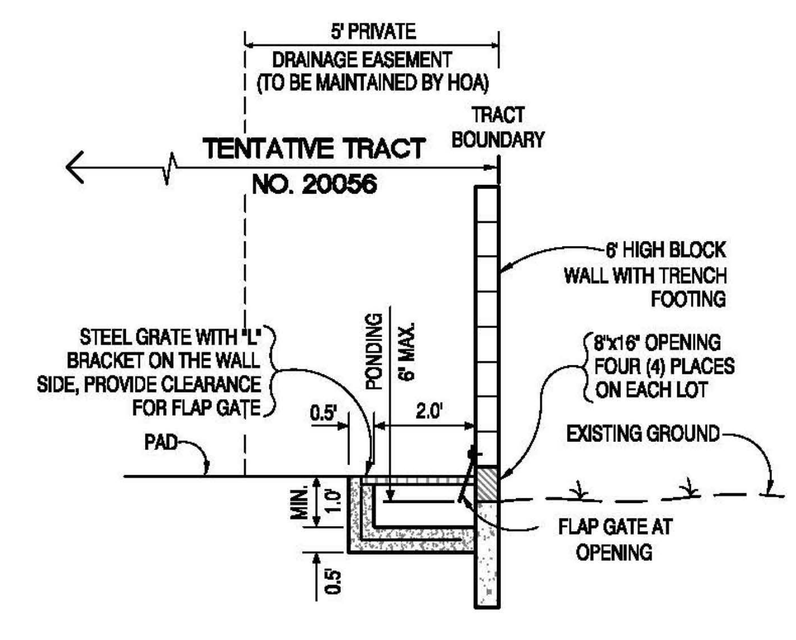
1 MAXWELL DRAINAGE SYSTEM

NOT TO SCALE



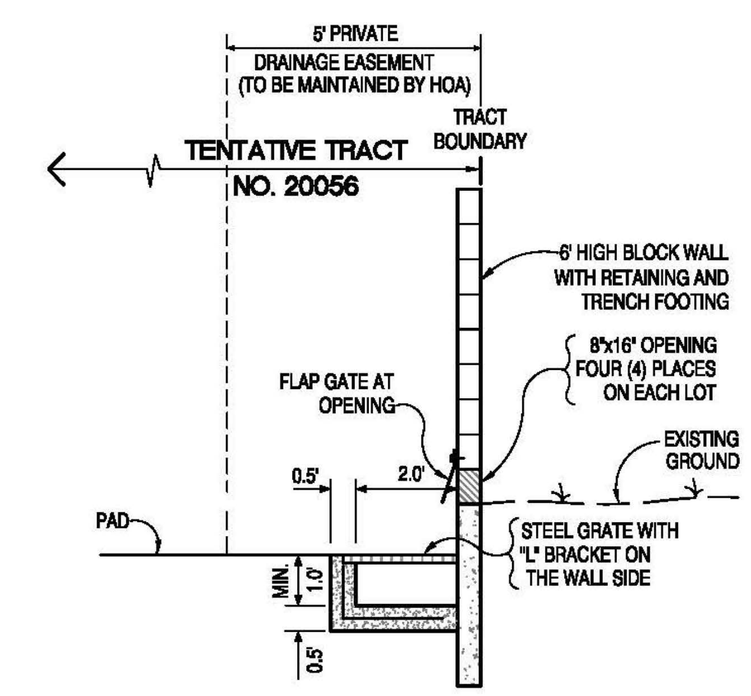
3 PILOT CHANNEL

NTS



SECTION A–A
RECTANGULAR CHANNEL DETAIL
FOR LOTS 1 - 6

SCALE: 1"=3'



SECTION B–B
RECTANGULAR CHANNEL DETAIL
FOR LOTS 7 - 11

SCALE: 1"=3'

VESTING TENTATIVE TRACT NO. 20394

PRELIMINARY WATER QUALITY MANAGEMENT PLAN SHEET 2 OF 2

COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

Prepared: November 2021

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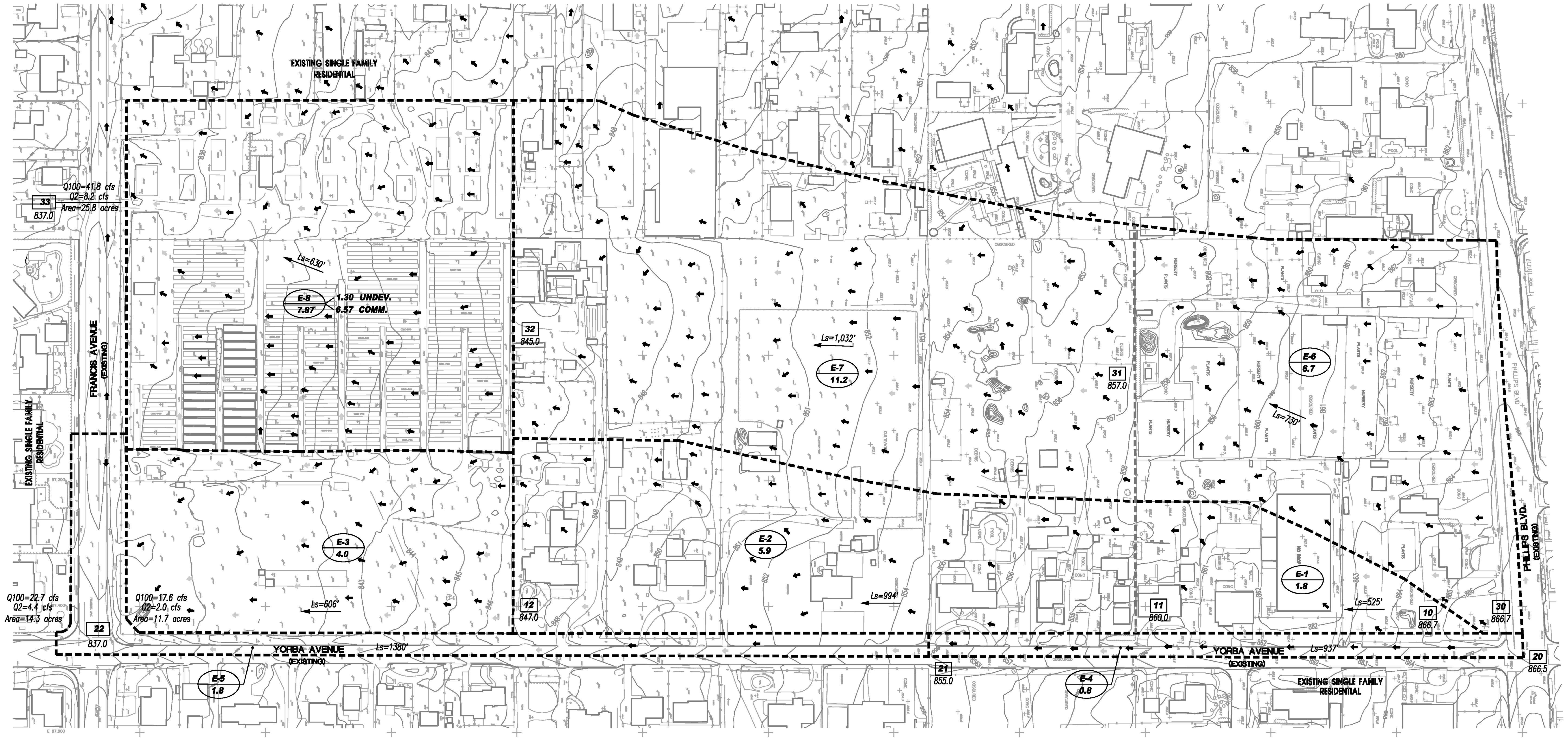
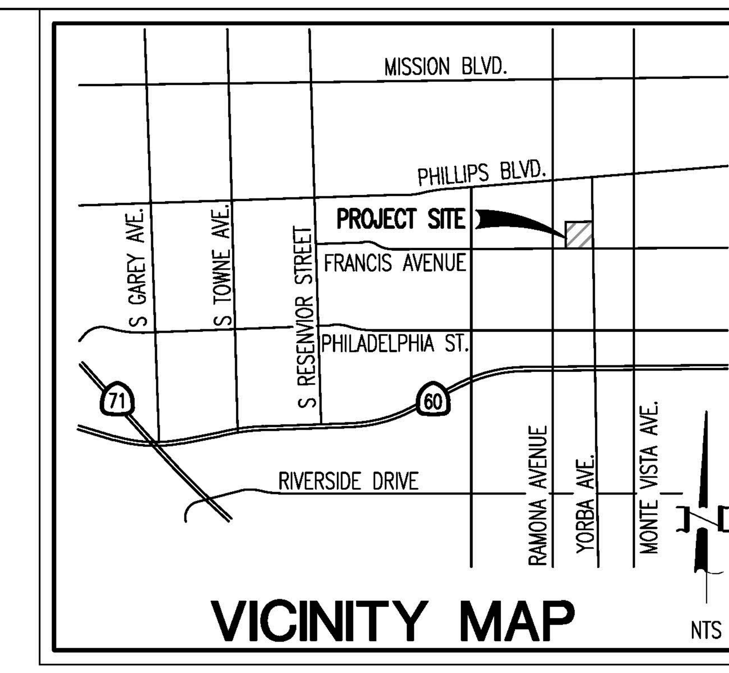
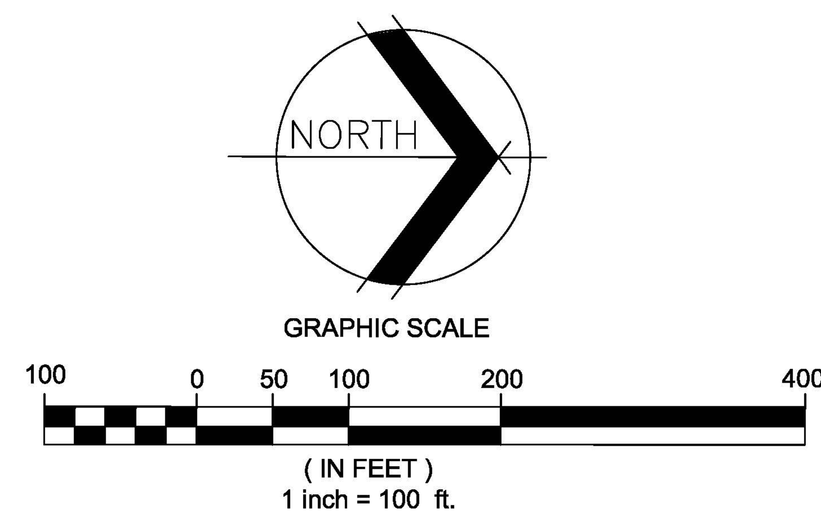




LEGEND:

C.B.	CATCH BASIN
J.S.	JUNCTION STRUCTURE
Lp=XX'	LENGTH OF PIPE FLOW (feet)
X-Y / X.XX	SUB-AREA DESIGNATION / AREA (acres)
Q=X.X	100-year STORM PEAK FLOW (cfs)
Q10=X.X	10-year STORM PEAK FLOW (cfs)
Ls=XXX'	SURFACE FLOW LENGTH (feet)
	DRAINAGE BOUNDARY
	SUB-AREA DRAINAGE BOUNDARY
	DIRECTION OF SURFACE FLOW
XX / XX.X / XX.X	NODE NUMBER / ELEVATION / INVERT
	LOT AREA DRAIN SYSTEM WITH DIRECTION OF FLOW ARROW



TENTATIVE TRACT NO. 20394

PRELIMINARY HYDROLOGY MAP EXISTING CONDITION

COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

Prepared: November 2021

PREPARED FOR:

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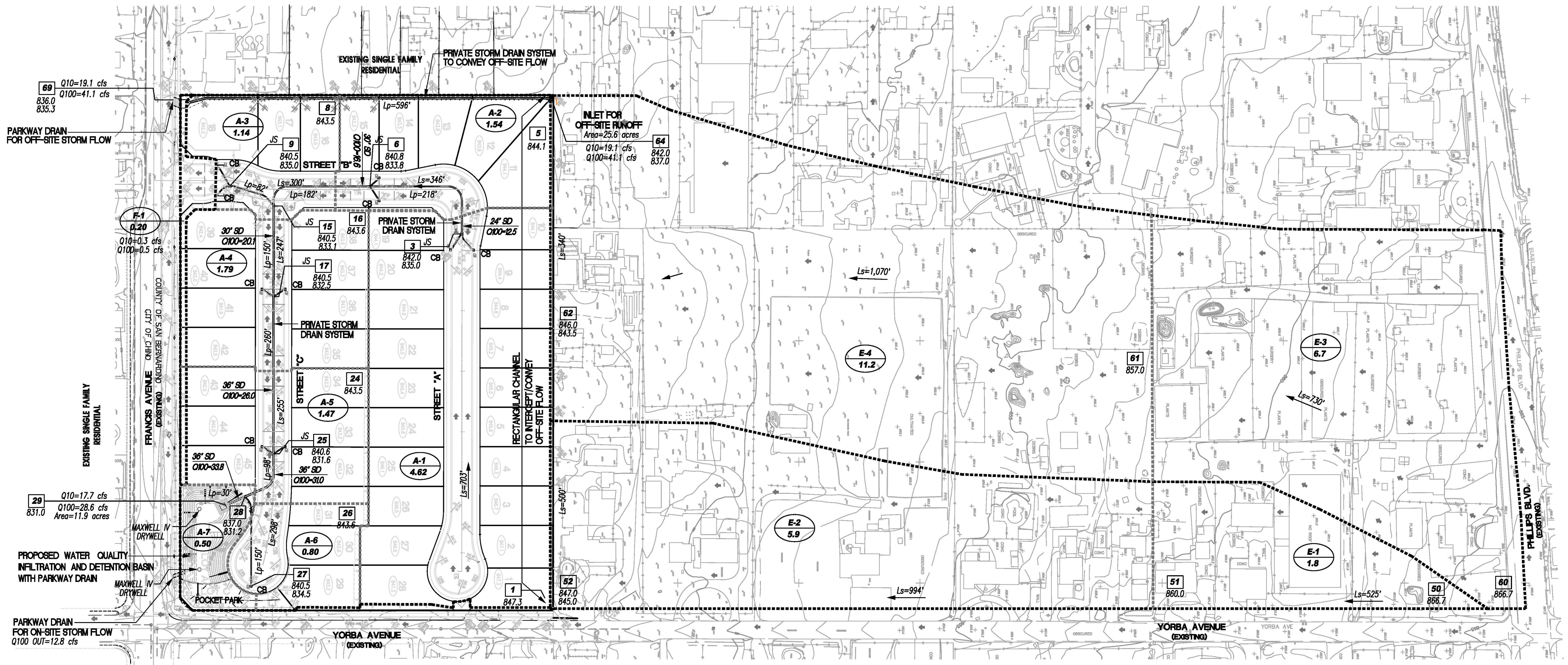
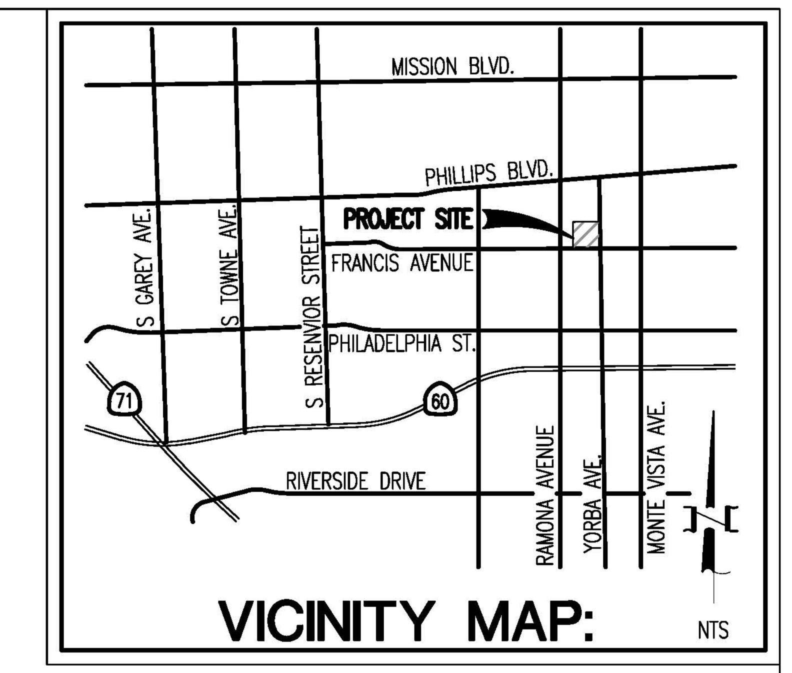
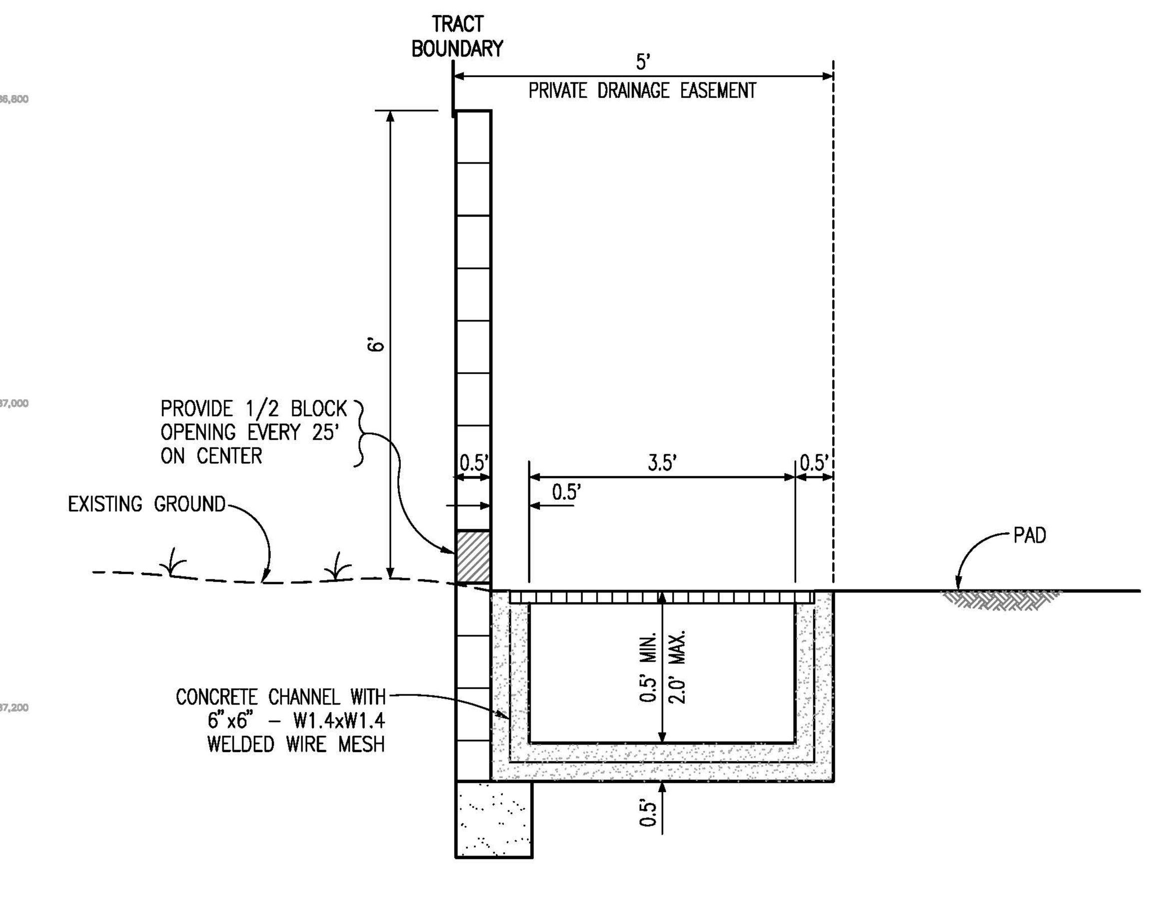






RECTANGULAR CHANNEL DETAIL

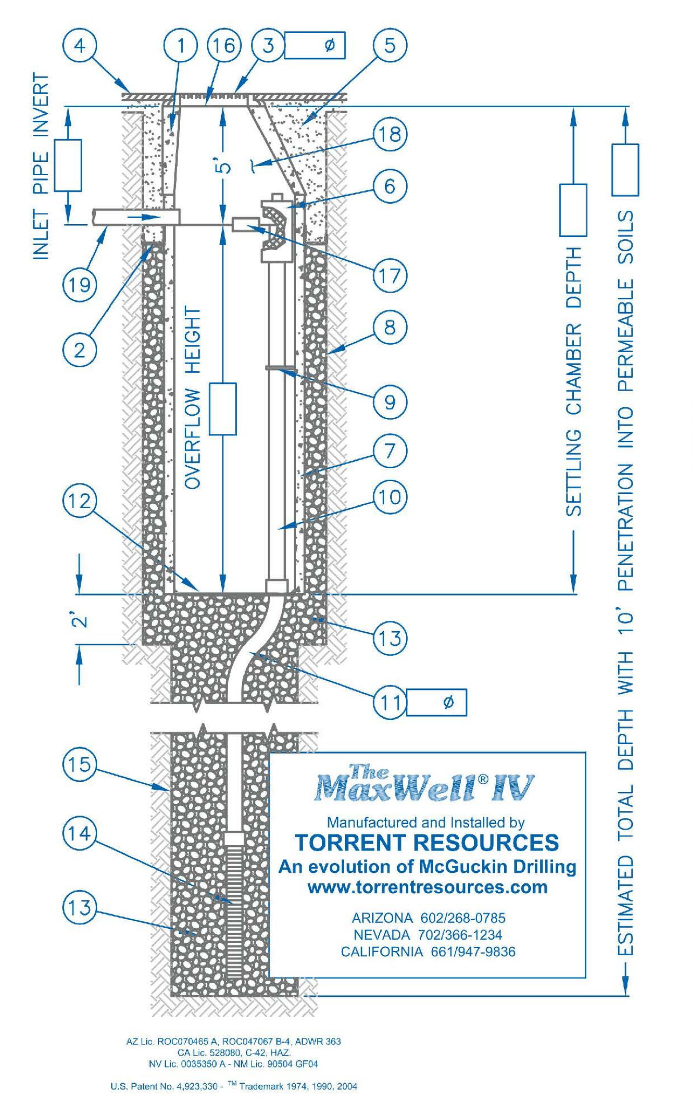
N.T.S.

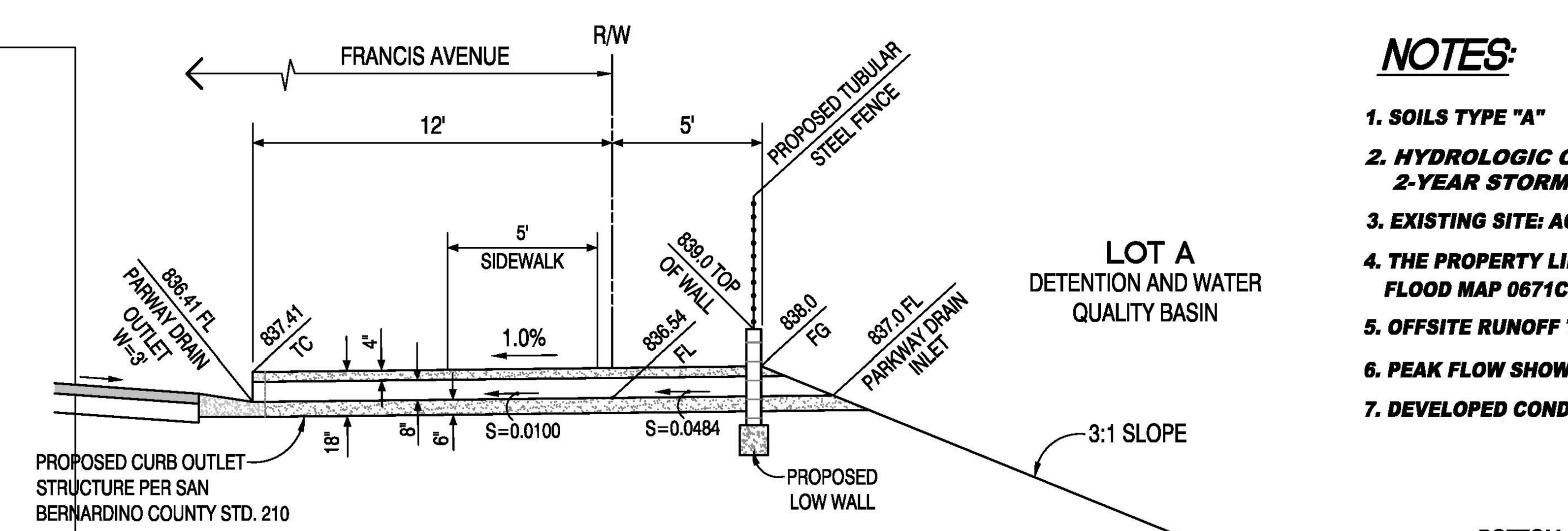
MAXWELL® IV DRAINAGE SYSTEM DETAIL AND SPECIFICATIONS

ITEM NUMBERS

1. **Manhole Cone** - Modified Flat Bottom.
2. **Moisture Membrane** - 6 Mil. Plastic. Applies only when native material is used for backfill. Place membrane securely against eccentric cone and hole sidewall.
3. **Bolted Ring & Grate** - Diameter as shown. Clean cast iron with wording **"Storm Water Only"** in raised letters. **Bolted in 2 locations** and secured to cone with mortar. Rim elevation ±0.02' of plans.
4. **Graded Basin or Paving** (by Others).
5. **Compacted Base Material** - 1-Sack Slurry except in landscaped installtions with no pipe connections.
6. **PureFlo® Debris Shield** - Rolled 16 ga. steel X 24" length with vented anti-siphon and Internal .265" Max. SWO flattened expanded steel screen X 12" length. **Fusion bonded epoxy coated.**
7. **Pre-cast Liner** - 4000 PSI concrete 48" ID. X 54" OD. **Center in hole** and align sections **to maximize bearing surface.**
8. **Min. 6' Ø Drilled Shaft.**
9. **Support Bracket** - Formed 12 Ga. steel. **Fusion bonded epoxy coated.**
10. **Overflow Pipe** - Sch. 40 PVC mated to drainage pipe at base seal.
11. **Drainage Pipe** - ADS highway grade with TRI-A coupler. **Suspend pipe** during backfill operations to prevent buckling or breakage. Diameter as noted.
12. **Base Seal** - Geotextile or concrete slurry.
13. **Rock** - Washed, sized between 3/8" and 1-1/2" to **best complement soil conditions.**
14. **FloFast® Drainage Screen** - Sch. 40 PVC 0.120" slotted well screen with 32 slots per row/ft.Diameter varies 120" overall length with TRI-B coupler.
15. **Min. 4' Ø Shaft** - Drilled to **maintain permeability** of drainage soils.
16. **Fabric Seal** - U.V. resistant geotextile - **to be removed by customer** at project completion.
17. **Absorbent** – Hydrophobic Petrochemical Sponge. Min. to 128 oz. capacity.
18. **Freeboard Depth** Varies with inlet pipe elevation. Increase settling chamber depth as needed to maintain all inlet pipe elevations above overflow pipe inlet.
19. **Optional Inlet Pipe** (Maximum 4", by Others). Extend moisture membrane and compacted base material or 1 sack slurry backfill below pipe invert.

The referenced drawing and specifications are available on CAD either through our office or web site. This detail is copyrighted (2004) but may be used as is in construction plans without further release. For information on product application, individual project specifications or site evaluation, contact our Design Staff for no-charge assistance in any phase of your planning.



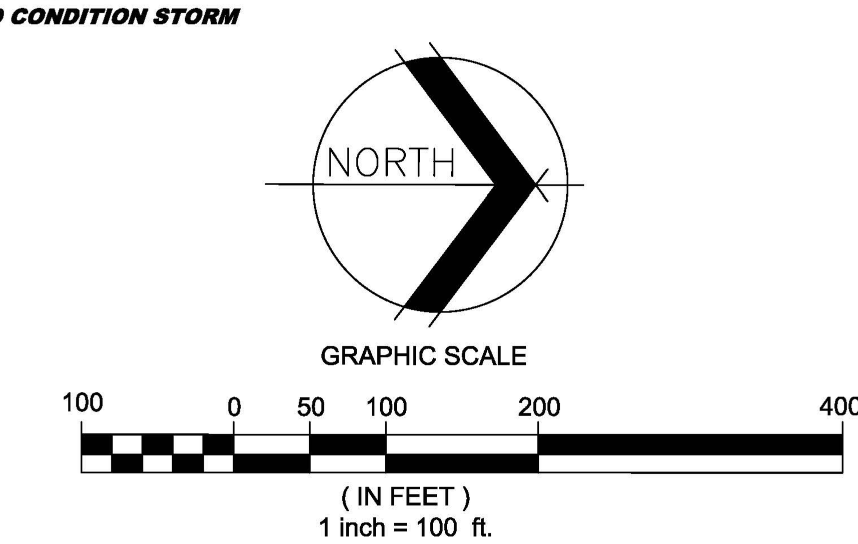


CURB OUTLET STRUCTURE DETAIL

N.T.S.

NOTES:

1. SOILS TYPE "A"
2. HYDROLOGIC CONDITIONS OF CONCERN (HCOC) CALCULATIONS PER PWQMP REPORT, POST DEVELOPED 2-YEAR STORM TO BE MITIGATED AND 100-YEAR STORM MITIGATED TO 80% OF PRE-DEVELOPED CONDITION STORM
3. EXISTING SITE: AGRICULTURE USE, 40% IMPERVIOUS
4. THE PROPERTY LIES WITHIN FLOOD ZONE 'X' UNSHADED PER FEMA FLOOD MAP 0671C8615H, DATED AUGUST 28, 2008.
5. OFFSITE RUNOFF TO BYPASS ONSITE WATER QUALITY INFITRATION BASIN
6. PEAK FLOW SHOWN ARE FOR 100-YEAR STORM UNLESS NOTED OTHERWISE
7. DEVELOPED CONDITION PEAK TO BE DETAINED TO 80% OF PRE-DEVELOPED CONDITION PEAK FLOW



LEGEND:

C.B.	CATCH BASIN
J.S.	JUNCTION STRUCTURE
Lp=XX'	LENGTH OF PIPE FLOW (feet)
X-Y / X.XX	SUB-AREA DESIGNATION / AREA (acres)
Q=X.X	100-year STORM PEAK FLOW (cfs)
Q10=X.X	10-year STORM PEAK FLOW (cfs)
Ls=XXX'	SURFACE FLOW LENGTH (feet)
	DRAINAGE BOUNDARY
	SUB-AREA DRAINAGE BOUNDARY
	DIRECTION OF SURFACE FLOW
XX / XX.X / XX.X	NODE NUMBER / ELEVATION / INVERT
	LOT AREA DRAIN SYSTEM WITH DIRECTION OF FLOW ARROW

TENTATIVE TRACT NO. 20394

PRELIMINARY HYDROLOGY MAP DEVELOPED CONDITION

COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

Prepared: November 2021

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