Appendix I
Preliminary Water Quality Management Plan

Preliminary Water Quality Management Plan

For:

Miro Way Industrial – Scheme 24

PM# TBD

PPD# TBD

Prepared for:

Lewis-Hillwood Rialto Company, LLC

1156 North Mountain Avenue

Upland, CA 91786

(909) 985 - 0971

Prepared by:

Kimley-Horn and Associates

3801 University Avenue, Suite 300

Riverside, CA 92501

(951) 543-9868

Approval Date: _____

Prepared: April 2024

Revised:

Project Owner's Certification

This Preliminary Water Quality Management Plan (PWQMP) has been prepared for **Lewis-Hillwood Rialto Company, LLC** by Kimley-Horn and Associates. The PWQMP is intended to comply with the requirements of the **City of Rialto, San Bernardino County** and the NPDES Areawide Stormwater Program requiring the preparation of a PWQMP. 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 PWQMP. 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 PWQMP have been accepted and that the plan will be transferred to future successors."

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	TBD	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0264-211-15, 0264-212-45, 0264-212-54, 0264-211-20, 2064-212-44, 0264-212-17, 0264-212-46

Owner's Signature		
Owner Name: Glen Crosby		
Title	Vice President – Regional Planned Communities	
Company	Lewis-Hillwood Rialto Company, LLC	
Address	1156 North Mountain Avenue Upland, California 91786	
Email	Glen.Crosby@lewismc.com	
Telephone #	(909) 985-0971	
Signature	Date	

Preparer's Certification

Project Data			
Permit/Application Number(s):	TBD	Grading Permit Number(s):	TBD
Tract/Parcel Map Number(s):	TBD	Building Permit Number(s):	TBD
CUP, SUP, and/or APN (Specify Lot Numbers if Portions of Tract):			APN: 0264-211-15, 0264-212-45, 0264-212-54, 0264-211-20, 2064-212-44, 0264-212-17, 0264-212-46

"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: Davie Cowan		PE Stamp Below
Title	Civil Engineer	PRELIMINARY
Company	Kimley-Horn and Associates	
Address	3801 University Avenue, Suite 300 Riverside, CA 92501	
Email	Davie.cowan@kimley-horn.com	
Telephone #	619-744-0144	
Signature		
Date		

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Section 1 Discretionary Permit(s)

Form 1-1 Project Information					
Project Name	Miro Way Industrial				
Project Owner Contact Name:	Glen Crosby				
Mailing Address:	1156 North Mountain Avenue Upland, California 91786	E-mail Address:	Glen.Crosby@lewismc.com	Telephone:	(909) 985-0971
Permit/Application Number(s):	TBD		Tract/Parcel Map Number(s):	TBD	
Additional Information/ Comments:	N/A				
Description of Project:	The proposed Miro Way industrial project is a multi-warehouse development that intends to develop seven existing parcels. The overall project totals to about 23.90 acres and the two proposed warehouse buildings total to about ± 415,715 SF square feet. The site is currently undeveloped with an existing dirt road that will be improved as an extension of the public road, Miro Way, which is about 1,700 linear feet of planned development. The project is located between North Linden Avenue and West Ayala Drive and is part of the City of Rialto's Renaissance SP (Business District) zoning designation. This project proposes four onsite underground infiltration basins to to capture and fully infiltrate the water quailty design capture volume and the 100yr design storm runoff volume.				
Provide summary of Conceptual WQMP conditions (if previously submitted and approved). Attach complete copy.	N/A.				

Section 2 Project Description

2.1 Project Information

This section of the PWQMP 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):	1,041,218 sf (23.90 Acres)	**3** Number of Dwelling Units:	N/A	**4** SIC Code:	5900

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. 1*

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)*

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:

The project site, including the two proposed warehouse buildings, paved and unpaved areas, onsite utilities, landscaping, and the BMPs included within this PWQMP will be owned, operated, and maintained by Lewis-Hillwood Rialto Company, LLC and/or end user. Long-term stormwater facility maintenance will be conducted by Lewis-Hillwood Rialto Company, LLC. staff and/ or subcontracted maintenance staff.

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 ☐	Pollutant includes petroleum hydrocarbons
Nutrients - Phosphorous	E ☒	N ☐	Landscaping is proposed on-site
Nutrients - Nitrogen	E ☒	N ☐	Landscaping is proposed on-site
Noxious Aquatic Plants	E ☒	N ☐	Landscaping is proposed on-site
Sediment	E ☒	N ☐	Landscaping is proposed on-site
Metals	E ☒	N ☐	Brake dust from vehicular traffic
Oil and Grease	E ☒	N ☐	Vehicular Traffic in parking areas
Trash/Debris	E ☒	N ☐	Covered trash enclosure proposed on-site
Pesticides / Herbicides	E ☒	N ☐	Landscaping is proposed on-site
Organic Compounds	E ☒	N ☐	Landscaping is proposed on-site
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: *Select all that apply*

☐ 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%]

NOT APPLICABLE

2 Total Credit % *(Total all credit percentages up to a maximum allowable credit of 50 percent)*

Description of Water Quality Credit Eligibility (if applicable)	N/A

Section 3 Site and Watershed Description

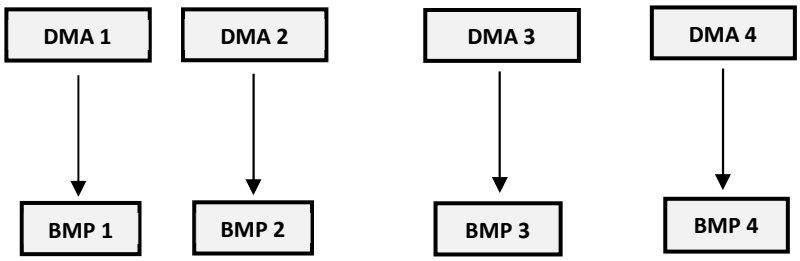
Describe the project site conditions that will facilitate the selection of BMP through an analysis of the physical conditions and limitations of the site and its receiving waters. Identify distinct drainage areas (DA) that collect flow from a portion of the site and describe how runoff from each DA (and 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° 07'29.75" N	Longitude 117°23'53.31" W	Google Earth Pro

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
DMA 1 to BMP 1	Stormwater from DMA 1 surface flows to onsite curb inlets and is conveyed to the proposed underground chamber (BMP 1). The water quality volume is fully infiltrated into the ground.
DMA 2 to BMP 2	Stormwater from DMA 2 surface flows to onsite curb and grate inlets and flows are conveyed to the proposed underground chamber (BMP 2). The water quality volume is fully infiltrated into the ground.
DMA 3 to BMP 3	Stormwater from DMA 3 surface flows to onsite curb and grate inlets and flows are conveyed to the proposed underground chamber (BMP 3A & 3B). The water quality volume is fully infiltrated into the ground.
DMA 4 to BMP 4	Stormwater from DMA 4 surface flows to onsite curb and a trench drain in which flows are conveyed to the proposed underground chamber (BMP 3A & 3B). The water quality volume is fully infiltrated into the ground.

Form 3-2 Existing Hydrologic Characteristics for Drainage Areas

For Drainage Areas' sub-watershed DMA, provide the following characteristics	DMA 1	DMA 2	DMA3					
1 DMA drainage area (ft^2)	975,973	634,813	128,323					
2 Existing site impervious area (ft^2)	975,973	634,813	128,323					
3 Antecedent moisture condition *For desert areas, use http://www.sbcounty.gov/dpw/floodcontrol/pdf/20100412_map.pdf*	3	3	3					
4 Hydrologic soil group *Refer to Watershed Mapping Tool – http://sbcounty.permitrack.com/WAP*	A	A	A					
5 Longest flowpath length (ft)	1,690	1,215	376					
6 Longest flowpath slope (ft/ft)	1.79	1.73	2.12					
7 Current land cover type(s) *Select from Fig C-3 of Hydrology Manual*	78	78	78					
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*	Poor	Poor	Poor					

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 PWQMP 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 PWQMP 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		Describe BMP Implementation OR, if not applicable, state reason
		Included	Not Applicable	
N1	Education of Property Owners, Tenants and Occupants on Stormwater BMPs	☒	☐	Property owner will familiarize himself/ herself with the education materials provided within this WQMP and educate tenants and employees.
N2	Activity Restrictions	☒	☐	No outdoor work areas, processing, storage or wash area proposed.
N3	Landscape Management BMPs	☒	☐	Irrigation must be consistent with the City's Water Conservation Ordinance. Fertilizer and pesticide usage will be consistent with County Management Guidelines for Use of Fertilizers and Pesticides.
N4	BMP Maintenance	☒	☐	BMP maintenance, implementation schedules, and responsible parties are included within this WQMP.
N5	Title 22 CCR Compliance (How development will comply)	☐	☒	Not Applicable – No hazardous waste onsite.
N6	Local Water Quality Ordinances	☐	☒	Not Applicable – Local agency does not have additional water quality ordinances.
N7	Spill Contingency Plan	☒	☐	Owner will have a spill contingency plan based on site needs.
N8	Underground Storage Tank Compliance	☐	☒	Not Applicable – No underground storage tank proposed onsite.
N9	Hazardous Materials Disclosure Compliance	☐	☒	Not Applicable – No hazardous materials onsite.

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	☒	☐	Owner will comply with Article 80 of the Uniform Fire Code enforced by the fire protection agency.
N11	Litter/Debris Control Program	☒	☐	Owner to implement litter debris control program to provide during regularly scheduled maintenance.
N12	Employee Training	☒	☐	Owner to ensure tenants are familiar with onsite BMPs and the associated maintenance required. Owner will check with City and County at least once a year to obtain new or updated education materials and provide these materials to tenants. Employees shall be trained to clean up spills and participate in ongoing maintenance. The WQMP requires bi-annually employee training and training for new hires within 2 months.
N13	Housekeeping of Loading Docks	☒	☐	All fluids to be kept indoors. Clean up spills immediately and keep spills from entering the storm drain system. No direct discharges are allowed into the storm drain system. Area shall be inspected weekly for proper containment and practices with spills cleansed up immediately and disposed of properly.
N14	Catch Basin Inspection Program	☒	☐	Monthly catch basin and inlet inspection by Owner's designee required. Vacuum when sediment or trash becomes 2 inches deep and dispose of properly.
N15	Vacuum Sweeping of Private Streets and Parking Lots	☒	☐	All landscape maintenance contractors will be required to sweep up all landscape cuttings, mowings and fertilizer materials off paved areas weekly and dispose of properly. Parking areas and drive ways will be swept monthly by sweeping contractor.
N16	Other Non-structural Measures for Public Agency Projects	☐	☒	Not Applicable – Not a public agency project.
N17	Comply with all other applicable NPDES permits	☒	☐	Project will comply with Construction General permit.

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)	☒	☐	"No Dumping" stencils will be included on all proposed catch basins and inlets. Legibility of stencil will be maintained on a yearly basis.
S2	Design and construct outdoor material storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-34)	☐	☒	Not Applicable – No outdoor material storage areas onsite.
S3	Design and construct trash and waste storage areas to reduce pollution introduction (CASQA New Development BMP Handbook SD-32)	☒	☐	Trash and wastes storage areas will be paved with an impervious surface and not allowed any run-on from adjacent areas. Drainage will be diverted from adjoining roofs and pavements. Trash and waste storage area will be screened or walled to prevent offsite transport of trash and have solid roof or awning to prevent direct contact with rainfall.
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)	☒	☐	Irrigation systems shall include reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines. Timers will be used to avoid over watering and watering cycles and duration shall be adjusted seasonally by the landscape maintenance contractor. The landscaping areas will be grouped with plants that have similar water requirements. Native or drought tolerant species shall also be used where appropriate to reduce excess irrigation runoff and propose surface filtration.
S5	Finish grade of landscaped areas at a minimum of 1-2 inches below top of curb, sidewalk, or pavement	☒	☐	Where applicable, landscaped areas will be depressed in order to increase retention of stormwater/ irrigation water promote infiltration. This includes around parking lots.
S6	Protect slopes and channels and provide energy dissipation (CASQA New Development BMP Handbook SD-10)	☒	☐	All slopes will be vegetated or properly mulched with non-organic mulch (gravel/rocks) and maintained to prevent erosion and transport of sediment. Energy dissipaters are installed at all inlets into the basin.
S7	Covered dock areas (CASQA New Development BMP Handbook SD-31)	☐	☒	Not Applicable – No covered docks onsite.

Form 4.1-2 Structural Source Control BMPs

Identifier	Name	Check One		Describe BMP Implementation OR, If not applicable, state reason
		Included	Not Applicable	
S8	Covered maintenance bays with spill containment plans (CASQA New Development BMP Handbook SD-31)	☐	☒	Not Applicable – No maintenance bays onsite.
S9	Vehicle wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Not Applicable – No vehicle wash areas onsite.
S10	Covered outdoor processing areas (CASQA New Development BMP Handbook SD-36)	☐	☒	Not Applicable – No outdoor processing areas onsite.
S11	Equipment wash areas with spill containment plans (CASQA New Development BMP Handbook SD-33)	☐	☒	Not Applicable - No equipment wash area on-site.
S12	Fueling areas (CASQA New Development BMP Handbook SD-30)	☐	☒	Not Applicable - No fueling areas on-site.
S13	Hillside landscaping (CASQA New Development BMP Handbook SD-10)	☐	☒	Not Applicable - No hillsides on-site.
S14	Wash water control for food preparation areas	☐	☒	Not Applicable – No food preparation areas onsite.
S15	Community car wash racks (CASQA New Development BMP Handbook SD-33)	☐	☒	Not Applicable - No community car wash racks on-site.

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: The project will utilize onsite underground chambers to collect runoff from impervious areas. Landscaped areas are provided throughout the site.

Maximize natural infiltration capacity: Yes ☒ No ☐

Explanation: The underground chambers will maximize the site's natural infiltration.

Preserve existing drainage patterns and time of concentration: Yes ☐ No ☒

Explanation:
In the existing condition, the site is undeveloped and generally flows from the northwest corner to the southeast corner discharging to an existing curb inlets and storm risers located along Ayala Drive. In the developed condition, the project will be mostly impervious and proposes to fully infiltrate the 100-year storm event.

Disconnect impervious areas: Yes ☒ No ☐

Explanation: Landscaped areas are provided throughout the site.

Protect existing vegetation and sensitive areas: Yes ☐ No ☒

Explanation: Not applicable – There are not any sensitive areas onsite. Areas that are not paved will be planted with approved landscape per the landscape plans.

Re-vegetate disturbed areas: Yes ☐ No ☒

Explanation: Not applicable – most disturbed areas will be paved.

Minimize unnecessary compaction in stormwater retention/infiltration basin/trench areas: Yes ☒ No ☐

Explanation: Heavy construction vehicles will be prohibited from unnecessary soil compaction within the underground chamber area.

Utilize vegetated drainage swales in place of underground piping or imperviously lined swales: Yes ☐ No ☒
Explanation: The site is mostly impervious surfaces. Underground piping is used to route stormwater to the underground chambers for treatment.

Stake off areas that will be used for landscaping to minimize compaction during construction: Yes ☒ No ☐
Explanation: Landscape areas will be staked to minimize unnecessary compaction during construction.

4.2 Project Performance Criteria

The purpose of this section of the Project PWQMP 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 4.2-1.1 LID BMP Performance Criteria for Design Capture Volume (DMA 1)

1 Project area BMP 1 (ft^2): 128,502	**2** Imperviousness after applying preventative site design practices (Imp%): 0.76	**3** Runoff Coefficient (Rc): 0.56 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.662 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.980 *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): 11,496 *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 4.2-1.2 LID BMP Performance Criteria for Design Capture Volume (DMA 2)

1 Project area BMP 2 (ft^2): 342,382	**2** Imperviousness after applying preventative site design practices (Imp%): 0.86	**3** Runoff Coefficient (Rc): 0.662 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*

4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.662 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

5 Compute P_6, Mean 6-hr Precipitation (inches): 0.980

*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): 37,068

*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 4.2-1.1 LID BMP Performance Criteria for Design Capture Volume (DMA 3)

1 Project area BMP 3A (ft^2): 369,389	**2** Imperviousness after applying preventative site design practices (Imp%): 0.90	**3** Runoff Coefficient (Rc): 0.73 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*

4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.662 http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html

5 Compute P_6, Mean 6-hr Precipitation (inches): 0.980

*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): 43,169

*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 4.2-1.1 LID BMP Performance Criteria for Design Capture Volume (DMA 4)

1 Project area BMP 3B (ft^2): 64,469	**2** Imperviousness after applying preventative site design practices (Imp%): 0.60	**3** Runoff Coefficient (Rc): 0.41 *$R_c = 0.858(Imp\%)^{\wedge 3}-0.78(Imp\%)^{\wedge 2}+0.774(Imp\%)+0.04$*
4 Determine 1-hour rainfall depth for a 2-year return period $P_{2yr\text{-}1hr}$ (in): 0.662 *http://hdsc.nws.noaa.gov/hdsc/pfds/sa/sca_pfds.html*		
5 Compute P_6, Mean 6-hr Precipitation (inches): 0.980 *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): 4,215 *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

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** *Form 4.2-3 Item 12*	**2** *Form 4.2-4 Item 13*	**3** *Form 4.2-5 Item 10*
Post-developed	**4** *Form 4.2-3 Item 13*	**5** *Form 4.2-4 Item 14*	**6** *Form 4.2-5 Item 14*
Difference	**7** *Item 4 – Item 1*	**8** *Item 2 – Item 5*	**9** *Item 6 – Item 3*
Difference (as % of pre-developed)	**10** % *Item 7 / Item 1*	**11** % *Item 8 / Item 2*	**12** % *Item 9 / Item 3*

NOT APPLICABLE

Form 4.2-3 HCOC Assessment for Runoff Volume

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, ft^2 *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)								

NOT APPLICABLE

3b DMA Area, ft^2 *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 (ft^3):
*V_{pre} =(1 / 12) * (Item sum of Item 3) * [(Item 11 – Item 9)^2 / ((Item 11 – Item 9 + Item 7)*

13 Post-developed Volume (ft^3):
*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, (ft^3):
*V_{HCOC} = (Item 13 * 0.95) – Item 12*

NOT APPLICABLE

Form 4.2-4 HCOC Assessment for Time of Concentration

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 (ft^2)								
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*
14 Post-developed time of concentration (min):	*Minimum of Item 12 post-developed DMA*
15 Additional time of concentration needed to meet HCOC requirement (min):	$T_{C\text{-}HCOC}$ = *(Item 13 * 0.95) – Item 14*

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 (Acres) *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 SGD 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):		*Maximum of Item 8, 9, and 10 (including additional forms as needed)*
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):		*Maximum of Item 11, 12, and 13 (including additional forms as needed)*
15 Peak runoff reduction needed to meet HCOC Requirement (cfs):		*$Q_{p\text{-}HCOC}$ = (Item 14 * 0.95) – Item 10*

NOT APPLICABLE

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 (DMA 1 - 6)

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: (attach)

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: (attach)

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)

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 8 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":

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.

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 (ft^2)			
3 Ratio of pervious area receiving runoff to impervious area			
4 Retention volume achieved from impervious area dispersion (ft^3) *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 (ft^3): *$V_{retention}$ =Sum of Item 4 for all BMPs*			
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 DMA BMP Type	DA DMA BMP Type	DA DMA BMP Type *(Use additional forms for more BMPs)*
7 Ponding surface area (ft^2)			
8 Ponding depth (ft)			
9 Surface area of amended soil/gravel (ft^2)			
10 Average depth of amended soil/gravel (ft)			
11 Average porosity of amended soil/gravel			
12 Retention volume achieved from on-lot infiltration (ft^3) *$V_{retention}$ = (Item 7 *Item 8) + (Item 9 * Item 10 * Item 11)*			
13 Runoff volume retention from on-lot infiltration (ft^3): *$V_{retention}$ =Sum of Item 12 for all BMPs*			

NOT APPLICABLE

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

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 (ft^2)			
16 Average wet season ET demand (in/day) *Use local values, typical ~ 0.1*			
17 Daily ET demand (ft^3/day) *Item 15 * (Item 16 / 12)*			
18 Drawdown time (hrs) *Copy Item 6 in Form 4.2-1*			
19 Retention Volume (ft^3) $V_{retention}$ *= Item 17 * (Item 18 / 24)*			
20 Runoff volume retention from evapotranspiration BMPs (ft^3):	$V_{retention}$ *= Sum of Item 19 for all BMPs*		
21 Implementation of Street Trees: Yes ☐ No ☒ *If yes, complete Items 22-25. If no, proceed to Item 26*	DA 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 per impervious area (ft^2)			
24 Runoff volume retention from street trees (ft^3) $V_{retention}$ *= Item 22 * Item 23 * (0.05/12) assume runoff retention of 0.05 inches*			
25 Runoff volume retention from street tree BMPs (ft^3):	$V_{retention}$ *= Sum of Item 24 for all BMPs*		
26 Implementation of residential rain barrel/cisterns: Yes ☐ No ☒ *If yes, complete Items 27-29; If no, proceed to Item 30*	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 (ft^3) $V_{retention}$ *= Item 27 * 3*			
29 Runoff volume retention from residential rain barrels/Cisterns (ft3):	$V_{retention}$ *=Sum of Item 28 for all BMPs*		
30 Total Retention Volume from Site Design Hydrologic Source Control BMPs:	*Sum of Items 5, 13, 20, 25 and 29*		

NOT APPLICABLE

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).

The proposed underground chamber is sized to both infiltrate the entire design capture volume (DCV) and the 100-year design storm volume. The calculations included in Form 4.3-3 show that the chamber geometry achieves the required DCV through underground storage.

Form 4.3-3.1 Infiltration LID BMP (DMA 1)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): *V_{unmet} = 11,496 ft^3 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*	BMP 1 BMP Type Underground Chamber		
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*	0.6 in/hr		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.3 in/hr		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48 hours		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	N/A		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	N/A		
8 Infiltrating surface area, *SA_{BMP}* (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	N/A		
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*	N/A		
10 Amended soil porosity	N/A		
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*	N/A		
12 Gravel porosity	N/A		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3)	N/A		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	22,060 ft^3		
16 Total Retention Volume from LID Infiltration BMPs = 22,060 ft^3 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: % 192			
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.*			

Form 4.3-3.1 Infiltration LID BMP (DMA 2)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): *V_{unmet} = 37,068 ft^3 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*	BMP 1 BMP Type Underground Chamber		
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*	0.6 in/hr		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.3 in/hr		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48 hours		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	N/A		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	N/A		
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	N/A		
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*	N/A		
10 Amended soil porosity	N/A		
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*	N/A		
12 Gravel porosity	N/A		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3)	N/A		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	38,160 ft^3		
16 Total Retention Volume from LID Infiltration BMPs = 38,160 ft^3 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: % 103			
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.*			

Form 4.3-3.1 Infiltration LID BMP (DMA 3)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): *V_{unmet} = 43,169 ft^3 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*	BMP 1 BMP Type Underground Chamber		
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*	0.6 in/hr		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.3 in/hr		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48 hours		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	N/A		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	N/A		
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	N/A		
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*	N/A		
10 Amended soil porosity	N/A		
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*	N/A		
12 Gravel porosity	N/A		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3)	N/A		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	44,772 ft^3		
16 Total Retention Volume from LID Infiltration BMPs = 44,772 ft^3 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: % 104			
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.*			

Form 4.3-3.1 Infiltration LID BMP (DMA 4)

1 Remaining LID DCV not met by site design HSC BMP (ft^3): *V_{unmet} = 4,215 ft^3 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*	BMP 1 BMP Type Underground Chamber		
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*	0.6 in/hr		
3 Infiltration safety factor *See TGD Section 5.4.2 and Appendix D*	2		
4 Design percolation rate (in/hr) *P_{design} = Item 2 / Item 3*	0.3 in/hr		
5 Ponded water drawdown time (hr) *Copy Item 6 in Form 4.2-1*	48 hours		
6 Maximum ponding depth (ft) *BMP specific, see Table 5-4 of the TGD for WQMP for BMP design details*	N/A		
7 Ponding Depth (ft) *d_{BMP} = Minimum of (1/12*Item 4*Item 5) or Item 6*	N/A		
8 Infiltrating surface area, SA_{BMP} (ft^2) *the lesser of the area needed for infiltration of full DCV or minimum space requirements from Table 5.7 of the TGD for WQMP*	N/A		
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*	N/A		
10 Amended soil porosity	N/A		
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*	N/A		
12 Gravel porosity	N/A		
13 Duration of storm as basin is filling (hrs) *Typical ~ 3hrs*	3		
14 Above Ground Retention Volume (ft^3)	N/A		
15 Underground Retention Volume (ft^3) *Volume determined using manufacturer's specifications and calculations*	8,761 ft^3		
16 Total Retention Volume from LID Infiltration BMPs = 8,761 ft^3 *(Sum of Items 14 and 15 for all infiltration BMP included in plan)*			
17 Fraction of DCV achieved with infiltration BMP: % 208			
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 *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.*			

NOT APPLICABLE

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*	List pollutants of concern *Copy from Form 2.3-1.*	
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*	Flow-based biotreatment *Use Form 4.3-8 to compute treated volume*
	☐ Bioretention with underdrain ☐ Planter box with underdrain ☐ Constructed wetlands ☐ Wet extended detention ☐ Dry extended retention	☐ Vegetated swale ☐ Vegetated filter strip ☐ Proprietary biotreatment
3 Volume biotreated in volume based biotreatment BMP (ft^3): *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): *Item 1 – Item 3*	5 Remaining fraction of LID DCV for sizing flow based biotreatment BMP: % *Item 4 / Item 1*
6 Flow-based biotreatment BMP capacity provided (cfs): *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.*		

NOT APPLICABLE

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) *Use = Minimum of (1/12 * Item 4 * Item 5) or Item 6*			
8 Amended soil surface area (ft^2)			
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 (ft^3) $V_{biotreated}$ = *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: *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)*				

NOT APPLICABLE

Form 4.3-8 Flow Based Biotreatment (DA 1)

Biotreatment BMP Type *Vegetated swale, vegetated filter strip, or other comparable proprietary 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 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*			

NOT APPLICABLE

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 4.3-9.1 Conformance Summary and Alternative Compliance Volume Estimate (DMA)

1 Total LID DCV for the Project DA-1 (ft^3): N/A *Copy Item 7 in Form 4.2-1*

2 On-site retention with site design hydrologic source control LID BMP (ft^3): *Copy Item 30 in Form 4.3-2*

3 On-site retention with LID infiltration BMP (ft^3): N/A *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): 0 *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 po

- rtion 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): *(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): *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): *Item 1 – Item 2*	4 Volume capture provided by incorporating additional on-site or off-site retention BMPs (ft^3): *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 ☐

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 additional 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 ☐

NOT APPLICABLE

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
N1 Education	Owner	Provide educational materials to tenants and employees.	Upon turn over to tenant or lease agreement, Anually
N2 Activity Restriction	Owner	The following activities are prohibited through lease agreement and employees: no outdoor work areas, processing, storage of materials, wash area	Daily
N3 Landscape Management	Owner	Irrigation must be consistent with the City's Water Conservation Ordinance. Fertilizer and pesticide usage will be consistent with County Management Guidelines for Use of Fertilizers and Pesticides.	Bi-weekly
N4 BMP Maintenance (Underground Chambers)	Owner	Trash, debris and sediment must be removed and disposed of per local jurisdiction requirements. The sump manhole shall be cleaned of all debris, silt and trash when the capacity has reached 75% of the total depth to maintain clear flow from inlet and outlet pipe.	Inspection and maintenance required after every rain event greater than 0.5 inches. Inspections should occur on a regular interval to ensure optimum performance
N7 Spill Contingency	Owner	Provide spill contingency plan.	Daily

N10 Uniform Fire Code Implementation	Owner	Comply with Article 80 of the Uniform Fire Code enforced by the fire protection agency.	Daily
N11 Litter/Debris Control Program	Owner	Implement Litter Debris control program	Regular scheduled maintenance
N12 Employee Training	Owner	Ensure tenants and employees are familiar with onsite BMPs and the associated maintenance required. Check with City and County to obtain new or updated education materials and provide to tenants and employess. Employees shall be trained to clean up spills and participate in ongoing maintenance.	Bi-annually
N13 Housekeeping of Loading Docks	Owner	All fluids to be kept indoors. Clean up spills immediately and keep spills from entering the storm drain system. No direct discharges are allowed into the storm drain system. Area shall be inspected weekly for proper containment and practices with spills cleansed up immediately and disposed of properly.	Weekly
N14 Catch Basin Inspection Program	Owner	Monthly catch basin and inlet inspection by Owner's designee required. Vacuum when sediment or trash becomes 2 inches deep and dispose of properly.	Monthly
N15 Vacuum Sweeping of Private Streets and Parking Lots	Owner	All landscape maintenance contractors hire by owner or tenant will be required to sweep up all landscape cuttings, mowing and fertilizer materials off paved areas weekly and dispose of properly. Parking areas and driveways will be swept monthly by sweeping contractor.	Monthly
N17 Comply with all other applicable NPDES permits	Owner	Project will comply with Construction General Permit.	Daily
S1 Storm Drain Stencilling and Signage	Owner	Owner will provide stenciling and signage on all proposed catch basins and inlets. Owner will re-stencil as necessary to maintain legibility.	As needed, or June of each odd year
S3 Trash and Waste Storage	Owner	Trash and wastes storage areas will be paved with an impervious surface and not allowed any run-on from adjacent areas. Drainage will be diverted from	Fix as needed

		adjoining roofs and pavements. Trash and waste storage area will be screened or walled to prevent offsite transport of trash and have solid roof or awning to prevent direct contact with rainfall.	
S4 Landscape Planning and Site Design & Efficient Irrigation	Owner	Irrigation systems shall include reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines. Timers will be used to avoid over watering and watering cycles and duration shall be adjusted seasonally by the landscape maintenance contractor. The landscaping areas will be grouped with plants that have similar water requirements. Native or drought tolerant species shall also be used where appropriate to reduce excess irrigation runoff and propose surface filtration. Inspect all landscape areas and replace dead vegetation and remove trash.	Weekly
S5 Finished grade of landscape areas at minimum 1-2 inches below concrete	Owner	Where applicable, landscaped areas will be depressed in order to increase retention of stormwater/ irrigation water promote infiltration. This includes around parking lots.	Where applicable
S6 Protect slopes and channels	Owner	All slopes need to be vegetated or properly mulched with non-organic mulch (gravel/rocks) and maintained to prevent erosion and transport of sediment. Energy dissipaters are installed at all inlets into the basin.	Weekly

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

See Appendix A for WQMP Exhibits and BMP Design Details

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

Attach all O&M Plans and Maintenance Agreements for BMP to the WQMP.

See Appendix D for BMP O&M

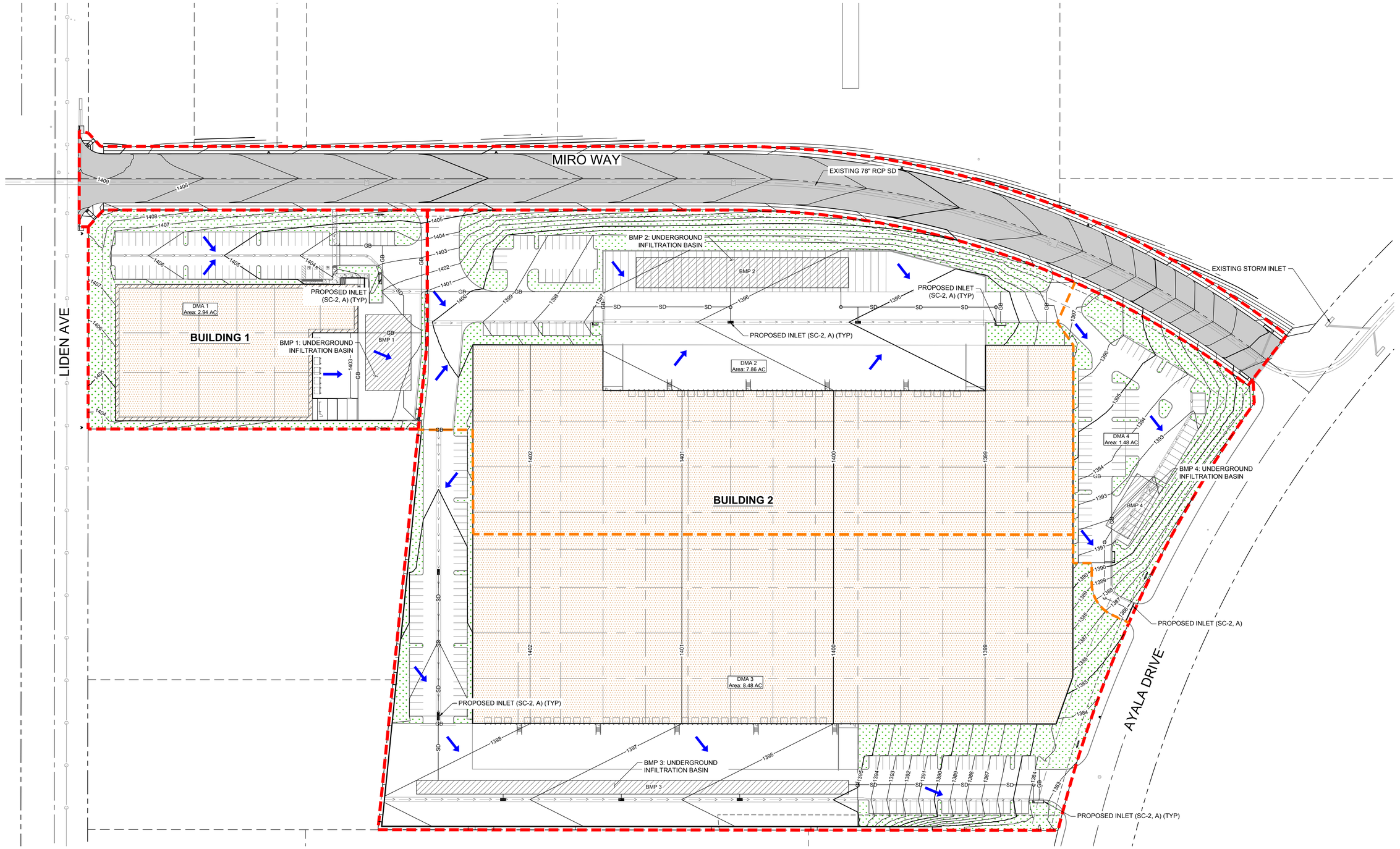
6.4 Other Supporting Documentation

- BMP Educational Materials
- Activity Restriction – C, C&R's & Lease Agreements

See Appendix B for BMP Educational Materials
See Appendix C for WQMP Agreement
See Appendix E for Geotechnical Report
See Appendix F for Hydromodification Exemption Documentation

APPENDIX A

WQMP EXHIBIT AND BMP DESIGN DETAILS



LEGEND

DMA ID — SUB-DMA ID (DA X.XX, X.XX AC) — ACREAGE

DMA ID — SUB-DMA ID (X.XX)

L=XX.XX' — FLOW PATH LENGTH (FEET)

- OVERALL DMA BOUNDARY
- SUB-DMA BOUNDARY
- FLOWLINE
- 1000 — EX MAJOR CONTOUR
- 1001 — EX MINOR CONTOUR
- 1000 — PROP MAJOR CONTOUR
- 1001 — PROP MINOR CONTOUR
- FLOW DIRECTION
- UNDERGROUND BASIN
- LANDSCAPE AREA
- BUILDING AREA
- OFFSITE SHEET FLOW (3.13 ACRES)

UNDERGROUND BASINS

DMA ID	BMP ID	TRIBUTARY AREA (ACRE)	BMP TYPE	DESIGN CAPTURE VOLUME (CU FT)	TOTAL PROPOSED STORAGE PROVIDED (CU FT)
DMA 1	1	2.95	INFILTRATION BASIN	11,496	22,060
DMA 2	2	7.86	INFILTRATION BASIN	37,068	38,160
DMA 3	3	8.48	INFILTRATION BASIN	43,169	44,772
DMA 4	4	1.48	INFILTRATION BASIN	4,215	8,761

SOURCE CONTROL BMPS	
BMP ID	BMP DESCRIPTION
SC-1	PREVENT ILLICIT DISCHARGE INTO MS4 ---> ALL LANDSCAPE AREAS (TYP.)
SC-2	STORM DRAIN STENCILING AND SIGNAGE ---> ALL SD GRATED INLETS, CURB CUTS (TYP.)
SC-34	TRASH AND STORAGE AREAS
SC -74	LANDSCAPE MAINTENANCE

NORTH

GRAPHIC SCALE IN FEET
0 50 100

ARISING OF THE CLIENTS DECISION TO OBTAIN BIDS, ORDER MATERIALS, OR PROCEED WITH CONSTRUCTION PRIOR TO KIMLEY-HORN HAS ISSUED FINAL, FULLY-APPROVED PLANS AND SPECIFICATIONS. THE CLIENT ACKNOWLEDGES THAT ALL PRELIMINARY PLANS ARE SUBJECT TO SUBSTANTIAL REVISIONS UNTIL PLANS ARE FULLY APPROVED AND ALL PERMITS OBTAINED.

No.	REVISIONS	DATE	BY

Kimley»Horn

401 B STREET, SUITE 600, SAN DIEGO, CA 92101
PHONE: 619-234-9411
WWW.KIMLEY-HORN.COM

PRELIMINARY
FOR REVIEW ONLY
Prepared for Concept Plan submittal
Not for construction purposes or permits.
Kimley»Horn
Engineer KEVIN PATRICK SMITH
P.E. No. 94269 Date

KHA PROJECT 069095128
DATE 4/5/2024
SCALE AS SHOWN | DESIGNED BY KPS | DRAWN BY KPS | CHECKED BY DC

PROPOSED WQMP SITE PLAN

MIRO WAY INDUSTRIAL
PREPARED FOR
LEWIS-HILLWOOD RIALTO COMPANY, LLC
CITY OF RIALTO CA

SHEET NUMBER
1 OF 1

Miro Way Industrial (Scheme 24) - Design Capture Volume (DCV) Calculations

BMP 1 **DMA 1**

Total Site (SF)	Total Pervious Area (SF)	Total Impervious Area (SF)	Imp% (Total Site)	Rainfall depth (2 yr - 1 hr)
128502	30414	98088	0.76	0.662

Runoff Coefficient (RC)	6 hours precipitation (P6)	Design Capture Volume (ft^3)
0.56	0.980	11496

BMP 2 **DMA 2**

Total Site (SF)	Total Pervious Area (SF)	Total Impervious Area (SF)	Imp% (Total Site)	Rainfall depth (2 yr - 1 hr)
342382	47,756	294625.6	0.86	0.662

Runoff Coefficient (RC)	6 hours precipitation (P6)	Design Capture Volume (ft^3)
0.68	0.980	37068

BMP 3 **DMA 3**

Total Site (SF)	Total Pervious Area (SF)	Total Impervious Area (SF)	Imp% (Total Site)	Rainfall depth (2 yr - 1 hr)
369389	37,308	332080.8	0.90	0.662

Runoff Coefficient (RC)	6 hours precipitation (P6)	Design Capture Volume (ft^3)
0.73	0.980	43169

BMP 4 **DMA 4**

Total Site (SF)	Total Pervious Area (SF)	Total Impervious Area (SF)	Imp% (Total Site)	Rainfall depth (2 yr - 1 hr)
64469	25889	38579.8	0.60	0.662

Runoff Coefficient (RC)	6 hours precipitation (P6)	Design Capture Volume (ft^3)
0.41	0.980	4215

Date: 4/4/2024
Project Name: BMP 1 - 49295 (4-4-2024 16-42-19)

City / County:
State:

Designed By:
Company:
Telephone:

CMP: Underground Detention System
Storage Volume Estimation

=Adjustable Input Cells

Contech Engineered Solutions, LLC is pleased to offer the following estimate of storage volume for the above named project. The results are submitted as an estimate only, without liability on the part of Contech Engineered Solutions, LLC for accuracy or suitability to any particular applicaton and are subject to verification of the Engineer of Record. **This tool is only applicable for rectangular shaped systems.**

Summary of Inputs

System Information		Backfill Information		Pipe & Analysis Information	
Out-to-out length (ft):	98.0	Backfill Porosity (%):	40%	System Diameter (in):	48
Out-to-out width (ft):	58.0	Depth Above Pipe (in):	12.0	Pipe Spacing (in):	24
Number of Manifolds (ea):	2.0	Depth Below Pipe (in):	12.0	Incremental Analysis (in):	12
Number of Barrels (ea):	10.0	Width At Ends (ft):	1.0	System Invert (Elevation):	0.2
		Width At Sides (ft):	1.0		

Storage Volume Estimation

System		Pipe		Stone		Total System		Miscellaneous	
Depth (ft)	Elevation (ft)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Percent Open Storage (%)	Ave. Surface Area (sf)
0.00	0.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0%	2,400.0
1.00	1.20	0.0	0.0	2,400.0	2,400.0	2,400.0	2,400.0	0.0%	2,400.0
2.00	2.20	2,496.0	2,496.0	1,401.6	3,801.6	3,897.6	6,297.6	39.6%	4,511.7
3.00	3.20	3,887.7	6,383.7	844.9	4,646.5	4,732.6	11,030.2	57.9%	4,838.4
4.00	4.20	3,887.7	10,271.4	844.9	5,491.4	4,732.6	15,762.8	65.2%	4,511.7
5.00	5.20	2,496.0	12,767.4	1,401.6	6,893.0	3,897.6	19,660.5	64.9%	2,400.0
6.00	6.20	0.0	12,767.4	2,400.0	9,293.0	2,400.0	22,060.5	57.9%	2,400.0

Date: 4/5/2024
Project Name: BMP 2 - 49298 (4-5-2024 15-28-32)

City / County:
State:

Designed By:
Company:
Telephone:

CMP: Underground Detention System
Storage Volume Estimation

=Adjustable Input Cells

Contech Engineered Solutions, LLC is pleased to offer the following estimate of storage volume for the above named project. The results are submitted as an estimate only, without liability on the part of Contech Engineered Solutions, LLC for accuracy or suitability to any particular applicaton and are subject to verification of the Engineer of Record. **This tool is only applicable for rectangular shaped systems.**

Summary of Inputs

System Information		Backfill Information		Pipe & Analysis Information	
Out-to-out length (ft):	288.0	Backfill Porosity (%):	40%	System Diameter (in):	48
Out-to-out width (ft):	34.0	Depth Above Pipe (in):	12.0	Pipe Spacing (in):	24
Number of Manifolds (ea):	1.0	Depth Below Pipe (in):	12.0	Incremental Analysis (in):	12
Number of Barrels (ea):	6.0	Width At Ends (ft):	1.0	System Invert (Elevation):	0
		Width At Sides (ft):	1.0		

Storage Volume Estimation

System		Pipe		Stone		Total System		Miscellaneous	
Depth (ft)	Elevation (ft)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Percent Open Storage (%)	Ave. Surface Area (sf)
0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0%	4,176.0
1.00	1.00	0.0	0.0	4,176.0	4,176.0	4,176.0	4,176.0	0.0%	4,176.0
2.00	2.00	4,269.8	4,269.8	2,468.1	6,644.1	6,737.9	10,913.9	39.1%	7,788.4
3.00	3.00	6,650.4	10,920.2	1,515.9	8,159.9	8,166.2	19,080.1	57.2%	8,347.2
4.00	4.00	6,650.4	17,570.5	1,515.9	9,675.8	8,166.2	27,246.3	64.5%	7,788.4
5.00	5.00	4,269.8	21,840.4	2,468.1	12,143.9	6,737.9	33,984.2	64.3%	4,176.0
6.00	6.00	0.0	21,840.4	4,176.0	16,319.9	4,176.0	38,160.2	57.2%	4,176.0

Date: 4/5/2024
Project Name: BMP 3 - 49348 (4-5-2024 15-41-21)

City / County:
State:

Designed By:
Company:
Telephone:

CMP: Underground Detention System
Storage Volume Estimation

=Adjustable Input Cells

Contech Engineered Solutions, LLC is pleased to offer the following estimate of storage volume for the above named project. The results are submitted as an estimate only, without liability on the part of Contech Engineered Solutions, LLC for accuracy or suitability to any particular applicaton and are subject to verification of the Engineer of Record. **This tool is only applicable for rectangular shaped systems.**

Summary of Inputs

System Information		Backfill Information		Pipe & Analysis Information	
Out-to-out length (ft):	678.0	Backfill Porosity (%):	40%	System Diameter (in):	48
Out-to-out width (ft):	16.0	Depth Above Pipe (in):	12.0	Pipe Spacing (in):	24
Number of Manifolds (ea):	2.0	Depth Below Pipe (in):	12.0	Incremental Analysis (in):	12
Number of Barrels (ea):	3.0	Width At Ends (ft):	1.0	System Invert (Elevation):	0
		Width At Sides (ft):	1.0		

Storage Volume Estimation

System		Pipe		Stone		Total System		Miscellaneous	
Depth (ft)	Elevation (ft)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Percent Open Storage (%)	Ave. Surface Area (sf)
0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0%	4,896.0
1.00	1.00	0.0	0.0	4,896.0	4,896.0	4,896.0	4,896.0	0.0%	4,896.0
2.00	2.00	5,016.7	5,016.7	2,889.3	7,785.3	7,906.0	12,802.0	39.2%	9,140.2
3.00	3.00	7,813.6	12,830.3	1,770.6	9,555.9	9,584.2	22,386.2	57.3%	9,796.8
4.00	4.00	7,813.6	20,643.9	1,770.6	11,326.5	9,584.2	31,970.3	64.6%	9,140.2
5.00	5.00	5,016.7	25,660.5	2,889.3	14,215.8	7,906.0	39,876.3	64.4%	4,896.0
6.00	6.00	0.0	25,660.5	4,896.0	19,111.8	4,896.0	44,772.3	57.3%	4,896.0

Date: 4/4/2024
Project Name: BMP 4 - 49301 (4-4-2024 16-54-16)

City / County:
State:

Designed By:
Company:
Telephone:

CMP: Underground Detention System
Storage Volume Estimation

=Adjustable Input Cells

Contech Engineered Solutions, LLC is pleased to offer the following estimate of storage volume for the above named project. The results are submitted as an estimate only, without liability on the part of Contech Engineered Solutions, LLC for accuracy or suitability to any particular applicaton and are subject to verification of the Engineer of Record. **This tool is only applicable for rectangular shaped systems.**

Summary of Inputs

System Information		Backfill Information		Pipe & Analysis Information	
Out-to-out length (ft):	78.0	Backfill Porosity (%):	40%	System Diameter (in):	48
Out-to-out width (ft):	28.0	Depth Above Pipe (in):	12.0	Pipe Spacing (in):	24
Number of Manifolds (ea):	1.0	Depth Below Pipe (in):	12.0	Incremental Analysis (in):	12
Number of Barrels (ea):	5.0	Width At Ends (ft):	1.0	System Invert (Elevation):	0
		Width At Sides (ft):	1.0		

Storage Volume Estimation

System		Pipe		Stone		Total System		Miscellaneous	
Depth (ft)	Elevation (ft)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Incremental Storage (cf)	Cumulative Storage (cf)	Percent Open Storage (%)	Ave. Surface Area (sf)
0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0%	960.0
1.00	1.00	0.0	0.0	960.0	960.0	960.0	960.0	0.0%	960.0
2.00	2.00	977.8	977.8	568.9	1,528.9	1,546.7	2,506.7	39.0%	1,787.2
3.00	3.00	1,522.9	2,500.7	350.8	1,879.7	1,873.8	4,380.4	57.1%	1,915.2
4.00	4.00	1,522.9	4,023.6	350.8	2,230.5	1,873.8	6,254.2	64.3%	1,787.2
5.00	5.00	977.8	5,001.4	568.9	2,799.4	1,546.7	7,800.8	64.1%	960.0
6.00	6.00	0.0	5,001.4	960.0	3,759.4	960.0	8,760.8	57.1%	960.0

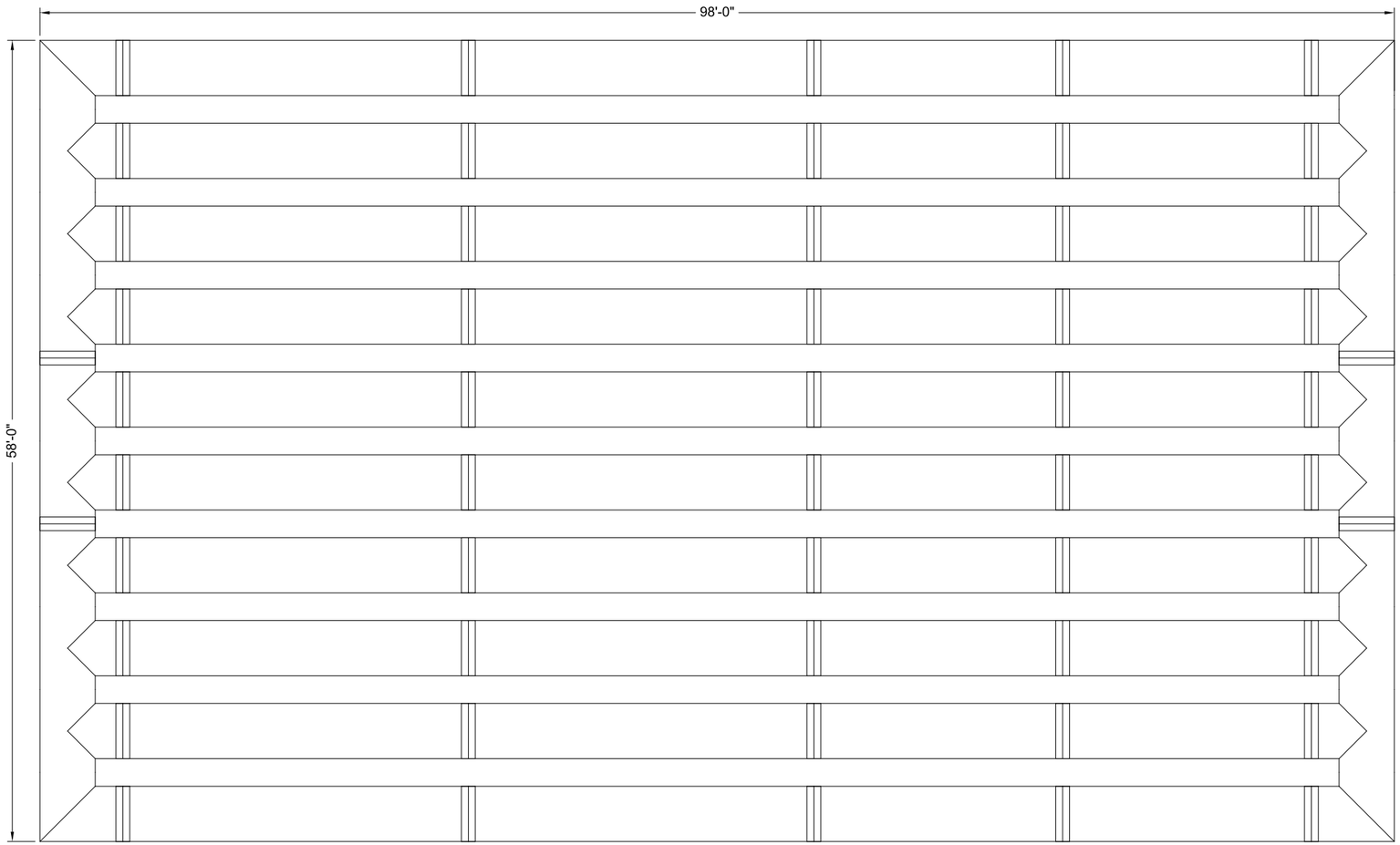
PROJECT SUMMARY

CALCULATION DETAILS
- LOADING = HS20/HS25
- APPROX. LINEAR FOOTAGE = 1,016 LF

STORAGE SUMMARY
- STORAGE VOLUME REQUIRED = N/A
- PIPE STORAGE VOLUME = 12,767 CF
- BACKFILL STORAGE VOLUME = 9,293 CF
- TOTAL STORAGE PROVIDED = 22,060 CF

PIPE DETAILS
- DIAMETER = 48"
- CORRUGATION = 2 2/3x1/2
- GAGE = 16
- COATING = ALT2
- WALL TYPE = SOLID
- BARREL SPACING = 24"

BACKFILL DETAILS
- WIDTH AT ENDS = 12"
- ABOVE PIPE = 12"
- WIDTH AT SIDES = 12"
- BELOW PIPE = 12"



ASSEMBLY
SCALE: 1" = 10'

NOTES

- ALL RISER AND STUB DIMENSIONS ARE TO CENTERLINE. ALL ELEVATIONS, DIMENSIONS, AND LOCATIONS OF RISERS AND INLETS, SHALL BE VERIFIED BY THE ENGINEER OF RECORD PRIOR TO RELEASING FOR FABRICATION.
- ALL FITTINGS AND REINFORCEMENT COMPLY WITH ASTM A998.
- ALL RISERS AND STUBS ARE $2\frac{2}{3}$" x $\frac{1}{2}$" CORRUGATION AND 16 GAGE UNLESS OTHERWISE NOTED.
- RISERS TO BE FIELD TRIMMED TO GRADE.
- QUANTITY OF PIPE SHOWN DOES NOT PROVIDE EXTRA PIPE FOR CONNECTING THE SYSTEM TO EXISTING PIPE OR DRAINAGE STRUCTURES. OUR SYSTEM AS DETAILED PROVIDES NOMINAL INLET AND/OR OUTLET PIPE STUB FOR CONNECTION TO EXISTING DRAINAGE FACILITIES. IF ADDITIONAL PIPE IS NEEDED IT IS THE RESPONSIBILITY OF THE CONTRACTOR.
- BAND TYPE TO BE DETERMINED UPON FINAL DESIGN.
- THE PROJECT SUMMARY IS REFLECTIVE OF THE DYODS DESIGN, QUANTITIES ARE APPROX. AND SHOULD BE VERIFIED UPON FINAL DESIGN AND APPROVAL. FOR EXAMPLE, TOTAL EXCAVATION DOES NOT CONSIDER ALL VARIABLES SUCH AS SHORING AND ONLY ACCOUNTS FOR MATERIAL WITHIN THE ESTIMATED EXCAVATION FOOTPRINT.
- THESE DRAWINGS ARE FOR CONCEPTUAL PURPOSES AND DO NOT REFLECT ANY LOCAL PREFERENCES OR REGULATIONS. PLEASE CONTACT YOUR LOCAL CONTECH REP FOR MODIFICATIONS.

DATE	REVISION DESCRIPTION	BY

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

DYO49295 Miro Way
BMP 1
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
34165	49295	4/4/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

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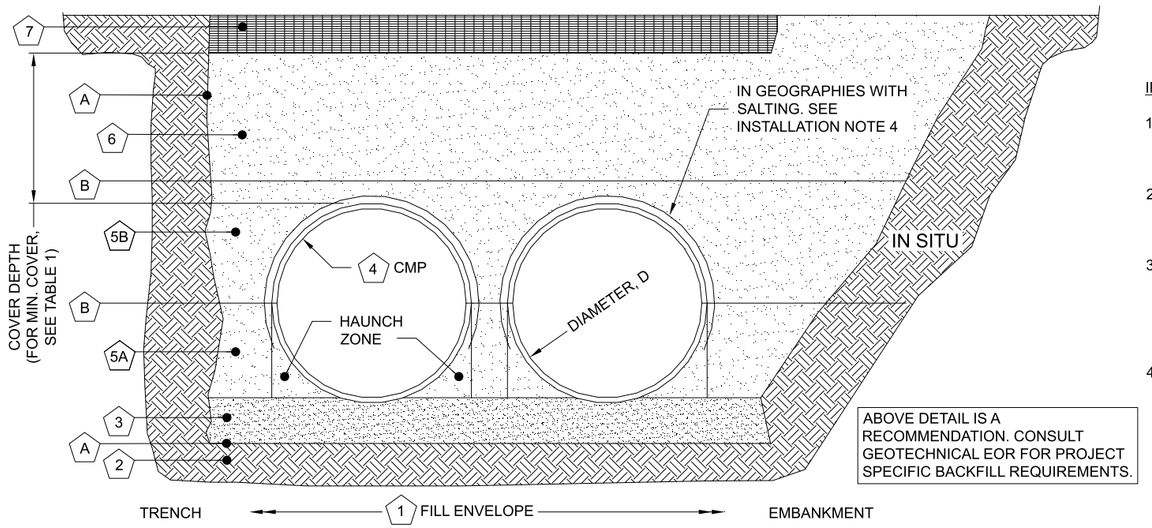
TABLE 1:

DIAMETER, D	MIN. COVER	CORR. PROFILE
6"-10"	12"	1 1/2" x 1/4"
12"-48"	12"	2 2/3" x 1/2"
>48"-96"	12"	3" x 1", 5" x 1"
>96"	D/8	3" x 1", 5" x 1"

- STRUCTURAL BACKFILL MUST EXTEND TO LIMITS OF THE TABLE
- TOTAL HEIGHT OF COMPACTED COVER FOR CONVENTIONAL HIGHWAY LOADS IS MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT
- ULTRAFLO ALSO AVAILABLE FOR SIZES 18" - 120" WITH 3/4"x 3/4"x 7 1/2" CORRUGATION



INSTALLATION NOTES

1. WHEN PLACING THE FIRST LIFTS OF BACKFILL IT IS IMPORTANT TO MAKE SURE THAT THE BACKFILL IS PROPERLY COMPACTED UNDER AND AROUND THE PIPE HAUNCHES.
2. OTHER ALTERNATE BACKFILL MATERIAL MAY BE ALLOWED DEPENDING ON SITE SPECIFIC CONDITIONS, AS APPROVED BY SITE ENGINEER.
3. BACKFILL USING CONTROLLED LOW-STRENGTH MATERIAL (CLSM, "FLASH FILL" OR "FLOWABLE FILL") MAY BE USED WHEN THE SPACING BETWEEN THE PIPES WILL NOT ALLOW FOR PLACEMENT AND ADEQUATE COMPACTION OF THE BACKFILL. CONTACT CONTECH FOR FURTHER EVALUATION.
4. IF SALTING AGENTS FOR SNOW AND ICE REMOVAL ARE USED ON OR NEAR THE PROJECT, A GEOMEMBRANE BARRIER IS RECOMMENDED OVER THE UPPER HALF OF THE PIPE. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.

TABLE 2: SOLID STANDARD

CMP DETENTION AND CMP DRAINAGE STANDARD BACKFILL SPECIFICATIONS

	MATERIAL LOCATION	MATERIAL SPECIFICATION	DESCRIPTION	
1	FILL ENVELOPE WIDTH	PER ENGINEER OF RECORD	MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER THE PIPE. THE SUGGESTED MINIMUM TRENCH WIDTH, OR EOR RECOMMENDATION: PIPE ≤ 12": D + 16" PIPE > 12": 1.5D + 12"	MINIMUM EMBANKMENT WIDTH (IN FEET) FOR INITIAL FILL ENVELOPE: PIPE < 24": 3.0D PIPE 24" - 144": D + 4'0" PIPE > 144": D + 10'0"
2	FOUNDATION	**AASHTO 26.5.2** OR PER ENGINEER OF RECORD	PRIOR TO PLACING THE BEDDING, THE FOUNDATION MUST BE CONSTRUCTED TO A UNIFORM AND STABLE GRADE. IN THE EVENT THAT UNSUITABLE FOUNDATION MATERIALS ARE ENCOUNTERED DURING EXCAVATION, THEY SHALL BE REMOVED AND FOUNDATION BROUGHT BACK TO GRADE WITH A FILL MATERIAL APPROVED BY THE ENGINEER OF RECORD.	
3	BEDDING	**AASHTO M 43: 3, 357, 4, 467, 5, 56, 57** (APPROVED REGIONAL EQUIVALENTS INCLUDE CA-7)	ENGINEER OF RECORD TO DETERMINE IF BEDDING IS REQUIRED. PIPE MAY BE PLACED ON THE TRENCH BOTTOM OF A RELATIVELY LOOSE, NATIVE SUITABLE WELL GRADED GRANULAR MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, 2" MIN DEPTH. THE BEDDING MATERIAL MAY BE SUITABLE FOUNDATION SOILS CONFORMING TO AASHTO SOIL CLASSIFICATIONS A1, A2, OR A3 WITH MAXIMUM PARTICLE SIZE OF 3" PER AASHTO 26.3.8.1	
4	CORRUGATED METAL PIPE			
5A	CRITICAL BACKFILL	**AASHTO M 145: A-1, A-2, A-3** *	HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION WITHOUT SOFT SPOTS. BACKFILL SHALL BE PLACED IN 8" +/- LOOSE LIFTS AND COMPACTED TO 90% STANDARD PROCTOR PER AASHTO T 99. BACKFILL SHALL BE PLACED SUCH THAT THERE IS NO MORE THAN A THREE LIFT (24") DIFFERENTIAL BETWEEN ANY OF THE PIPES AT ANY TIME DURING THE BACKFILL PROCESS. THE BACKFILL SHOULD BE ADVANCED ALONG THE LENGTH OF THE SYSTEM TO AVOID DIFFERENTIAL LOADING. WELL GRADED GRANULAR MATERIAL WHICH MAY CONTAIN SMALL AMOUNTS OF SILT OR CLAY AND MAXIMUM PARTICLE SIZE OF 3" (PER AASHTO 26.3.8.1 AND 12.4-1.3).	
5B	BACKFILL	**AASHTO M 145: A-1, A-2, A-3**		
6	COVER MATERIAL	UP TO MIN. COVER - SEE 5A AND 5B ABOVE ABOVE MIN. COVER - PER ENGINEER OF RECORD	COVER MATERIAL MAY INCLUDE NON-BITUMINOUS, GRANULAR ROAD BASE MATERIAL WITHIN MIN COVER LIMITS	
7	RIGID OR FLEXIBLE PAVEMENT (IF APPLICABLE)	PER ENGINEER OF RECORD	FLEXIBLE PAVEMENT SHOULD NOT BE COUNTED AS PART OF THE FILL HEIGHT OVER THE CMP. FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS SHALL FOLLOW THE PROJECT PLANS AND SPECIFICATIONS PER THE ENGINEER OF RECORD.	
A	OPTIONAL SIDE GEOTEXTILE	NONE	GEOTEXTILE LAYER IS RECOMMENDED ON SIDES OF EXCAVATION TO PREVENT SOIL MIGRATION.	
B	OPTIONAL GEOTEXTILE BETWEEN LAYERS	NONE	IF SOIL TYPES DIFFER AT ANY POINT ABOVE PIPE INVERT, A GEOTEXTILE LAYER IS RECOMMENDED TO BE PLACED BETWEEN THE LAYERS TO PREVENT SOIL MIGRATION.	

NOTES:
- FOR MULTIPLE BARREL INSTALLATIONS, THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE THE PIPE DIAMETER /2 BUT NO LESS THAN 12" FOR DIAMETERS <72". FOR 72" AND LARGER DIAMETERS, THE MINIMUM SPACING IS 36". CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING.

* APPROVED REGIONAL EQUIVALENTS FOR SECTION 5A INCLUDE CA-7, MIDOT 2G, 34G, OR 21AA STONE OR GRAVEL; #8; #57; MIDOT 6A, 2G, 3G, 34G.

MANUFACTURER RECOMMENDED BACKFILL

NOT TO SCALE

DATE	REVISION DESCRIPTION	BY

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH CMP DETENTION SYSTEMS

CONTECH
DYODS
DRAWING

DYO49295 Miro Way
BMP 1
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
34165	49295	4/4/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

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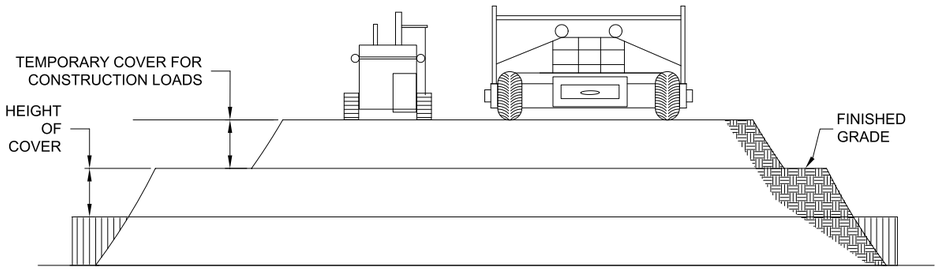


CONSTRUCTION LOADS

FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

CONSTRUCTION LOADING DIAGRAM

SCALE: N.T.S.

SPECIFICATION FOR DESIGNED DETENTION SYSTEM:

SCOPE
THIS SPECIFICATION COVERS THE MANUFACTURE AND INSTALLATION OF THE DESIGNED DETENTION SYSTEM DETAILED IN THE PROJECT PLANS.

MATERIAL
THE MATERIAL SHALL CONFORM TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2 STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-274 OR ASTM A-92.

THE GALVANIZED STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-218 OR ASTM A-929.

THE POLYMER COATED STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-246 OR ASTM A-742.

THE ALUMINUM COILS SHALL CONFORM TO THE APPLICABLE OF AASHTO M-197 OR ASTM B-744.

CONSTRUCTION LOADS
CONSTRUCTION LOADS MAY BE HIGHER THAN FINAL LOADS. FOLLOW THE MANUFACTURER'S OR NCSPA GUIDELINES.

PIPE
THE PIPE SHALL BE MANUFACTURED IN ACCORDANCE TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2: AASHTO M-36 OR ASTM A-760

GALVANIZED: AASHTO M-36 OR ASTM A-760

APPLICABLE POLYMER COATED: AASHTO M-245 OR ASTM A-762

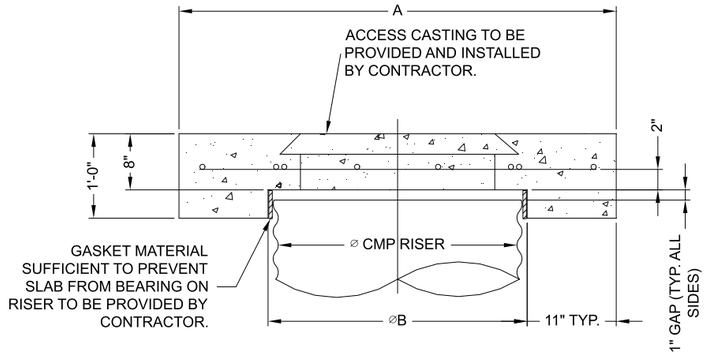
ALUMINUM: AASHTO M-196 OR ASTM B-745

APPLICABLE HANDLING AND ASSEMBLY
SHALL BE IN ACCORDANCE WITH NCSP'S (NATIONAL CORRUGATED STEEL PIPE ASSOCIATION) FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL. SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS FOR ALUMINUM PIPE.

REQUIREMENTS INSTALLATION
SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II DIVISION II OR ASTM A-798 (FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL) OR ASTM B-788 (FOR ALUMINUM PIPE) AND IN CONFORMANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. IF THERE ARE ANY INCONSISTENCIES OR CONFLICTS THE CONTRACTOR SHOULD DISCUSS AND RESOLVE WITH THE SITE ENGINEER.

IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.

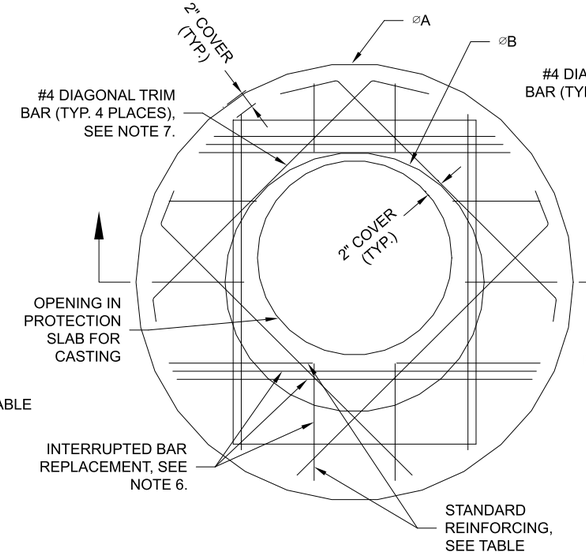
NOTE:
THESE DRAWINGS ARE FOR CONCEPTUAL PURPOSES AND DO NOT REFLECT ANY LOCAL PREFERENCES OR REGULATIONS. PLEASE CONTACT YOUR LOCAL CONTECH REP FOR MODIFICATIONS.



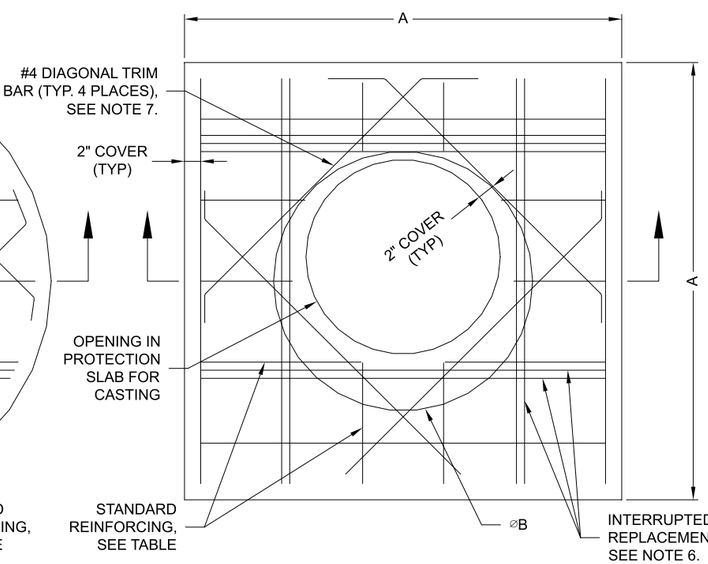
SECTION VIEW

REINFORCING TABLE				
⌀ CMP RISER	A	⌀ B	REINFORCING	**BEARING PRESSURE (PSF)
24"	⌀ 4' 4'X4'	26"	#5 @ 12" OCEW #5 @ 12" OCEW	2,410 1,780
30"	⌀ 4'-6" 4'-6" X 4'-6"	32"	#5 @ 12" OCEW #5 @ 12" OCEW	2,120 1,530
36"	⌀ 5' 5' X 5'	38"	#5 @ 10" OCEW #5 @ 10" OCEW	1,890 1,350
42"	⌀ 5'-6" 5'-6" X 5'-6"	44"	#5 @ 10" OCEW #5 @ 9" OCEW	1,720 1,210
48"	⌀ 6' 6' X 6'	50"	#5 @ 9" OCEW #5 @ 8" OCEW	1,600 1,100

** ASSUMED SOIL BEARING CAPACITY



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 3,500 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERING, BINGHAMTON, NY.

MANHOLE CAP DETAIL

SCALE: N.T.S.

DATE	REVISION DESCRIPTION	BY

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

DYO49295 Miro Way
BMP 1
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
34165	49295	4/4/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

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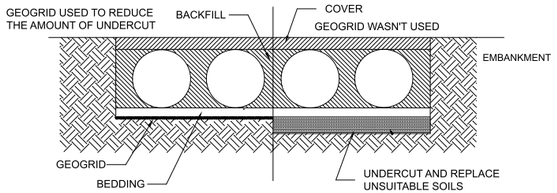
CMP DETENTION INSTALLATION GUIDE

PROPER INSTALLATION OF A FLEXIBLE UNDERGROUND DETENTION SYSTEM WILL ENSURE LONG-TERM PERFORMANCE. THE CONFIGURATION OF THESE SYSTEMS OFTEN REQUIRES SPECIAL CONSTRUCTION PRACTICES THAT DIFFER FROM CONVENTIONAL FLEXIBLE PIPE CONSTRUCTION. CONTECH ENGINEERED SOLUTIONS STRONGLY SUGGESTS SCHEDULING A PRE-CONSTRUCTION MEETING WITH YOUR LOCAL SALES ENGINEER TO DETERMINE IF ADDITIONAL MEASURES, NOT COVERED IN THIS GUIDE, ARE APPROPRIATE FOR YOUR SITE.

FOUNDATION

CONSTRUCT A FOUNDATION THAT CAN SUPPORT THE DESIGN LOADING APPLIED BY THE PIPE AND ADJACENT BACKFILL WEIGHT AS WELL AS MAINTAIN ITS INTEGRITY DURING CONSTRUCTION.

IF SOFT OR UNSUITABLE SOILS ARE ENCOUNTERED, REMOVE THE POOR SOILS DOWN TO A SUITABLE DEPTH AND THEN BUILD UP TO THE APPROPRIATE ELEVATION WITH A COMPETENT BACKFILL MATERIAL. THE STRUCTURAL FILL MATERIAL GRADATION SHOULD NOT ALLOW THE MIGRATION OF FINES, WHICH CAN CAUSE SETTLEMENT OF THE DETENTION SYSTEM OR PAVEMENT ABOVE. IF THE STRUCTURAL FILL MATERIAL IS NOT COMPATIBLE WITH THE UNDERLYING SOILS AN ENGINEERING FABRIC SHOULD BE USED AS A SEPARATOR. IN SOME CASES, USING A STIFF REINFORCING GEOGRID REDUCES OVER EXCAVATION AND REPLACEMENT FILL QUANTITIES.

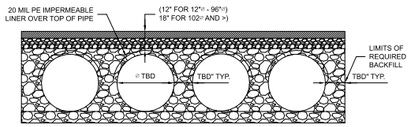


GRADE THE FOUNDATION SUBGRADE TO A UNIFORM OR SLIGHTLY SLOPING GRADE. IF THE SUBGRADE IS CLAY OR RELATIVELY NON-POROUS AND THE CONSTRUCTION SEQUENCE WILL LAST FOR AN EXTENDED PERIOD OF TIME, IT IS BEST TO SLOPE THE GRADE TO ONE END OF THE SYSTEM. THIS WILL ALLOW EXCESS WATER TO DRAIN QUICKLY, PREVENTING SATURATION OF THE SUBGRADE.

GEOMEMBRANE BARRIER

A SITE'S RESISTIVITY MAY CHANGE OVER TIME WHEN VARIOUS TYPES OF SALTING AGENTS ARE USED, SUCH AS ROAD SALTS FOR DEICING AGENTS. IF SALTING AGENTS ARE USED ON OR NEAR THE PROJECT SITE, A GEOMEMBRANE BARRIER IS RECOMMENDED WITH THE SYSTEM. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM THE USE OF SUCH AGENTS INCLUDING PREMATURE CORROSION AND REDUCED ACTUAL SERVICE LIFE.

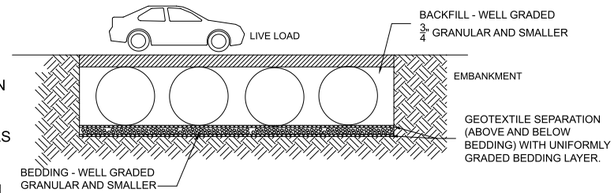
THE PROJECT'S ENGINEER OF RECORD IS TO EVALUATE WHETHER SALTING AGENTS WILL BE USED ON OR NEAR THE PROJECT SITE, AND USE HIS/HER BEST JUDGEMENT TO DETERMINE IF ANY ADDITIONAL PROTECTIVE MEASURES ARE REQUIRED. BELOW IS A TYPICAL DETAIL SHOWING THE PLACEMENT OF A GEOMEMBRANE BARRIER FOR PROJECTS WHERE SALTING AGENTS ARE USED ON OR NEAR THE PROJECT SITE.



IN-SITU TRENCH WALL

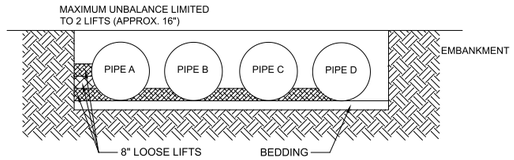
IF EXCAVATION IS REQUIRED, THE TRENCH WALL NEEDS TO BE CAPABLE OF SUPPORTING THE LOAD THAT THE PIPE SHEDS AS THE SYSTEM IS LOADED. IF SOILS ARE NOT CAPABLE OF SUPPORTING THESE LOADS, THE PIPE CAN DEFLECT. PERFORM A SIMPLE SOIL PRESSURE CHECK USING THE APPLIED LOADS TO DETERMINE THE LIMITS OF EXCAVATION BEYOND THE SPRING LINE OF THE OUTER MOST PIPES.

IN MOST CASES THE REQUIREMENTS FOR A SAFE WORK ENVIRONMENT AND PROPER BACKFILL PLACEMENT AND COMPACTION TAKE CARE OF THIS CONCERN.



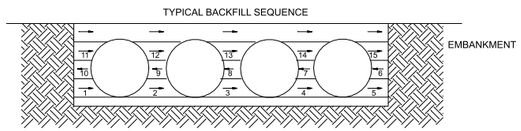
BACKFILL PLACEMENT

MATERIAL SHALL BE WORKED INTO THE PIPE HAUNCHES BY MEANS OF SHOVEL-SLICING, RODDING, AIR TAMPER, VIBRATORY ROD, OR OTHER EFFECTIVE METHODS.

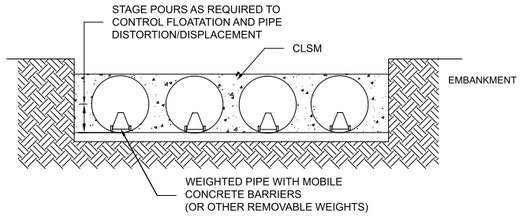


IF AASHTO T99 PROCEDURES ARE DETERMINED INFEASIBLE BY THE GEOTECHNICAL ENGINEER OF RECORD, COMPACTION IS CONSIDERED ADEQUATE WHEN NO FURTHER YIELDING OF THE MATERIAL IS OBSERVED UNDER THE COMPACTOR, OR UNDER FOOT, AND THE GEOTECHNICAL ENGINEER OF RECORD (OR REPRESENTATIVE THEREOF) IS SATISFIED WITH THE LEVEL OF COMPACTION.

FOR LARGE SYSTEMS, CONVEYOR SYSTEMS, BACKHOES WITH LONG REACHES OR DRAGLINES WITH STONE BUCKETS MAY BE USED TO PLACE BACKFILL. ONCE MINIMUM COVER FOR CONSTRUCTION LOADING ACROSS THE ENTIRE WIDTH OF THE SYSTEM IS REACHED, ADVANCE THE EQUIPMENT TO THE END OF THE RECENTLY PLACED FILL, AND BEGIN THE SEQUENCE AGAIN UNTIL THE SYSTEM IS COMPLETELY BACKFILLED. THIS TYPE OF CONSTRUCTION SEQUENCE PROVIDES ROOM FOR STOCKPILED BACKFILL DIRECTLY BEHIND THE BACKHOE, AS WELL AS THE MOVEMENT OF CONSTRUCTION TRAFFIC. MATERIAL STOCKPILES ON TOP OF THE BACKFILLED DETENTION SYSTEM SHOULD BE LIMITED TO 8- TO 10-FEET HIGH AND MUST PROVIDE BALANCED LOADING ACROSS ALL BARRELS. TO DETERMINE THE PROPER COVER OVER THE PIPES TO ALLOW THE MOVEMENT OF CONSTRUCTION EQUIPMENT SEE TABLE 1, OR CONTACT YOUR LOCAL CONTECH SALES ENGINEER.



WHEN FLOWABLE FILL IS USED, YOU MUST PREVENT PIPE FLOATATION. TYPICALLY, SMALL LIFTS ARE PLACED BETWEEN THE PIPES AND THEN ALLOWED TO SET-UP PRIOR TO THE PLACEMENT OF THE NEXT LIFT. THE ALLOWABLE THICKNESS OF THE CLSM LIFT IS A FUNCTION OF A PROPER BALANCE BETWEEN THE UPLIFT FORCE OF THE CLSM, THE OPPOSING WEIGHT OF THE PIPE, AND THE EFFECT OF OTHER RESTRAINING MEASURES. THE PIPE CAN CARRY LIMITED FLUID PRESSURE WITHOUT PIPE DISTORTION OR DISPLACEMENT, WHICH ALSO AFFECTS THE CLSM LIFT THICKNESS. YOUR LOCAL CONTECH SALES ENGINEER CAN HELP DETERMINE THE PROPER LIFT THICKNESS.

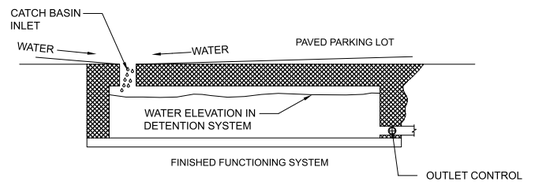


CONSTRUCTION LOADING

TYPICALLY, THE MINIMUM COVER SPECIFIED FOR A PROJECT ASSUMES H-20 LIVE LOAD. BECAUSE CONSTRUCTION LOADS OFTEN EXCEED DESIGN LIVE LOADS, INCREASED TEMPORARY MINIMUM COVER REQUIREMENTS ARE NECESSARY. SINCE CONSTRUCTION EQUIPMENT VARIES FROM JOB TO JOB, IT IS BEST TO ADDRESS EQUIPMENT SPECIFIC MINIMUM COVER REQUIREMENTS WITH YOUR LOCAL CONTECH SALES ENGINEER DURING YOUR PRE-CONSTRUCTION MEETING.

ADDITIONAL CONSIDERATIONS

BECAUSE MOST SYSTEMS ARE CONSTRUCTED BELOW-GRADE, RAINFALL CAN RAPIDLY FILL THE EXCAVATION; POTENTIALLY CAUSING FLOATATION AND MOVEMENT OF THE PREVIOUSLY PLACED PIPES. TO HELP MITIGATE POTENTIAL PROBLEMS, IT IS BEST TO START THE INSTALLATION AT THE DOWNSTREAM END WITH THE OUTLET ALREADY CONSTRUCTED TO ALLOW A ROUTE FOR THE WATER TO ESCAPE. TEMPORARY DIVERSION MEASURES MAY BE REQUIRED FOR HIGH FLOWS DUE TO THE RESTRICTED NATURE OF THE OUTLET PIPE.



CMP DETENTION SYSTEM INSPECTION AND MAINTENANCE

UNDERGROUND STORMWATER DETENTION AND INFILTRATION SYSTEMS MUST BE INSPECTED AND MAINTAINED AT REGULAR INTERVALS FOR PURPOSES OF PERFORMANCE AND LONGEVITY.

INSPECTION

INSPECTION IS THE KEY TO EFFECTIVE MAINTENANCE OF CMP DETENTION SYSTEMS AND IS EASILY PERFORMED. CONTECH RECOMMENDS ONGOING, ANNUAL INSPECTIONS. SITES WITH HIGH TRASH LOAD OR SMALL OUTLET CONTROL ORIFICES MAY NEED MORE FREQUENT INSPECTIONS. THE RATE AT WHICH THE SYSTEM COLLECTS POLLUTANTS WILL DEPEND MORE ON SITE SPECIFIC ACTIVITIES RATHER THAN THE SIZE OR CONFIGURATION OF THE SYSTEM.

INSPECTIONS SHOULD BE PERFORMED MORE OFTEN IN EQUIPMENT WASHDOWN AREAS, IN CLIMATES WHERE SANDING AND/OR SALTING OPERATIONS TAKE PLACE, AND IN OTHER VARIOUS INSTANCES IN WHICH ONE WOULD EXPECT HIGHER ACCUMULATIONS OF SEDIMENT OR ABRASIVE/ CORROSIVE CONDITIONS. A RECORD OF EACH INSPECTION IS TO BE MAINTAINED FOR THE LIFE OF THE SYSTEM

MAINTENANCE

CMP DETENTION SYSTEMS SHOULD BE CLEANED WHEN AN INSPECTION REVEALS ACCUMULATED SEDIMENT OR TRASH IS CLOGGING THE DISCHARGE ORIFICE.

ACCUMULATED SEDIMENT AND TRASH CAN TYPICALLY BE EVACUATED THROUGH THE MANHOLE OVER THE OUTLET ORIFICE. IF MAINTENANCE IS NOT PERFORMED AS RECOMMENDED, SEDIMENT AND TRASH MAY ACCUMULATE IN FRONT OF THE OUTLET ORIFICE. MANHOLE COVERS SHOULD BE SECURELY SEATED FOLLOWING CLEANING ACTIVITIES. CONTECH SUGGESTS THAT ALL SYSTEMS BE DESIGNED WITH AN ACCESS/INSPECTION MANHOLE SITUATED AT OR NEAR THE INLET AND THE OUTLET ORIFICE. SHOULD IT BE NECESSARY TO GET INSIDE THE SYSTEM TO PERFORM MAINTENANCE ACTIVITIES, ALL APPROPRIATE PRECAUTIONS REGARDING CONFINED SPACE ENTRY AND OSHA REGULATIONS SHOULD BE FOLLOWED.

ANNUAL INSPECTIONS ARE BEST PRACTICE FOR ALL UNDERGROUND SYSTEMS. DURING THIS INSPECTION, IF EVIDENCE OF SALTING/DE-ICING AGENTS IS OBSERVED WITHIN THE SYSTEM, IT IS BEST PRACTICE FOR THE SYSTEM TO BE RINSED, INCLUDING ABOVE THE SPRING LINE SOON AFTER THE SPRING THAW AS PART OF THE MAINTENANCE PROGRAM FOR THE SYSTEM.

MAINTAINING AN UNDERGROUND DETENTION OR INFILTRATION SYSTEM IS EASIEST WHEN THERE IS NO FLOW ENTERING THE SYSTEM. FOR THIS REASON, IT IS A GOOD IDEA TO SCHEDULE THE CLEANOUT DURING DRY WEATHER.

THE FOREGOING INSPECTION AND MAINTENANCE EFFORTS HELP ENSURE UNDERGROUND PIPE SYSTEMS USED FOR STORMWATER STORAGE CONTINUE TO FUNCTION AS INTENDED BY IDENTIFYING RECOMMENDED REGULAR INSPECTION AND MAINTENANCE PRACTICES. INSPECTION AND MAINTENANCE RELATED TO THE STRUCTURAL INTEGRITY OF THE PIPE OR THE SOUNDNESS OF PIPE JOINT CONNECTIONS IS BEYOND THE SCOPE OF THIS GUIDE.

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DATE	REVISION DESCRIPTION	BY

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH CMP DETENTION SYSTEMS

CONTECH **DYODS** DRAWING

DYO49295 Miro Way
BMP 1
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
34165	49295	4/4/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

PROJECT SUMMARY

CALCULATION DETAILS
- LOADING = HS20/HS25
- APPROX. LINEAR FOOTAGE = 1,738 LF

STORAGE SUMMARY
- STORAGE VOLUME REQUIRED = N/A
- PIPE STORAGE VOLUME = 21,840 CF
- BACKFILL STORAGE VOLUME = 16,320 CF
- TOTAL STORAGE PROVIDED = 38,160 CF

PIPE DETAILS
- DIAMETER = 48"
- CORRUGATION = 2 2/3x1/2
- GAGE = 16
- COATING = ALT2
- WALL TYPE = PERFORATED
- BARREL SPACING = 24"

BACKFILL DETAILS
- WIDTH AT ENDS = 12"
- ABOVE PIPE = 12"
- WIDTH AT SIDES = 12"
- BELOW PIPE = 12"

NOTES

- ALL RISER AND STUB DIMENSIONS ARE TO CENTERLINE. ALL ELEVATIONS, DIMENSIONS, AND LOCATIONS OF RISERS AND INLETS, SHALL BE VERIFIED BY THE ENGINEER OF RECORD PRIOR TO RELEASING FOR FABRICATION.
- ALL FITTINGS AND REINFORCEMENT COMPLY WITH ASTM A998.
- ALL RISERS AND STUBS ARE $2\frac{2}{3}$" x $\frac{1}{2}$" CORRUGATION AND 16 GAGE UNLESS OTHERWISE NOTED.
- RISERS TO BE FIELD TRIMMED TO GRADE.
- QUANTITY OF PIPE SHOWN DOES NOT PROVIDE EXTRA PIPE FOR CONNECTING THE SYSTEM TO EXISTING PIPE OR DRAINAGE STRUCTURES. OUR SYSTEM AS DETAILED PROVIDES NOMINAL INLET AND/OR OUTLET PIPE STUB FOR CONNECTION TO EXISTING DRAINAGE FACILITIES. IF ADDITIONAL PIPE IS NEEDED IT IS THE RESPONSIBILITY OF THE CONTRACTOR.
- BAND TYPE TO BE DETERMINED UPON FINAL DESIGN.
- THE PROJECT SUMMARY IS REFLECTIVE OF THE DYODS DESIGN, QUANTITIES ARE APPROX. AND SHOULD BE VERIFIED UPON FINAL DESIGN AND APPROVAL. FOR EXAMPLE, TOTAL EXCAVATION DOES NOT CONSIDER ALL VARIABLES SUCH AS SHORING AND ONLY ACCOUNTS FOR MATERIAL WITHIN THE ESTIMATED EXCAVATION FOOTPRINT.
- THESE DRAWINGS ARE FOR CONCEPTUAL PURPOSES AND DO NOT REFLECT ANY LOCAL PREFERENCES OR REGULATIONS. PLEASE CONTACT YOUR LOCAL CONTECH REP FOR MODIFICATIONS.

ASSEMBLY
SCALE: 1" = 30'

DATE	REVISION DESCRIPTION	BY

CONTECH ENGINEERED SOLUTIONS LLC
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9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

DYO49298 Miro Way
BMP 2
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
34168	49298	4/5/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

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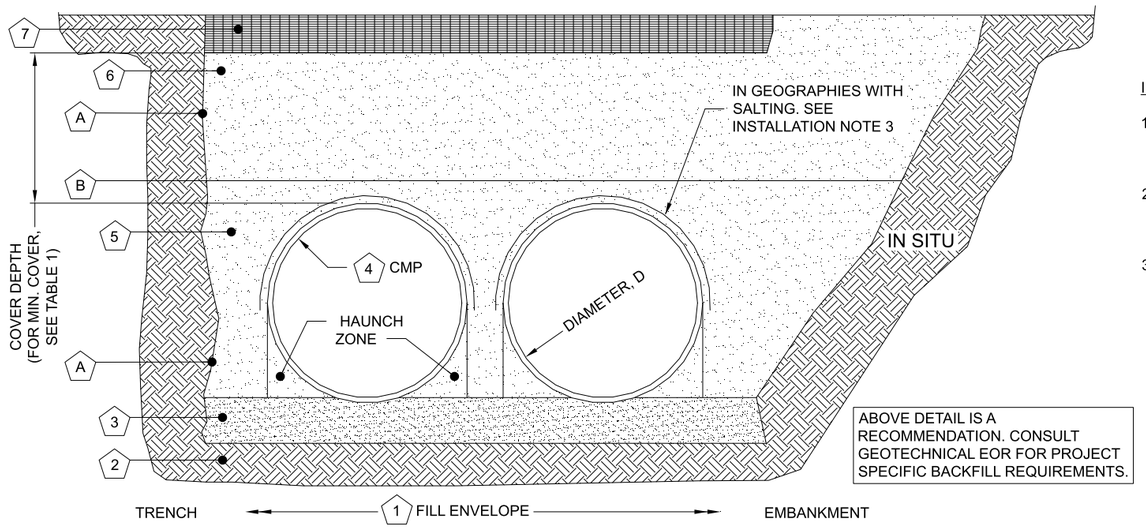
TABLE 1:

DIAMETER, D	MIN. COVER	CORR. PROFILE
6"-10"	12"	1 1/2" x 1/4"
12"-48"	12"	2 2/3" x 1/2"
>48"-96"	12"	3" x 1", 5" x 1"
>96"	D/8	3" x 1", 5" x 1"

- STRUCTURAL BACKFILL MUST EXTEND TO LIMITS OF THE TABLE
- TOTAL HEIGHT OF COMPACTED COVER FOR CONVENTIONAL HIGHWAY LOADS IS MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT.



INSTALLATION NOTES

1. WHEN PLACING THE FIRST LIFTS OF BACKFILL IT IS IMPORTANT TO MAKE SURE THAT THE BACKFILL IS PROPERLY COMPACTED UNDER AND AROUND THE PIPE HAUNCHES.
2. OTHER ALTERNATE BACKFILL MATERIAL MAY BE ALLOWED DEPENDING ON SITE SPECIFIC CONDITIONS, AS APPROVED BY SITE ENGINEER.
3. IF SALTING AGENTS FOR SNOW AND ICE REMOVAL ARE USED ON OR NEAR THE PROJECT, A GEOMEMBRANE BARRIER IS RECOMMENDED OVER THE UPPER HALF OF THE PIPE. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.

TABLE 2: PERFORATED STANDARD

	CMP RETENTION STANDARD BACKFILL SPECIFICATIONS			
	MATERIAL LOCATION	MATERIAL SPECIFICATION	DESCRIPTION	
1	FILL ENVELOPE WIDTH	PER ENGINEER OF RECORD	MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER THE PIPE. THE SUGGESTED MINIMUM TRENCH WIDTH, OR EOR RECOMMENDATION: PIPE ≤ 12": D + 16" PIPE > 12": 1.5D + 12"	MINIMUM EMBANKMENT WIDTH (IN FEET) FOR INITIAL FILL ENVELOPE: PIPE < 24": 3.0D PIPE 24" - 144": D + 4'0" PIPE > 144": D + 10'0"
2	FOUNDATION	**AASHTO 26.5.2** - PER ENGINEER OF RECORD	PRIOR TO PLACING THE BEDDING, THE FOUNDATION MUST BE CONSTRUCTED TO A UNIFORM AND STABLE GRADE. IN THE EVENT THAT UNSUITABLE FOUNDATION MATERIALS ARE ENCOUNTERED DURING EXCAVATION, THEY SHALL BE REMOVED AND FOUNDATION BROUGHT BACK TO GRADE WITH A FILL MATERIAL APPROVED BY THE ENGINEER OF RECORD.	
3	BEDDING	**AASHTO M 43: 3, 357, 4, 467, 5, 56, 57**	ENGINEER OF RECORD TO DETERMINE IF BEDDING IS REQUIRED. PIPE MAY BE PLACED ON THE TRENCH BOTTOM OF A RELATIVELY LOOSE, NATIVE SUITABLE WELL GRADED GRANULAR MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, 2" MIN DEPTH. THE BEDDING MATERIAL MAY BE SUITABLE OPEN GRADED GRANULAR BEDDING CONFORMING TO AASHTO SOIL CLASSIFICATIONS A1, A2, OR A3 WITH MAXIMUM PARTICLE SIZE OF 3" PER AASHTO 26.3.8.1	
4	CORRUGATED METAL PIPE			
5	BACKFILL	FREE-DRAINING, ANGULAR, NATURALLY OCCURRING WASHED-STONE PER **AASHTO M 43: 3, 357, 4, 467, 5, 56, 57** OR APPROVED EQUAL *	HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION WITHOUT SOFT SPOTS. BACKFILL SHALL BE PLACED IN 8" +/- LOOSE LIFTS AND COMPACTED TO 90% STANDARD PROCTOR PER AASHTO T 99. BACKFILL SHALL BE PLACED SUCH THAT THERE IS NO MORE THAN A TWO LIFT (16") DIFFERENTIAL BETWEEN ANY OF THE PIPES AT ANY TIME DURING THE BACKFILL PROCESS. THE BACKFILL SHOULD BE ADVANCED ALONG THE LENGTH OF THE SYSTEM TO AVOID DIFFERENTIAL LOADING. WHERE CONVENTIONAL COMPACTION TESTING IS NOT PRACTICAL, THE MATERIAL SHALL BE MECHANICALLY COMPACTED UNTIL NO FURTHER YIELDING OF MATERIAL IS OBSERVED UNDER THE COMPACTOR. **IN AREAS WITH HIGH WATER TABLE FLUCTUATIONS THAT INTERACT WITH THE PIPE ZONE, CONSIDER INSTALLING A GEOTEXTILE SEPARATION LAYER TO PREVENT SOIL MIGRATION.	
6	COVER MATERIAL	UP TO MIN. COVER - **AASHTO M 145: A-1, A-2, A-3** ABOVE MIN. COVER - PER ENGINEER OF RECORD	COVER MATERIAL MAY INCLUDE NON-BITUMINOUS, GRANULAR ROADBASE MATERIAL WITHIN MIN COVER LIMITS	
7	RIGID OR FLEXIBLE PAVEMENT (IF APPLICABLE)	PER ENGINEER OF RECORD	FLEXIBLE PAVEMENT SHOULD NOT BE COUNTED AS PART OF THE FILL HEIGHT OVER THE CMP. FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS SHALL FOLLOW THE PROJECT PLANS AND SPECIFICATIONS PER THE ENGINEER OF RECORD.	
A	OPTIONAL SIDE GEOTEXTILE	NONE	GEOTEXTILE LAYER IS RECOMMENDED ON SIDES OF EXCAVATION TO PREVENT SOIL MIGRATION.	
B	GEOTEXTILE BETWEEN LAYERS	NONE	IF SOIL TYPES DIFFER AT ANY POINT ABOVE PIPE INVERT, A GEOTEXTILE LAYER IS RECOMMENDED TO BE PLACED BETWEEN THE LAYERS TO PREVENT SOIL MIGRATION.	

NOTES:
- FOR MULTIPLE BARREL INSTALLATIONS, THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE THE PIPE DIAMETER /2 BUT NO LESS THAN 12" FOR DIAMETERS <72". FOR 72" AND LARGER DIAMETERS, THE MINIMUM SPACING IS 36". CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING.

* APPROVED REGIONAL EQUIVALENTS FOR SECTION 5 INCLUDE CA-7, MIDOT 6AA, 6A, OR 5G, PROVIDED THEY MEET THE PARTICLE SIZES INDICATED.

MANUFACTURER RECOMMENDED BACKFILL

NOT TO SCALE

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CONTECH CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

DYO49298 Miro Way
BMP 2
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
34168	49298	4/5/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

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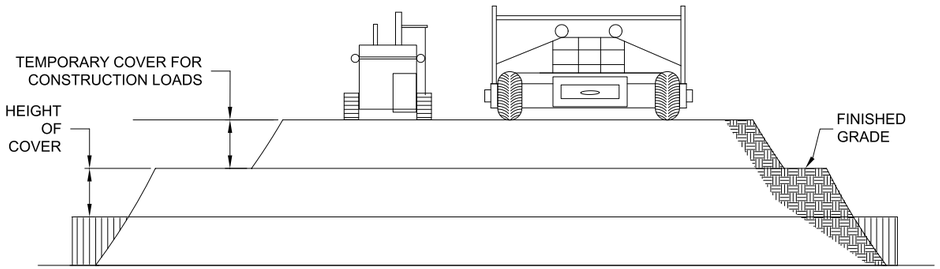


CONSTRUCTION LOADS

FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

CONSTRUCTION LOADING DIAGRAM

SCALE: N.T.S.

SPECIFICATION FOR DESIGNED DETENTION SYSTEM:

SCOPE
THIS SPECIFICATION COVERS THE MANUFACTURE AND INSTALLATION OF THE DESIGNED DETENTION SYSTEM DETAILED IN THE PROJECT PLANS.

MATERIAL
THE MATERIAL SHALL CONFORM TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2 STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-274 OR ASTM A-92.

THE GALVANIZED STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-218 OR ASTM A-929.

THE POLYMER COATED STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-246 OR ASTM A-742.

THE ALUMINUM COILS SHALL CONFORM TO THE APPLICABLE OF AASHTO M-197 OR ASTM B-744.

CONSTRUCTION LOADS
CONSTRUCTION LOADS MAY BE HIGHER THAN FINAL LOADS. FOLLOW THE MANUFACTURER'S OR NCSPA GUIDELINES.

PIPE
THE PIPE SHALL BE MANUFACTURED IN ACCORDANCE TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2: AASHTO M-36 OR ASTM A-760

GALVANIZED: AASHTO M-36 OR ASTM A-760

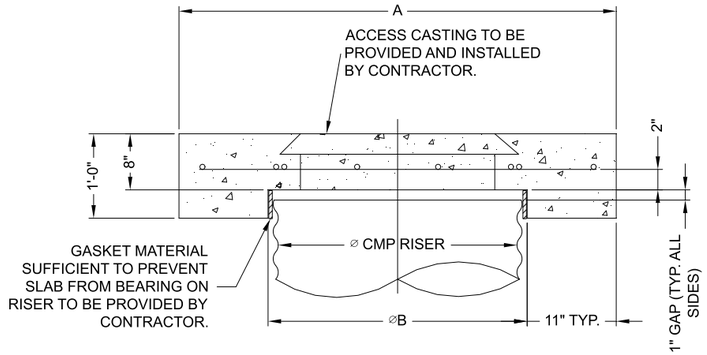
APPLICABLE POLYMER COATED: AASHTO M-245 OR ASTM A-762

ALUMINUM: AASHTO M-196 OR ASTM B-745

APPLICABLE
HANDLING AND ASSEMBLY
SHALL BE IN ACCORDANCE WITH NCSP'S (NATIONAL CORRUGATED STEEL PIPE ASSOCIATION) FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL. SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS FOR ALUMINUM PIPE.
REQUIREMENTS
INSTALLATION
SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II DIVISION II OR ASTM A-798 (FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL) OR ASTM B-788 (FOR ALUMINUM PIPE) AND IN CONFORMANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. IF THERE ARE ANY INCONSISTENCIES OR CONFLICTS THE CONTRACTOR SHOULD DISCUSS AND RESOLVE WITH THE SITE ENGINEER.

IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.

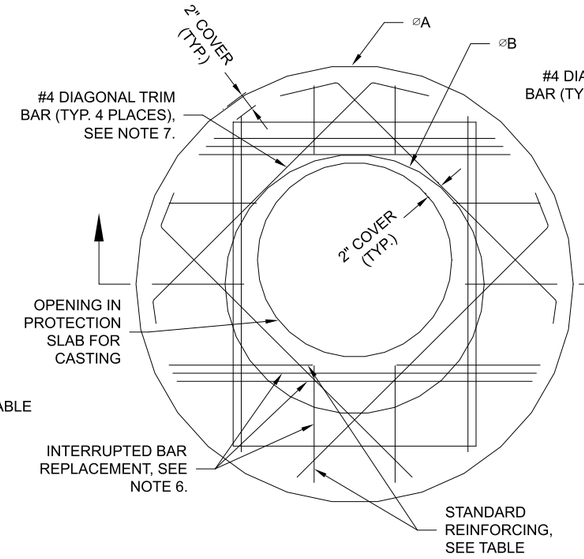
NOTE:
THESE DRAWINGS ARE FOR CONCEPTUAL PURPOSES AND DO NOT REFLECT ANY LOCAL PREFERENCES OR REGULATIONS. PLEASE CONTACT YOUR LOCAL CONTECH REP FOR MODIFICATIONS.



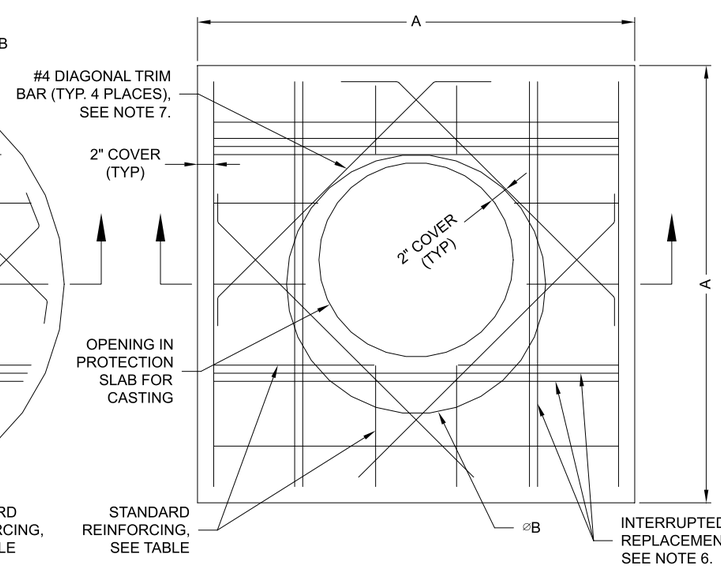
SECTION VIEW

REINFORCING TABLE				
⌀ CMP RISER	A	⌀ B	REINFORCING	**BEARING PRESSURE (PSF)
24"	⌀ 4' 4'X4'	26"	#5 @ 12" OCEW #5 @ 12" OCEW	2,410 1,780
30"	⌀ 4'-6" 4'-6" X 4'-6"	32"	#5 @ 12" OCEW #5 @ 12" OCEW	2,120 1,530
36"	⌀ 5' 5' X 5'	38"	#5 @ 10" OCEW #5 @ 10" OCEW	1,890 1,350
42"	⌀ 5'-6" 5'-6" X 5'-6"	44"	#5 @ 10" OCEW #5 @ 9" OCEW	1,720 1,210
48"	⌀ 6' 6' X 6'	50"	#5 @ 9" OCEW #5 @ 8" OCEW	1,600 1,100

** ASSUMED SOIL BEARING CAPACITY



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 3,500 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERING, BINGHAMTON, NY.

MANHOLE CAP DETAIL

SCALE: N.T.S.

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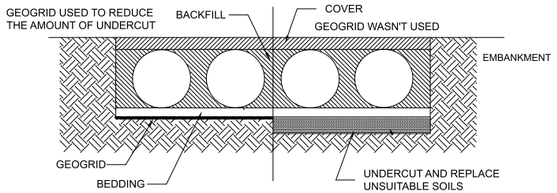
CMP DETENTION INSTALLATION GUIDE

PROPER INSTALLATION OF A FLEXIBLE UNDERGROUND DETENTION SYSTEM WILL ENSURE LONG-TERM PERFORMANCE. THE CONFIGURATION OF THESE SYSTEMS OFTEN REQUIRES SPECIAL CONSTRUCTION PRACTICES THAT DIFFER FROM CONVENTIONAL FLEXIBLE PIPE CONSTRUCTION. CONTECH ENGINEERED SOLUTIONS STRONGLY SUGGESTS SCHEDULING A PRE-CONSTRUCTION MEETING WITH YOUR LOCAL SALES ENGINEER TO DETERMINE IF ADDITIONAL MEASURES, NOT COVERED IN THIS GUIDE, ARE APPROPRIATE FOR YOUR SITE.

FOUNDATION

CONSTRUCT A FOUNDATION THAT CAN SUPPORT THE DESIGN LOADING APPLIED BY THE PIPE AND ADJACENT BACKFILL WEIGHT AS WELL AS MAINTAIN ITS INTEGRITY DURING CONSTRUCTION.

IF SOFT OR UNSUITABLE SOILS ARE ENCOUNTERED, REMOVE THE POOR SOILS DOWN TO A SUITABLE DEPTH AND THEN BUILD UP TO THE APPROPRIATE ELEVATION WITH A COMPETENT BACKFILL MATERIAL. THE STRUCTURAL FILL MATERIAL GRADATION SHOULD NOT ALLOW THE MIGRATION OF FINES, WHICH CAN CAUSE SETTLEMENT OF THE DETENTION SYSTEM OR PAVEMENT ABOVE. IF THE STRUCTURAL FILL MATERIAL IS NOT COMPATIBLE WITH THE UNDERLYING SOILS AN ENGINEERING FABRIC SHOULD BE USED AS A SEPARATOR. IN SOME CASES, USING A STIFF REINFORCING GEOGRID REDUCES OVER EXCAVATION AND REPLACEMENT FILL QUANTITIES.

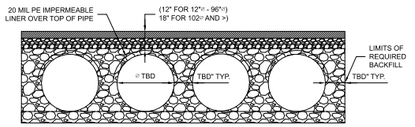


GRADE THE FOUNDATION SUBGRADE TO A UNIFORM OR SLIGHTLY SLOPING GRADE. IF THE SUBGRADE IS CLAY OR RELATIVELY NON-POROUS AND THE CONSTRUCTION SEQUENCE WILL LAST FOR AN EXTENDED PERIOD OF TIME, IT IS BEST TO SLOPE THE GRADE TO ONE END OF THE SYSTEM. THIS WILL ALLOW EXCESS WATER TO DRAIN QUICKLY, PREVENTING SATURATION OF THE SUBGRADE.

GEOMEMBRANE BARRIER

A SITE'S RESISTIVITY MAY CHANGE OVER TIME WHEN VARIOUS TYPES OF SALTING AGENTS ARE USED, SUCH AS ROAD SALTS FOR DEICING AGENTS. IF SALTING AGENTS ARE USED ON OR NEAR THE PROJECT SITE, A GEOMEMBRANE BARRIER IS RECOMMENDED WITH THE SYSTEM. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM THE USE OF SUCH AGENTS INCLUDING PREMATURE CORROSION AND REDUCED ACTUAL SERVICE LIFE.

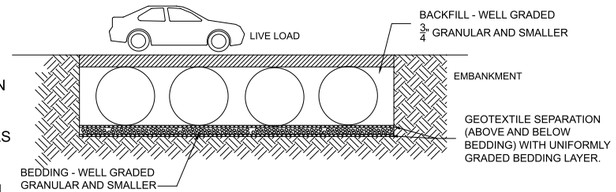
THE PROJECT'S ENGINEER OF RECORD IS TO EVALUATE WHETHER SALTING AGENTS WILL BE USED ON OR NEAR THE PROJECT SITE, AND USE HIS/HER BEST JUDGEMENT TO DETERMINE IF ANY ADDITIONAL PROTECTIVE MEASURES ARE REQUIRED. BELOW IS A TYPICAL DETAIL SHOWING THE PLACEMENT OF A GEOMEMBRANE BARRIER FOR PROJECTS WHERE SALTING AGENTS ARE USED ON OR NEAR THE PROJECT SITE.



IN-SITU TRENCH WALL

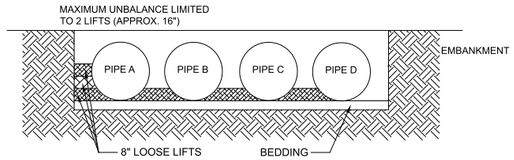
IF EXCAVATION IS REQUIRED, THE TRENCH WALL NEEDS TO BE CAPABLE OF SUPPORTING THE LOAD THAT THE PIPE SHEDS AS THE SYSTEM IS LOADED. IF SOILS ARE NOT CAPABLE OF SUPPORTING THESE LOADS, THE PIPE CAN DEFLECT. PERFORM A SIMPLE SOIL PRESSURE CHECK USING THE APPLIED LOADS TO DETERMINE THE LIMITS OF EXCAVATION BEYOND THE SPRING LINE OF THE OUTER MOST PIPES.

IN MOST CASES THE REQUIREMENTS FOR A SAFE WORK ENVIRONMENT AND PROPER BACKFILL PLACEMENT AND COMPACTION TAKE CARE OF THIS CONCERN.



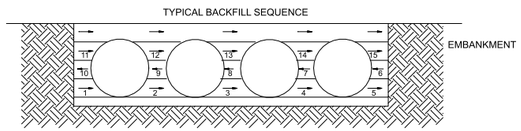
BACKFILL PLACEMENT

MATERIAL SHALL BE WORKED INTO THE PIPE HAUNCHES BY MEANS OF SHOVEL-SLICING, RODDING, AIR TAMPER, VIBRATORY ROD, OR OTHER EFFECTIVE METHODS.

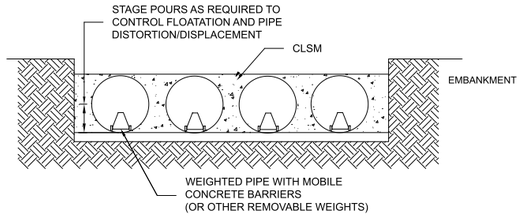


IF AASHTO T99 PROCEDURES ARE DETERMINED INFEASIBLE BY THE GEOTECHNICAL ENGINEER OF RECORD, COMPACTION IS CONSIDERED ADEQUATE WHEN NO FURTHER YIELDING OF THE MATERIAL IS OBSERVED UNDER THE COMPACTOR, OR UNDER FOOT, AND THE GEOTECHNICAL ENGINEER OF RECORD (OR REPRESENTATIVE THEREOF) IS SATISFIED WITH THE LEVEL OF COMPACTION.

FOR LARGE SYSTEMS, CONVEYOR SYSTEMS, BACKHOES WITH LONG REACHES OR DRAGLINES WITH STONE BUCKETS MAY BE USED TO PLACE BACKFILL. ONCE MINIMUM COVER FOR CONSTRUCTION LOADING ACROSS THE ENTIRE WIDTH OF THE SYSTEM IS REACHED, ADVANCE THE EQUIPMENT TO THE END OF THE RECENTLY PLACED FILL, AND BEGIN THE SEQUENCE AGAIN UNTIL THE SYSTEM IS COMPLETELY BACKFILLED. THIS TYPE OF CONSTRUCTION SEQUENCE PROVIDES ROOM FOR STOCKPILED BACKFILL DIRECTLY BEHIND THE BACKHOE, AS WELL AS THE MOVEMENT OF CONSTRUCTION TRAFFIC. MATERIAL STOCKPILES ON TOP OF THE BACKFILLED DETENTION SYSTEM SHOULD BE LIMITED TO 8- TO 10-FEET HIGH AND MUST PROVIDE BALANCED LOADING ACROSS ALL BARRELS. TO DETERMINE THE PROPER COVER OVER THE PIPES TO ALLOW THE MOVEMENT OF CONSTRUCTION EQUIPMENT SEE TABLE 1, OR CONTACT YOUR LOCAL CONTECH SALES ENGINEER.



WHEN FLOWABLE FILL IS USED, YOU MUST PREVENT PIPE FLOATATION. TYPICALLY, SMALL LIFTS ARE PLACED BETWEEN THE PIPES AND THEN ALLOWED TO SET-UP PRIOR TO THE PLACEMENT OF THE NEXT LIFT. THE ALLOWABLE THICKNESS OF THE CLSM LIFT IS A FUNCTION OF A PROPER BALANCE BETWEEN THE UPLIFT FORCE OF THE CLSM, THE OPPOSING WEIGHT OF THE PIPE, AND THE EFFECT OF OTHER RESTRAINING MEASURES. THE PIPE CAN CARRY LIMITED FLUID PRESSURE WITHOUT PIPE DISTORTION OR DISPLACEMENT, WHICH ALSO AFFECTS THE CLSM LIFT THICKNESS. YOUR LOCAL CONTECH SALES ENGINEER CAN HELP DETERMINE THE PROPER LIFT THICKNESS.

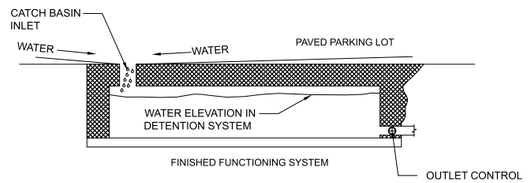


CONSTRUCTION LOADING

TYPICALLY, THE MINIMUM COVER SPECIFIED FOR A PROJECT ASSUMES H-20 LIVE LOAD. BECAUSE CONSTRUCTION LOADS OFTEN EXCEED DESIGN LIVE LOADS, INCREASED TEMPORARY MINIMUM COVER REQUIREMENTS ARE NECESSARY. SINCE CONSTRUCTION EQUIPMENT VARIES FROM JOB TO JOB, IT IS BEST TO ADDRESS EQUIPMENT SPECIFIC MINIMUM COVER REQUIREMENTS WITH YOUR LOCAL CONTECH SALES ENGINEER DURING YOUR PRE-CONSTRUCTION MEETING.

ADDITIONAL CONSIDERATIONS

BECAUSE MOST SYSTEMS ARE CONSTRUCTED BELOW-GRADE, RAINFALL CAN RAPIDLY FILL THE EXCAVATION; POTENTIALLY CAUSING FLOATATION AND MOVEMENT OF THE PREVIOUSLY PLACED PIPES. TO HELP MITIGATE POTENTIAL PROBLEMS, IT IS BEST TO START THE INSTALLATION AT THE DOWNSTREAM END WITH THE OUTLET ALREADY CONSTRUCTED TO ALLOW A ROUTE FOR THE WATER TO ESCAPE. TEMPORARY DIVERSION MEASURES MAY BE REQUIRED FOR HIGH FLOWS DUE TO THE RESTRICTED NATURE OF THE OUTLET PIPE.



CMP DETENTION SYSTEM INSPECTION AND MAINTENANCE

UNDERGROUND STORMWATER DETENTION AND INFILTRATION SYSTEMS MUST BE INSPECTED AND MAINTAINED AT REGULAR INTERVALS FOR PURPOSES OF PERFORMANCE AND LONGEVITY.

INSPECTION

INSPECTION IS THE KEY TO EFFECTIVE MAINTENANCE OF CMP DETENTION SYSTEMS AND IS EASILY PERFORMED. CONTECH RECOMMENDS ONGOING, ANNUAL INSPECTIONS. SITES WITH HIGH TRASH LOAD OR SMALL OUTLET CONTROL ORIFICES MAY NEED MORE FREQUENT INSPECTIONS. THE RATE AT WHICH THE SYSTEM COLLECTS POLLUTANTS WILL DEPEND MORE ON SITE SPECIFIC ACTIVITIES RATHER THAN THE SIZE OR CONFIGURATION OF THE SYSTEM.

INSPECTIONS SHOULD BE PERFORMED MORE OFTEN IN EQUIPMENT WASHDOWN AREAS, IN CLIMATES WHERE SANDING AND/OR SALTING OPERATIONS TAKE PLACE, AND IN OTHER VARIOUS INSTANCES IN WHICH ONE WOULD EXPECT HIGHER ACCUMULATIONS OF SEDIMENT OR ABRASIVE/ CORROSIVE CONDITIONS. A RECORD OF EACH INSPECTION IS TO BE MAINTAINED FOR THE LIFE OF THE SYSTEM

MAINTENANCE

CMP DETENTION SYSTEMS SHOULD BE CLEANED WHEN AN INSPECTION REVEALS ACCUMULATED SEDIMENT OR TRASH IS CLOGGING THE DISCHARGE ORIFICE.

ACCUMULATED SEDIMENT AND TRASH CAN TYPICALLY BE EVACUATED THROUGH THE MANHOLE OVER THE OUTLET ORIFICE. IF MAINTENANCE IS NOT PERFORMED AS RECOMMENDED, SEDIMENT AND TRASH MAY ACCUMULATE IN FRONT OF THE OUTLET ORIFICE. MANHOLE COVERS SHOULD BE SECURELY SEATED FOLLOWING CLEANING ACTIVITIES. CONTECH SUGGESTS THAT ALL SYSTEMS BE DESIGNED WITH AN ACCESS/INSPECTION MANHOLE SITUATED AT OR NEAR THE INLET AND THE OUTLET ORIFICE. SHOULD IT BE NECESSARY TO GET INSIDE THE SYSTEM TO PERFORM MAINTENANCE ACTIVITIES, ALL APPROPRIATE PRECAUTIONS REGARDING CONFINED SPACE ENTRY AND OSHA REGULATIONS SHOULD BE FOLLOWED.

ANNUAL INSPECTIONS ARE BEST PRACTICE FOR ALL UNDERGROUND SYSTEMS. DURING THIS INSPECTION, IF EVIDENCE OF SALTING/DE-ICING AGENTS IS OBSERVED WITHIN THE SYSTEM, IT IS BEST PRACTICE FOR THE SYSTEM TO BE RINSED, INCLUDING ABOVE THE SPRING LINE SOON AFTER THE SPRING THAW AS PART OF THE MAINTENANCE PROGRAM FOR THE SYSTEM.

MAINTAINING AN UNDERGROUND DETENTION OR INFILTRATION SYSTEM IS EASIEST WHEN THERE IS NO FLOW ENTERING THE SYSTEM. FOR THIS REASON, IT IS A GOOD IDEA TO SCHEDULE THE CLEANOUT DURING DRY WEATHER.

THE FOREGOING INSPECTION AND MAINTENANCE EFFORTS HELP ENSURE UNDERGROUND PIPE SYSTEMS USED FOR STORMWATER STORAGE CONTINUE TO FUNCTION AS INTENDED BY IDENTIFYING RECOMMENDED REGULAR INSPECTION AND MAINTENANCE PRACTICES. INSPECTION AND MAINTENANCE RELATED TO THE STRUCTURAL INTEGRITY OF THE PIPE OR THE SOUNDNESS OF PIPE JOINT CONNECTIONS IS BEYOND THE SCOPE OF THIS GUIDE.

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BMP 2
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
34168	49298	4/5/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

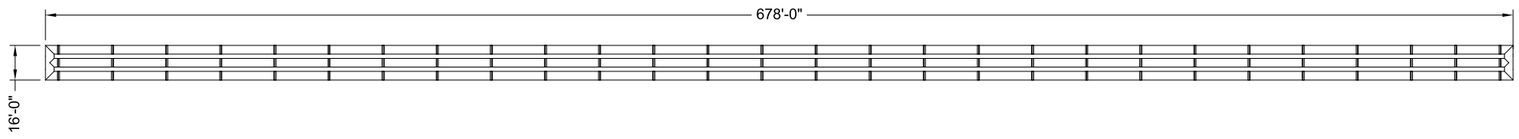
PROJECT SUMMARY

CALCULATION DETAILS
- LOADING = HS20/HS25
- APPROX. LINEAR FOOTAGE = 2,042 LF

STORAGE SUMMARY
- STORAGE VOLUME REQUIRED = N/A
- PIPE STORAGE VOLUME = 25,661 CF
- BACKFILL STORAGE VOLUME = 19,112 CF
- TOTAL STORAGE PROVIDED = 44,772 CF

PIPE DETAILS
- DIAMETER = 48"
- CORRUGATION = 2 2/3x1/2
- GAGE = 16
- COATING = ALT2
- WALL TYPE = PERFORATED
- BARREL SPACING = 24"

BACKFILL DETAILS
- WIDTH AT ENDS = 12"
- ABOVE PIPE = 12"
- WIDTH AT SIDES = 12"
- BELOW PIPE = 12"



NOTES

- ALL RISER AND STUB DIMENSIONS ARE TO CENTERLINE. ALL ELEVATIONS, DIMENSIONS, AND LOCATIONS OF RISERS AND INLETS, SHALL BE VERIFIED BY THE ENGINEER OF RECORD PRIOR TO RELEASING FOR FABRICATION.
- ALL FITTINGS AND REINFORCEMENT COMPLY WITH ASTM A998.
- ALL RISERS AND STUBS ARE $2\frac{2}{3}$" x $\frac{1}{2}$" CORRUGATION AND 16 GAGE UNLESS OTHERWISE NOTED.
- RISERS TO BE FIELD TRIMMED TO GRADE.
- QUANTITY OF PIPE SHOWN DOES NOT PROVIDE EXTRA PIPE FOR CONNECTING THE SYSTEM TO EXISTING PIPE OR DRAINAGE STRUCTURES. OUR SYSTEM AS DETAILED PROVIDES NOMINAL INLET AND/OR OUTLET PIPE STUB FOR CONNECTION TO EXISTING DRAINAGE FACILITIES. IF ADDITIONAL PIPE IS NEEDED IT IS THE RESPONSIBILITY OF THE CONTRACTOR.
- BAND TYPE TO BE DETERMINED UPON FINAL DESIGN.
- THE PROJECT SUMMARY IS REFLECTIVE OF THE DYODS DESIGN, QUANTITIES ARE APPROX. AND SHOULD BE VERIFIED UPON FINAL DESIGN AND APPROVAL. FOR EXAMPLE, TOTAL EXCAVATION DOES NOT CONSIDER ALL VARIABLES SUCH AS SHORING AND ONLY ACCOUNTS FOR MATERIAL WITHIN THE ESTIMATED EXCAVATION FOOTPRINT.
- THESE DRAWINGS ARE FOR CONCEPTUAL PURPOSES AND DO NOT REFLECT ANY LOCAL PREFERENCES OR REGULATIONS. PLEASE CONTACT YOUR LOCAL CONTECH REP FOR MODIFICATIONS.

ASSEMBLY
SCALE: 1" = 70'

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CONTECH CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

DYO49348 Miro Way
BMP 3
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
34169	49348	4/5/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

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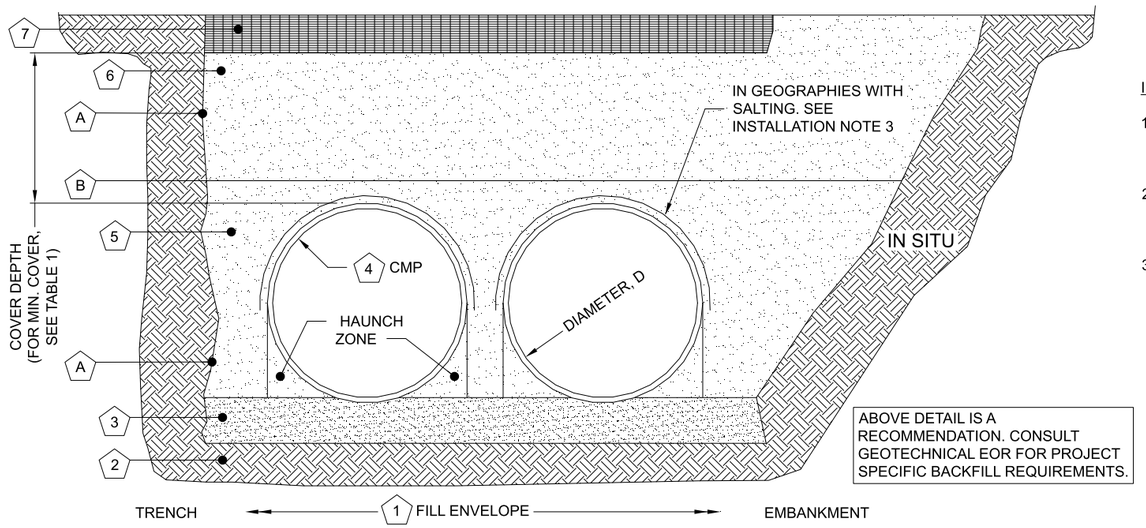
TABLE 1:

DIAMETER, D	MIN. COVER	CORR. PROFILE
6"-10"	12"	1 1/2" x 1/4"
12"-48"	12"	2 2/3" x 1/2"
>48"-96"	12"	3" x 1", 5" x 1"
>96"	D/8	3" x 1", 5" x 1"

- STRUCTURAL BACKFILL MUST EXTEND TO LIMITS OF THE TABLE
- TOTAL HEIGHT OF COMPACTED COVER FOR CONVENTIONAL HIGHWAY LOADS IS MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT.



INSTALLATION NOTES

1. WHEN PLACING THE FIRST LIFTS OF BACKFILL IT IS IMPORTANT TO MAKE SURE THAT THE BACKFILL IS PROPERLY COMPACTED UNDER AND AROUND THE PIPE HAUNCHES.
2. OTHER ALTERNATE BACKFILL MATERIAL MAY BE ALLOWED DEPENDING ON SITE SPECIFIC CONDITIONS, AS APPROVED BY SITE ENGINEER.
3. IF SALTING AGENTS FOR SNOW AND ICE REMOVAL ARE USED ON OR NEAR THE PROJECT, A GEOMEMBRANE BARRIER IS RECOMMENDED OVER THE UPPER HALF OF THE PIPE. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.

TABLE 2: PERFORATED STANDARD

	CMP RETENTION STANDARD BACKFILL SPECIFICATIONS			
	MATERIAL LOCATION	MATERIAL SPECIFICATION	DESCRIPTION	
1	FILL ENVELOPE WIDTH	PER ENGINEER OF RECORD	MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER THE PIPE. THE SUGGESTED MINIMUM TRENCH WIDTH, OR EOR RECOMMENDATION: PIPE ≤ 12": D + 16" PIPE > 12": 1.5D + 12"	MINIMUM EMBANKMENT WIDTH (IN FEET) FOR INITIAL FILL ENVELOPE: PIPE < 24": 3.0D PIPE 24" - 144": D + 4'0" PIPE > 144": D + 10'0"
2	FOUNDATION	**AASHTO 26.5.2** - PER ENGINEER OF RECORD	PRIOR TO PLACING THE BEDDING, THE FOUNDATION MUST BE CONSTRUCTED TO A UNIFORM AND STABLE GRADE. IN THE EVENT THAT UNSUITABLE FOUNDATION MATERIALS ARE ENCOUNTERED DURING EXCAVATION, THEY SHALL BE REMOVED AND FOUNDATION BROUGHT BACK TO GRADE WITH A FILL MATERIAL APPROVED BY THE ENGINEER OF RECORD.	
3	BEDDING	**AASHTO M 43: 3, 357, 4, 467, 5, 56, 57**	ENGINEER OF RECORD TO DETERMINE IF BEDDING IS REQUIRED. PIPE MAY BE PLACED ON THE TRENCH BOTTOM OF A RELATIVELY LOOSE, NATIVE SUITABLE WELL GRADED GRANULAR MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, 2" MIN DEPTH. THE BEDDING MATERIAL MAY BE SUITABLE OPEN GRADED GRANULAR BEDDING CONFORMING TO AASHTO SOIL CLASSIFICATIONS A1, A2, OR A3 WITH MAXIMUM PARTICLE SIZE OF 3" PER AASHTO 26.3.8.1	
4	CORRUGATED METAL PIPE			
5	BACKFILL	FREE-DRAINING, ANGULAR, NATURALLY OCCURRING WASHED-STONE PER **AASHTO M 43: 3, 357, 4, 467, 5, 56, 57** OR APPROVED EQUAL *	HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION WITHOUT SOFT SPOTS. BACKFILL SHALL BE PLACED IN 8" +/- LOOSE LIFTS AND COMPACTED TO 90% STANDARD PROCTOR PER AASHTO T 99. BACKFILL SHALL BE PLACED SUCH THAT THERE IS NO MORE THAN A TWO LIFT (16") DIFFERENTIAL BETWEEN ANY OF THE PIPES AT ANY TIME DURING THE BACKFILL PROCESS. THE BACKFILL SHOULD BE ADVANCED ALONG THE LENGTH OF THE SYSTEM TO AVOID DIFFERENTIAL LOADING. WHERE CONVENTIONAL COMPACTION TESTING IS NOT PRACTICAL, THE MATERIAL SHALL BE MECHANICALLY COMPACTED UNTIL NO FURTHER YIELDING OF MATERIAL IS OBSERVED UNDER THE COMPACTOR. **IN AREAS WITH HIGH WATER TABLE FLUCTUATIONS THAT INTERACT WITH THE PIPE ZONE, CONSIDER INSTALLING A GEOTEXTILE SEPARATION LAYER TO PREVENT SOIL MIGRATION.	
6	COVER MATERIAL	UP TO MIN. COVER - **AASHTO M 145: A-1, A-2, A-3** ABOVE MIN. COVER - PER ENGINEER OF RECORD	COVER MATERIAL MAY INCLUDE NON-BITUMINOUS, GRANULAR ROADBASE MATERIAL WITHIN MIN COVER LIMITS	
7	RIGID OR FLEXIBLE PAVEMENT (IF APPLICABLE)	PER ENGINEER OF RECORD	FLEXIBLE PAVEMENT SHOULD NOT BE COUNTED AS PART OF THE FILL HEIGHT OVER THE CMP. FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS SHALL FOLLOW THE PROJECT PLANS AND SPECIFICATIONS PER THE ENGINEER OF RECORD.	
A	OPTIONAL SIDE GEOTEXTILE	NONE	GEOTEXTILE LAYER IS RECOMMENDED ON SIDES OF EXCAVATION TO PREVENT SOIL MIGRATION.	
B	GEOTEXTILE BETWEEN LAYERS	NONE	IF SOIL TYPES DIFFER AT ANY POINT ABOVE PIPE INVERT, A GEOTEXTILE LAYER IS RECOMMENDED TO BE PLACED BETWEEN THE LAYERS TO PREVENT SOIL MIGRATION.	

NOTES:
- FOR MULTIPLE BARREL INSTALLATIONS, THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE THE PIPE DIAMETER /2 BUT NO LESS THAN 12" FOR DIAMETERS <72". FOR 72" AND LARGER DIAMETERS, THE MINIMUM SPACING IS 36". CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING.

* APPROVED REGIONAL EQUIVALENTS FOR SECTION 5 INCLUDE CA-7, MIDOT 6AA, 6A, OR 5G, PROVIDED THEY MEET THE PARTICLE SIZES INDICATED.

MANUFACTURER RECOMMENDED BACKFILL

NOT TO SCALE

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CONTECH CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

DYO49348 Miro Way
BMP 3
Rialto, CA
DETENTION SYSTEM

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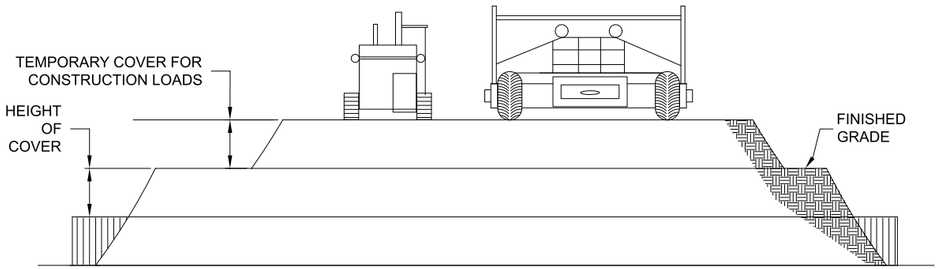

CONSTRUCTION LOADS

FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

CONSTRUCTION LOADING DIAGRAM

SCALE: N.T.S.

SPECIFICATION FOR DESIGNED DETENTION SYSTEM:

SCOPE
THIS SPECIFICATION COVERS THE MANUFACTURE AND INSTALLATION OF THE DESIGNED DETENTION SYSTEM DETAILED IN THE PROJECT PLANS.

MATERIAL
THE MATERIAL SHALL CONFORM TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2 STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-274 OR ASTM A-92.

THE GALVANIZED STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-218 OR ASTM A-929.

THE POLYMER COATED STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-246 OR ASTM A-742.

THE ALUMINUM COILS SHALL CONFORM TO THE APPLICABLE OF AASHTO M-197 OR ASTM B-744.

CONSTRUCTION LOADS
CONSTRUCTION LOADS MAY BE HIGHER THAN FINAL LOADS. FOLLOW THE MANUFACTURER'S OR NCSPA GUIDELINES.

PIPE
THE PIPE SHALL BE MANUFACTURED IN ACCORDANCE TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2: AASHTO M-36 OR ASTM A-760

GALVANIZED: AASHTO M-36 OR ASTM A-760

APPLICABLE POLYMER COATED: AASHTO M-245 OR ASTM A-762

ALUMINUM: AASHTO M-196 OR ASTM B-745

APPLICABLE
HANDLING AND ASSEMBLY
SHALL BE IN ACCORDANCE WITH NCSP'S (NATIONAL CORRUGATED STEEL PIPE ASSOCIATION) FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL. SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS FOR ALUMINUM PIPE.
REQUIREMENTS
INSTALLATION
SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II DIVISION II OR ASTM A-798 (FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL) OR ASTM B-788 (FOR ALUMINUM PIPE) AND IN CONFORMANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. IF THERE ARE ANY INCONSISTENCIES OR CONFLICTS THE CONTRACTOR SHOULD DISCUSS AND RESOLVE WITH THE SITE ENGINEER.

IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.

NOTE:
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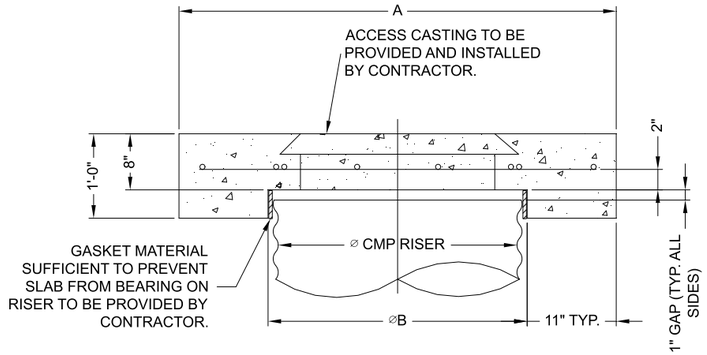
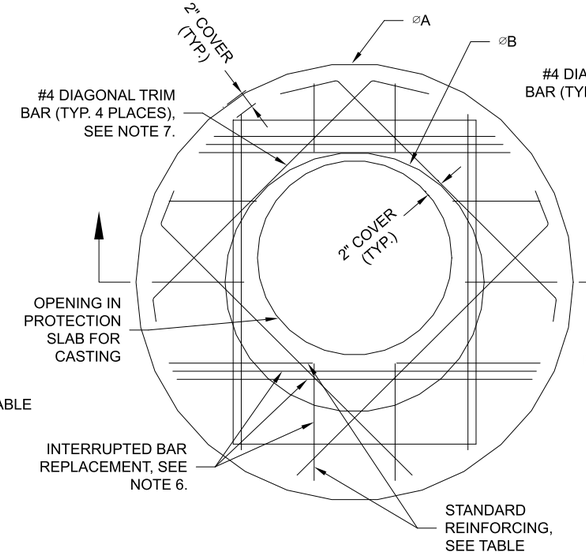


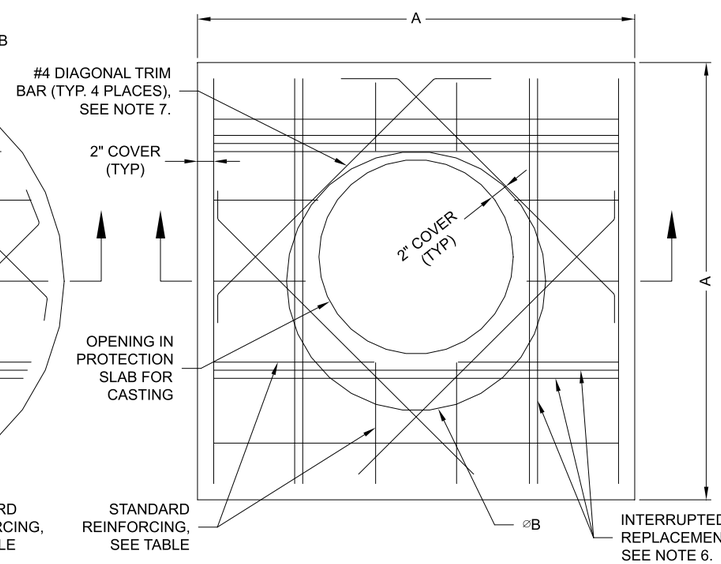
SECTION VIEW

REINFORCING TABLE				
⌀ CMP RISER	A	⌀ B	REINFORCING	**BEARING PRESSURE (PSF)
24"	⌀ 4' 4'X4'	26"	#5 @ 12" OCEW #5 @ 12" OCEW	2,410 1,780
30"	⌀ 4'-6" 4'-6" X 4'-6"	32"	#5 @ 12" OCEW #5 @ 12" OCEW	2,120 1,530
36"	⌀ 5' 5' X 5'	38"	#5 @ 10" OCEW #5 @ 10" OCEW	1,890 1,350
42"	⌀ 5'-6" 5'-6" X 5'-6"	44"	#5 @ 10" OCEW #5 @ 9" OCEW	1,720 1,210
48"	⌀ 6' 6' X 6'	50"	#5 @ 9" OCEW #5 @ 8" OCEW	1,600 1,100

** ASSUMED SOIL BEARING CAPACITY



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 3,500 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERING, BINGHAMTON, NY.

MANHOLE CAP DETAIL

SCALE: N.T.S.

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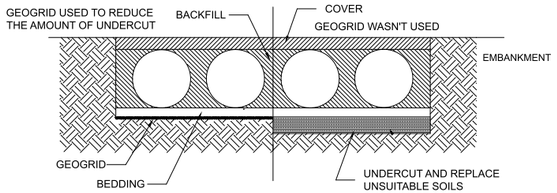
CMP DETENTION INSTALLATION GUIDE

PROPER INSTALLATION OF A FLEXIBLE UNDERGROUND DETENTION SYSTEM WILL ENSURE LONG-TERM PERFORMANCE. THE CONFIGURATION OF THESE SYSTEMS OFTEN REQUIRES SPECIAL CONSTRUCTION PRACTICES THAT DIFFER FROM CONVENTIONAL FLEXIBLE PIPE CONSTRUCTION. CONTECH ENGINEERED SOLUTIONS STRONGLY SUGGESTS SCHEDULING A PRE-CONSTRUCTION MEETING WITH YOUR LOCAL SALES ENGINEER TO DETERMINE IF ADDITIONAL MEASURES, NOT COVERED IN THIS GUIDE, ARE APPROPRIATE FOR YOUR SITE.

FOUNDATION

CONSTRUCT A FOUNDATION THAT CAN SUPPORT THE DESIGN LOADING APPLIED BY THE PIPE AND ADJACENT BACKFILL WEIGHT AS WELL AS MAINTAIN ITS INTEGRITY DURING CONSTRUCTION.

IF SOFT OR UNSUITABLE SOILS ARE ENCOUNTERED, REMOVE THE POOR SOILS DOWN TO A SUITABLE DEPTH AND THEN BUILD UP TO THE APPROPRIATE ELEVATION WITH A COMPETENT BACKFILL MATERIAL. THE STRUCTURAL FILL MATERIAL GRADATION SHOULD NOT ALLOW THE MIGRATION OF FINES, WHICH CAN CAUSE SETTLEMENT OF THE DETENTION SYSTEM OR PAVEMENT ABOVE. IF THE STRUCTURAL FILL MATERIAL IS NOT COMPATIBLE WITH THE UNDERLYING SOILS AN ENGINEERING FABRIC SHOULD BE USED AS A SEPARATOR. IN SOME CASES, USING A STIFF REINFORCING GEOGRID REDUCES OVER EXCAVATION AND REPLACEMENT FILL QUANTITIES.

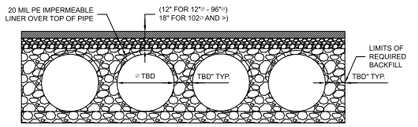


GRADE THE FOUNDATION SUBGRADE TO A UNIFORM OR SLIGHTLY SLOPING GRADE. IF THE SUBGRADE IS CLAY OR RELATIVELY NON-POROUS AND THE CONSTRUCTION SEQUENCE WILL LAST FOR AN EXTENDED PERIOD OF TIME, IT IS BEST TO SLOPE THE GRADE TO ONE END OF THE SYSTEM. THIS WILL ALLOW EXCESS WATER TO DRAIN QUICKLY, PREVENTING SATURATION OF THE SUBGRADE.

GEOMEMBRANE BARRIER

A SITE'S RESISTIVITY MAY CHANGE OVER TIME WHEN VARIOUS TYPES OF SALTING AGENTS ARE USED, SUCH AS ROAD SALTS FOR DEICING AGENTS. IF SALTING AGENTS ARE USED ON OR NEAR THE PROJECT SITE, A GEOMEMBRANE BARRIER IS RECOMMENDED WITH THE SYSTEM. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM THE USE OF SUCH AGENTS INCLUDING PREMATURE CORROSION AND REDUCED ACTUAL SERVICE LIFE.

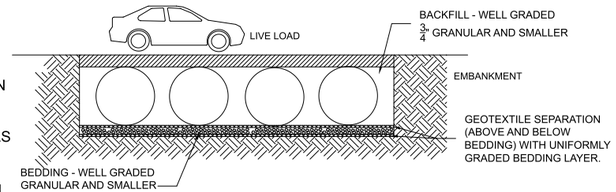
THE PROJECT'S ENGINEER OF RECORD IS TO EVALUATE WHETHER SALTING AGENTS WILL BE USED ON OR NEAR THE PROJECT SITE, AND USE HIS/HER BEST JUDGEMENT TO DETERMINE IF ANY ADDITIONAL PROTECTIVE MEASURES ARE REQUIRED. BELOW IS A TYPICAL DETAIL SHOWING THE PLACEMENT OF A GEOMEMBRANE BARRIER FOR PROJECTS WHERE SALTING AGENTS ARE USED ON OR NEAR THE PROJECT SITE.



IN-SITU TRENCH WALL

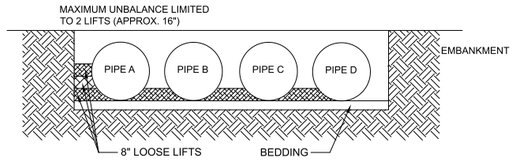
IF EXCAVATION IS REQUIRED, THE TRENCH WALL NEEDS TO BE CAPABLE OF SUPPORTING THE LOAD THAT THE PIPE SHEDS AS THE SYSTEM IS LOADED. IF SOILS ARE NOT CAPABLE OF SUPPORTING THESE LOADS, THE PIPE CAN DEFLECT. PERFORM A SIMPLE SOIL PRESSURE CHECK USING THE APPLIED LOADS TO DETERMINE THE LIMITS OF EXCAVATION BEYOND THE SPRING LINE OF THE OUTER MOST PIPES.

IN MOST CASES THE REQUIREMENTS FOR A SAFE WORK ENVIRONMENT AND PROPER BACKFILL PLACEMENT AND COMPACTION TAKE CARE OF THIS CONCERN.



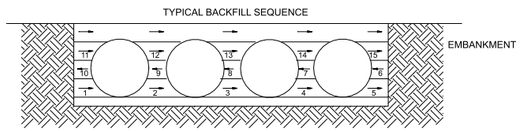
BACKFILL PLACEMENT

MATERIAL SHALL BE WORKED INTO THE PIPE HAUNCHES BY MEANS OF SHOVEL-SLICING, RODDING, AIR TAMPER, VIBRATORY ROD, OR OTHER EFFECTIVE METHODS.

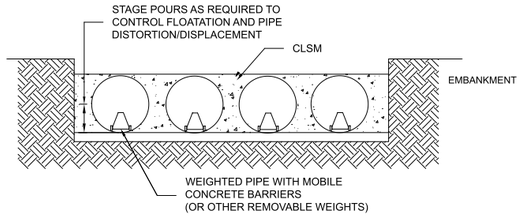


IF AASHTO T99 PROCEDURES ARE DETERMINED INFEASIBLE BY THE GEOTECHNICAL ENGINEER OF RECORD, COMPACTION IS CONSIDERED ADEQUATE WHEN NO FURTHER YIELDING OF THE MATERIAL IS OBSERVED UNDER THE COMPACTOR, OR UNDER FOOT, AND THE GEOTECHNICAL ENGINEER OF RECORD (OR REPRESENTATIVE THEREOF) IS SATISFIED WITH THE LEVEL OF COMPACTION.

FOR LARGE SYSTEMS, CONVEYOR SYSTEMS, BACKHOES WITH LONG REACHES OR DRAGLINES WITH STONE BUCKETS MAY BE USED TO PLACE BACKFILL. ONCE MINIMUM COVER FOR CONSTRUCTION LOADING ACROSS THE ENTIRE WIDTH OF THE SYSTEM IS REACHED, ADVANCE THE EQUIPMENT TO THE END OF THE RECENTLY PLACED FILL, AND BEGIN THE SEQUENCE AGAIN UNTIL THE SYSTEM IS COMPLETELY BACKFILLED. THIS TYPE OF CONSTRUCTION SEQUENCE PROVIDES ROOM FOR STOCKPILED BACKFILL DIRECTLY BEHIND THE BACKHOE, AS WELL AS THE MOVEMENT OF CONSTRUCTION TRAFFIC. MATERIAL STOCKPILES ON TOP OF THE BACKFILLED DETENTION SYSTEM SHOULD BE LIMITED TO 8- TO 10-FEET HIGH AND MUST PROVIDE BALANCED LOADING ACROSS ALL BARRELS. TO DETERMINE THE PROPER COVER OVER THE PIPES TO ALLOW THE MOVEMENT OF CONSTRUCTION EQUIPMENT SEE TABLE 1, OR CONTACT YOUR LOCAL CONTECH SALES ENGINEER.



WHEN FLOWABLE FILL IS USED, YOU MUST PREVENT PIPE FLOATATION. TYPICALLY, SMALL LIFTS ARE PLACED BETWEEN THE PIPES AND THEN ALLOWED TO SET-UP PRIOR TO THE PLACEMENT OF THE NEXT LIFT. THE ALLOWABLE THICKNESS OF THE CLSM LIFT IS A FUNCTION OF A PROPER BALANCE BETWEEN THE UPLIFT FORCE OF THE CLSM, THE OPPOSING WEIGHT OF THE PIPE, AND THE EFFECT OF OTHER RESTRAINING MEASURES. THE PIPE CAN CARRY LIMITED FLUID PRESSURE WITHOUT PIPE DISTORTION OR DISPLACEMENT, WHICH ALSO AFFECTS THE CLSM LIFT THICKNESS. YOUR LOCAL CONTECH SALES ENGINEER CAN HELP DETERMINE THE PROPER LIFT THICKNESS.

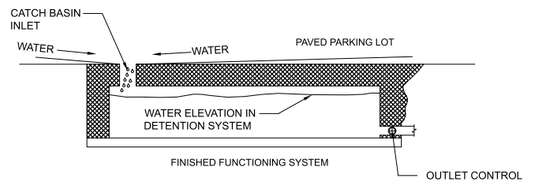


CONSTRUCTION LOADING

TYPICALLY, THE MINIMUM COVER SPECIFIED FOR A PROJECT ASSUMES H-20 LIVE LOAD. BECAUSE CONSTRUCTION LOADS OFTEN EXCEED DESIGN LIVE LOADS, INCREASED TEMPORARY MINIMUM COVER REQUIREMENTS ARE NECESSARY. SINCE CONSTRUCTION EQUIPMENT VARIES FROM JOB TO JOB, IT IS BEST TO ADDRESS EQUIPMENT SPECIFIC MINIMUM COVER REQUIREMENTS WITH YOUR LOCAL CONTECH SALES ENGINEER DURING YOUR PRE-CONSTRUCTION MEETING.

ADDITIONAL CONSIDERATIONS

BECAUSE MOST SYSTEMS ARE CONSTRUCTED BELOW-GRADE, RAINFALL CAN RAPIDLY FILL THE EXCAVATION; POTENTIALLY CAUSING FLOATATION AND MOVEMENT OF THE PREVIOUSLY PLACED PIPES. TO HELP MITIGATE POTENTIAL PROBLEMS, IT IS BEST TO START THE INSTALLATION AT THE DOWNSTREAM END WITH THE OUTLET ALREADY CONSTRUCTED TO ALLOW A ROUTE FOR THE WATER TO ESCAPE. TEMPORARY DIVERSION MEASURES MAY BE REQUIRED FOR HIGH FLOWS DUE TO THE RESTRICTED NATURE OF THE OUTLET PIPE.



CMP DETENTION SYSTEM INSPECTION AND MAINTENANCE

UNDERGROUND STORMWATER DETENTION AND INFILTRATION SYSTEMS MUST BE INSPECTED AND MAINTAINED AT REGULAR INTERVALS FOR PURPOSES OF PERFORMANCE AND LONGEVITY.

INSPECTION

INSPECTION IS THE KEY TO EFFECTIVE MAINTENANCE OF CMP DETENTION SYSTEMS AND IS EASILY PERFORMED. CONTECH RECOMMENDS ONGOING, ANNUAL INSPECTIONS. SITES WITH HIGH TRASH LOAD OR SMALL OUTLET CONTROL ORIFICES MAY NEED MORE FREQUENT INSPECTIONS. THE RATE AT WHICH THE SYSTEM COLLECTS POLLUTANTS WILL DEPEND MORE ON SITE SPECIFIC ACTIVITIES RATHER THAN THE SIZE OR CONFIGURATION OF THE SYSTEM.

INSPECTIONS SHOULD BE PERFORMED MORE OFTEN IN EQUIPMENT WASHDOWN AREAS, IN CLIMATES WHERE SANDING AND/OR SALTING OPERATIONS TAKE PLACE, AND IN OTHER VARIOUS INSTANCES IN WHICH ONE WOULD EXPECT HIGHER ACCUMULATIONS OF SEDIMENT OR ABRASIVE/ CORROSIVE CONDITIONS. A RECORD OF EACH INSPECTION IS TO BE MAINTAINED FOR THE LIFE OF THE SYSTEM

MAINTENANCE

CMP DETENTION SYSTEMS SHOULD BE CLEANED WHEN AN INSPECTION REVEALS ACCUMULATED SEDIMENT OR TRASH IS CLOGGING THE DISCHARGE ORIFICE.

ACCUMULATED SEDIMENT AND TRASH CAN TYPICALLY BE EVACUATED THROUGH THE MANHOLE OVER THE OUTLET ORIFICE. IF MAINTENANCE IS NOT PERFORMED AS RECOMMENDED, SEDIMENT AND TRASH MAY ACCUMULATE IN FRONT OF THE OUTLET ORIFICE. MANHOLE COVERS SHOULD BE SECURELY SEATED FOLLOWING CLEANING ACTIVITIES. CONTECH SUGGESTS THAT ALL SYSTEMS BE DESIGNED WITH AN ACCESS/INSPECTION MANHOLE SITUATED AT OR NEAR THE INLET AND THE OUTLET ORIFICE. SHOULD IT BE NECESSARY TO GET INSIDE THE SYSTEM TO PERFORM MAINTENANCE ACTIVITIES, ALL APPROPRIATE PRECAUTIONS REGARDING CONFINED SPACE ENTRY AND OSHA REGULATIONS SHOULD BE FOLLOWED.

ANNUAL INSPECTIONS ARE BEST PRACTICE FOR ALL UNDERGROUND SYSTEMS. DURING THIS INSPECTION, IF EVIDENCE OF SALTING/DE-ICING AGENTS IS OBSERVED WITHIN THE SYSTEM, IT IS BEST PRACTICE FOR THE SYSTEM TO BE RINSED, INCLUDING ABOVE THE SPRING LINE SOON AFTER THE SPRING THAW AS PART OF THE MAINTENANCE PROGRAM FOR THE SYSTEM.

MAINTAINING AN UNDERGROUND DETENTION OR INFILTRATION SYSTEM IS EASIEST WHEN THERE IS NO FLOW ENTERING THE SYSTEM. FOR THIS REASON, IT IS A GOOD IDEA TO SCHEDULE THE CLEANOUT DURING DRY WEATHER.

THE FOREGOING INSPECTION AND MAINTENANCE EFFORTS HELP ENSURE UNDERGROUND PIPE SYSTEMS USED FOR STORMWATER STORAGE CONTINUE TO FUNCTION AS INTENDED BY IDENTIFYING RECOMMENDED REGULAR INSPECTION AND MAINTENANCE PRACTICES. INSPECTION AND MAINTENANCE RELATED TO THE STRUCTURAL INTEGRITY OF THE PIPE OR THE SOUNDNESS OF PIPE JOINT CONNECTIONS IS BEYOND THE SCOPE OF THIS GUIDE.

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www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH CMP DETENTION SYSTEMS
CONTECH DYODS DRAWING

DYO49348 Miro Way
BMP 3
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
34169	49348	4/5/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

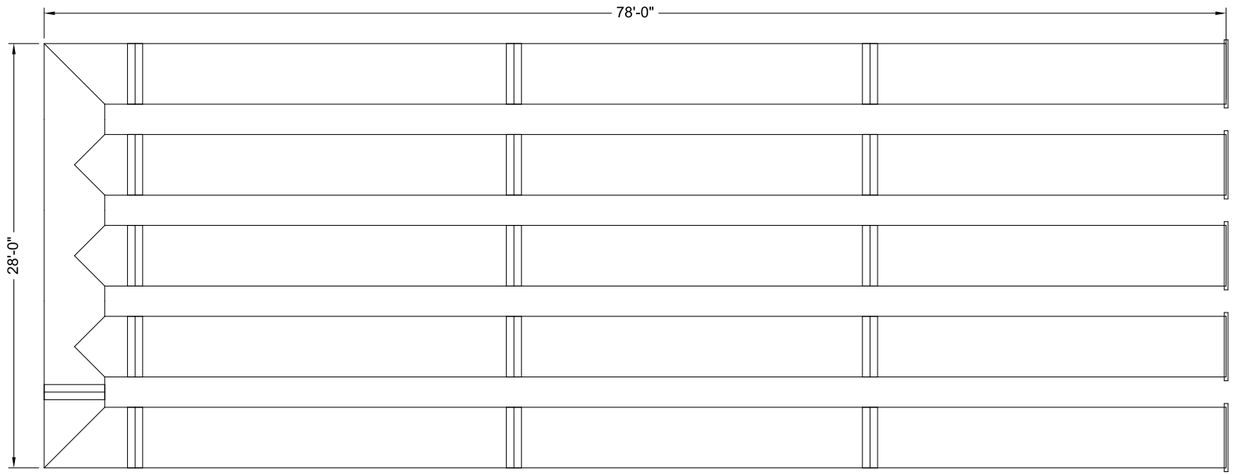
PROJECT SUMMARY

CALCULATION DETAILS
- LOADING = HS20/HS25
- APPROX. LINEAR FOOTAGE = 398 LF

STORAGE SUMMARY
- STORAGE VOLUME REQUIRED = N/A
- PIPE STORAGE VOLUME = 5,001 CF
- BACKFILL STORAGE VOLUME = 3,759 CF
- TOTAL STORAGE PROVIDED = 8,761 CF

PIPE DETAILS
- DIAMETER = 48"
- CORRUGATION = 2 2/3x1/2
- GAGE = 16
- COATING = ALT2
- WALL TYPE = SOLID
- BARREL SPACING = 24"

BACKFILL DETAILS
- WIDTH AT ENDS = 12"
- ABOVE PIPE = 12"
- WIDTH AT SIDES = 12"
- BELOW PIPE = 12"



NOTES

- ALL RISER AND STUB DIMENSIONS ARE TO CENTERLINE. ALL ELEVATIONS, DIMENSIONS, AND LOCATIONS OF RISERS AND INLETS, SHALL BE VERIFIED BY THE ENGINEER OF RECORD PRIOR TO RELEASING FOR FABRICATION.
- ALL FITTINGS AND REINFORCEMENT COMPLY WITH ASTM A998.
- ALL RISERS AND STUBS ARE 2 2/3" x 1/2" CORRUGATION AND 16 GAGE UNLESS OTHERWISE NOTED.
- RISERS TO BE FIELD TRIMMED TO GRADE.
- QUANTITY OF PIPE SHOWN DOES NOT PROVIDE EXTRA PIPE FOR CONNECTING THE SYSTEM TO EXISTING PIPE OR DRAINAGE STRUCTURES. OUR SYSTEM AS DETAILED PROVIDES NOMINAL INLET AND/OR OUTLET PIPE STUB FOR CONNECTION TO EXISTING DRAINAGE FACILITIES. IF ADDITIONAL PIPE IS NEEDED IT IS THE RESPONSIBILITY OF THE CONTRACTOR.
- BAND TYPE TO BE DETERMINED UPON FINAL DESIGN.
- THE PROJECT SUMMARY IS REFLECTIVE OF THE DYODS DESIGN, QUANTITIES ARE APPROX. AND SHOULD BE VERIFIED UPON FINAL DESIGN AND APPROVAL. FOR EXAMPLE, TOTAL EXCAVATION DOES NOT CONSIDER ALL VARIABLES SUCH AS SHORING AND ONLY ACCOUNTS FOR MATERIAL WITHIN THE ESTIMATED EXCAVATION FOOTPRINT.
- THESE DRAWINGS ARE FOR CONCEPTUAL PURPOSES AND DO NOT REFLECT ANY LOCAL PREFERENCES OR REGULATIONS. PLEASE CONTACT YOUR LOCAL CONTECH REP FOR MODIFICATIONS.

ASSEMBLY
SCALE: 1" = 10'

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CONTECH® CMP DETENTION SYSTEMS
CONTECH **DYODS** DRAWING

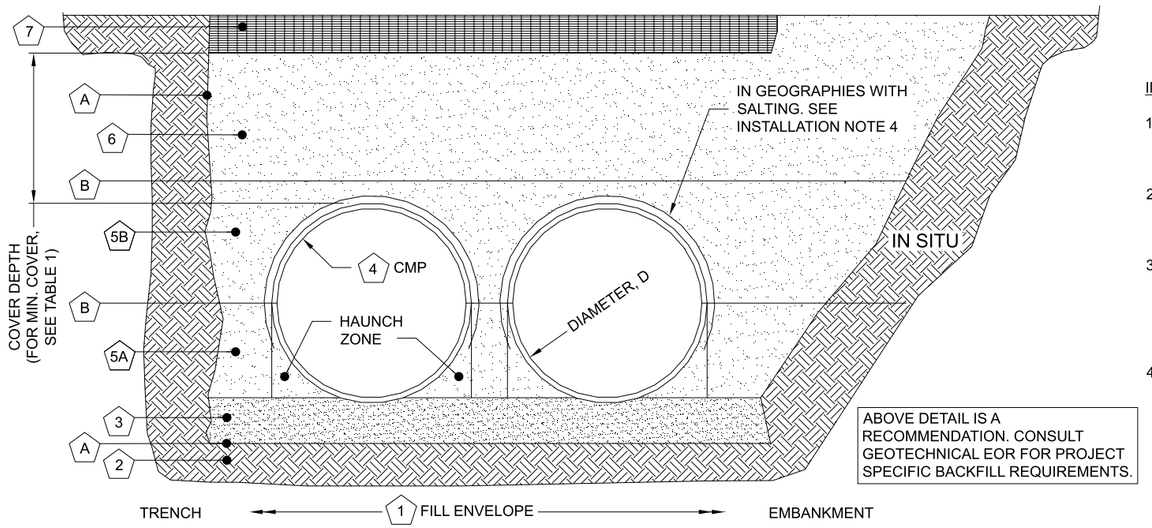
DYO49301 Miro Way
BMP 4
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
34171	49301	4/4/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

TABLE 1:

DIAMETER, D	MIN. COVER	CORR. PROFILE
6"-10"	12"	1 1/2" x 1/4"
12"-48"	12"	2 2/3" x 1/2"
>48"-96"	12"	3" x 1", 5" x 1"
>96"	D/8	3" x 1", 5" x 1"

- STRUCTURAL BACKFILL MUST EXTEND TO LIMITS OF THE TABLE
- TOTAL HEIGHT OF COMPACTED COVER FOR CONVENTIONAL HIGHWAY LOADS IS MEASURED FROM TOP OF PIPE TO BOTTOM OF FLEXIBLE PAVEMENT OR TOP OF RIGID PAVEMENT
- ULTRAFLO ALSO AVAILABLE FOR SIZES 18" - 120" WITH 3/4"x 3/4"x 7 1/2" CORRUGATION



INSTALLATION NOTES

1. WHEN PLACING THE FIRST LIFTS OF BACKFILL IT IS IMPORTANT TO MAKE SURE THAT THE BACKFILL IS PROPERLY COMPACTED UNDER AND AROUND THE PIPE HAUNCHES.
2. OTHER ALTERNATE BACKFILL MATERIAL MAY BE ALLOWED DEPENDING ON SITE SPECIFIC CONDITIONS, AS APPROVED BY SITE ENGINEER.
3. BACKFILL USING CONTROLLED LOW-STRENGTH MATERIAL (CLSM, "FLASH FILL" OR "FLOWABLE FILL") MAY BE USED WHEN THE SPACING BETWEEN THE PIPES WILL NOT ALLOW FOR PLACEMENT AND ADEQUATE COMPACTION OF THE BACKFILL. CONTACT CONTECH FOR FURTHER EVALUATION.
4. IF SALTING AGENTS FOR SNOW AND ICE REMOVAL ARE USED ON OR NEAR THE PROJECT, A GEOMEMBRANE BARRIER IS RECOMMENDED OVER THE UPPER HALF OF THE PIPE. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM A CHANGE IN THE SURROUNDING ENVIRONMENT OVER A PERIOD OF TIME. PLEASE REFER TO THE CORRUGATED METAL PIPE DETENTION DESIGN GUIDE FOR ADDITIONAL INFORMATION.

TABLE 2: SOLID STANDARD

CMP DETENTION AND CMP DRAINAGE STANDARD BACKFILL SPECIFICATIONS

	MATERIAL LOCATION	MATERIAL SPECIFICATION	DESCRIPTION	
1	FILL ENVELOPE WIDTH	PER ENGINEER OF RECORD	MINIMUM TRENCH WIDTH MUST ALLOW ROOM FOR PROPER COMPACTION OF HAUNCH MATERIALS UNDER THE PIPE. THE SUGGESTED MINIMUM TRENCH WIDTH, OR EOR RECOMMENDATION: PIPE ≤ 12": D + 16" PIPE > 12": 1.5D + 12"	MINIMUM EMBANKMENT WIDTH (IN FEET) FOR INITIAL FILL ENVELOPE: PIPE < 24": 3.0D PIPE 24" - 144": D + 4'0" PIPE > 144": D + 10'0"
2	FOUNDATION	**AASHTO 26.5.2** OR PER ENGINEER OF RECORD	PRIOR TO PLACING THE BEDDING, THE FOUNDATION MUST BE CONSTRUCTED TO A UNIFORM AND STABLE GRADE. IN THE EVENT THAT UNSUITABLE FOUNDATION MATERIALS ARE ENCOUNTERED DURING EXCAVATION, THEY SHALL BE REMOVED AND FOUNDATION BROUGHT BACK TO GRADE WITH A FILL MATERIAL APPROVED BY THE ENGINEER OF RECORD.	
3	BEDDING	**AASHTO M 43: 3, 357, 4, 467, 5, 56, 57** (APPROVED REGIONAL EQUIVALENTS INCLUDE CA-7)	ENGINEER OF RECORD TO DETERMINE IF BEDDING IS REQUIRED. PIPE MAY BE PLACED ON THE TRENCH BOTTOM OF A RELATIVELY LOOSE, NATIVE SUITABLE WELL GRADED GRANULAR MATERIAL THAT IS ROUGHLY SHAPED TO FIT THE BOTTOM OF THE PIPE, 2" MIN DEPTH. THE BEDDING MATERIAL MAY BE SUITABLE FOUNDATION SOILS CONFORMING TO AASHTO SOIL CLASSIFICATIONS A1, A2, OR A3 WITH MAXIMUM PARTICLE SIZE OF 3" PER AASHTO 26.3.8.1	
4	CORRUGATED METAL PIPE			
5A	CRITICAL BACKFILL	**AASHTO M 145: A-1, A-2, A-3** *	HAUNCH ZONE MATERIAL SHALL BE HAND SHOVELED OR SHOVEL SLICED INTO PLACE TO ALLOW FOR PROPER COMPACTION WITHOUT SOFT SPOTS. BACKFILL SHALL BE PLACED IN 8" +/- LOOSE LIFTS AND COMPACTED TO 90% STANDARD PROCTOR PER AASHTO T 99. BACKFILL SHALL BE PLACED SUCH THAT THERE IS NO MORE THAN A THREE LIFT (24") DIFFERENTIAL BETWEEN ANY OF THE PIPES AT ANY TIME DURING THE BACKFILL PROCESS. THE BACKFILL SHOULD BE ADVANCED ALONG THE LENGTH OF THE SYSTEM TO AVOID DIFFERENTIAL LOADING. WELL GRADED GRANULAR MATERIAL WHICH MAY CONTAIN SMALL AMOUNTS OF SILT OR CLAY AND MAXIMUM PARTICLE SIZE OF 3" (PER AASHTO 26.3.8.1 AND 12.4-1.3).	
5B	BACKFILL	**AASHTO M 145: A-1, A-2, A-3**		
6	COVER MATERIAL	UP TO MIN. COVER - SEE 5A AND 5B ABOVE ABOVE MIN. COVER - PER ENGINEER OF RECORD	COVER MATERIAL MAY INCLUDE NON-BITUMINOUS, GRANULAR ROAD BASE MATERIAL WITHIN MIN COVER LIMITS	
7	RIGID OR FLEXIBLE PAVEMENT (IF APPLICABLE)	PER ENGINEER OF RECORD	FLEXIBLE PAVEMENT SHOULD NOT BE COUNTED AS PART OF THE FILL HEIGHT OVER THE CMP. FINAL BACKFILL MATERIAL SELECTION AND COMPACTION REQUIREMENTS SHALL FOLLOW THE PROJECT PLANS AND SPECIFICATIONS PER THE ENGINEER OF RECORD.	
A	OPTIONAL SIDE GEOTEXTILE	NONE	GEOTEXTILE LAYER IS RECOMMENDED ON SIDES OF EXCAVATION TO PREVENT SOIL MIGRATION.	
B	OPTIONAL GEOTEXTILE BETWEEN LAYERS	NONE	IF SOIL TYPES DIFFER AT ANY POINT ABOVE PIPE INVERT, A GEOTEXTILE LAYER IS RECOMMENDED TO BE PLACED BETWEEN THE LAYERS TO PREVENT SOIL MIGRATION.	

NOTES:
- FOR MULTIPLE BARREL INSTALLATIONS, THE RECOMMENDED STANDARD SPACING BETWEEN PARALLEL PIPE RUNS SHALL BE THE PIPE DIAMETER /2 BUT NO LESS THAN 12" FOR DIAMETERS <72". FOR 72" AND LARGER DIAMETERS, THE MINIMUM SPACING IS 36". CONTACT YOUR CONTECH REPRESENTATIVE FOR NONSTANDARD SPACING.

* APPROVED REGIONAL EQUIVALENTS FOR SECTION 5A INCLUDE CA-7, MIDOT 2G, 34G, OR 21AA STONE OR GRAVEL; #8; #57; MIDOT 6A, 2G, 3G, 34G.

MANUFACTURER RECOMMENDED BACKFILL

NOT TO SCALE

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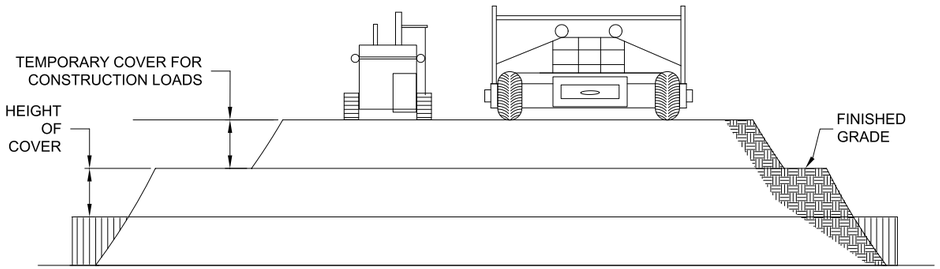

CONSTRUCTION LOADS

FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

*MINIMUM COVER MAY VARY, DEPENDING ON LOCAL CONDITIONS. THE CONTRACTOR MUST PROVIDE THE ADDITIONAL COVER REQUIRED TO AVOID DAMAGE TO THE PIPE. MINIMUM COVER IS MEASURED FROM THE TOP OF THE PIPE TO THE TOP OF THE MAINTAINED CONSTRUCTION ROADWAY SURFACE.

CONSTRUCTION LOADING DIAGRAM

SCALE: N.T.S.

SPECIFICATION FOR DESIGNED DETENTION SYSTEM:

SCOPE
THIS SPECIFICATION COVERS THE MANUFACTURE AND INSTALLATION OF THE DESIGNED DETENTION SYSTEM DETAILED IN THE PROJECT PLANS.

MATERIAL
THE MATERIAL SHALL CONFORM TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2 STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-274 OR ASTM A-92.

THE GALVANIZED STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-218 OR ASTM A-929.

THE POLYMER COATED STEEL COILS SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M-246 OR ASTM A-742.

THE ALUMINUM COILS SHALL CONFORM TO THE APPLICABLE OF AASHTO M-197 OR ASTM B-744.

CONSTRUCTION LOADS
CONSTRUCTION LOADS MAY BE HIGHER THAN FINAL LOADS. FOLLOW THE MANUFACTURER'S OR NCSPA GUIDELINES.

PIPE
THE PIPE SHALL BE MANUFACTURED IN ACCORDANCE TO THE APPLICABLE REQUIREMENTS LISTED BELOW:

ALUMINIZED TYPE 2: AASHTO M-36 OR ASTM A-760

GALVANIZED: AASHTO M-36 OR ASTM A-760

APPLICABLE POLYMER COATED: AASHTO M-245 OR ASTM A-762

ALUMINUM: AASHTO M-196 OR ASTM B-745

APPLICABLE
HANDLING AND ASSEMBLY
SHALL BE IN ACCORDANCE WITH NCSP'S (NATIONAL CORRUGATED STEEL PIPE ASSOCIATION) FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL. SHALL BE IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS FOR ALUMINUM PIPE.
REQUIREMENTS
INSTALLATION
SHALL BE IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES, SECTION 26, DIVISION II DIVISION II OR ASTM A-798 (FOR ALUMINIZED TYPE 2, GALVANIZED OR POLYMER COATED STEEL) OR ASTM B-788 (FOR ALUMINUM PIPE) AND IN CONFORMANCE WITH THE PROJECT PLANS AND SPECIFICATIONS. IF THERE ARE ANY INCONSISTENCIES OR CONFLICTS THE CONTRACTOR SHOULD DISCUSS AND RESOLVE WITH THE SITE ENGINEER.

IT IS ALWAYS THE RESPONSIBILITY OF THE CONTRACTOR TO FOLLOW OSHA GUIDELINES FOR SAFE PRACTICES.

NOTE:
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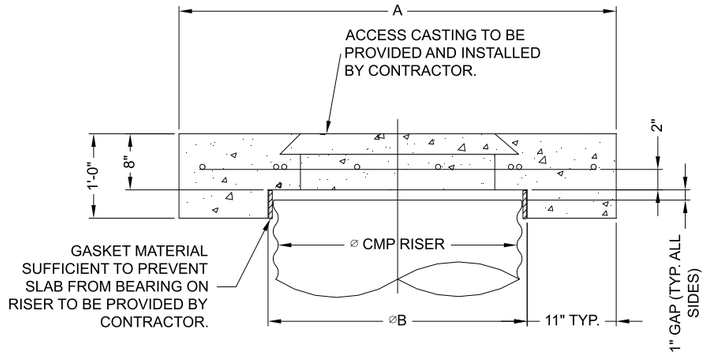
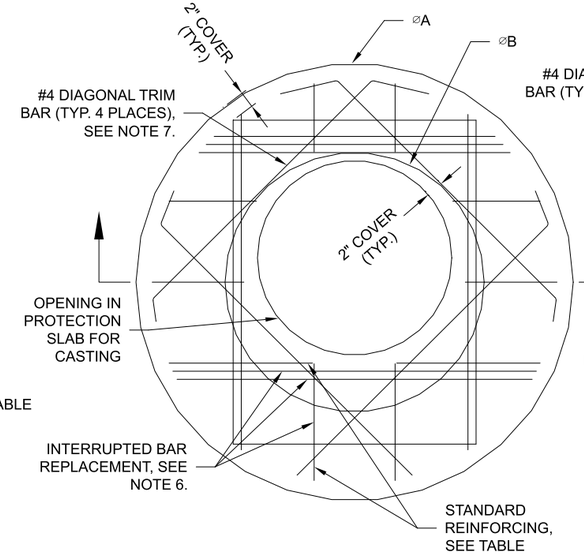


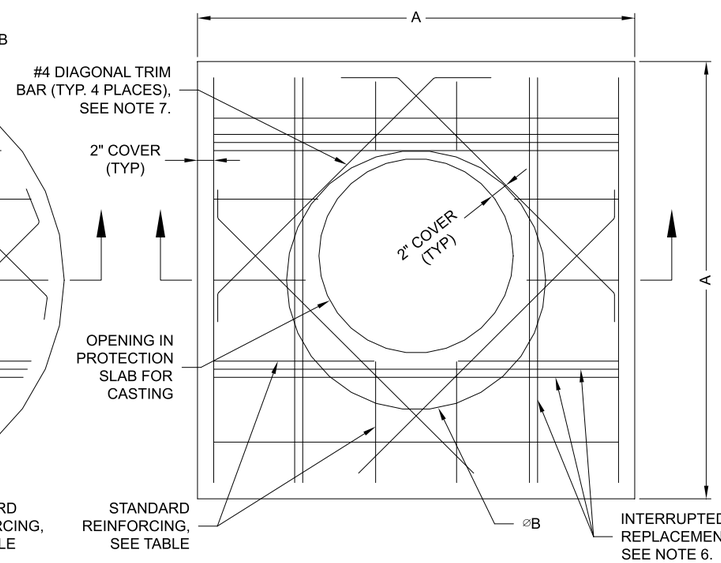
SECTION VIEW

REINFORCING TABLE				
⌀ CMP RISER	A	⌀ B	REINFORCING	**BEARING PRESSURE (PSF)
24"	⌀ 4' 4'X4'	26"	#5 @ 12" OCEW #5 @ 12" OCEW	2,410 1,780
30"	⌀ 4'-6" 4'-6" X 4'-6"	32"	#5 @ 12" OCEW #5 @ 12" OCEW	2,120 1,530
36"	⌀ 5' 5' X 5'	38"	#5 @ 10" OCEW #5 @ 10" OCEW	1,890 1,350
42"	⌀ 5'-6" 5'-6" X 5'-6"	44"	#5 @ 10" OCEW #5 @ 9" OCEW	1,720 1,210
48"	⌀ 6' 6' X 6'	50"	#5 @ 9" OCEW #5 @ 8" OCEW	1,600 1,100

** ASSUMED SOIL BEARING CAPACITY



ROUND OPTION PLAN VIEW



SQUARE OPTION PLAN VIEW

NOTES:

1. DESIGN IN ACCORDANCE WITH AASHTO, 17th EDITION.
2. DESIGN LOAD HS25.
3. EARTH COVER = 1' MAX.
4. CONCRETE STRENGTH = 3,500 psi
5. REINFORCING STEEL = ASTM A615, GRADE 60.
6. PROVIDE ADDITIONAL REINFORCING AROUND OPENINGS EQUAL TO THE BARS INTERRUPTED, HALF EACH SIDE. ADDITIONAL BARS TO BE IN THE SAME PLANE.
7. TRIM OPENING WITH DIAGONAL #4 BARS, EXTEND BARS A MINIMUM OF 12" BEYOND OPENING, BEND BARS AS REQUIRED TO MAINTAIN BAR COVER.
8. PROTECTION SLAB AND ALL MATERIALS TO BE PROVIDED AND INSTALLED BY CONTRACTOR.
9. DETAIL DESIGN BY DELTA ENGINEERING, BINGHAMTON, NY.

MANHOLE CAP DETAIL

SCALE: N.T.S.

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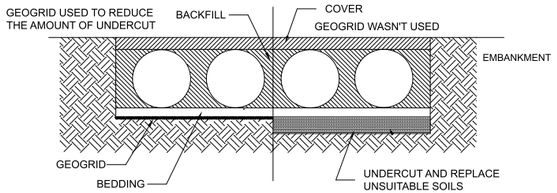
CMP DETENTION INSTALLATION GUIDE

PROPER INSTALLATION OF A FLEXIBLE UNDERGROUND DETENTION SYSTEM WILL ENSURE LONG-TERM PERFORMANCE. THE CONFIGURATION OF THESE SYSTEMS OFTEN REQUIRES SPECIAL CONSTRUCTION PRACTICES THAT DIFFER FROM CONVENTIONAL FLEXIBLE PIPE CONSTRUCTION. CONTECH ENGINEERED SOLUTIONS STRONGLY SUGGESTS SCHEDULING A PRE-CONSTRUCTION MEETING WITH YOUR LOCAL SALES ENGINEER TO DETERMINE IF ADDITIONAL MEASURES, NOT COVERED IN THIS GUIDE, ARE APPROPRIATE FOR YOUR SITE.

FOUNDATION

CONSTRUCT A FOUNDATION THAT CAN SUPPORT THE DESIGN LOADING APPLIED BY THE PIPE AND ADJACENT BACKFILL WEIGHT AS WELL AS MAINTAIN ITS INTEGRITY DURING CONSTRUCTION.

IF SOFT OR UNSUITABLE SOILS ARE ENCOUNTERED, REMOVE THE POOR SOILS DOWN TO A SUITABLE DEPTH AND THEN BUILD UP TO THE APPROPRIATE ELEVATION WITH A COMPETENT BACKFILL MATERIAL. THE STRUCTURAL FILL MATERIAL GRADATION SHOULD NOT ALLOW THE MIGRATION OF FINES, WHICH CAN CAUSE SETTLEMENT OF THE DETENTION SYSTEM OR PAVEMENT ABOVE. IF THE STRUCTURAL FILL MATERIAL IS NOT COMPATIBLE WITH THE UNDERLYING SOILS AN ENGINEERING FABRIC SHOULD BE USED AS A SEPARATOR. IN SOME CASES, USING A STIFF REINFORCING GEOGRID REDUCES OVER EXCAVATION AND REPLACEMENT FILL QUANTITIES.

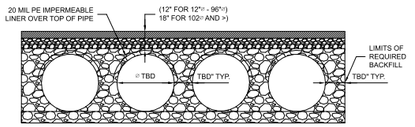


GRADE THE FOUNDATION SUBGRADE TO A UNIFORM OR SLIGHTLY SLOPING GRADE. IF THE SUBGRADE IS CLAY OR RELATIVELY NON-POROUS AND THE CONSTRUCTION SEQUENCE WILL LAST FOR AN EXTENDED PERIOD OF TIME, IT IS BEST TO SLOPE THE GRADE TO ONE END OF THE SYSTEM. THIS WILL ALLOW EXCESS WATER TO DRAIN QUICKLY, PREVENTING SATURATION OF THE SUBGRADE.

GEOMEMBRANE BARRIER

A SITE'S RESISTIVITY MAY CHANGE OVER TIME WHEN VARIOUS TYPES OF SALTING AGENTS ARE USED, SUCH AS ROAD SALTS FOR DEICING AGENTS. IF SALTING AGENTS ARE USED ON OR NEAR THE PROJECT SITE, A GEOMEMBRANE BARRIER IS RECOMMENDED WITH THE SYSTEM. THE GEOMEMBRANE LINER IS INTENDED TO HELP PROTECT THE SYSTEM FROM THE POTENTIAL ADVERSE EFFECTS THAT MAY RESULT FROM THE USE OF SUCH AGENTS INCLUDING PREMATURE CORROSION AND REDUCED ACTUAL SERVICE LIFE.

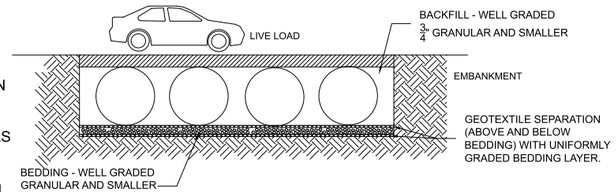
THE PROJECT'S ENGINEER OF RECORD IS TO EVALUATE WHETHER SALTING AGENTS WILL BE USED ON OR NEAR THE PROJECT SITE, AND USE HIS/HER BEST JUDGEMENT TO DETERMINE IF ANY ADDITIONAL PROTECTIVE MEASURES ARE REQUIRED. BELOW IS A TYPICAL DETAIL SHOWING THE PLACEMENT OF A GEOMEMBRANE BARRIER FOR PROJECTS WHERE SALTING AGENTS ARE USED ON OR NEAR THE PROJECT SITE.



IN-SITU TRENCH WALL

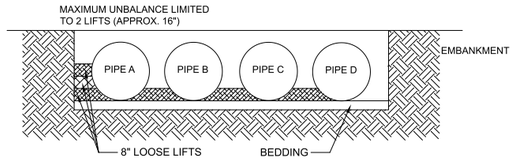
IF EXCAVATION IS REQUIRED, THE TRENCH WALL NEEDS TO BE CAPABLE OF SUPPORTING THE LOAD THAT THE PIPE SHEDS AS THE SYSTEM IS LOADED. IF SOILS ARE NOT CAPABLE OF SUPPORTING THESE LOADS, THE PIPE CAN DEFLECT. PERFORM A SIMPLE SOIL PRESSURE CHECK USING THE APPLIED LOADS TO DETERMINE THE LIMITS OF EXCAVATION BEYOND THE SPRING LINE OF THE OUTER MOST PIPES.

IN MOST CASES THE REQUIREMENTS FOR A SAFE WORK ENVIRONMENT AND PROPER BACKFILL PLACEMENT AND COMPACTION TAKE CARE OF THIS CONCERN.



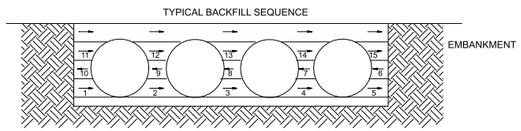
BACKFILL PLACEMENT

MATERIAL SHALL BE WORKED INTO THE PIPE HAUNCHES BY MEANS OF SHOVEL-SLICING, RODDING, AIR TAMPER, VIBRATORY ROD, OR OTHER EFFECTIVE METHODS.

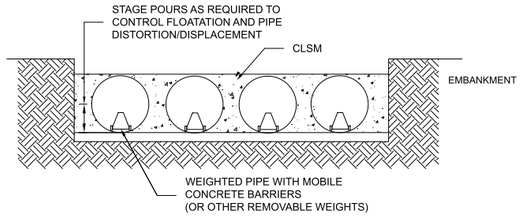


IF AASHTO T99 PROCEDURES ARE DETERMINED INFEASIBLE BY THE GEOTECHNICAL ENGINEER OF RECORD, COMPACTION IS CONSIDERED ADEQUATE WHEN NO FURTHER YIELDING OF THE MATERIAL IS OBSERVED UNDER THE COMPACTOR, OR UNDER FOOT, AND THE GEOTECHNICAL ENGINEER OF RECORD (OR REPRESENTATIVE THEREOF) IS SATISFIED WITH THE LEVEL OF COMPACTION.

FOR LARGE SYSTEMS, CONVEYOR SYSTEMS, BACKHOES WITH LONG REACHES OR DRAGLINES WITH STONE BUCKETS MAY BE USED TO PLACE BACKFILL. ONCE MINIMUM COVER FOR CONSTRUCTION LOADING ACROSS THE ENTIRE WIDTH OF THE SYSTEM IS REACHED, ADVANCE THE EQUIPMENT TO THE END OF THE RECENTLY PLACED FILL, AND BEGIN THE SEQUENCE AGAIN UNTIL THE SYSTEM IS COMPLETELY BACKFILLED. THIS TYPE OF CONSTRUCTION SEQUENCE PROVIDES ROOM FOR STOCKPILED BACKFILL DIRECTLY BEHIND THE BACKHOE, AS WELL AS THE MOVEMENT OF CONSTRUCTION TRAFFIC. MATERIAL STOCKPILES ON TOP OF THE BACKFILLED DETENTION SYSTEM SHOULD BE LIMITED TO 8- TO 10-FEET HIGH AND MUST PROVIDE BALANCED LOADING ACROSS ALL BARRELS. TO DETERMINE THE PROPER COVER OVER THE PIPES TO ALLOW THE MOVEMENT OF CONSTRUCTION EQUIPMENT SEE TABLE 1, OR CONTACT YOUR LOCAL CONTECH SALES ENGINEER.



WHEN FLOWABLE FILL IS USED, YOU MUST PREVENT PIPE FLOATATION. TYPICALLY, SMALL LIFTS ARE PLACED BETWEEN THE PIPES AND THEN ALLOWED TO SET-UP PRIOR TO THE PLACEMENT OF THE NEXT LIFT. THE ALLOWABLE THICKNESS OF THE CLSM LIFT IS A FUNCTION OF A PROPER BALANCE BETWEEN THE UPLIFT FORCE OF THE CLSM, THE OPPOSING WEIGHT OF THE PIPE, AND THE EFFECT OF OTHER RESTRAINING MEASURES. THE PIPE CAN CARRY LIMITED FLUID PRESSURE WITHOUT PIPE DISTORTION OR DISPLACEMENT, WHICH ALSO AFFECTS THE CLSM LIFT THICKNESS. YOUR LOCAL CONTECH SALES ENGINEER CAN HELP DETERMINE THE PROPER LIFT THICKNESS.

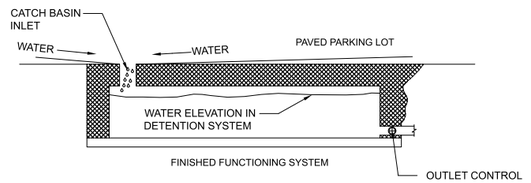


CONSTRUCTION LOADING

TYPICALLY, THE MINIMUM COVER SPECIFIED FOR A PROJECT ASSUMES H-20 LIVE LOAD. BECAUSE CONSTRUCTION LOADS OFTEN EXCEED DESIGN LIVE LOADS, INCREASED TEMPORARY MINIMUM COVER REQUIREMENTS ARE NECESSARY. SINCE CONSTRUCTION EQUIPMENT VARIES FROM JOB TO JOB, IT IS BEST TO ADDRESS EQUIPMENT SPECIFIC MINIMUM COVER REQUIREMENTS WITH YOUR LOCAL CONTECH SALES ENGINEER DURING YOUR PRE-CONSTRUCTION MEETING.

ADDITIONAL CONSIDERATIONS

BECAUSE MOST SYSTEMS ARE CONSTRUCTED BELOW-GRADE, RAINFALL CAN RAPIDLY FILL THE EXCAVATION; POTENTIALLY CAUSING FLOATATION AND MOVEMENT OF THE PREVIOUSLY PLACED PIPES. TO HELP MITIGATE POTENTIAL PROBLEMS, IT IS BEST TO START THE INSTALLATION AT THE DOWNSTREAM END WITH THE OUTLET ALREADY CONSTRUCTED TO ALLOW A ROUTE FOR THE WATER TO ESCAPE. TEMPORARY DIVERSION MEASURES MAY BE REQUIRED FOR HIGH FLOWS DUE TO THE RESTRICTED NATURE OF THE OUTLET PIPE.



CMP DETENTION SYSTEM INSPECTION AND MAINTENANCE

UNDERGROUND STORMWATER DETENTION AND INFILTRATION SYSTEMS MUST BE INSPECTED AND MAINTAINED AT REGULAR INTERVALS FOR PURPOSES OF PERFORMANCE AND LONGEVITY.

INSPECTION

INSPECTION IS THE KEY TO EFFECTIVE MAINTENANCE OF CMP DETENTION SYSTEMS AND IS EASILY PERFORMED. CONTECH RECOMMENDS ONGOING, ANNUAL INSPECTIONS. SITES WITH HIGH TRASH LOAD OR SMALL OUTLET CONTROL ORIFICES MAY NEED MORE FREQUENT INSPECTIONS. THE RATE AT WHICH THE SYSTEM COLLECTS POLLUTANTS WILL DEPEND MORE ON SITE SPECIFIC ACTIVITIES RATHER THAN THE SIZE OR CONFIGURATION OF THE SYSTEM.

INSPECTIONS SHOULD BE PERFORMED MORE OFTEN IN EQUIPMENT WASHDOWN AREAS, IN CLIMATES WHERE SANDING AND/OR SALTING OPERATIONS TAKE PLACE, AND IN OTHER VARIOUS INSTANCES IN WHICH ONE WOULD EXPECT HIGHER ACCUMULATIONS OF SEDIMENT OR ABRASIVE/ CORROSIVE CONDITIONS. A RECORD OF EACH INSPECTION IS TO BE MAINTAINED FOR THE LIFE OF THE SYSTEM

MAINTENANCE

CMP DETENTION SYSTEMS SHOULD BE CLEANED WHEN AN INSPECTION REVEALS ACCUMULATED SEDIMENT OR TRASH IS CLOGGING THE DISCHARGE ORIFICE.

ACCUMULATED SEDIMENT AND TRASH CAN TYPICALLY BE EVACUATED THROUGH THE MANHOLE OVER THE OUTLET ORIFICE. IF MAINTENANCE IS NOT PERFORMED AS RECOMMENDED, SEDIMENT AND TRASH MAY ACCUMULATE IN FRONT OF THE OUTLET ORIFICE. MANHOLE COVERS SHOULD BE SECURELY SEATED FOLLOWING CLEANING ACTIVITIES. CONTECH SUGGESTS THAT ALL SYSTEMS BE DESIGNED WITH AN ACCESS/INSPECTION MANHOLE SITUATED AT OR NEAR THE INLET AND THE OUTLET ORIFICE. SHOULD IT BE NECESSARY TO GET INSIDE THE SYSTEM TO PERFORM MAINTENANCE ACTIVITIES, ALL APPROPRIATE PRECAUTIONS REGARDING CONFINED SPACE ENTRY AND OSHA REGULATIONS SHOULD BE FOLLOWED.

ANNUAL INSPECTIONS ARE BEST PRACTICE FOR ALL UNDERGROUND SYSTEMS. DURING THIS INSPECTION, IF EVIDENCE OF SALTING/DE-ICING AGENTS IS OBSERVED WITHIN THE SYSTEM, IT IS BEST PRACTICE FOR THE SYSTEM TO BE RINSED, INCLUDING ABOVE THE SPRING LINE SOON AFTER THE SPRING THAW AS PART OF THE MAINTENANCE PROGRAM FOR THE SYSTEM.

MAINTAINING AN UNDERGROUND DETENTION OR INFILTRATION SYSTEM IS EASIEST WHEN THERE IS NO FLOW ENTERING THE SYSTEM. FOR THIS REASON, IT IS A GOOD IDEA TO SCHEDULE THE CLEANOUT DURING DRY WEATHER.

THE FOREGOING INSPECTION AND MAINTENANCE EFFORTS HELP ENSURE UNDERGROUND PIPE SYSTEMS USED FOR STORMWATER STORAGE CONTINUE TO FUNCTION AS INTENDED BY IDENTIFYING RECOMMENDED REGULAR INSPECTION AND MAINTENANCE PRACTICES. INSPECTION AND MAINTENANCE RELATED TO THE STRUCTURAL INTEGRITY OF THE PIPE OR THE SOUNDNESS OF PIPE JOINT CONNECTIONS IS BEYOND THE SCOPE OF THIS GUIDE.

DATE	REVISION DESCRIPTION	BY

CONTECH ENGINEERED SOLUTIONS LLC
www.ContechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CONTECH CMP DETENTION SYSTEMS

CONTECH **DYODS** DRAWING

DYO49301 Miro Way
BMP 4
Rialto, CA
DETENTION SYSTEM

PROJECT No.:	SEQ. No.:	DATE:
34171	49301	4/4/2024
DESIGNED: DYO	DRAWN: DYO	
CHECKED: DYO	APPROVED: DYO	
SHEET NO.: 1		

C:\EXPORTS\TEMPLATES\NEW\CMP_V8.DWG 10/18/2019 10:02 AM

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

Study date 04/04/24

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

Program License Serial Number 6443

MIRO WAY INDUSTRIAL PROJECT - RIALTO
PROPOSED CONDITION UH ANALYSIS (DA 1)
100 YR 24HR DESIGN STORM
BY LP 04/04/24

Storm Event Year = 100

Antecedent Moisture Condition = 3

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 (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 10		
2.95	1	1.05
Rainfall data for year 2		
2.95	6	1.80
Rainfall data for year 2		
2.95	24	3.37
Rainfall data for year 100		

```
             2.95            1           1.69
------------------------------------------------------------------------
Rainfall data for year 100
             2.95            6           4.16
------------------------------------------------------------------------
Rainfall data for year 100
             2.95           24           7.73
------------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 32.0      52.0          2.95      1.000     0.785    0.200    0.157

Area-averaged adjusted loss rate Fm (In/Hr) =  0.157

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

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
     0.59   0.200         32.0      52.0       9.23     0.296
     2.36   0.800         98.0      98.0       0.20     0.969

Area-averaged catchment yield fraction, Y =  0.834
Area-averaged low loss fraction, Yb =  0.166
Direct entry of lag time by user
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =       2.95(Ac.)
Catchment Lag time =   0.103 hours
Unit interval =  15.000 minutes
Unit interval percentage of lag time = 241.5459
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.157(In/Hr)
Average low loss rate fraction (Yb) = 0.166 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall =  0.625(In)
Computed peak 30-minute rainfall =  1.281(In)
Specified peak 1-hour rainfall =  1.690(In)
Computed peak 3-hour rainfall =  2.936(In)
Specified peak 6-hour rainfall =  4.160(In)
Specified peak 24-hour rainfall =  7.730(In)


Rainfall depth area reduction factors:
Using a total area of       2.95(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000     Adjusted rainfall =  0.625(In)
```

```
30-minute factor = 1.000    Adjusted rainfall =  1.281(In)
1-hour factor = 1.000       Adjusted rainfall =  1.690(In)
3-hour factor = 1.000       Adjusted rainfall =  2.936(In)
6-hour factor = 1.000       Adjusted rainfall =  4.160(In)
24-hour factor = 1.000      Adjusted rainfall =  7.730(In)
--------------------------------------------------------------------

                        U n i t  H y d r o g r a p h
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Interval          'S' Graph          Unit Hydrograph
Number            Mean values             ((CFS))
--------------------------------------------------------------------
                (K =        11.89 (CFS))

  1               56.617                   6.733
  2              100.000                   5.159
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Total soil rain loss =      1.15(In)
Total effective rainfall =      6.58(In)
Peak flow rate in flood hydrograph =      7.39(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  15   Minute intervals ((CFS))

     --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        2.5       5.0       7.5      10.0
----------------------------------------------------------------------
  0+15       0.0042      0.20  Q         |         |         |         |
  0+30       0.0116      0.36  VQ        |         |         |         |
  0+45       0.0191      0.36  VQ        |         |         |         |
  1+ 0       0.0267      0.37  VQ        |         |         |         |
  1+15       0.0344      0.37  VQ        |         |         |         |
  1+30       0.0421      0.37   Q        |         |         |         |
  1+45       0.0499      0.38  |Q        |         |         |         |
  2+ 0       0.0577      0.38  |Q        |         |         |         |
  2+15       0.0657      0.38  |Q        |         |         |         |
  2+30       0.0737      0.39  |Q        |         |         |         |
  2+45       0.0818      0.39  |QV       |         |         |         |
  3+ 0       0.0900      0.40  |QV       |         |         |         |
  3+15       0.0983      0.40  |QV       |         |         |         |
  3+30       0.1066      0.40  |QV       |         |         |         |
  3+45       0.1151      0.41  |QV       |         |         |         |
  4+ 0       0.1236      0.41  |Q V      |         |         |         |
  4+15       0.1323      0.42  |Q V      |         |         |         |
  4+30       0.1410      0.42  |Q V      |         |         |         |
```

4+45	0.1499	0.43	Q V				
5+ 0	0.1588	0.43	Q V				
5+15	0.1679	0.44	Q V				
5+30	0.1771	0.44	Q V				
5+45	0.1864	0.45	Q V				
6+ 0	0.1958	0.46	Q V				
6+15	0.2054	0.46	Q V				
6+30	0.2151	0.47	Q V				
6+45	0.2249	0.48	Q V				
7+ 0	0.2349	0.48	Q V				
7+15	0.2451	0.49	Q V				
7+30	0.2554	0.50	Q V				
7+45	0.2658	0.51	Q V				
8+ 0	0.2765	0.51	Q V				
8+15	0.2873	0.52	Q V				
8+30	0.2983	0.53	Q V				
8+45	0.3095	0.54	Q V				
9+ 0	0.3209	0.55	Q V				
9+15	0.3326	0.56	Q V				
9+30	0.3445	0.58	Q V				
9+45	0.3566	0.59	Q V				
10+ 0	0.3690	0.60	Q V				
10+15	0.3817	0.61	Q V				
10+30	0.3947	0.63	Q V				
10+45	0.4080	0.64	Q V				
11+ 0	0.4216	0.66	Q V				
11+15	0.4356	0.68	Q V				
11+30	0.4501	0.70	Q V				
11+45	0.4649	0.72	Q V				
12+ 0	0.4803	0.74	Q V				
12+15	0.4973	0.82	Q V				
12+30	0.5157	0.89	Q V				
12+45	0.5348	0.92	Q V				
13+ 0	0.5546	0.96	Q V				
13+15	0.5752	1.00	Q V				
13+30	0.5967	1.04	Q V				
13+45	0.6192	1.09	Q V				
14+ 0	0.6430	1.15	Q V				
14+15	0.6682	1.22	Q V				
14+30	0.6951	1.30	Q V				
14+45	0.7242	1.41	Q V				
15+ 0	0.7561	1.54	Q V				
15+15	0.7918	1.73	Q V				
15+30	0.8297	1.83	Q V				
15+45	0.8733	2.11	Q V				
16+ 0	0.9509	3.75	Q V				
16+15	1.1036	7.39	V Q				
16+30	1.2102	5.16	Q V				
16+45	1.2463	1.74	Q V				
17+ 0	1.2760	1.44	Q V				

```
   17+15       1.3016      1.24  |   Q     |         |         | V       |
   17+30       1.3244      1.10  |   Q     |         |         | V       |
   17+45       1.3451      1.00  |   Q     |         |         |  V      |
   18+ 0       1.3643      0.93  |  Q      |         |         |  V      |
   18+15       1.3812      0.81  |  Q      |         |         |   V     |
   18+30       1.3961      0.72  | Q       |         |         |   V     |
   18+45       1.4102      0.68  | Q       |         |         |   V     |
   19+ 0       1.4236      0.65  | Q       |         |         |    V    |
   19+15       1.4363      0.62  | Q       |         |         |    V    |
   19+30       1.4485      0.59  | Q       |         |         |    V    |
   19+45       1.4602      0.57  | Q       |         |         |     V   |
   20+ 0       1.4714      0.54  | Q       |         |         |     V   |
   20+15       1.4823      0.53  | Q       |         |         |     V   |
   20+30       1.4928      0.51  | Q       |         |         |     V   |
   20+45       1.5029      0.49  |Q        |         |         |      V  |
   21+ 0       1.5128      0.48  |Q        |         |         |      V  |
   21+15       1.5224      0.46  |Q        |         |         |      V  |
   21+30       1.5317      0.45  |Q        |         |         |      V  |
   21+45       1.5408      0.44  |Q        |         |         |       V |
   22+ 0       1.5497      0.43  |Q        |         |         |       V |
   22+15       1.5583      0.42  |Q        |         |         |       V |
   22+30       1.5668      0.41  |Q        |         |         |       V |
   22+45       1.5751      0.40  |Q        |         |         |       V |
   23+ 0       1.5832      0.39  |Q        |         |         |        V|
   23+15       1.5911      0.38  |Q        |         |         |        V|
   23+30       1.5989      0.38  |Q        |         |         |        V|
   23+45       1.6066      0.37  |Q        |         |         |        V|
   24+ 0       1.6141      0.36  |Q        |         |         |        V|
-------------------------------------------------------------------------
```

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

Study date 04/04/24

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

Program License Serial Number 6443

MIRO WAY INDUSTRIAL PROJECT - RIALTO
PROPOSED CONDITION UH ANALYSIS (DA 2)
100 YR 24HR DESIGN STORM
BY LP 04/04/24

Storm Event Year = 100

Antecedent Moisture Condition = 3

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 (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 10		
7.86	1	1.05
Rainfall data for year 2		
7.86	6	1.80
Rainfall data for year 2		
7.86	24	3.37
Rainfall data for year 100		

```
             7.86            1           1.69
------------------------------------------------------------------------
Rainfall data for year 100
             7.86            6           4.16
------------------------------------------------------------------------
Rainfall data for year 100
             7.86           24           7.73
------------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 32.0      52.0          7.86      1.000     0.785    0.200    0.157

Area-averaged adjusted loss rate Fm (In/Hr) =  0.157

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

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
     1.57   0.200         32.0      52.0       9.23     0.296
     6.29   0.800         98.0      98.0       0.20     0.969

Area-averaged catchment yield fraction, Y =  0.834
Area-averaged low loss fraction, Yb =  0.166
Direct entry of lag time by user
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =       7.86(Ac.)
Catchment Lag time =   0.161 hours
Unit interval =  15.000 minutes
Unit interval percentage of lag time = 155.5694
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.157(In/Hr)
Average low loss rate fraction (Yb) = 0.166 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall =  0.625(In)
Computed peak 30-minute rainfall =  1.281(In)
Specified peak 1-hour rainfall =  1.690(In)
Computed peak 3-hour rainfall =  2.936(In)
Specified peak 6-hour rainfall =  4.160(In)
Specified peak 24-hour rainfall =  7.730(In)


Rainfall depth area reduction factors:
Using a total area of       7.86(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000     Adjusted rainfall =  0.625(In)
```

30-minute factor = 1.000 Adjusted rainfall = 1.280(In)
1-hour factor = 1.000 Adjusted rainfall = 1.689(In)
3-hour factor = 1.000 Adjusted rainfall = 2.936(In)
6-hour factor = 1.000 Adjusted rainfall = 4.160(In)
24-hour factor = 1.000 Adjusted rainfall = 7.730(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 = 31.69 (CFS))	
1	36.159	11.457
2	95.935	18.940
3	100.000	1.288

Total soil rain loss = 1.15(In)
Total effective rainfall = 6.58(In)
Peak flow rate in flood hydrograph = 17.29(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 15 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	5.0	10.0	15.0	20.0
0+15	0.0071	0.35	Q				
0+30	0.0261	0.92	VQ				
0+45	0.0461	0.97	VQ				
1+ 0	0.0662	0.97	VQ				
1+15	0.0865	0.98	VQ				
1+30	0.1070	0.99	VQ				
1+45	0.1278	1.00	|VQ				
2+ 0	0.1487	1.01	|VQ				
2+15	0.1698	1.02	|VQ				
2+30	0.1911	1.03	|VQ				
2+45	0.2126	1.04	|VQ				
3+ 0	0.2344	1.05	| Q				
3+15	0.2564	1.06	| Q				
3+30	0.2786	1.08	| Q				
3+45	0.3010	1.09	| Q				
4+ 0	0.3238	1.10	| QV				
4+15	0.3467	1.11	| QV				

4+30	0.3700	1.13	QV				
4+45	0.3935	1.14	QV				
5+ 0	0.4173	1.15	QV				
5+15	0.4414	1.17	Q V				
5+30	0.4658	1.18	Q V				
5+45	0.4905	1.20	Q V				
6+ 0	0.5156	1.21	Q V				
6+15	0.5410	1.23	Q V				
6+30	0.5667	1.25	Q V				
6+45	0.5929	1.26	Q V				
7+ 0	0.6194	1.28	Q V				
7+15	0.6463	1.30	Q V				
7+30	0.6736	1.32	Q V				
7+45	0.7014	1.34	Q V				
8+ 0	0.7296	1.37	Q V				
8+15	0.7583	1.39	Q V				
8+30	0.7875	1.41	Q V				
8+45	0.8173	1.44	Q V				
9+ 0	0.8476	1.47	Q V				
9+15	0.8784	1.49	Q V				
9+30	0.9100	1.53	Q V				
9+45	0.9421	1.56	Q V				
10+ 0	0.9750	1.59	Q V				
10+15	1.0086	1.63	Q V				
10+30	1.0430	1.66	Q V				
10+45	1.0782	1.71	Q V				
11+ 0	1.1144	1.75	Q V				
11+15	1.1515	1.80	Q V				
11+30	1.1897	1.85	Q V				
11+45	1.2290	1.90	Q V				
12+ 0	1.2696	1.96	Q V				
12+15	1.3134	2.12	Q V				
12+30	1.3619	2.35	Q V				
12+45	1.4123	2.44	Q V				
13+ 0	1.4646	2.53	Q V				
13+15	1.5189	2.63	Q V				
13+30	1.5756	2.74	Q V				
13+45	1.6349	2.87	Q V				
14+ 0	1.6974	3.02	Q V				
14+15	1.7636	3.20	Q V				
14+30	1.8342	3.42	Q V				
14+45	1.9102	3.68	Q V				
15+ 0	1.9932	4.02	Q V				
15+15	2.0856	4.47	Q V				
15+30	2.1858	4.85	Q V				
15+45	2.2968	5.37	Q V				
16+ 0	2.4738	8.57	Q V				
16+15	2.8244	16.97	V	Q			
16+30	3.1816	17.29	V	Q			
16+45	3.2982	5.65	Q	V			

```
   17+ 0       3.3812      4.02  |        Q |          |           V         |
   17+15       3.4518      3.41  |      Q   |          |          | V        |
   17+30       3.5141      3.02  |      Q   |          |          | V        |
   17+45       3.5707      2.74  |     Q    |          |          |  V       |
   18+ 0       3.6228      2.52  |     Q    |          |          |  V       |
   18+15       3.6695      2.26  |    Q     |          |          |   V      |
   18+30       3.7102      1.97  |  Q       |          |          |   V      |
   18+45       3.7483      1.84  |  Q       |          |          |   V      |
   19+ 0       3.7843      1.75  |  Q       |          |          |    V     |
   19+15       3.8186      1.66  |  Q       |          |          |    V     |
   19+30       3.8514      1.59  |  Q       |          |          |    V     |
   19+45       3.8829      1.52  |  Q       |          |          |     V    |
   20+ 0       3.9131      1.46  | Q        |          |          |     V    |
   20+15       3.9423      1.41  | Q        |          |          |     V    |
   20+30       3.9705      1.36  | Q        |          |          |     V    |
   20+45       3.9977      1.32  | Q        |          |          |      V   |
   21+ 0       4.0242      1.28  | Q        |          |          |      V   |
   21+15       4.0499      1.24  | Q        |          |          |      V   |
   21+30       4.0749      1.21  | Q        |          |          |      V   |
   21+45       4.0993      1.18  | Q        |          |          |       V  |
   22+ 0       4.1231      1.15  | Q        |          |          |       V  |
   22+15       4.1463      1.12  | Q        |          |          |       V  |
   22+30       4.1690      1.10  | Q        |          |          |       V  |
   22+45       4.1912      1.07  | Q        |          |          |       V  |
   23+ 0       4.2129      1.05  | Q        |          |          |        V |
   23+15       4.2342      1.03  | Q        |          |          |        V |
   23+30       4.2551      1.01  | Q        |          |          |        V |
   23+45       4.2756      0.99  |Q         |          |          |        V |
   24+ 0       4.2957      0.97  |Q         |          |          |        V |
-------------------------------------------------------------------------------
```

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

Study date 04/04/24

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

Program License Serial Number 6443

MIRO WAY INDUSTRIAL PROJECT - RIALTO
PROPOSED CONDITION UH ANALYSIS (DA 3)
100 YR 24HR DESIGN STORM
BY LP 04/04/24

Storm Event Year = 100

Antecedent Moisture Condition = 3

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 (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 10		
8.48	1	1.05
Rainfall data for year 2		
8.48	6	1.80
Rainfall data for year 2		
8.48	24	3.37
Rainfall data for year 100		

```
            8.48            1           1.69
------------------------------------------------------------------------
Rainfall data for year 100
            8.48            6           4.16
------------------------------------------------------------------------
Rainfall data for year 100
            8.48           24           7.73
------------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 32.0      52.0          8.48      1.000     0.785    0.200    0.157

Area-averaged adjusted loss rate Fm (In/Hr) =  0.157

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

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
     1.70   0.200         32.0      52.0       9.23     0.296
     6.78   0.800         98.0      98.0       0.20     0.969

Area-averaged catchment yield fraction, Y =  0.834
Area-averaged low loss fraction, Yb =  0.166
Direct entry of lag time by user
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =       8.48(Ac.)
Catchment Lag time =   0.149 hours
Unit interval =  15.000 minutes
Unit interval percentage of lag time = 167.4481
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.157(In/Hr)
Average low loss rate fraction (Yb) = 0.166 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall =  0.625(In)
Computed peak 30-minute rainfall =  1.281(In)
Specified peak 1-hour rainfall =  1.690(In)
Computed peak 3-hour rainfall =  2.936(In)
Specified peak 6-hour rainfall =  4.160(In)
Specified peak 24-hour rainfall =  7.730(In)


Rainfall depth area reduction factors:
Using a total area of       8.48(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000     Adjusted rainfall =  0.625(In)
```

```
30-minute factor = 1.000    Adjusted rainfall =  1.280(In)
1-hour factor = 1.000       Adjusted rainfall =  1.689(In)
3-hour factor = 1.000       Adjusted rainfall =  2.936(In)
6-hour factor = 1.000       Adjusted rainfall =  4.160(In)
24-hour factor = 1.000      Adjusted rainfall =  7.730(In)
--------------------------------------------------------------------

                        U n i t  H y d r o g r a p h
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Interval          'S' Graph          Unit Hydrograph
Number            Mean values             ((CFS))
--------------------------------------------------------------------
                (K =        34.19 (CFS))

  1               39.792                  13.603
  2               97.064                  19.579
  3              100.000                   1.004
--------------------------------------------------------------------
--------------------------------------------------------------------
--------------------------------------------------------------------
Total soil rain loss =      1.15(In)
Total effective rainfall =      6.58(In)
Peak flow rate in flood hydrograph =     18.86(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  15   Minute intervals ((CFS))

      --------------------------------------------------------------------
Time(h+m) Volume Ac.Ft   Q(CFS)  0        5.0      10.0      15.0      20.0
-------------------------------------------------------------------------
  0+15       0.0085      0.41  Q         |         |         |         |
  0+30       0.0292      1.00  V Q       |         |         |         |
  0+45       0.0507      1.04  V Q       |         |         |         |
  1+ 0       0.0725      1.05  V Q       |         |         |         |
  1+15       0.0944      1.06  V Q       |         |         |         |
  1+30       0.1166      1.07   VQ       |         |         |         |
  1+45       0.1389      1.08  |VQ       |         |         |         |
  2+ 0       0.1615      1.09  |VQ       |         |         |         |
  2+15       0.1842      1.10  |VQ       |         |         |         |
  2+30       0.2073      1.11  |VQ       |         |         |         |
  2+45       0.2305      1.12  |VQ       |         |         |         |
  3+ 0       0.2540      1.14  | Q       |         |         |         |
  3+15       0.2777      1.15  | Q       |         |         |         |
  3+30       0.3017      1.16  | Q       |         |         |         |
  3+45       0.3260      1.17  | Q       |         |         |         |
  4+ 0       0.3505      1.19  | QV      |         |         |         |
  4+15       0.3753      1.20  | QV      |         |         |         |
```

4+30	0.4004	1.21	QV				
4+45	0.4258	1.23	QV				
5+ 0	0.4515	1.24	QV				
5+15	0.4775	1.26	Q V				
5+30	0.5038	1.28	Q V				
5+45	0.5305	1.29	Q V				
6+ 0	0.5576	1.31	Q V				
6+15	0.5850	1.33	Q V				
6+30	0.6128	1.35	Q V				
6+45	0.6410	1.36	Q V				
7+ 0	0.6696	1.39	Q V				
7+15	0.6987	1.41	Q V				
7+30	0.7282	1.43	Q V				
7+45	0.7581	1.45	Q V				
8+ 0	0.7886	1.48	Q V				
8+15	0.8196	1.50	Q V				
8+30	0.8512	1.53	Q V				
8+45	0.8833	1.55	Q V				
9+ 0	0.9160	1.58	Q V				
9+15	0.9493	1.61	Q V				
9+30	0.9834	1.65	Q V				
9+45	1.0181	1.68	Q V				
10+ 0	1.0536	1.72	Q V				
10+15	1.0899	1.76	Q V				
10+30	1.1270	1.80	Q V				
10+45	1.1651	1.84	Q V				
11+ 0	1.2042	1.89	Q V				
11+15	1.2443	1.94	Q V				
11+30	1.2855	2.00	Q V				
11+45	1.3280	2.06	Q V				
12+ 0	1.3718	2.12	Q V				
12+15	1.4194	2.30	Q V				
12+30	1.4719	2.54	Q V				
12+45	1.5263	2.64	Q V				
13+ 0	1.5828	2.73	Q V				
13+15	1.6415	2.84	Q V				
13+30	1.7028	2.97	Q V				
13+45	1.7670	3.11	Q V				
14+ 0	1.8346	3.27	Q V				
14+15	1.9062	3.46	Q V				
14+30	1.9826	3.70	Q V				
14+45	2.0650	3.99	Q V				
15+ 0	2.1549	4.35	Q V				
15+15	2.2551	4.85	Q V				
15+30	2.3635	5.24	Q V				
15+45	2.4842	5.84	Q V				
16+ 0	2.6809	9.52	Q V				
16+15	3.0706	18.86	Q V				
16+30	3.4430	18.02	Q V				
16+45	3.5631	5.81	Q V				

17+ 0	3.6519	4.30		Q		V
17+15	3.7274	3.66		Q		V
17+30	3.7944	3.24		Q		V
17+45	3.8551	2.94		Q		V
18+ 0	3.9111	2.71		Q		V
18+15	3.9611	2.42		Q		V
18+30	4.0048	2.11		Q		V
18+45	4.0458	1.98		Q		V
19+ 0	4.0846	1.88		Q		V
19+15	4.1216	1.79		Q		V
19+30	4.1569	1.71		Q		V
19+45	4.1907	1.64		Q		V
20+ 0	4.2233	1.58		Q		V
20+15	4.2547	1.52		Q		V
20+30	4.2851	1.47		Q		V
20+45	4.3145	1.42		Q		V
21+ 0	4.3430	1.38		Q		V
21+15	4.3707	1.34		Q		V
21+30	4.3976	1.30		Q		V
21+45	4.4239	1.27		Q		V
22+ 0	4.4495	1.24		Q		V
22+15	4.4745	1.21		Q		V
22+30	4.4990	1.18		Q		V
22+45	4.5229	1.16		Q		V
23+ 0	4.5463	1.13		Q		V
23+15	4.5693	1.11		Q		V
23+30	4.5918	1.09		Q		V
23+45	4.6139	1.07		Q		V
24+ 0	4.6356	1.05		Q		V

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

Study date 04/04/24

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

Program License Serial Number 6443

MIRO WAY INDUSTRIAL PROJECT - RIALTO
PROPOSED CONDITION UH ANALYSIS (DA 4)
100 YR 24HR DESIGN STORM
BY LP 04/04/24

Storm Event Year = 100

Antecedent Moisture Condition = 3

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 (Ac.)	Duration (hours)	Isohyetal (In)
Rainfall data for year 10		
1.48	1	1.05
Rainfall data for year 2		
1.48	6	1.80
Rainfall data for year 2		
1.48	24	3.37
Rainfall data for year 100		

```
            1.48           1           1.69
------------------------------------------------------------------------
Rainfall data for year 100
            1.48           6           4.16
------------------------------------------------------------------------
Rainfall data for year 100
            1.48          24           7.73
------------------------------------------------------------------------
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

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


SCS curve  SCS curve     Area     Area     Fp(Fig C6)    Ap      Fm
No.(AMCII) NO.(AMC 3)    (Ac.)    Fraction     (In/Hr)  (dec.)   (In/Hr)
 32.0      52.0          1.48      1.000     0.785    0.200    0.157

Area-averaged adjusted loss rate Fm (In/Hr) =  0.157

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

Area       Area          SCS CN    SCS CN      S     Pervious
 (Ac.)      Fract         (AMC2)    (AMC3)           Yield Fr
     0.30   0.200         32.0      52.0       9.23     0.296
     1.18   0.800         98.0      98.0       0.20     0.969

Area-averaged catchment yield fraction, Y =  0.834
Area-averaged low loss fraction, Yb =  0.166
Direct entry of lag time by user
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Watershed area =       1.48(Ac.)
Catchment Lag time =   0.108 hours
Unit interval =  15.000 minutes
Unit interval percentage of lag time = 232.3420
Hydrograph baseflow =     0.00(CFS)
Average maximum watershed loss rate(Fm) =  0.157(In/Hr)
Average low loss rate fraction (Yb) = 0.166 (decimal)
VALLEY DEVELOPED S-Graph Selected
Computed peak 5-minute rainfall =  0.625(In)
Computed peak 30-minute rainfall =  1.281(In)
Specified peak 1-hour rainfall =  1.690(In)
Computed peak 3-hour rainfall =  2.936(In)
Specified peak 6-hour rainfall =  4.160(In)
Specified peak 24-hour rainfall =  7.730(In)


Rainfall depth area reduction factors:
Using a total area of       1.48(Ac.) (Ref: fig. E-4)

5-minute factor = 1.000     Adjusted rainfall =  0.625(In)
```

30-minute factor = 1.000 Adjusted rainfall = 1.281(In)
1-hour factor = 1.000 Adjusted rainfall = 1.690(In)
3-hour factor = 1.000 Adjusted rainfall = 2.936(In)
6-hour factor = 1.000 Adjusted rainfall = 4.160(In)
24-hour factor = 1.000 Adjusted rainfall = 7.730(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 = 5.97 (CFS))	
1	54.980	3.280
2	100.000	2.686

Total soil rain loss = 1.15(In)
Total effective rainfall = 6.58(In)
Peak flow rate in flood hydrograph = 3.67(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 15 Minute intervals ((CFS))

Time(h+m)	Volume Ac.Ft	Q(CFS)	0	2.5	5.0	7.5	10.0
0+15	0.0020	0.10	Q	|	|	|	|
0+30	0.0058	0.18	Q	|	|	|	|
0+45	0.0095	0.18	Q	|	|	|	|
1+ 0	0.0133	0.18	Q	|	|	|	|
1+15	0.0172	0.19	Q	|	|	|	|
1+30	0.0210	0.19	QV	|	|	|	|
1+45	0.0250	0.19	QV	|	|	|	|
2+ 0	0.0289	0.19	QV	|	|	|	|
2+15	0.0329	0.19	QV	|	|	|	|
2+30	0.0369	0.19	QV	|	|	|	|
2+45	0.0410	0.20	Q V	|	|	|	|
3+ 0	0.0451	0.20	Q V	|	|	|	|
3+15	0.0492	0.20	Q V	|	|	|	|
3+30	0.0534	0.20	Q V	|	|	|	|
3+45	0.0577	0.21	Q V	|	|	|	|
4+ 0	0.0619	0.21	Q V	|	|	|	|
4+15	0.0663	0.21	Q V	|	|	|	|
4+30	0.0707	0.21	Q V	|	|	|	|

```
 4+45       0.0751      0.21  Q  V      |          |          |          |
 5+ 0       0.0796      0.22  Q  V      |          |          |          |
 5+15       0.0842      0.22  Q   V     |          |          |          |
 5+30       0.0888      0.22  Q   V     |          |          |          |
 5+45       0.0934      0.23  Q   V     |          |          |          |
 6+ 0       0.0982      0.23  Q   V     |          |          |          |
 6+15       0.1030      0.23  Q    V    |          |          |          |
 6+30       0.1078      0.24  Q    V    |          |          |          |
 6+45       0.1128      0.24  Q    V    |          |          |          |
 7+ 0       0.1178      0.24  Q    V    |          |          |          |
 7+15       0.1229      0.25  Q     V   |          |          |          |
 7+30       0.1280      0.25  Q     V   |          |          |          |
 7+45       0.1333      0.25  |Q    V   |          |          |          |
 8+ 0       0.1386      0.26  |Q    V   |          |          |          |
 8+15       0.1440      0.26  |Q     V  |          |          |          |
 8+30       0.1496      0.27  |Q     V  |          |          |          |
 8+45       0.1552      0.27  |Q     V  |          |          |          |
 9+ 0       0.1609      0.28  |Q     V  |          |          |          |
 9+15       0.1668      0.28  |Q      V |          |          |          |
 9+30       0.1727      0.29  |Q      V |          |          |          |
 9+45       0.1788      0.29  |Q      V |          |          |          |
10+ 0       0.1850      0.30  |Q       V|          |          |          |
10+15       0.1914      0.31  |Q       V|          |          |          |
10+30       0.1979      0.32  |Q       V|          |          |          |
10+45       0.2046      0.32  |Q        V          |          |          |
11+ 0       0.2114      0.33  |Q        V          |          |          |
11+15       0.2184      0.34  |Q        V          |          |          |
11+30       0.2257      0.35  |Q         V         |          |          |
11+45       0.2331      0.36  |Q         |V         |          |          |
12+ 0       0.2408      0.37  |Q         |V         |          |          |
12+15       0.2493      0.41  |Q         | V        |          |          |
12+30       0.2586      0.45  |Q         | V        |          |          |
12+45       0.2681      0.46  |Q         |  V       |          |          |
13+ 0       0.2781      0.48  |Q         |  V       |          |          |
13+15       0.2884      0.50  |Q         |   V      |          |          |
13+30       0.2992      0.52  | Q        |   V      |          |          |
13+45       0.3105      0.55  | Q        |    V     |          |          |
14+ 0       0.3224      0.58  | Q        |    V     |          |          |
14+15       0.3350      0.61  | Q        |     V    |          |          |
14+30       0.3485      0.65  | Q        |      V   |          |          |
14+45       0.3631      0.71  | Q        |      V   |          |          |
15+ 0       0.3790      0.77  |  Q       |       V  |          |          |
15+15       0.3969      0.86  |  Q       |        V |          |          |
15+30       0.4159      0.92  |  Q       |         V|          |          |
15+45       0.4378      1.06  |   Q      |          V          |          |
16+ 0       0.4762      1.86  |      Q   |          |  V       |          |
16+15       0.5521      3.67  |          |   Q      |      V   |          |
16+30       0.6068      2.65  |          Q          |        V |          |
16+45       0.6250      0.88  |  Q       |          |         V|          |
17+ 0       0.6399      0.72  | Q        |          |          |V         |
```

17+15	0.6528	0.62	| Q	|	|	| V	|
17+30	0.6643	0.55	| Q	|	|	| V	|
17+45	0.6747	0.50	| Q	|	|	| V	|
18+ 0	0.6843	0.47	|Q	|	|	| V	|
18+15	0.6928	0.41	|Q	|	|	| V	|
18+30	0.7003	0.36	|Q	|	|	| V	|
18+45	0.7074	0.34	|Q	|	|	| V	|
19+ 0	0.7141	0.32	|Q	|	|	| V	|
19+15	0.7205	0.31	|Q	|	|	| V	|
19+30	0.7266	0.30	|Q	|	|	| V	|
19+45	0.7325	0.28	|Q	|	|	| V	|
20+ 0	0.7381	0.27	|Q	|	|	| V	|
20+15	0.7436	0.26	|Q	|	|	| V	|
20+30	0.7488	0.25	|Q	|	|	| V	|
20+45	0.7539	0.25	Q	|	|	| V	|
21+ 0	0.7589	0.24	Q	|	|	| V	|
21+15	0.7637	0.23	Q	|	|	| V	|
21+30	0.7684	0.23	Q	|	|	| V	|
21+45	0.7729	0.22	Q	|	|	| V	|
22+ 0	0.7774	0.22	Q	|	|	| V	|
22+15	0.7817	0.21	Q	|	|	| V	|
22+30	0.7860	0.21	Q	|	|	| V	|
22+45	0.7901	0.20	Q	|	|	| V	|
23+ 0	0.7942	0.20	Q	|	|	| V	|
23+15	0.7982	0.19	Q	|	|	| V	|
23+30	0.8021	0.19	Q	|	|	| V	|
23+45	0.8060	0.19	Q	|	|	| V	|
24+ 0	0.8097	0.18	Q	|	|	| V	|

APPENDIX B

EDUCATIONAL MATERIALS

EPA
United States
Environmental Protection
Agency

EPA 841-F-03-003

Protecting Water Quality *from* URBAN RUNOFF

Clean Water Is Everybody's Business

In urban and suburban areas, much of the land surface is covered by buildings and pavement, which do not allow rain and snowmelt to soak into the ground. Instead, most developed areas rely on storm drains to carry large amounts of runoff from roofs and paved areas to nearby waterways. The stormwater runoff carries pollutants such as oil, dirt, chemicals, and lawn fertilizers directly to streams and rivers, where they seriously harm water quality. To protect surface water quality and groundwater resources, development should be designed and built to minimize increases in runoff.

The most recent National Water Quality Inventory reports that runoff from urbanized areas is the leading source of water quality impairments to surveyed estuaries and the third-largest source of impairments to surveyed lakes.

Did you know that because of impervious surfaces like pavement and rooftops, a typical city block generates more than 5 times more runoff than a woodland area of the same size?

How Urbanized Areas Affect Water Quality

Increased Runoff

The porous and varied terrain of natural landscapes like forests, wetlands, and grasslands traps rainwater and snowmelt and allows them to filter slowly into the ground. In contrast, impervious (nonporous) surfaces like roads, parking lots, and rooftops prevent rain and snowmelt from infiltrating, or soaking, into the ground. Most of the rainfall and snowmelt remains above the surface, where it runs off rapidly in unnaturally large amounts.

Storm sewer systems concentrate runoff into smooth, straight conduits. This runoff gathers speed and erosional power as it travels underground. When this runoff leaves the storm drains and empties into a stream, its excessive volume and power blast out streambanks, damaging streamside vegetation and wiping out aquatic habitat. These increased storm flows carry sediment loads from construction sites and other denuded surfaces and eroded streambanks. They often carry higher water temperatures from streets, roof tops, and parking lots, which are harmful to the health and reproduction of aquatic life.

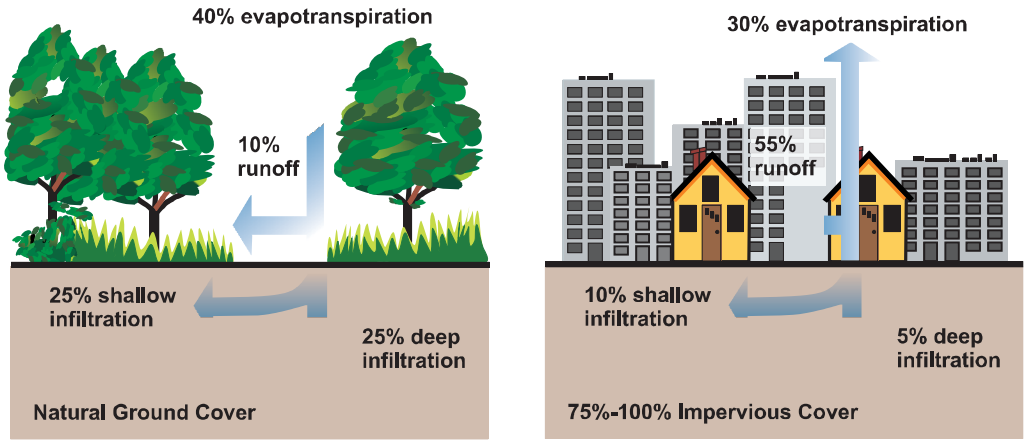
The loss of infiltration from urbanization may also cause profound groundwater changes. Although urbanization leads to great increases in flooding during and immediately after wet weather, in many instances it results in lower stream flows during dry weather. Many native fish and other aquatic life cannot survive when these conditions prevail.

Increased Pollutant Loads

Urbanization increases the variety and amount of pollutants carried into streams, rivers, and lakes. The pollutants include:

- Sediment
- Oil, grease, and toxic chemicals from motor vehicles
- Pesticides and nutrients from lawns and gardens
- Viruses, bacteria, and nutrients from pet waste and failing septic systems
- Road salts
- Heavy metals from roof shingles, motor vehicles, and other sources
- Thermal pollution from dark impervious surfaces such as streets and rooftops

These pollutants can harm fish and wildlife populations, kill native vegetation, foul drinking water supplies, and make recreational areas unsafe and unpleasant.



Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface ruunoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.

Managing Urban Runoff

What Homeowners Can Do

To decrease polluted runoff from paved surfaces, households can develop alternatives to areas traditionally covered by impervious surfaces. Porous pavement materials are available for driveways and sidewalks, and native vegetation and mulch can replace high maintenance grass lawns. Homeowners can use fertilizers sparingly and sweep driveways, sidewalks, and roads instead of using a hose. Instead of disposing of yard waste, they can use the materials to start a compost pile. And homeowners can learn to use Integrated Pest Management (IPM) to reduce dependence on harmful pesticides.

In addition, households can prevent polluted runoff by picking up after pets and using, storing, and disposing of chemicals properly. Drivers should check their cars for leaks and recycle their motor oil and antifreeze when these fluids are changed. Drivers can also avoid impacts from car wash runoff (e.g., detergents, grime, etc.) by using car wash facilities that do not generate runoff. Households served by septic systems should have them professionally inspected and pumped every 3 to 5 years. They should also practice water conservation measures to extend the life of their septic systems.

Controlling Impacts from New Development

Developers and city planners should attempt to control the volume of runoff from new development by using low impact development, structural controls, and pollution prevention strategies. Low impact development includes measures that conserve natural areas (particularly sensitive hydrologic areas like riparian buffers and infiltrable soils); reduce development impacts; and reduce site runoff rates by maximizing surface roughness, infiltration opportunities, and flow paths.

Controlling Impacts from Existing Development

Controlling runoff from existing urban areas is often more costly than controlling runoff from new developments. Economic efficiencies are often realized through approaches that target "hot spots" of runoff pollution or have multiple benefits, such as high-efficiency street sweeping (which addresses aesthetics, road safety, and water quality). Urban planners and others responsible for managing urban and suburban areas can first identify and implement pollution prevention strategies and examine source control opportunities. They should seek out priority pollutant reduction opportunities, then protect natural areas that help control runoff, and finally begin ecological restoration and retrofit activities to clean up degraded water bodies. Local governments are encouraged to take lead roles in public education efforts through public signage, storm drain marking, pollution prevention outreach campaigns, and partnerships with citizen groups and businesses. Citizens can help prioritize the clean-up strategies, volunteer to become involved in restoration efforts, and mark storm drains with approved "don't dump" messages.

Related Publications

Turn Your Home into a Stormwater Pollution Solution!

www.epa.gov/nps

This web site links to an EPA homeowner's guide to healthy habits for clean water that provides tips for better vehicle and garage care, lawn and garden techniques, home improvement, pet care, and more.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas

www.epa.gov/owow/nps/urbanmm

This technical guidance and reference document is useful to local, state, and tribal managers in implementing management programs for polluted runoff. Contains information on the best available, economically achievable means of reducing pollution of surface waters and groundwater from urban areas.

Onsite Wastewater Treatment System Resources

www.epa.gov/owm/onsite

This web site contains the latest brochures and other resources from EPA for managing onsite wastewater treatment systems (OWTS) such as conventional septic systems and alternative decentralized systems. These resources provide basic information to help individual homeowners, as well as detailed, up-to-date technical guidance of interest to local and state health departments.

Low Impact Development Center

www.lowimpactdevelopment.org

This center provides information on protecting the environment and water resources through integrated site design techniques that are intended to replicate preexisting hydrologic site conditions.

Stormwater Manager's Resource Center (SMRC)

www.stormwatercenter.net

Created and maintained by the Center for Watershed Protection, this resource center is designed specifically for stormwater practitioners, local government officials, and others that need technical assistance on stormwater management issues.

Strategies: Community Responses to Runoff Pollution

www.nrdc.org/water/pollution/storm/stoinx.asp

The Natural Resources Defense Council developed this interactive web document to explore some of the most effective strategies that communities are using around the nation to control urban runoff pollution. The document is also available in print form and as an interactive CD-ROM.

For More Information

U.S. Environmental Protection Agency
Nonpoint Source Control Branch (4503T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

www.epa.gov/nps

February 2003

STORMWATER Pollution Prevention

Important Phone Numbers

San Bernardino County Flood Control
(909) 387-8112

County of San Bernardino
(909) 387-8109

City of Big Bear Lake
(909) 866-5831

City of Chino (909) 591-9850

City of Chino Hills (909) 364-2722

City of Colton (909) 370-6128

City of Fontana (909) 350-6772

City of Grand Terrace
(909) 824-6671 x 226

City of Highland (909) 864-8732 x 230

City of Loma Linda (909) 799-4405

City of Montclair (909) 625-9470

City of Ontario (909) 395-2025

City of Rancho Cucamonga
(909) 477-2740 x 4063

City of Redlands (909) 798-7655

City of Rialto (909) 421-4921

City of San Bernardino (909) 384-5154

City of Upland (909) 931-4370

City of Yucaipa (909) 797-2489 x 243

San Bernardino County
Stormwater Program
825 East Third Street • Room 201
San Bernardino, CA 94215-0835

STORMWATER Pollution Prevention

INDUSTRIAL AND COMMERCIAL FACILITIES

STORMWATER Pollution Prevention

To reduce the amount of pollutants reaching our storm drain system, which leads to the Santa Ana River and Pacific Ocean, the San Bernardino County Stormwater Program has developed Best Management Practices (BMPs) for Industrial and Commercial Facilities. City and County ordinances require that businesses comply with these BMPs, where applicable, to protect local water quality. Local cities and the County are required to verify implementation of these BMPs by performing regular facility inspections.

Prohibited Discharges

- Discontinue all non-stormwater discharges to the storm drain system. It is prohibited to discharge any chemicals, wastes or wastewater into the gutter, street or storm drain.

Outdoor Storage

- Install covers and secondary containment areas for all hazardous materials and wastes stored outdoors in accordance with County and/or City standards.
- Keep all temporary waste containers covered, except when in direct use.
- Sweep outdoor areas instead of using a hose or pressure washer.

Outdoor Processes

- Move all process operations including vehicle and equipment maintenance inside of the building or into a covered and contained area.
- Wash equipment and vehicles in a contained and covered wash bay which is closed-loop or connected to a clarifier sized to city standards, then discharged to a sanitary sewer or take them to a commercial car wash.

Spills and Clean Ups

- Clean up spills immediately when they occur, using dry clean up methods such as absorbent materials and followed by proper disposal of materials.
- Always have a spill kit available near chemical loading dock doors, vehicle maintenance and fueling areas.
- Follow your Business Emergency Plan, as filed with the County Fire Department at (909) 386-8401.

Industrial and Commercial Facilities

- Report all prohibited discharges and non-implementation of BMPs to your local Stormwater Coordinator either at (800) CLEANUP or as listed at www.sbcounty.gov/stormwater.
- Report hazardous materials spills to (800) 33 TOXIC and your local Fire Department Hazmat Team at 911.

Training

Train employees in spill response procedures and prohibited discharges to the storm drain system, as prescribed in your local Stormwater Ordinance and in applicable Best Management Practices available at www.cabmphandbooks.com and www. sbcounty.gov/stormwater.

Permitting

Stormwater discharges associated with specific categories of commercial and industrial facilities are regulated by the State Water Resources Control Board (SWRCB) through an Industrial Storm Water General Permit. A copy of the General Permit and application forms are available at: www.waterboards.ca.gov/stormwtr/industrial.html

To report illegal dumping or for more information on stormwater pollution prevention, call:

1 (800) CLEANUP

or visit our websites at:

www.sbcounty.gov/stormwater

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

Prevención de Contaminación
AL SISTEMA DE DRENAJE

Números de Teléfono Importantes

San Bernardino County Flood Control
(909) 387-8112

County of San Bernardino
(909) 387-8109

City of Big Bear Lake
(909) 866-5831

City of Chino (909) 591-9850

City of Chino Hills (909) 364-2722

City of Colton (909) 370-6128

City of Fontana (909) 350-6772

City of Grand Terrace
(909) 824-6671 x 226

City of Highland (909) 864-8732 x 230

City of Loma Linda (909) 799-4405

City of Montclair (909) 625-9470

City of Ontario (909) 395-2025

City of Rancho Cucamonga
(909) 477-2740 x 4063

City of Redlands (909) 798-7655

City of Rialto (909) 421-4921

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City of Yucaipa (909) 797-2489 x 243

San Bernardino County
Stormwater Program
825 East Third Street • Room 201
San Bernardino, CA 94215-0835

Prevención de Contaminación
AL SISTEMA DE DRENAJE

INSTALACIONES INDUSTRIALES Y COMERCIALES

Prevención de Contaminación
AL SISTEMA DE DRENAJE

Para reducir la cantidad de contaminantes que alcanzan nuestro sistema de aguas pluviales, las cuales desembocan en el Río Santa Ana y el Océano Pacífico, el Programa del Condado de San Bernandino ha desarrollado las pautas de Mejores Prácticas de Manejo (BMPs, por sus siglas en inglés) para instalaciones industriales y comerciales. Los decretos de la ciudad y del condado establecen que todas las empresas deben de cumplir con estas BMPs, cuando corresponda, para proteger la calidad del agua local. Las ciudades locales y el condado tienen la obligación de verificar la implementación de estas BMPs al llevar a cabo inspecciones regulares en sus instalaciones.

Desagües Prohibidos

- Descontinúe todo desagüe de aguas no pluviales al sistema de drenaje de aguas pluviales. Está prohibido descargar cualquier sustancia química, residuo o agua residual a los drenajes de la cuneta, de la calle o de aguas pluviales.

Almacenamiento al Aire Libre

- Instale cubiertas y áreas de retención secundarias para todos los materiales peligrosos y residuos almacenados al aire libre, estas instalaciones deberán de cumplir con los estándares establecidos por el condado y/o la ciudad.
- Mantenga todos los recipientes temporales de residuos cubiertos, con la excepción de cuando se estén utilizando directamente.
- Barra todas las áreas al aire libre en lugar de usar una manguera o un equipo de limpieza con agua a alta presión.

Procesos al Aire Libre

- Reubique todos los procesos u operaciones, incluyendo el mantenimiento de vehículos y equipo, dentro de un edificio en una área cubierta e independiente.
- Lave el equipo y los vehículos en una fosa de lavado independiente que tenga un anillo cerrado o bien, esté conectada a un clarificador del tamaño de los estándares municipales, luego elimine los residuos en un drenaje sanitario o llévelos a un lavador de carros comercial.

Derrames y Limpieza

- Limpie los derrames inmediatamente, utilice métodos de limpieza en seco como son el uso de materiales absorbentes y elimine estos materiales de la manera adecuada.
- Siempre tenga a la mano un estuche para derrames cerca de las puertas de los muelles de carga de sustancias químicas, en las áreas de mantenimiento de vehículos y en las áreas de combustible.
- Siga su Plan de Emergencia Comercial, como lo registró con el Departamento de Bomberos del Condado marcando al (909) 386-8401.
- Reporte todos los desagües prohibidos y cualquier punto no implementado de las BMPs a su coordinador local de Aguas Pluviales llamando al (800) CLEANUP o como se indica en el enlace www.sbcounty.gov/stormwater.
- Reporte cualquier derrame peligroso al (800) 33 TOXIC y al equipo Hazmat de su departamento local de bomberos marcando al 911.

Instalaciones Industriales y Comerciales

Capacitación

Capacite a los empleados sobre los procedimientos de respuesta ante un derrame y los desagües prohibidos al sistema de aguas pluviales, como lo indica el decreto local de aguas pluviales de Mejores Prácticas de Manejo (BMPs) disponibles en el sitio www.cabmphandbooks.com y www.sbcounty.gov/stormwater.

Autoridad Competente

Los desagües de aguas pluviales relacionados con categorías específicas de instalaciones comerciales e industriales están regulados por la Junta Estatal de Control de Recursos Acuáticos (State Water Resources Control Board, SWRCB) a través de un permiso industrial general de aguas pluviales. Para obtener una copia de este permiso general y una solicitud, visite el sitio: www.waterboards.ca.gov/stormwtr/industrial.html

Para reportar el desagüe de residuos ilegales o para obtener información adicional sobre la prevención de contaminación a las aguas pluviales, llame a:

1 (800) CLEANUP

o visite nuestro sitio:

www.sbcounty.gov/stormwater

www.1800cleanup.org

San Bernardino County STORMWATER PROGRAM

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

- 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.

*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

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

Outdoor Loading/Unloading SC-30

Objectives

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

Description

The loading/unloading of materials usually takes place outside on docks or terminals; therefore, materials spilled, leaked, or lost during loading/unloading may collect in the soil or on other surfaces and have the potential to be carried away by stormwater runoff or when the area is cleaned. Additionally, rainfall may wash pollutants from machinery used to unload or move materials. Loading and unloading of material may include package products, barrels, and bulk products. Implementation of the following protocols will prevent or reduce the discharge of pollutants to stormwater from outdoor loading/unloading of materials.

Targeted Constituents

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

Approach

Pollution Prevention

- Keep accurate maintenance logs to evaluate materials removed and improvements made.
- Park tank trucks or delivery vehicles in designated areas so that spills or leaks can be contained.
- Limit exposure of materials with the potential to contaminate stormwater.
- Prevent stormwater runon.
- Regularly check equipment for leaks.

CASQA California Stormwater Quality Association

Suggested Protocols

Loading and Unloading – General Guidelines

- Develop an operations plan that describes procedures for loading and/or unloading.
- Do not conduct loading and unloading during wet weather, whenever possible.
- Cover designated loading/unloading areas to reduce exposure of materials to rain.
- A seal or door skirt between delivery vehicles and building can reduce or prevent exposure to rain.
- Design loading/unloading area to prevent stormwater runon which would include grading or berming the area, and positioning roof downspouts so they direct stormwater away from the loading/unloading areas.
- If feasible, load and unload all materials and equipment in covered areas such as building overhangs at loading docks.
- Load/unload only at designated loading areas.
- Use drip pans underneath hose and pipe connections and other leak-prone spots during liquid transfer operations, and when making and breaking connections. Several drip pans should be stored in a covered location near the liquid transfer area so that they are always available, yet protected from precipitation when not in use. Drip pans can be made specifically for railroad tracks. Drip pans must be cleaned periodically, and drip collected materials must be disposed of properly.
- Pave loading areas with concrete instead of asphalt.
- Avoid placing storm drains in the area.
- Grade and/or berm he loading/ unloading area to a drain that is connected to a dead-end sump.

Inspection

- Check loading and unloading equipment regularly for leaks, including valves, pumps, flanges and connections.
- Look for dust or fumes during loading or unloading operations.

Training

- Train employees (e.g. fork lift operators) and contractors on proper spill containment and cleanup.
- Employees trained in spill containment and cleanup should be present during the loading/unloading.
- Train employees in proper handling techniques during liquid transfers to avoid spills.

- Make sure forklift operators are properly trained on loading and unloading procedures.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup
- Keep your spill prevention Control and countermeasure (SPCC) Plan up-to-date, and implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Space, material characteristics and/or time limitations may preclude all transfers from being performed indoors or under cover.

Requirements

Costs

- Should be low except when covering a large loading/unloading area.

Maintenance

- Conduct regular inspections and make repairs as necessary. The frequency of repairs will depend on the age of the facility.
- Check loading and unloading equipment regularly for leaks.
- Regular broom dry-sweeping of area.
- Conduct major clean-out of loading and unloading area and sump prior to October 1 of each year.

Supplemental Information

Further Detail of the BMP

Special Circumstances for Indoor Loading/Unloading of Materials

As appropriate loading or unloading of liquids should occur indoors so that any spills that are not completely retained can be discharged to the sanitary sewer, treatment plant, or treated in a manner consistent with local sewer authorities and permit requirements.

- For loading and unloading tank trucks to above and below ground storage tanks, the following procedures should be used:
  - The area where the transfer takes place should be paved. If the liquid is reactive with the asphalt, Portland cement should be used to pave the area.
  - Transfer area should be designed to prevent runon of stormwater from adjacent areas. Sloping the pad and using a curb, like a speed bump, around the uphill side of the transfer area should reduce run-on.

- Transfer area should be designed to prevent runoff of spilled liquids from the area. Sloping the area to a drain should prevent runoff. The drain should be connected to a dead-end sump or to the sanitary sewer (if allowed). A positive control valve should be installed on the drain.

- For transfer from rail cars to storage tanks that must occur outside, use the following procedures:

  - Drip pans should be placed at locations where spillage may occur, such as hose connections, hose reels, and filler nozzles, Use drip pans when making and breaking connections.

  - Drip pan systems should be installed between the rails to collect spillage from tank cars.

References and Resources

http://www.stormwatercenter.net/

King County - ftp://dnr.metrokc.gov/wlr/dss/spcm/Chapter%203.PDF

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

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) -
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

Building & Grounds Maintenance SC-41

Objectives

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

Targeted Constituents

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

Description

Stormwater runoff from building and grounds maintenance activities can be contaminated with toxic hydrocarbons in solvents, fertilizers and pesticides, suspended solids, heavy metals, abnormal pH, and oils and greases. Utilizing the protocols in this fact sheet will prevent or reduce the discharge of pollutants to stormwater from building and grounds maintenance activities by washing and cleaning up with as little water as possible, following good landscape management practices, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the stormwater collection system.

Approach

Reduce potential for pollutant discharge through source control pollution prevention and BMP implementation. Successful implementation depends on effective training of employees on applicable BMPs and general pollution prevention strategies and objectives.

Pollution Prevention

- Switch to non-toxic chemicals for maintenance when possible.
- Choose cleaning agents that can be recycled.
- Encourage proper lawn management and landscaping, including use of native vegetation.

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- Encourage use of Integrated Pest Management techniques for pest control.
- Encourage proper onsite recycling of yard trimmings.
- Recycle residual paints, solvents, lumber, and other material as much as possible.

Suggested Protocols

Pressure Washing of Buildings, Rooftops, and Other Large Objects

- In situations where soaps or detergents are used and the surrounding area is paved, pressure washers must use a water collection device that enables collection of wash water and associated solids. A sump pump, wet vacuum or similarly effective device must be used to collect the runoff and loose materials. The collected runoff and solids must be disposed of properly.
- If soaps or detergents are not used, and the surrounding area is paved, wash runoff does not have to be collected but must be screened. Pressure washers must use filter fabric or some other type of screen on the ground and/or in the catch basin to trap the particles in wash water runoff.
- If you are pressure washing on a grassed area (with or without soap), runoff must be dispersed as sheet flow as much as possible, rather than as a concentrated stream. The wash runoff must remain on the grass and not drain to pavement.

Landscaping Activities

- Dispose of grass clippings, leaves, sticks, or other collected vegetation as garbage, or by composting. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures on exposed soils.

Building Repair, Remodeling, and Construction

- Do not dump any toxic substance or liquid waste on the pavement, the ground, or toward a storm drain.
- Use ground or drop cloths underneath outdoor painting, scraping, and sandblasting work, and properly dispose of collected material daily.
- Use a ground cloth or oversized tub for activities such as paint mixing and tool cleaning.
- Clean paintbrushes and tools covered with water-based paints in sinks connected to sanitary sewers or in portable containers that can be dumped into a sanitary sewer drain. Brushes and tools covered with non-water-based paints, finishes, or other materials must be cleaned in a manner that enables collection of used solvents (e.g., paint thinner, turpentine, etc.) for recycling or proper disposal.
- Use a storm drain cover, filter fabric, or similarly effective runoff control mechanism if dust, grit, wash water, or other pollutants may escape the work area and enter a catch basin. This is particularly necessary on rainy days. The containment device(s) must be in place at the beginning of the work day, and accumulated dirty runoff and solids must be collected and disposed of before removing the containment device(s) at the end of the work day.

- If you need to de-water an excavation site, you may need to filter the water before discharging to a catch basin or off-site. If directed off-site, you should direct the water through hay bales and filter fabric or use other sediment filters or traps.
- Store toxic material under cover during precipitation events and when not in use. A cover would include tarps or other temporary cover material.

Mowing, Trimming, and Planting

- Dispose of leaves, sticks, or other collected vegetation as garbage, by composting or at a permitted landfill. Do not dispose of collected vegetation into waterways or storm drainage systems.
- Use mulch or other erosion control measures when soils are exposed.
- Place temporarily stockpiled material away from watercourses and drain inlets, and berm or cover stockpiles to prevent material releases to the storm drain system.
- Consider an alternative approach when bailing out muddy water: do not put it in the storm drain; pour over landscaped areas.
- Use hand weeding where practical.

Fertilizer and Pesticide Management

- Follow all federal, state, and local laws and regulations governing the use, storage, and disposal of fertilizers and pesticides and training of applicators and pest control advisors.
- Use less toxic pesticides that will do the job when applicable. Avoid use of copper-based pesticides if possible.
- Do not use pesticides if rain is expected.
- Do not mix or prepare pesticides for application near storm drains.
- Use the minimum amount needed for the job.
- Calibrate fertilizer distributors to avoid excessive application.
- Employ techniques to minimize off-target application (e.g., spray drift) of pesticides, including consideration of alternative application techniques.
- Apply pesticides only when wind speeds are low.
- Fertilizers should be worked into the soil rather than dumped or broadcast onto the surface.
- Irrigate slowly to prevent runoff and then only as much as is needed.
- Clean pavement and sidewalk if fertilizer is spilled on these surfaces before applying irrigation water.
- Dispose of empty pesticide containers according to the instructions on the container label.

- Use up the pesticides. Rinse containers, and use rinse water as product. Dispose of unused pesticide as hazardous waste.
- Implement storage requirements for pesticide products with guidance from the local fire department and County Agricultural Commissioner. Provide secondary containment for pesticides.

Inspection

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

Training

- Educate and train employees on pesticide use and in pesticide application techniques to prevent pollution.
- Train employees and contractors in proper techniques for spill containment and cleanup.
- Be sure the frequency of training takes into account the complexity of the operations and the nature of the staff.

Spill Response and Prevention

- Keep your Spill Prevention Control and Countermeasure (SPCC) Plan up-to-date.
- Place a stockpile of spill cleanup materials, such as brooms, dustpans, and vacuum sweepers (if desired) near the storage area where it will be readily accessible.
- Have employees trained in spill containment and cleanup present during the loading/unloading of dangerous wastes, liquid chemicals, or other materials.
- Familiarize employees with the Spill Prevention Control and Countermeasure Plan.
- Clean up spills immediately.

Other Considerations

Alternative pest/weed controls may not be available, suitable, or effective in many cases.

Requirements

Costs

- Cost will vary depending on the type and size of facility.
- Overall costs should be low in comparison to other BMPs.

Maintenance

Sweep paved areas regularly to collect loose particles. Wipe up spills with rags and other absorbent material immediately, do not hose down the area to a storm drain.

Supplemental Information

Further Detail of the BMP

Fire Sprinkler Line Flushing

Building fire sprinkler line flushing may be a source of non-stormwater runoff pollution. The water entering the system is usually potable water, though in some areas it may be non-potable reclaimed wastewater. There are subsequent factors that may drastically reduce the quality of the water in such systems. Black iron pipe is usually used since it is cheaper than potable piping, but it is subject to rusting and results in lower quality water. Initially, the black iron pipe has an oil coating to protect it from rusting between manufacture and installation; this will contaminate the water from the first flush but not from subsequent flushes. Nitrates, poly-phosphates and other corrosion inhibitors, as well as fire suppressants and antifreeze may be added to the sprinkler water system. Water generally remains in the sprinkler system a long time (typically a year) and between flushes may accumulate iron, manganese, lead, copper, nickel, and zinc. The water generally becomes anoxic and contains living and dead bacteria and breakdown products from chlorination. This may result in a significant BOD problem and the water often smells. Consequently dispose fire sprinkler line flush water into the sanitary sewer. Do not allow discharge to storm drain or infiltration due to potential high levels of pollutants in fire sprinkler line water.

References and Resources

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

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

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

Mobile Cleaners Pilot Program: Final Report. 1997. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA). http://www.basmaa.org/

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

The Storm Water Managers Resource Center http://www.stormwatercenter.net/

Parking/Storage Area Maintenance SC-43

Objectives

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

Targeted Constituents

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

Description

Parking lots and storage areas can contribute a number of substances, such as trash, suspended solids, hydrocarbons, oil and grease, and heavy metals that can enter receiving waters through stormwater runoff or non-stormwater discharges. The following protocols are intended to prevent or reduce the discharge of pollutants from parking/storage areas and include using good housekeeping practices, following appropriate cleaning BMPs, and training employees.

Approach

Pollution Prevention

- Encourage alternative designs and maintenance strategies for impervious parking lots. (See New Development and Redevelopment BMP Handbook).
- Keep accurate maintenance logs to evaluate BMP implementation.

Suggested Protocols

General

- Keep the parking and storage areas clean and orderly. Remove debris in a timely fashion.
- Allow sheet runoff to flow into biofilters (vegetated strip and swale) and/or infiltration devices.
- Utilize sand filters or oleophilic collectors for oily waste in low concentrations.

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- Arrange rooftop drains to prevent drainage directly onto paved surfaces.
- Design lot to include semi-permeable hardscape.

Controlling Litter

- Post "No Littering" signs and enforce anti-litter laws.
- Provide an adequate number of litter receptacles.
- Clean out and cover litter receptacles frequently to prevent spillage.
- Provide trash receptacles in parking lots to discourage litter.
- Routinely sweep, shovel and dispose of litter in the trash.

Surface cleaning

- Use dry cleaning methods (e.g. sweeping or vacuuming) to prevent the discharge of pollutants into the stormwater conveyance system.
- Establish frequency of public parking lot sweeping based on usage and field observations of waste accumulation.
- Sweep all parking lots at least once before the onset of the wet season.
- If water is used follow the procedures below:
  - Block the storm drain or contain runoff.
  - Wash water should be collected and pumped to the sanitary sewer or discharged to a pervious surface, do not allow wash water to enter storm drains.
  - Dispose of parking lot sweeping debris and dirt at a landfill.
- When cleaning heavy oily deposits:
  - Use absorbent materials on oily spots prior to sweeping or washing.
  - Dispose of used absorbents appropriately.

Surface Repair

- Pre-heat, transfer or load hot bituminous material away from storm drain inlets.
- Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form contacting stormwater runoff.
- Cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc., where applicable. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal.

- Use only as much water as necessary for dust control, to avoid runoff.
- Catch drips from paving equipment that is not in use with pans or absorbent material placed under the machines. Dispose of collected material and absorbents properly.

Inspection

- Have designated personnel conduct inspections of the parking facilities and stormwater conveyance systems associated with them on a regular basis.
- Inspect cleaning equipment/sweepers for leaks on a regular basis.

Training

- Provide regular training to field employees and/or contractors regarding cleaning of paved areas and proper operation of equipment.
- Train employees and contractors in proper techniques for spill containment and cleanup.

Spill Response and Prevention

- Refer to SC-11, Spill Prevention, Control & Cleanup.
- Keep your Spill Prevention Control and countermeasure (SPCC) plan up-to-date, nad implement accordingly.
- Have spill cleanup materials readily available and in a known location.
- Cleanup spills immediately and use dry methods if possible.
- Properly dispose of spill cleanup material.

Other Considerations

- Limitations related to sweeping activities at large parking facilities may include high equipment costs, the need for sweeper operator training, and the inability of current sweeper technology to remove oil and grease.

Requirements

Costs

Cleaning/sweeping costs can be quite large, construction and maintenance of stormwater structural controls can be quite expensive as well.

Maintenance

- Sweep parking lot to minimize cleaning with water.
- Clean out oil/water/sand separators regularly, especially after heavy storms.
- Clean parking facilities on a regular basis to prevent accumulated wastes and pollutants from being discharged into conveyance systems during rainy conditions.

SC-43 Parking/Storage Area Maintenance

Supplemental Information

Further Detail of the BMP

Surface Repair

Apply concrete, asphalt, and seal coat during dry weather to prevent contamination form contacting stormwater runoff. Where applicable, cover and seal nearby storm drain inlets (with waterproof material or mesh) and manholes before applying seal coat, slurry seal, etc. Leave covers in place until job is complete and until all water from emulsified oil sealants has drained or evaporated. Clean any debris from these covered manholes and drains for proper disposal. Use only as much water as necessary for dust control, to avoid runoff.

References and Resources

http://www.stormwatercenter.net/

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

Model Urban Runoff Program: A How-To Guide for Developing Urban Runoff Programs for Small Municipalities. Prepared by City of Monterey, City of Santa Cruz, California Coastal Commission, Monterey Bay National Marine Sanctuary, Association of Monterey Bay Area Governments, Woodward-Clyde, Central Coast Regional Water Quality control Board. July 1998 (Revised February 2002 by the California Coastal Commission).

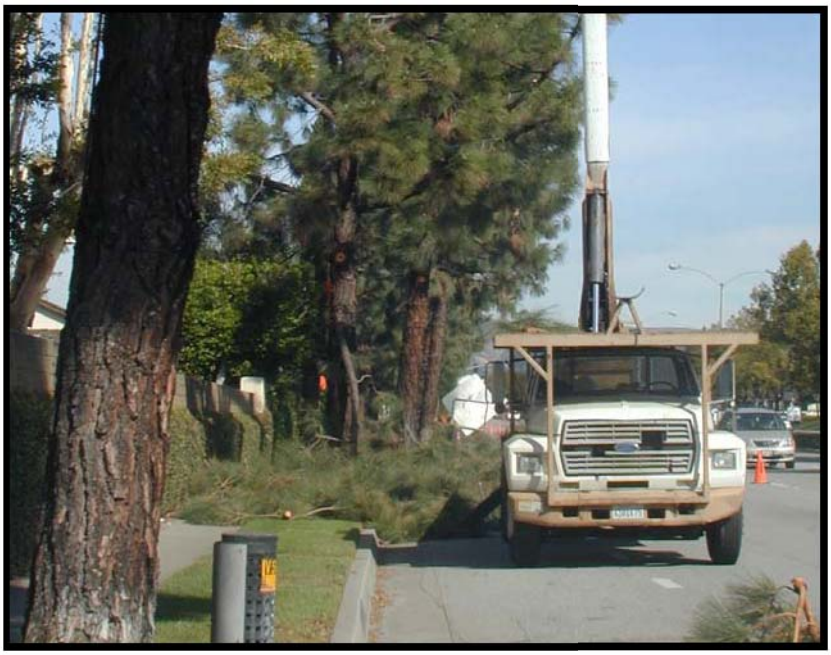
Orange County Stormwater Program
http://www.ocwatersheds.com/StormWater/swp_introduction.asp

Oregon Association of Clean Water Agencies. Oregon Municipal Stormwater Toolbox for Maintenance Practices. June 1998.

Pollution from Surface Cleaning Folder. 1996. Bay Area Stormwater Management Agencies Association (BASMAA) http://www.basma.org

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP)
http://www.projectcleanwater.org/pdf/Model%20Program%20Municipal%20Facilities.pdf

Landscape Maintenance SC-73



Objectives

- Contain
- Educate
- Reduce/Minimize
- Product Substitution

Targeted Constituents

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

Description

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

Approach

Pollution Prevention

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

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

Suggested Protocols

Mowing, Trimming, and Weeding

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

Planting

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

Waste Management

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

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

Irrigation

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

Fertilizer and Pesticide Management

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

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

Inspection

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

Training

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

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

Spill Response and Prevention

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

Other Considerations

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

Requirements

Costs

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

Maintenance

Not applicable

Supplemental Information

Further Detail of the BMP

Waste Management

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

Contractors and Other Pesticide Users

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

References and Resources

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

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

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

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

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

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

Drainage System Maintenance SC-74

Photo Credit: Geoff Brosseau

Objectives

- Contain
- Educate
- Reduce/Minimize

Description

As a consequence of its function, the stormwater conveyance system collects and transports urban runoff that may contain certain pollutants. Maintaining catch basins, stormwater inlets, and other stormwater conveyance structures on a regular basis will remove pollutants, prevent clogging of the downstream conveyance system, restore catch basins' sediment trapping capacity, and ensure the system functions properly hydraulically to avoid flooding.

Targeted Constituents

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

Approach

Suggested Protocols

Catch Basins/Inlet Structures

- Municipal staff should regularly inspect facilities to ensure the following:
  - Immediate repair of any deterioration threatening structural integrity.
  - Cleaning before the sump is 40% full. Catch basins should be cleaned as frequently as needed to meet this standard.
  - Stenciling of catch basins and inlets (see SC-75 Waste Handling and Disposal).
- Clean catch basins, storm drain inlets, and other conveyance structures in high pollutant load areas just before the wet season to remove sediments and debris accumulated during the summer.

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- Conduct inspections more frequently during the wet season for problem areas where sediment or trash accumulates more often. Clean and repair as needed.
- Keep accurate logs of the number of catch basins cleaned.
- Record the amount of waste collected.
- Store wastes collected from cleaning activities of the drainage system in appropriate containers or temporary storage sites in a manner that prevents discharge to the storm drain.
- Dewater the wastes with outflow into the sanitary sewer if permitted. Water should be treated with an appropriate filtering device prior to discharge to the sanitary sewer. If discharge to the sanitary sewer is not allowed, water should be pumped or vacuumed to a tank and properly disposed of. Do not dewater near a storm drain or stream.
- Except for small communities with relatively few catch basins that may be cleaned manually, most municipalities will require mechanical cleaners such as eductors, vacuums, or bucket loaders.

Storm Drain Conveyance System

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

Pump Stations

- Clean all storm drain pump stations prior to the wet season to remove silt and trash.
- Do not allow discharge from cleaning a storm drain pump station or other facility to reach the storm drain system.
- Conduct quarterly routine maintenance at each pump station.
- Inspect, clean, and repair as necessary all outlet structures prior to the wet season.
- Sample collected sediments to determine if landfill disposal is possible, or illegal discharges in the watershed are occurring.

Open Channel

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

(SWRCB, RWQCB, Department of Forestry, Department of Water Resources), and Federal Corps of Engineers and USFWS

Illicit Connections and Discharges

- During routine maintenance of conveyance system and drainage structures field staff should look for evidence of illegal discharges or illicit connections:
  - Is there evidence of spills such as paints, discoloring, etc.
  - Are there any odors associated with the drainage system
  - Record locations of apparent illegal discharges/illicit connections
  - Track flows back to potential dischargers and conduct aboveground inspections. This can be done through visual inspection of up gradient manholes or alternate techniques including zinc chloride smoke testing, fluorometric dye testing, physical inspection testing, or television camera inspection.
  - Once the origin of flow is established, require illicit discharger to eliminate the discharge.
- Stencil storm drains, where applicable, to prevent illegal disposal of pollutants. Storm drain inlets should have messages such as "Dump No Waste Drains to Stream" stenciled next to them to warn against ignorant or intentional dumping of pollutants into the storm drainage system.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

Illegal Dumping

- Regularly inspect and clean up hot spots and other storm drainage areas where illegal dumping and disposal occurs.
- Establish a system for tracking incidents. The system should be designed to identify the following:
  - Illegal dumping hot spots
  - Types and quantities (in some cases) of wastes
  - Patterns in time of occurrence (time of day/night, month, or year)
  - Mode of dumping (abandoned containers, "midnight dumping" from moving vehicles, direct dumping of materials, accidents/spills)
  - Responsible parties
- Post "No Dumping" signs in problem areas with a phone number for reporting dumping and disposal. Signs should also indicate fines and penalties for illegal dumping.
- Refer to fact sheet SC-10 Non-Stormwater Discharges.

- The State Department of Fish and Game has a hotline for reporting violations called Cal TIP (1-800-952-5400). The phone number may be used to report any violation of a Fish and Game code (illegal dumping, poaching, etc.).
- The California Department of Toxic Substances Control's Waste Alert Hotline, 1-800-69TOXIC, can be used to report hazardous waste violations.

Training

- Train crews in proper maintenance activities, including record keeping and disposal.
- Only properly trained individuals are allowed to handle hazardous materials/wastes.
- Train municipal employees from all departments (public works, utilities, street cleaning, parks and recreation, industrial waste inspection, hazardous waste inspection, sewer maintenance) to recognize and report illegal dumping.
- Train municipal employees and educate businesses, contractors, and the general public in proper and consistent methods for disposal.
- Train municipal staff regarding non-stormwater discharges (See SC-10 Non-Stormwater Discharges).

Spill Response and Prevention

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

Other Considerations

- Cleanup activities may create a slight disturbance for local aquatic species. Access to items and material on private property may be limited. Trade-offs may exist between channel hydraulics and water quality/riparian habitat. If storm channels or basins are recognized as wetlands, many activities, including maintenance, may be subject to regulation and permitting.
- Storm drain flushing is most effective in small diameter pipes (36-inch diameter pipe or less, depending on water supply and sediment collection capacity). Other considerations associated with storm drain flushing may include the availability of a water source, finding a downstream area to collect sediments, liquid/sediment disposal, and disposal of flushed effluent to sanitary sewer may be prohibited in some areas.
- Regulations may include adoption of substantial penalties for illegal dumping and disposal.
- Municipal codes should include sections prohibiting the discharge of soil, debris, refuse, hazardous wastes, and other pollutants into the storm drain system.
- Private property access rights may be needed to track illegal discharges up gradient.

- Requirements of municipal ordinance authority for suspected source verification testing for illicit connections necessary for guaranteed rights of entry.

Requirements

Costs

- An aggressive catch basin cleaning program could require a significant capital and O&M budget. A careful study of cleaning effectiveness should be undertaken before increased cleaning is implemented. Catch basin cleaning costs are less expensive if vacuum street sweepers are available; cleaning catch basins manually can cost approximately twice as much as cleaning the basins with a vacuum attached to a sweeper.

- Methods used for illicit connection detection (smoke testing, dye testing, visual inspection, and flow monitoring) can be costly and time-consuming. Site-specific factors, such as the level of impervious area, the density and ages of buildings, and type of land use will determine the level of investigation necessary. Encouraging reporting of illicit discharges by employees can offset costs by saving expense on inspectors and directing resources more efficiently. Some programs have used funds available from "environmental fees" or special assessment districts to fund their illicit connection elimination programs.

Maintenance

- Two-person teams may be required to clean catch basins with vactor trucks.

- Identifying illicit discharges requires teams of at least two people (volunteers can be used), plus administrative personnel, depending on the complexity of the storm sewer system.

- Arrangements must be made for proper disposal of collected wastes.

- Requires technical staff to detect and investigate illegal dumping violations, and to coordinate public education.

Supplemental Information

Further Detail of the BMP

Storm Drain flushing

Sanitary sewer flushing is a common maintenance activity used to improve pipe hydraulics and to remove pollutants in sanitary sewer systems. The same principles that make sanitary sewer flushing effective can be used to flush storm drains. Flushing may be designed to hydraulically convey accumulated material to strategic locations, such as to an open channel, to another point where flushing will be initiated, or over to the sanitary sewer and on to the treatment facilities, thus preventing re-suspension and overflow of a portion of the solids during storm events. Flushing prevents "plug flow" discharges of concentrated pollutant loadings and sediments. The deposits can hinder the designed conveyance capacity of the storm drain system and potentially cause backwater conditions in severe cases of clogging.

Storm drain flushing usually takes place along segments of pipe with grades that are too flat to maintain adequate velocity to keep particles in suspension. An upstream manhole is selected to place an inflatable device that temporarily plugs the pipe. Further upstream, water is pumped into the line to create a flushing wave. When the upstream reach of pipe is sufficiently full to

cause a flushing wave, the inflated device is rapidly deflated with the assistance of a vacuum pump, releasing the backed up water and resulting in the cleaning of the storm drain segment.

To further reduce the impacts of stormwater pollution, a second inflatable device, placed well downstream, may be used to re-collect the water after the force of the flushing wave has dissipated. A pump may then be used to transfer the water and accumulated material to the sanitary sewer for treatment. In some cases, an interceptor structure may be more practical or required to re-collect the flushed waters.

It has been found that cleansing efficiency of periodic flush waves is dependent upon flush volume, flush discharge rate, sewer slope, sewer length, sewer flow rate, sewer diameter, and population density. As a rule of thumb, the length of line to be flushed should not exceed 700 feet. At this maximum recommended length, the percent removal efficiency ranges between 65-75 percent for organics and 55-65 percent for dry weather grit/inorganic material. The percent removal efficiency drops rapidly beyond that. Water is commonly supplied by a water truck, but fire hydrants can also supply water. To make the best use of water, it is recommended that reclaimed water be used or that fire hydrant line flushing coincide with storm drain flushing.

Flow Management

Flow management has been one of the principal motivations for designing urban stream corridors in the past. Such needs may or may not be compatible with the stormwater quality goals in the stream corridor.

Downstream flood peaks can be suppressed by reducing through flow velocity. This can be accomplished by reducing gradient with grade control structures or increasing roughness with boulders, dense vegetation, or complex banks forms. Reducing velocity correspondingly increases flood height, so all such measures have a natural association with floodplain open space. Flood elevations laterally adjacent to the stream can be lowered by increasing through flow velocity.

However, increasing velocity increases flooding downstream and inherently conflicts with channel stability and human safety. Where topography permits, another way to lower flood elevation is to lower the level of the floodway with drop structures into a large but subtly excavated bowl where flood flows we allowed to spread out.

Stream Corridor Planning

Urban streams receive and convey stormwater flows from developed or developing watersheds. Planning of stream corridors thus interacts with urban stormwater management programs. If local programs are intended to control or protect downstream environments by managing flows delivered to the channels, then it is logical that such programs should be supplemented by management of the materials, forms, and uses of the downstream riparian corridor. Any proposal for steam alteration or management should be investigated for its potential flow and stability effects on upstream, downstream, and laterally adjacent areas. The timing and rate of flow from various tributaries can combine in complex ways to alter flood hazards. Each section of channel is unique, influenced by its own distribution of roughness elements, management activities, and stream responses.

Flexibility to adapt to stream features and behaviors as they evolve must be included in stream reclamation planning. The amenity and ecology of streams may be enhanced through the landscape design options of 1) corridor reservation, 2) bank treatment, 3) geomorphic restoration, and 4) grade control.

Corridor reservation - Reserving stream corridors and valleys to accommodate natural stream meandering, aggradation, degradation, and over bank flows allows streams to find their own form and generate less ongoing erosion. In California, open stream corridors in recent urban developments have produced recreational open space, irrigation of streamside plantings, and the aesthetic amenity of flowing water.

Bank treatment - The use of armoring, vegetative cover, and flow deflection may be used to influence a channel's form, stability, and biotic habitat. To prevent bank erosion, armoring can be done with rigid construction materials, such as concrete, masonry, wood planks and logs, riprap, and gabions. Concrete linings have been criticized because of their lack of provision of biotic habitat. In contrast, riprap and gabions make relatively porous and flexible linings. Boulders, placed in the bed reduce velocity and erosive power.

Riparian vegetation can stabilize the banks of streams that are at or near a condition of equilibrium. Binding networks of roots increase bank shear strength. During flood flows, resilient vegetation is forced into erosion-inhibiting mats. The roughness of vegetation leads to lower velocity, further reducing erosive effects. Structural flow deflection can protect banks from erosion or alter fish habitat. By concentrating flow, a deflector causes a pool to be scoured in the bed.

Geomorphic restoration – Restoration refers to alteration of disturbed streams so their form and behavior emulate those of undisturbed streams. Natural meanders are retained, with grading to gentle slopes on the inside of curves to allow point bars and riffle-pool sequences to develop. Trees are retained to provide scenic quality, biotic productivity, and roots for bank stabilization, supplemented by plantings where necessary.

A restorative approach can be successful where the stream is already approaching equilibrium. However, if upstream urbanization continues new flow regimes will be generated that could disrupt the equilibrium of the treated system.

Grade Control - A grade control structure is a level shelf of a permanent material, such as stone, masonry, or concrete, over which stream water flows. A grade control structure is called a sill, weir, or drop structure, depending on the relation of its invert elevation to upstream and downstream channels.

A sill is installed at the preexisting channel bed elevation to prevent upstream migration of nick points. It establishes a firm base level below which the upstream channel can not erode.

A weir or check dam is installed with invert above the preexisting bed elevation. A weir raises the local base level of the stream and causes aggradation upstream. The gradient, velocity, and erosive potential of the stream channel are reduced. A drop structure lowers the downstream invert below its preexisting elevation, reducing downstream gradient and velocity. Weirs and drop structure control erosion by dissipating energy and reducing slope velocity.

When carefully applied, grade control structures can be highly versatile in establishing human and environmental benefits in stabilized channels. To be successful, application of grade control structures should be guided by analysis of the stream system both upstream and downstream from the area to he reclaimed.

Examples

The California Department of Water Resources began the Urban Stream Restoration Program in 1985. The program provides grant funds to municipalities and community groups to implement stream restoration projects. The projects reduce damages from streambank aid watershed instability arid floods while restoring streams' aesthetic, recreational, and fish and wildlife values.

In Buena Vista Park, upper floodway slopes are gentle and grassed to achieve continuity of usable park land across the channel of small boulders at the base of the slopes.

The San Diego River is a large, vegetative lined channel, which was planted in a variety of species to support riparian wildlife while stabilizing the steep banks of the floodway.

References and Resources

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

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

San Diego Stormwater Co-permittees Jurisdictional Urban Runoff Management Program (URMP) Municipal Activities Model Program Guidance. 2001. Project Clean Water. November.

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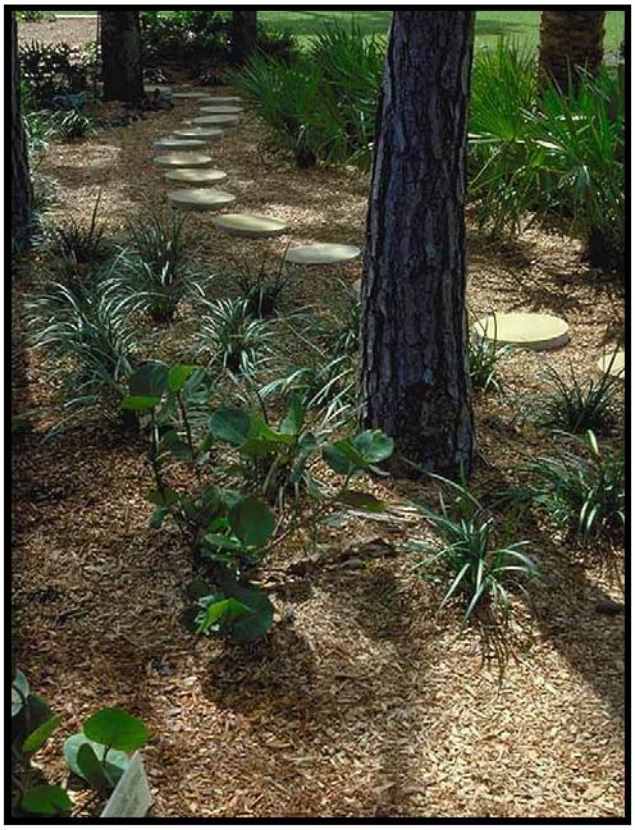
United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Illegal Dumping Control. On line: http://www.epa.gov/npdes/menuofbmps/poll_7.htm

United States Environmental Protection Agency (USEPA). 2002. Pollution Prevention/Good Housekeeping for Municipal Operations Storm Drain System Cleaning. On line: http://www.epa.gov/npdes/menuofbmps/poll_16.htm

Site Design & Landscape Planning SD-10



Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

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Designing New Installations

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

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

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

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

Conserve Natural Areas during Landscape Planning

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

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

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

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

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

- Preserve riparian areas and wetlands.

Maximize Natural Water Storage and Infiltration Opportunities Within the Landscape Unit

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

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

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

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

Protection of Slopes and Channels during Landscape Design

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

Redeveloping Existing Installations

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

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

Other Resources

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

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

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

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

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

Efficient Irrigation SD-12

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

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

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

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

Redeveloping Existing Installations

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

Other Resources

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

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

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

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

Storm Drain Signage SD-13

Design Objectives

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

Description

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

Approach

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

Suitable Applications

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

Design Considerations

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

Designing New Installations

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

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

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– 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.

Trash Storage Areas SD-32

Description

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

Approach

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

Design Objectives

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

Suitable Applications

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

Design Considerations

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

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

Designing New Installations

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

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

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

Redeveloping Existing Installations

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

Additional Information

Maintenance Considerations

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

Other Resources

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

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

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

Vortex Separator MP-51

Description

Vortex separators: (alternatively, swirl concentrators) are gravity separators, and in principle are essentially wet vaults. The difference from wet vaults, however, is that the vortex separator is round, rather than rectangular, and the water moves in a centrifugal fashion before exiting. By having the water move in a circular fashion, rather than a straight line as is the case with a standard wet vault, it is possible to obtain significant removal of suspended sediments and attached pollutants with less space. Vortex separators were originally developed for combined sewer overflows (CSOs), where it is used primarily to remove coarse inorganic solids. Vortex separation has been adapted to stormwater treatment by several manufacturers.

California Experience

There are currently about 100 installations in California.

Advantages

- May provide the desired performance in less space and therefore less cost.
- May be more cost-effective pre-treatment devices than traditional wet or dry basins.
- Mosquito control may be less of an issue than with traditional wet basins.

Limitations

- As some of the systems have standing water that remains between storms, there is concern about mosquito breeding.
- It is likely that vortex separators are not as effective as wet vaults at removing fine sediments, on the order 50 to 100 microns in diameter and less.
- The area served is limited by the capacity of the largest models.
- As the products come in standard sizes, the facilities will be oversized in many cases relative to the design treatment storm, increasing the cost.
- The non-steady flows of stormwater decreases the efficiency of vortex separators from what may be estimated or determined from testing under constant flow.
- Do not remove dissolved pollutants.
- A loss of dissolved pollutants may occur as accumulated organic

Design Considerations

- Service Area
- Settling Velocity
- Appropriate Sizing
- Inlet Pipe Diameter

Targeted Constituents

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

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

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matter (e.g., leaves) decomposes in the units.

Design and Sizing Guidelines

The stormwater enters, typically below the effluent line, tangentially into the basin, thereby imparting a circular motion in the system. Due to centrifugal forces created by the circular motion, the suspended particles move to the center of the device where they settle to the bottom. There are two general types of vortex separation: free vortex and dampened (or impeded) vortex. Free vortex separation becomes dampened vortex separation by the placement of radial baffles on the weir-plate that impede the free vortex-flow pattern

It has been stated with respect to CSOs that the practical lower limit of vortex separation is a particle with a settling velocity of 12 to 16.5 feet per hour (0.10 to 0.14 cm/s). As such, the focus for vortex separation in CSOs has been with settleable solids generally 200 microns and larger, given the presence of the lighter organic solids. For inorganic sediment, the above settling velocity range represents a particle diameter of 50 to 100 microns. Head loss is a function of the size of the target particle. At 200 microns it is normally minor but increases significantly if the goal is to remove smaller particles.

The commercial separators applied to stormwater treatment vary considerably with respect to geometry, and the inclusion of radial baffles and internal circular chambers. At one extreme is the inclusion of a chamber within the round concentrator. Water flows initially around the perimeter between the inner and outer chambers, and then into the inner chamber, giving rise to a sudden change in velocity that purportedly enhances removal efficiency. The opposite extreme is to introduce the water tangentially into a round manhole with no internal parts of any kind except for an outlet hood. Whether the inclusion of chambers and baffles gives better performance is unknown. Some contend that free vortex, also identified as swirl concentration, creates less turbulence thereby increasing removal efficiency. One product is unique in that it includes a static separator screen.

- Sized is based on the peak flow of the design treatment event as specified by local government.
- If an in-line facility, the design peak flow is four times the peak of the design treatment event.
- If an off-line facility, the design peak flow is equal to the peak of the design treatment event.
- Headloss differs with the product and the model but is generally on the order of one foot or less in most cases.

Construction/Inspection Considerations

No special considerations.

Performance

Manufacturer's differ with respect to performance claims, but a general statement is that the manufacturer's design and rated capacity (cfs) for each model is based on and believed to achieve an aggregate reduction of 90% of all particles with a specific gravity of 2.65 (glacial sand) down to 150 microns, and to capture the floatables, and oil and grease. Laboratory tests of two products support this claim. The stated performance expectation therefore implies that a

lesser removal efficiency is obtained with particles less than 150 microns, and the lighter, organic settleables. Laboratory tests of one of the products found about 60% removal of 50 micron sand at the expected average operating flow rate

Experience with the use of vortex separators for treating combined sewer overflows (CSOs), the original application of this technology, suggests that the lower practical limit for particle removal are particles with a settling velocity of 12 feet per hour (Sullivan, 1982), which represents a particle diameter of 100 to 200 microns, depending on the specific gravity of the particle. The CSO experience therefore seems consistent with the limited experience with treating stormwater, summarized above

Traditional treatment technologies such as wet ponds and extended detention basins are generally believed to be more effective at removing very small particles, down to the range of 10 to 20 microns. Hence, it is intuitively expected that vortex separators do not perform as well as the traditional wet and dry basins, and filters. Whether this matters depends on the particle size distribution of the sediments in stormwater. If the distribution leans towards small material, there should be a marked difference between vortex separators and, say, traditional wet vaults. There are little data to support this conjecture

In comparison to other treatment technologies, such as wet ponds and grass swales, there are few studies of vortex separators. Only two of manufactured products currently available have been field tested. Two field studies have been conducted. Both achieved in excess of 80% removal of TSS. However, the test was conducted in the Northeast (New York state and Maine) where it is possible the stormwater contained significant quantities of deicing sand. Consequently, the influent TSS concentrations and particle size are both likely considerably higher than is found in California stormwater. These data suggest that if the stormwater particles are for the most part fine (i.e., less than 50 microns), vortex separators will not be as efficient as traditional treatment BMPs such as wet ponds and swales, if the latter are sized according to the recommendations of this handbook.

There are no equations that provide a straightforward determination of efficiency as a function of unit configuration and size. Design specifications of commercial separators are derived from empirical equations that are unique and proprietary to each manufacturer. However, some general relationships between performance and the geometry of a separator have been developed. CSO studies have found that the primary determinants of performance of vortex separators are the diameters of the inlet pipe and chamber with all other geometry proportional to these two.

Sullivan et al. (1982) found that performance is related to the ratios of chamber to inlet diameters, D2/D1, and height between the inlet and outlet and the inlet diameter, H1/D1, shown in Figure 3. The relationships are: as D2/D1 approaches one, the efficiency decreases; and, as the H1/D1 ratio decreases, the efficiency decreases. These relationships may allow qualitative comparisons of the alternative designs of manufacturers. Engineers who wish to apply these concepts should review relevant publications presented in the References.

Siting Criteria

There are no particularly unique siting criteria. The size of the drainage area that can be served by vortex separators is directly related to the capacities of the largest models.

Additional Design Guidelines

Vortex separators have two capacities if positioned as in-line facilities, a treatment capacity and a hydraulic capacity. Failure to recognize the difference between the two may lead to significant under sizing; i.e., too small a model is selected. This observation is relevant to three of the five products. These three technologies all are designed to experience a unit flow rate of about 24 gallons/square foot of separator footprint at the peak of the design treatment event. This is the horizontal area of the separator zone within the container, not the total footprint of the unit. At this unit flow rate, laboratory tests by these manufacturers have established that the performance will meet the general claims previously described. However, the units are sized to handle 100 gallons/square foot at the peak of the hydraulic event. Hence, in selecting a particular model the design engineer must be certain to match the peak flow of the design event to the stated treatment capacity, not the hydraulic capacity. The former is one-fourth the latter. If the unit is positioned as an off-line facility, the model selected is based on the capacity equal to the peak of the design treatment event.

Maintenance

Maintenance consists of the removal of accumulated material with an eductor truck. It may be necessary to remove and dispose the floatables separately due to the presence of petroleum product.

Maintenance Requirements

Remove all accumulated sediment, and litter and other floatables, annually, unless experience indicates the need for more or less frequent maintenance.

Cost

Manufacturers provide costs for the units including delivery. Installation costs are generally on the order of 50 to 100 % of the manufacturer's cost. For most sites the units are cleaned annually.

Cost Considerations

The different geometry of the several manufactured separators suggests that when comparing the costs of these systems to each other, that local conditions (e.g., groundwater levels) may affect the relative cost-effectiveness.

References and Sources of Additional Information

Field, R., 1972, The swirl concentrator as a combined sewer overflow regulator facility, EPA/R2-72-008, U.S. Environmental Protection Agency, Washington, D.C.

Field, R., D. Averill, T.P. O'Connor, and P. Steel, 1997, Vortex separation technology, Water Qual. Res. J. Canada, 32, 1, 185

Manufacturers technical materials

Sullivan, R.H., et al., 1982, Design manual – swirl and helical bend pollution control devices, EPA-600/8-82/013, U.S. Environmental Protection Agency, Washington, D.C.

Sullivan, R.H., M.M. Cohn, J.E. Ure, F.F. Parkinson, and G. Caliana, 1974, Relationship between diameter and height for the design of a swirl concentrator as a combined sewer overflow regulator, EPA 670/2-74-039, U.S. Environmental Protection Agency, Washington, D.C.

Sullivan, R.H., M.M. Cohn, J.E. Ure, F.F. Parkinson, and G. Caliana, 1974, The swirl concentrator as a grit separator device, EPA670/2-74-026, U.S. Environmental Protection Agency, Washington, D.C.

Sullivan, R.H., M.M. Cohn, J.E. Ure, F.F. Parkinson, and G. Caliana, 1978, Swirl primary separator device and pilot demonstration, EPA600/2-78-126, U.S. Environmental Protection Agency, Washington, D.C.

APPENDIX C

WQMP AGREEMENT

RECORDING REQUESTED BY
AND WHEN RECORDED MAIL TO:

_____
(Please Print Name)
City of Rialto
335 W. Rialto Avenue
Rialto, CA 92376

SPACE ABOVE THIS LINE FOR RECORDERS USE

WATER QUALITY MANAGEMENT PLAN AND STORM WATER BMP TRANSFER, ACCESS AND MAINTENANCE AGREEMENT

CITY OF RIALTO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

This Agreement is made this _____ day of _____, 20XX, by and between _____ ("Owner"), and the City of Rialto, a municipal corporation ("City"). The Owner and the City are sometimes each individually referred to herein as a "Party" and, collectively, as the "Parties"

RECITALS

WHEREAS, the 1987 amendments to the Clean Water Act ("CWA") added new Section 402(p) to the CWA establishing a framework for regulating municipal, industrial, and construction storm water discharges under the National Pollutant Discharge Elimination System ("NPDES") Permit; and

WHEREAS, Section 402(p) of the CWA requires NPDES permits for storm water discharges from Municipal Separate Sewer Systems (MS4), as well as other designated storm water discharges that are considered significant contributors of pollutants to waters of the United States; and

WHEREAS, the City is a co-permittee under the "Waste Discharge Requirements for the County of San Bernardino and the Incorporated Cities of San Bernardino County, Order No. R8-2010-0036, NPDES NO> CAS618036, Areawide Urban Storm Water Runoff" dated January 29, 2010 and issued by the California Regional Water Quality Control Board – Santa Ana Region, (the "NPDES Permit"); and

WHEREAS, among other things, the NPDES Permit requires the City to review and approve a Water Quality Management Plan ("WQMP") developed using the appropriate and Regional Board approved WQMP template for each new development project; and to require the preparation and implementation of an Operation and Maintenance Plan to ensure the long-term maintenance and operation of all structural and non-structural Best Management Practices ("BMPs") incorporated in each WQMP; and

WHEREAS, to comply with its obligations under the NPDES Permit with respect to new development projects the City enacted Section 12.60.260 of the Rialto Municipal Code vesting the City Engineer or designee with the authority to review and approve a WQMP for all new development projects and further requiring that the Owner of each project and the City to enter into a recordable "Water Quality Management Plan" Agreement to ensure the long term maintenance and operations of structural and non-structural BMPs in each WQMP; and

WHEREAS, the Owner is the legal property owner of the real property situated in the State of California, County of San Bernardino, County of San Bernardino, located at _____ in the City of Rialto, more commonly identified by San Bernardino County Assessor's Parcel No. _____ and more particularly and legally described in "Exhibit A," and shown on "Exhibit B," (the "Property") as Tract Map No. _____, attached hereto and incorporated herein by reference.

WHEREAS, at the time of initial approval of the development project known as _____ within the Property described herein, (the "Project"), the City required the Project to employ BMPs to minimize pollutants in urban storm water runoff in accordance with section 12.60.260 of the Rialto Municipal Code and NPDES Permit; and

WHEREAS, in order to minimize pollutants in urban storm water runoff and to minimize other adverse impacts of urban storm water runoff, the Owner has chosen to install and/or implement BMPs as described in the WQMP for the Project, on file with the City, a copy of which is on file with the City Engineer, and is incorporated herein by reference; and

WHEREAS, said WQMP for the Project has been certified by the Owner and reviewed and approved by the City; and

WHEREAS, said BMPs specified in the approved WQMP for the Project have been installed according to the approved WQMP plans and are functional as intended, and have been certified by Owner's Engineer of Record and the Owner; and

WHEREAS, said BMPs, with installation and/or implementation on private property and draining only private property, are part of a private facility with all maintenance or replacement therefore, the sole responsibility of the Owner in accordance with the terms of this Agreement; 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 proper performance of all BMPs in the WQMP for the Project, and that, furthermore, such maintenance activity will require compliance with all Federal, State, and local laws and regulations, including those pertaining to confined space and waste disposal methods, in effect at the time such maintenance occurs.

NOW THEREFORE, in consideration of the City's approval of the Project and the mutual promises contained herein, the City of Rialto and _____ hereby agrees as follows:

1. The Owner hereby provides the City or the City's designee complete access, of any duration, to the BMPs and their immediate vicinity (a) at any time, upon reasonable notice; or (b) in the event of emergency , as determined by City Engineer or designee with 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 for in Section 3, below. The City shall make every effort at all times to minimize or avoid interference with Owner's use of the Property when undertaking such inspections and repairs.

2. The Owner shall use its best efforts diligently to inspect each and every BMP installed within the Project once each calendar year prior to October 1st, to document said inspections in writing with any supporting data or materials, to maintain a record of said inspections on site at all times, and to maintain all BMPs in a manner assuring peak performance at all times. All reasonable precautions shall be exercised by the Owner and the 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 manner consistent with all relevant laws and regulations in effect at the time. As may be requested from time to time by the City, the Owner shall provide the City with documentation identifying the materials(s) removed, the quantity, and the location of disposal destination, as appropriate.

3. In the event the Owner, or its successors or assigns, fails to accomplish the necessary maintenance contemplated by this Agreement, within thirty (30) days of being given written notice by the City to do so, setting forth with specificity the actions to be taken, the City is authorized to cause any maintenance necessary to be done and charge the entire cost and expense to the Owner or the Owner's successors or assigns, including administrative costs, attorneys fees and interest thereon at the maximum rate authorized by the law, twenty (20) days after the Owner's receipt of the notice of expense until paid in full.

4. The City may require the Owner to post security in a form and for a time period satisfactory to the City to guarantee the performance of the obligations stated herein. Should the Owner fail to perform the obligations under this Agreement, the City may, in the case of a cash bond, act for the Owner using the cash proceeds, or in the case of a surety bond, require the sureties to perform the obligations of this Agreement. As an additional remedy, the City Engineer may reasonably withdraw any previous storm water-related approval with respect to the Property on which BMPs have been improperly installed, modified without permission of the City and/or inadequately implemented and maintained until such time as the Owner repays to the City its reasonable costs incurred in accordance with paragraph 3 above.

5. This Agreement affects County of San Bernardino Assessor's Parcel Nos. _____, and shall be recorded in the Official Records of the County of San Bernardino County 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. This agreement shall also entitle the City to record a lien against the Property in such amount as will fully reimburse the City, including interest as herein above set forth, subject to foreclosure in event of default in payment.

6. In event any action is commenced to enforce or interpret any of the terms or conditions of this agreement the prevailing Party shall, in addition to any costs and other relief, be entitled to the recovery of its reasonable attorney's fees, including fees for the use of in-house counsel by a Party.

7. It is the intent of the Parties that the burdens and benefits herein undertaken shall constitute equitable servitudes that run with the Property and shall be binding upon future Owners of all or any portion of the Property. Any Owner's liability hereunder shall terminate at the time it ceases to be an Owner of the encumbered Property, except for obligations which accrue prior to the date of transfer by such Owner, which shall remain the personal obligation of such Owner.

8. 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 heirs, successors, executors, administrators, and assigns. The Owner shall notify any successor to title of all or part of the Property about the existence of this Agreement. The Owner shall provide a copy of such notice to the City at the same time such notice is provided to the successor.

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

10. Any notice to the Party required or called for in this Agreement shall be in writing and 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.

CITY	OWNER
Public Works Director/City Engineer	_____
City of Rialto	_____
335 W. Rialto Avenue	_____
Rialto, CA 92376	_____

11. This Agreement shall be governed by and constructed in accordance with the laws of the State of California.

12. Any amendment to this Agreement shall be in writing and approved by the City Engineer and the Owner.

IN WITNESS WHEREOF, the Parties hereto have affixed their signatures as the date first written above.

CITY OF RIALTO

By: _____
Savat Kamphou, P.E.
City Engineer

OWNER:

By: _____
Name: _____
Company Name: _____

APPENDIX D

BMP OPERATION & MAINTENANCE (O&M)

Contech® CMP Detention Inspection and Maintenance Guide

Underground stormwater detention and infiltration systems must be inspected and maintained at regular intervals for purposes of performance and longevity.

Inspection

Inspection is the key to effective maintenance of CMP detention systems and is easily performed. Contech recommends ongoing, annual inspections. Sites with high trash load or small outlet control orifices may need more frequent inspections. The rate at which the system collects pollutants will depend more on-site specific activities rather than the size or configuration of the system.

Inspections should be performed more often in equipment washdown areas, in climates where sanding and/or salting operations take place, and in other various instances in which one would expect higher accumulations of sediment or abrasive/corrosive conditions. A record of each inspection is to be maintained for the life of the system.

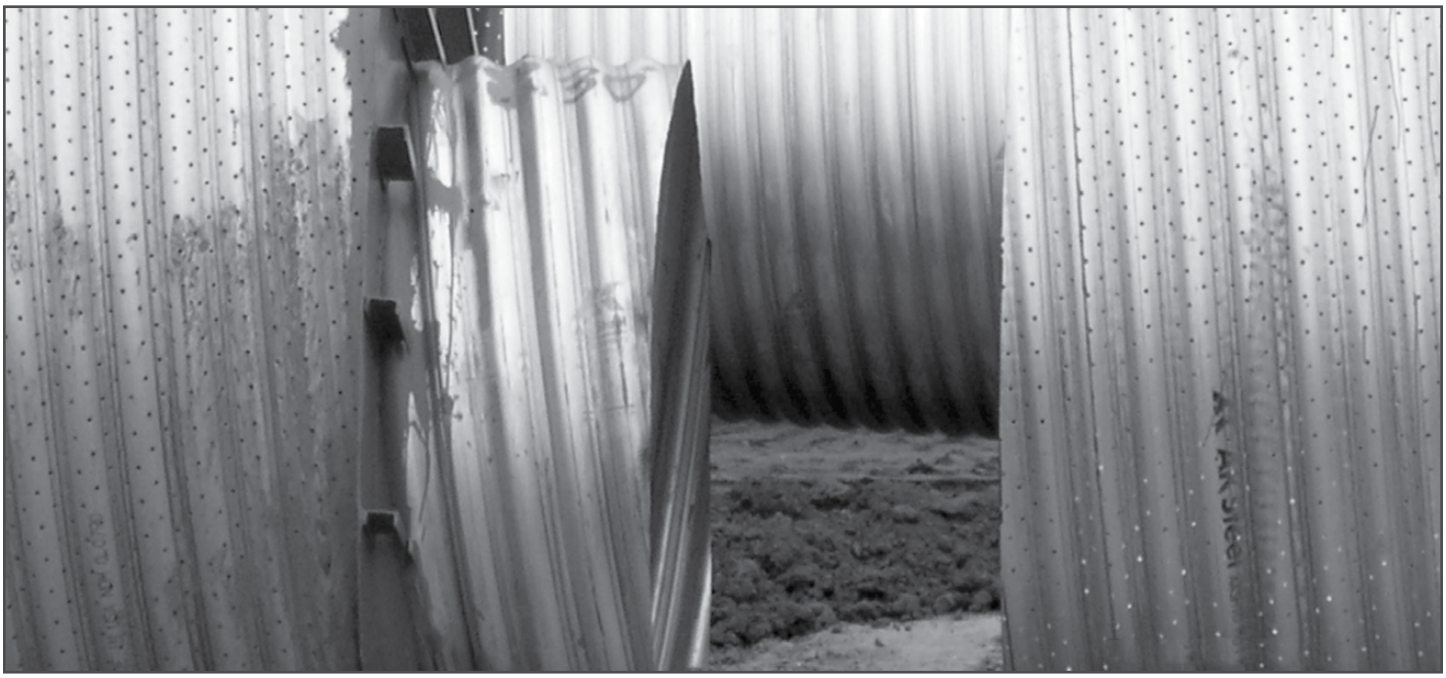
Maintenance

CMP detention systems should be cleaned when an inspection reveals accumulated sediment or trash is clogging the discharge orifice. Accumulated sediment and trash can typically be evacuated through the manhole over the outlet orifice. If maintenance is not performed as recommended, sediment and trash may accumulate in front of the outlet orifice. Manhole covers should be securely seated following cleaning activities. Contech suggests that all systems be designed with an access/inspection manhole situated at or near the inlet and the outlet orifice. Should it be necessary to get inside the system to perform maintenance activities, all appropriate precautions regarding confined space entry and OSHA regulations should be followed.

Annual inspections are best practice for all underground systems. During this inspection if evidence of salting/de-icing agents is observed within the system, it is best practice for the system to be rinsed, including above the spring line soon after the spring thaw as part of the maintenance program for the system.

Maintaining an underground detention or infiltration system is easiest when there is no flow entering the system. For this reason, it is a good idea to schedule the cleanout during dry weather.

The foregoing inspection and maintenance efforts help ensure underground pipe systems used for stormwater storage continue to function as intended by identifying recommended regular inspection and maintenance practices. Inspection and maintenance related to the structural integrity of the pipe or the soundness of pipe joint connections is beyond the scope of this guide.



CONTECH®
CMP DETENTION SYSTEMS

CONTECH®
ENGINEERED SOLUTIONS

CONTECH®
ENGINEERED SOLUTIONS

CMP Detention and Infiltration Installation Guide

CMP Detention and Infiltration Installation Guide

Proper installation of a flexible underground detention system will ensure long-term performance. The configuration of these systems often requires special construction practices that differ from conventional flexible pipe construction. Contech recommends scheduling a preconstruction meeting with your local Contech Representative to determine if additional measures, not covered in this guide, are appropriate for your site.

Preconstruction Meeting

It is a best practice to have a pre-construction meeting with the installation contractor and Contech personnel. Included at the end of this guide is a preconstruction checklist to review prior to installation.

Proper Pipe Unloading, Handling and Placement

The pipe should be unloaded off the flatbed trailer with a fork lift, excavator, crane or other piece of construction equipment. The pipe should never be dropped or rolled off the flatbed trailer. Nylon slings or lifting lugs should be used to lift the pipe into place.

Normally the header row pipe section is placed on the downstream end. For detention systems with a single header row on one end and pipe with bulkheads on the other end; it is a best practice to start pipe placement on the header row end.

Lifting CMP off the flatbed with a front end loader and forks.

Lifting ALT2 CMP with nylon slings.

Lowering the header pipe section into place first.

Lifting polymer-coated CMP into place with nylon slings.

Foundation and Pipe Bedding

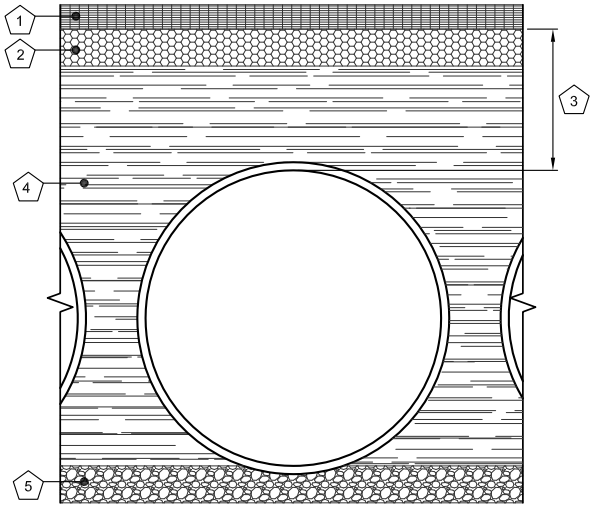
Construct a foundation that can support the design loading applied by the pipe and adjacent backfill weight as well as maintain its integrity during construction. If soft or unsuitable soils are encountered, remove the poor soils to a suitable depth and then replace with a competent granular material to the appropriate elevation. The granular material gradation should not allow the migration of fines, which can cause settlement of the detention system or pavement above. If the structural fill material is not compatible with the underlying soils a geotextile fabric should be used as a separator.

Grade the foundation subgrade to a uniform or slightly sloping grade. If the subgrade is clay or relatively non-porous and the construction sequence will last for an extended period of time, it is best to slope the grade to one end of the system. This will allow excess water to drain quickly, preventing saturation of the subgrade.

A 4" – 6" thick, well-graded granular material is preferred pipe bedding. If the existing foundation is made up of a course sand or other suitable granular material, imported bedding material will not be required.

Site conditions may require 4" – 6" of imported granular material as pipe bedding.

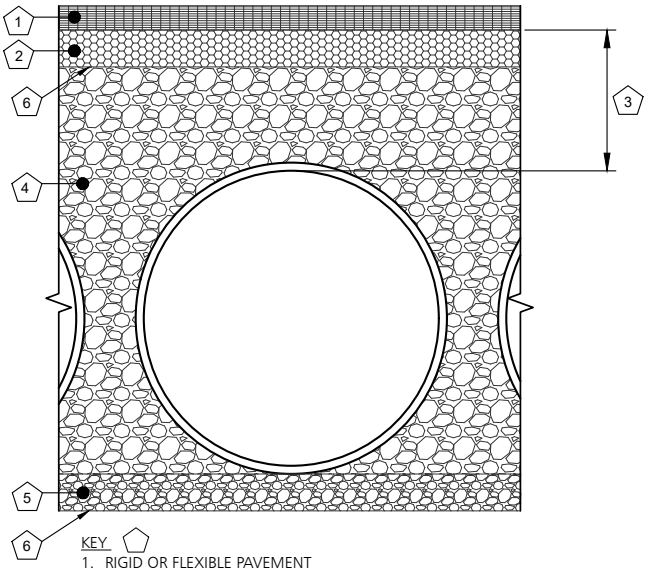
SOLIDWALL BACKFILL DETAIL



KEY ⬠

1. RIGID OR FLEXIBLE PAVEMENT
2. GRANULAR ROAD BASE
3. 12" MIN. FOR DIAMETERS THROUGH 96"
   18" MIN. FOR DIAMETERS FROM 102" AND LARGER MEASURED TO TOP OF RIGID OR BOTTOM OF FLEXIBLE PAVEMENT.
4. SELECT GRANULAR FILL PER AASHTO M145 A1, A2 OR A3 OR APPROVED EQUAL. PLACED IN 8" LIFTS (COMPACTED TO MIN. 90% STANDARD DENSITY PER AASHTO T99)
5. GRANULAR BEDDING, ROUGHLY SHAPED TO FIT THE BOTTOM OF PIPE, 4" TO 6" IN DEPTH.

PERFORATED BACKFILL DETAIL



KEY ⬠

1. RIGID OR FLEXIBLE PAVEMENT
2. GRANULAR ROAD BASE
3. 12" MIN. FOR DIAMETERS THROUGH 96"
   18" MIN. FOR DIAMETERS FROM 102" AND LARGER MEASURED TO TOP OF RIGID OR BOTTOM OF FLEXIBLE PAVEMENT.
4. FREE DRAINING ANGULAR WASHED STONE 3/4" - 2" MIN. PARTICLE SIZE.
5. GRANULAR BEDDING, ROUGHLY SHAPED TO FIT THE BOTTOM OF PIPE, 4" TO 6" IN DEPTH.
6. NON WOVEN GEOTEXTILE (IF REQUIRED), WRAPPING TRENCH ONLY. CONSULT GEOTECHNICAL EOR FOR PROJECT SPECIFIC BACKFILL REQUIREMENTS.

Connecting Bands

There are various types of connecting bands for connecting CMP. Hugger and corrugated bands are the most common. Flat gaskets or O-ring gaskets can also be used in conjunction with connecting bands to reduce leakage in the joints.

Installing a Hugger band on a perforated pipe.

Tightening bolts on a corrugated band.

Installation of band with flat neoprene gasket.

Some jobs may require special bands, such as rod and lug connection, flat bands, or dimple bands.

Geomembrane Barrier

If the underground detention system is installed under a future parking lot or roadway where winter de-icing salts are used, an HDPE liner barrier is recommended to be installed over the pipe. The liner should extend beyond the 9 and 3 o'clock positions (crown) of the pipe. The HDPE liner is intended to help protect the pipe system from the potential adverse effects of de-icing salts, including premature corrosion.

The project engineer of record is to evaluate whether de-icing salts will be used at the site in the future.

An HDPE liner is rolled out over the crown of the pipe prior to backfilling around the pipe.

For large diameter pipes, the liner is shipped in rolls that are folded in half. The liner is rolled out over the crown of the pipe, unfolded, and covered over the pipe from the nine and three o'clock position.

In-Situ Trench Wall

If excavation is required, the trench wall needs to be capable of supporting the load that the pipe sheds as the system is loaded. If soils are not capable of supporting these loads, the pipe can deflect. Perform a simple soil pressure check using the applied loads to determine the limits of excavation beyond the spring line of the outer most pipes.

In most cases, the requirements for a safe work environment and proper backfill placement and compaction take care of the concern. The contractor is responsible for the safety of his/her employees and agents.

Safe practices on construction work as outlined in the latest edition of the "Manual of Accident Prevention in Construction," published by the Associated General Contractors, shall be used as a guide and observed. The contractor shall comply with all applicable city, state, and federal safety codes in effect in the area where work is being performed. This conformance shall include the provisions of the current issue of the "OSHA Safety and Health Standards (29 CFR 1926/1910)" as published by the U.S. Department of Labor.

Backfill Material

Corrugated Steel Pipe is a flexible pipe. All buried flexible pipes are dependent on a quality backfill material for structural support. AASHTO refers to these pipe systems as, "Soil-Corrugated Metal Structure Interaction Systems". The best backfill material is an angular, well-graded, granular fill meeting the requirements of AASHTO A-1, A-2, or A-3. Aggregate materials that are free draining and compact easily such as crushed aggregate, crushed aggregate with fines, gravely sand, and coarse sand make good backfill. The aggregate particle size shall not exceed 3" in diameter.

For solid pipe, well graded or open graded granular material can be used as backfill. Infiltration pipe systems have a pipe perforation sized of 3/8" diameter. An open graded stone, with a particle size of ½" – 2 ½" diameter is recommended for backfill around perforated pipe.

Backfill using controlled low-strength material (CLSM, "flash fill", or "flowable fill") when the spacing between the pipes will not allow for placement and adequate compaction of the backfill.

EXAMPLES OF ACCEPTABLE BACKFILL MATERIAL

Course Sand

Crushed Limestone

Crushed Granite

Crushed River Gravel

Backfill Placement

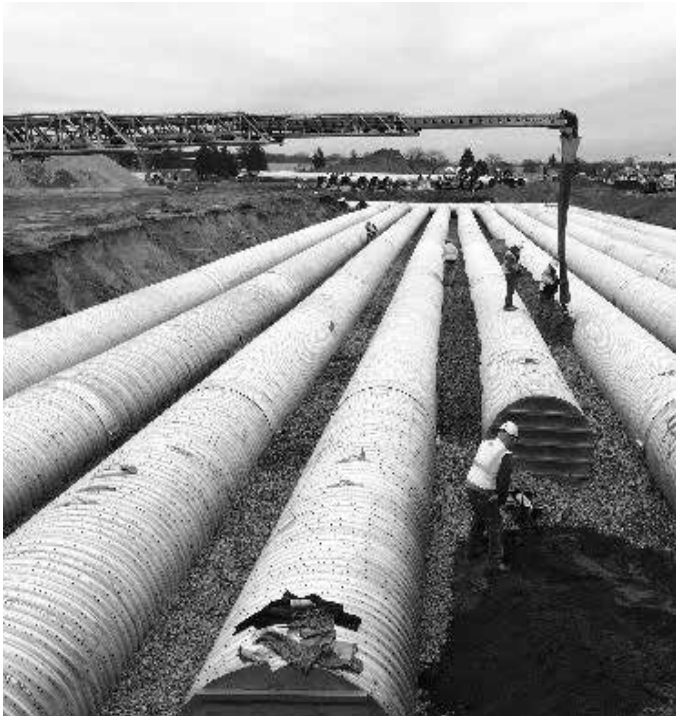
The backfill shall be placed in 8" +/- loose lifts and compacted to 90% AASHTO T99 standard proctor density. Material shall be worked into the pipe haunches by means of shovel-slicing, rodding, vibratory packer, or other effective methods. If AASHTO T99 procedures are determined infeasible by the geotechnical engineer of record, compaction is considered adequate when no further yielding of the material is observed under the compactor, or under foot, and the geotechnical engineer of record (or representative thereof) is satisfied with the level of compaction.

For large systems, conveyor systems, backhoes with long reaches may be used to place backfill. Once minimum cover for the construction loading across the entire width of the system is reached, advance the equipment to the end of the recently placed fill, and begin the sequence again until the system is completely backfilled. This type of construction sequence provides room for stockpiled backfill directly behind the backhoe, as well as the movement of construction traffic.

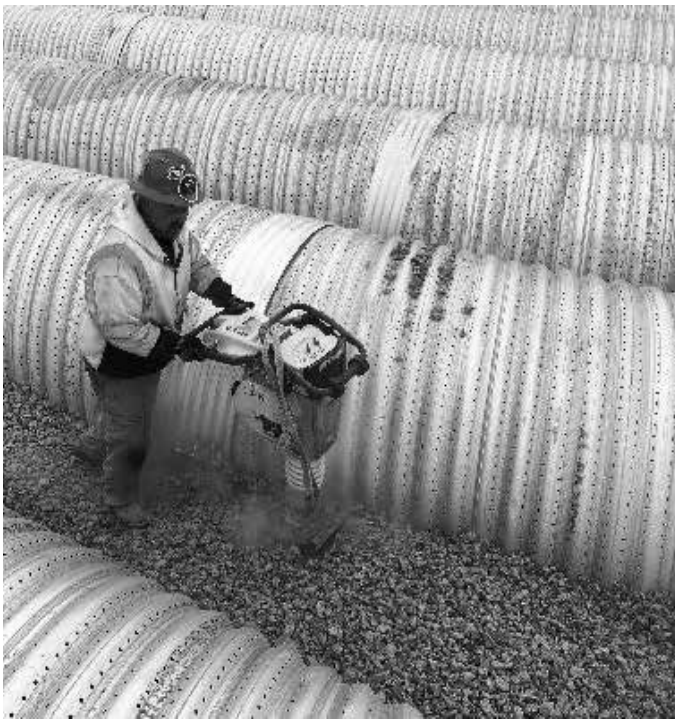
It is important to keep the elevation of backfill between pipes evenly. As a rule of thumb, do not allow for backfill to exceed the elevation of one side of pipe to the other by more than 24".

Material stockpiles on top of the backfilled detention system should be limited to 9' +/- high and must provide balanced loading across all barrels. To determine the proper minimum cover over the pipes to allow the movement of construction equipment, contact your local CONTECH Sales Engineer.

If CLSM or "flowable fill" is used as backfill, pipe flotation needs to be prevented. Typically, small lifts are placed between the pipes and then allowed to set-up prior to the placement of the next lift. The allowable thickness of the CLSM lift is a function of a proper balance between the uplift force of the CLSM, the opposing weight of the pipe, and the effect of other restraining measures. Your local Sales Engineer can help determine an appropriate lift thickness.



Placing backfill with a conveyor.



Compaction with vibratory equipment.

Final Cover Placement and Construction Loading

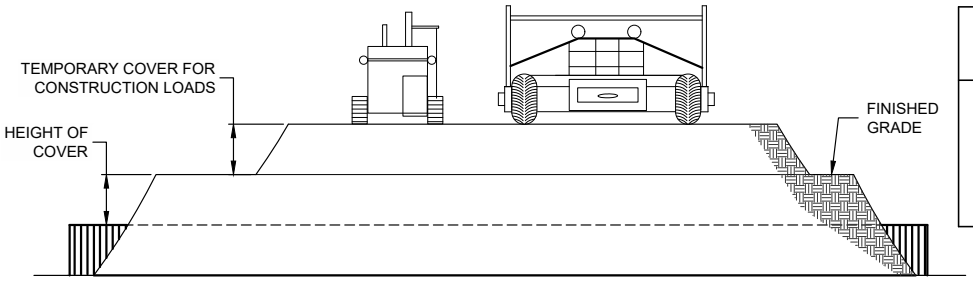
The minimum cover specified for a project normally assumes H-20 highway live loading. Backfill must be placed and fully compacted to the minimum cover level over the structure before the pipe is subjected to design loads. The minimum cover for AASHTO H-20 Live Loading per design section 12, is span of the pipe divided by eight plus asphalt pavement.

Construction loads often exceed design highway loading. During construction, keep heavy construction equipment that exceeds legal highway loads off the pipe. Light construction equipment on tracks such as a D-3 dozer (or lighter weight) may cross over the pipe when a minimum of 12" of compacted backfill is over pipe. When construction equipment that exceeds legal highway loads must cross over pipe, an additional thickness of compacted fill, beyond that required for planned cover is required. Since construction equipment varies from job to job, it is best to address equipment specific minimum cover requirements with your local Contech Sales Engineer during your pre-construction meeting.

Minimum cover for construction equipment operating on tracks is determined by the ground pressure of the tracks, total weight of the equipment, as well as the manor of operation of the equipment. As a rule of thumb, a 10,000 pound track dozer with a maximum ground pressure of 10 psi may cross over the pipe when there is a minimum of 12" of cover over the crown of the pipe. For all other tracked equipment contact your local Contech representative for minimum cover recommendations.

Examples of light, tracked, construction equipment used to place final cover over the pipe system.

Examples of heavy construction equipment that may require additional minimal cover. Contech can help evaluate minimum cover for the installation contractor for all the equipment on the site.



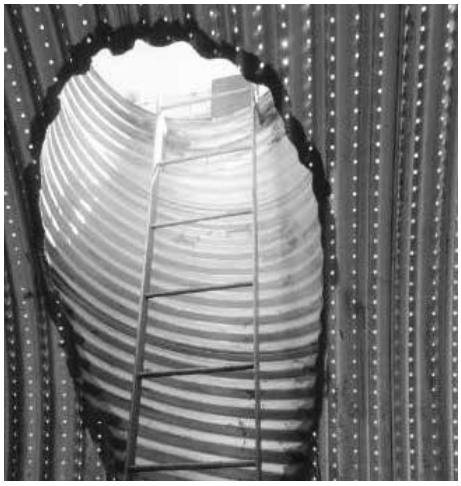
CONSTRUCTION LOADS

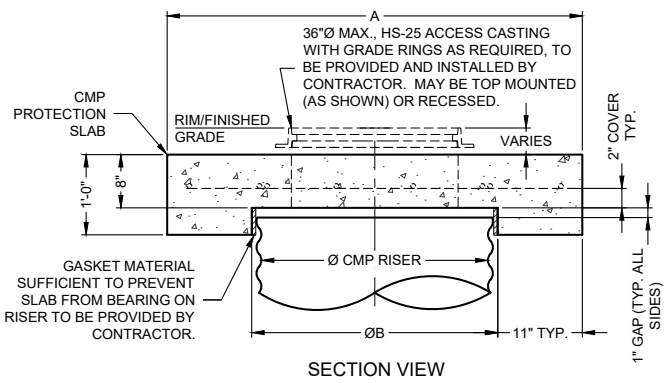
FOR TEMPORARY CONSTRUCTION VEHICLE LOADS, AN EXTRA AMOUNT OF COMPACTED COVER MAY BE REQUIRED OVER THE TOP OF THE PIPE. THE HEIGHT-OF-COVER SHALL MEET THE MINIMUM REQUIREMENTS SHOWN IN THE TABLE BELOW. THE USE OF HEAVY CONSTRUCTION EQUIPMENT NECESSITATES GREATER PROTECTION FOR THE PIPE THAN FINISHED GRADE COVER MINIMUMS FOR NORMAL HIGHWAY TRAFFIC.

PIPE SPAN, INCHES	AXLE LOADS (kips)			
	18-50	50-75	75-110	110-150
	MINIMUM COVER (FT)			
12-42	2.0	2.5	3.0	3.0
48-72	3.0	3.0	3.5	4.0
78-120	3.0	3.5	4.0	4.0
126-144	3.5	4.0	4.5	4.5

CMP Manhole Risers

CMP manhole risers allow easy access for future maintenance of the system. If the system is installed under a parking lot or road way subject to live loads, care must be taken to ensure loads are not applied directly to the riser structure. A pre-cast or cast-in-place slab should be installed above the riser. The manhole lid and frame should not rest directly on the CMP riser.





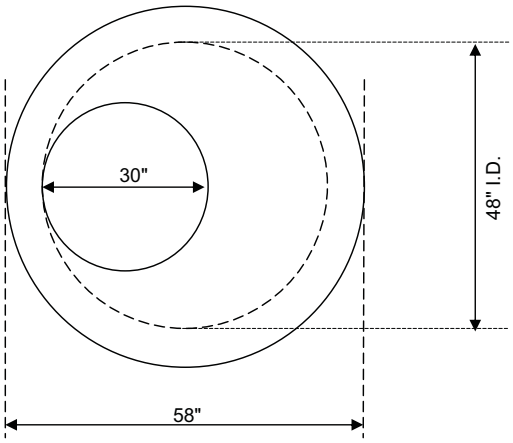
SECTION VIEW

Reinforcing Table				
Ø CMP Riser	A	ØB	Reinforcing	Bearing Pressure** (psf)
24	4′Ø	26″	#5 @ 10″ OCEW	2,540
	4′ x 4′		#5 @ 10″ OCEW	1,900
30″	4′-6″Ø	32″	#5 @ 10″ OCEW	2,260
	4′-6″ x 4′-6″		#5 @ 9″ OCEW	1,670
36″	5′Ø	38″	#5 @ 9″ OCEW	2,060
	5′ x 5′		#5 @ 8″ OCEW	1,500
42″	5′-6″Ø	44″	#5 @ 8″ OCEW	1,490
	5′-6″ x 5′-6″		#5 @ 8″ OCEW	1,370
48″	6′Ø	50″	#5 @ 7″ OCEW	1,210
	6′ x 6′		#5 @ 7″ OCEW	1,270

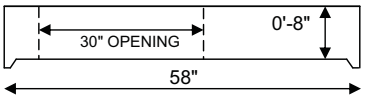
*** Assumed soil bearing capacity.*

Precast Option for Manhole Riser Caps

PLAN VIEW



SECTION



NOTES:

A.) 4000 P.S.I. CONCRETE

B.) GRADE 60 REINFORCING PER ASTM A-615

C.) BUTYL SEALANT IN JOINTS

Additional Considerations

Because most systems are constructed below-grade, rainfall can rapidly fill the excavation; potentially causing floatation and movement of the previously placed pipes. To help mitigate potential problems, it is best to start the installation at the downstream end with the outlet already constructed to allow a route for the water to escape. Temporary diversion measures may be required for high flows due to the restricted nature of the outlet pipe.

CMP Preconstruction Checklist

Contech Field Contact and Phone: _____

Contech Plant Contact and Phone: _____

Contractor Contact and Phone: _____

Project Name: _____

Site Address: _____

Pre-con Attendees: _____

Topics to Review:

- ☐ Truck access and pipe storage availability/expectation
- ☐ Pipe unloading and handling safety, equipment and procedures
- ☐ System layout and shop drawing review
- ☐ Shipping schedule and installation sequence
- ☐ Joint configuration and assembly
- ☐ Connection with unlike storm sewer materials
- ☐ Backfill material selection and placement strategy
- ☐ Backfill sequence, lift thickness and balanced loading
- ☐ Compaction requirement (90%) and equipment
- ☐ Additional cover requirements for heavy construction loads
- ☐ CMP riser concrete cap installation

Notes: _____

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The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; related foreign patents or other patents pending.

Support

Drawings and specifications are available at www.ContechES.com/cmp-detention

CMP Detention Install Guide 04/22

Retention Basin Diversion and Pretreatment Manhole: Operation and Maintenance

Maintenance Required

Trash, debris and sediment must be removed and disposed of per local jurisdiction requirements. The sump manhole shall be cleaned of all debris, silt and trash when the capacity has reached 75% of the total depth to maintain clear flow from inlet and outlet pipe.

Frequency

The diversion structure should be inspected at regular intervals (twice a year minimum) and maintained when necessary to ensure optimum performance. In addition, inspection and maintenance is required after every rain event greater than 0.5 inches.

Record Keeping

Records of inspection shall be maintained for a minimum of 5 years. At minimum, these records shall document:

- Inspection Date
- Depth of Sediment/ Trash/ Debris
- Type of Maintenance Performed
- Maintenance Personnel
- Comments

6.4 Other Supporting Documentation

- BMP Educational Materials
- Activity Restriction – C, C&R's & Lease Agreements

See Appendix B for BMP Educational Materials
See Appendix E for Geotechnical Report
See Appendix F for Hydromodification Exemption Documentation

APPENDIX E

GEOTECHNICAL REPORT

PRELIMINARY GEOTECHNICAL INVESTIGATION FOR DUE DILIGENCE PURPOSES, PROPOSED 600-ACRE RESIDENTIAL AND COMMERCIAL DEVELOPMENT, RIALTO AIRPORT AND ADJACENT PROPERTY TO THE NORTH AND EAST, EAST OF ALDER AVENUE AND SOUTH OF THE 210 FREEWAY, RIALTO, CALIFORNIA

Prepared for:

LEWIS OPERATING CORPORATION
1156 North Mountain Avenue
Upland, California 91785-0670

Project No. 021751-001

August 2, 2006

Leighton and Associates, Inc.
A LEIGHTON GROUP COMPANY

Leighton and Associates, Inc.
A LEIGHTON GROUP COMPANY

August 2, 2006

Project No. 021751-001

To: Lewis Operating Corporation
1156 North Mountain Avenue
Upland, California 91785-0670

Attention: Mr. Isaac Shikuma

Subject: Preliminary Geotechnical Investigation for Due Diligence Purposes, Proposed 600-Acre Residential and Commercial Development, Rialto Airport and Adjacent Property to the North and East, East of Alder Avenue and South of the 210 Freeway, Rialto, California

In accordance with your authorization, Leighton and Associates, Inc. has conducted this due-diligence-level preliminary geotechnical investigation for the proposed 600-acre combined residential and commercial development at the Rialto Municipal Airport and adjoining private property to the northwest and east, located east of Alder Avenue and south of the 210 Freeway in Rialto, California. The purpose of this investigation was to evaluate the general geotechnical conditions at the site, to evaluate whether there are major geotechnical or geologic issues at the site that would have significant impact to site development, and to provide preliminary geotechnical recommendations for design and construction for due diligence purposes. We have used the APN maps and detailed air photos provided by you in preparation of this report.

Our original field investigation at the Rialto Airport and adjacent property was conducted in August of 2005. However, at that time approximately 60 acres of private property were not accessible to us. Recently, 50 acres of that property (the Leiske and FJA Winery Properties) became accessible for field investigation. At the time of this report, one 10-acre parcel is not yet available for access (the area shaded in green on Figure 2). Interpolation of site conditions in this non-accessible area, based on data obtained from nearby borings and test pits, has been performed for due-diligence purposes. However, to confirm that our findings are representative,

10532 Acacia Street ▪ Suite B-6 ▪ Rancho Cucamonga, CA 91730
909.484.2205 ▪ Fax 909.484.2170 ▪ www.leightongeo.com

for this 10-acre parcel, additional borings and/or test pits should be performed when site access becomes available.

Based upon our investigation, the proposed development is feasible from a geotechnical viewpoint, provided our recommendations are incorporated in the design and construction of the project. The most significant geotechnical issues at the site are related to compressible soils and strong seismic shaking. Partial removal of the upper compressible soil will be required to provide uniform support of the proposed improvements. This report presents our findings, conclusions, and preliminary geotechnical recommendations for the project. Additional geotechnical review, evaluation and/or investigation may be required based on final development plans.

We appreciate the opportunity to work with you on this project. If you have any questions, or if we can be of further service, please call us at your convenience.

Respectfully submitted,

LEIGHTON AND ASSOCIATES, INC.

Siva K. Sivathasan, Ph. D., GE 2708
Associate Engineer

PROFESSIONAL GEOLOGIST
PHILIP A. BUCHIARELLI
No. 1715
CERTIFIED ENGINEERING GEOLOGIST
EXP 1-31-09
STATE OF CALIFORNIA

Philip A. Buchiarelli, CEG 1715
Principal Geologist

Reviewed by: David C. Smith, RCE 46222
Vice President/Principal Engineer

DAG/KS/PB/DCS/anl

Distribution: (4) Addressee
(1) Madole and Associates
Attention: Mr. Tom Miketree

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1.0 INTRODUCTION

1.1 Site Location and Project Description

The site is comprised of the existing Rialto Municipal Airport property, largely undeveloped private property to the northwest, and an approximately 5-acre parcel to the east. The site is roughly bounded on the north by the 210 Freeway (currently under construction, formerly Highland Avenue), mostly undeveloped land to the south, Ayala Drive to the east, and Alder Avenue to the west. A few commercial buildings border the site to the south and southeast, including a large commercial storage facility east of Linden Avenue and a furniture warehouse east of Laurel lane, among others. Miro Way to the south forms part of the southern site boundary.

We understand that the Rialto Airport property as well as the subject adjacent private property will be developed for a mixed-use residential and commercial development. No development plans are available at this time, however, we anticipate that the project will include single-family and/or multi-family residential housing, commercial warehouse-type structures similar to other commercial structures recently completed in the area, and perhaps retail development.

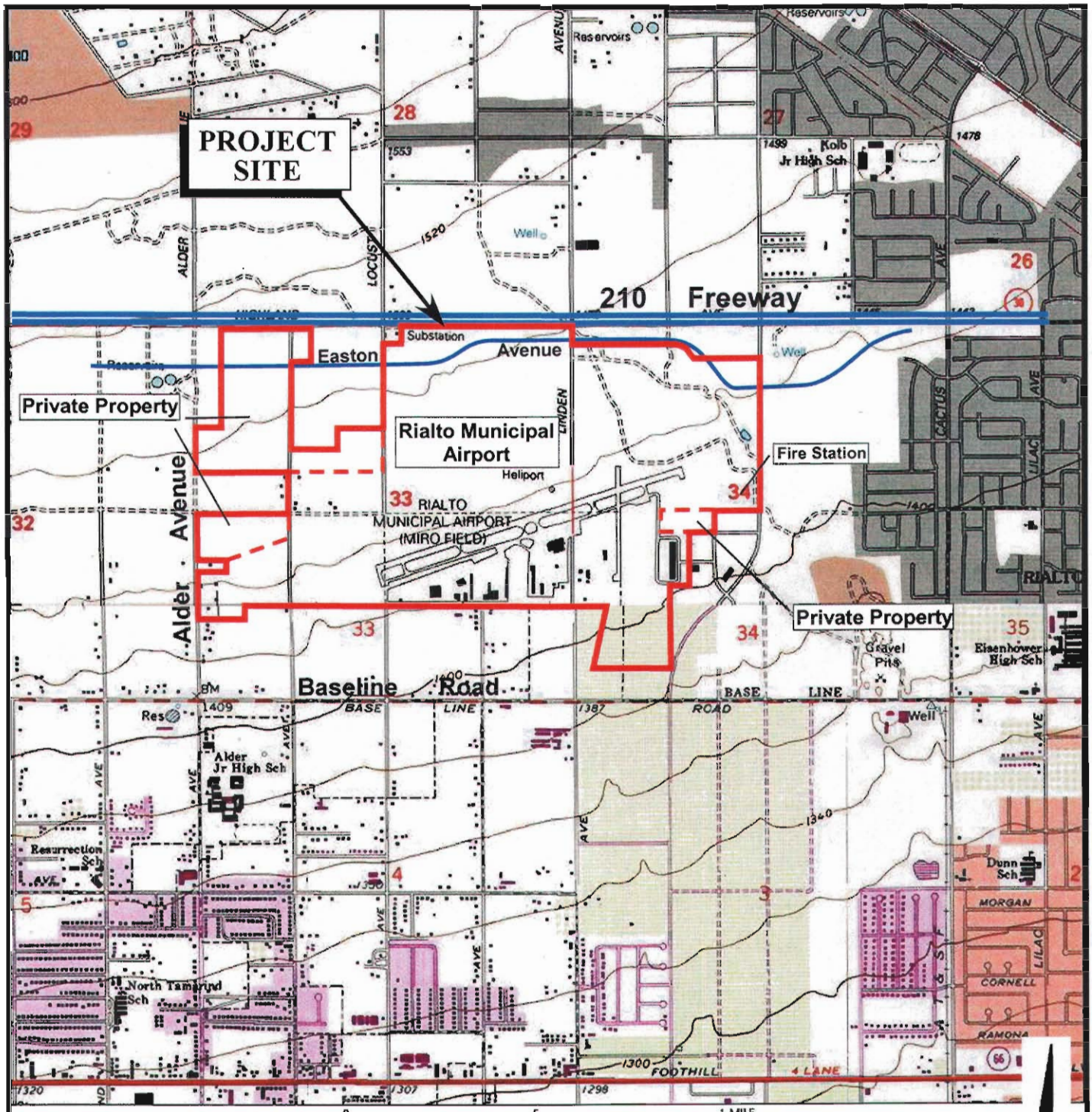
1.2 Purpose of Investigation

The purpose of this study has been to evaluate the general geotechnical conditions at the site, to identify significant geotechnical or geologic issues that would impact site development, and to provide preliminary geotechnical recommendations for design and construction.

1.3 Scope of Investigation

Approximately 60 acres of private property were not accessible to us during our initial investigation in 2005. Recently, 50 acres of that property (the Leiske and FJA Winery Properties) became accessible for field investigation (the recently accessible areas are shaded in yellow on the *Geotechnical Map*, Figure 2). At the time of this report, one 10-acre parcel is not yet available for access (the area shaded in green on Figure 2). The scope of our investigation has included the following tasks:

- Background Review - A background review of readily available, relevant, in-house geotechnical literature, and aerial photographs was performed.



Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)

BASE MAP: USGS Devore and Fontana 7.5-Minute Quadrangle Topographic Maps

Leighton

PROPOSED 600-ACRE RESIDENTIAL AND COMMERCIAL DEVELOPMENT Southwest of the 210 Freeway and Alder Avenue, Including the Rialto Municipal Airport, Rialto, California	**SITE LOCATION MAP**	PROJECT NO. 021751-001 DATE July 2006 Figure 1

- Pre-field Investigation Activities - We coordinated with airport officials and Underground Service Alert (USA) to have existing underground utilities located and marked prior to our subsurface investigation.

- Field Investigation - Our field investigation consisted of borings and test pit excavations. Due to restricted site access, our 2005 field investigation was limited to the airport property and approximately 23 acres of private property. In July of 2006, an additional 50 acres of private property became accessible for field work (the area shaded in yellow on Figure 2, *Geotechnical Map)*. At the time of this report, one 10-acre parcel (APN 0240-22-08) was not yet accessible (the area shaded in green on Figure 2).

  Hollow-stem Auger Borings

  A total of twenty-four hollow-stem auger borings (B-1 through B-24) were drilled, logged, and sampled at representative locations throughout the site. Eighteen of these borings (B-1 through B-18) were drilled in late 2005, and the remaining six borings (B-19 through B-24) were drilled in July 2006 after additional site access was granted. The borings were excavated to depths ranging from 3 to 21½ feet below the existing ground surface. Each boring was logged by a member of our technical staff. Relatively undisturbed soil samples were obtained at selected depth intervals within most of the borings using a Modified California Ring Sampler (obtaining relatively undisturbed ring samples was not always feasible due to the coarse, dry nature of the soil encountered). Standard Penetration Tests (SPT) were conducted at selected depths within the borings and samples were obtained. Bulk samples of representative soil types were also obtained from the borings. Logs of the geotechnical borings are provided in Appendix B. Boring locations are shown on the accompanying *Geotechnical Map*, Figure 2.

  Backhoe Test Pits

  Twenty backhoe test pits were excavated and logged at representative locations throughout the site to a maximum depth of 12 feet below the existing ground surface. Each test pit was logged by a member of our technical staff. Representative bulk samples of soil were obtained from the test pits. Approximate test pit locations are shown on the accompanying *Geotechnical Map*, Figure 2.

- Laboratory Tests - Laboratory tests were conducted on selected relatively undisturbed and bulk soil samples obtained during our field investigation. The laboratory testing program was designed to evaluate the engineering characteristics of the onsite soil.

Results of the laboratory testing are presented in Appendix C. The laboratory tests conducted during this investigation include:

- In situ moisture content and dry density
- Sieve analysis
- Consolidation
- R-value
- Maximum dry density and optimum moisture content
- Water-soluble sulfate
- Resistivity, chloride content and pH

- Engineering Analysis - The data obtained from our background review and field exploration was evaluated and analyzed in order to provide the conclusions and preliminary recommendations in the following sections.

- Report Preparation - The results of our geotechnical investigation have been summarized in this report, presenting our findings, conclusions and preliminary recommendations.

2.0 FINDINGS

2.1 Site Conditions

The roughly 509-acre Rialto Municipal Airport is currently an operational airport serving mostly small, private aircraft. The airport is largely undeveloped in the northern region (north, west, and east of the runway), with some westerly areas regularly being used for off-road racing. The runway and associated taxiways run diagonally through the lower 1/3 of the site. South of the runway are several paved areas with buildings, hangars, and warehouses. We understand that many of these southerly areas are currently leased by both private and public entities. In addition, a County Fire Station is located on airport property, west of Ayala Drive and north of Leiske Drive. The southernmost portion of the site has recently been used for agriculture.

The majority of the approximately 88 acres of private property is located to the north and west of the airport; a 5-acre private parcel is located east of the airport, north of Leiske Drive. The northeastern private properties are largely undeveloped and are currently covered with a thick cover of native grasses, brush, and mature trees, particularly heavy in the north. Illegal dumping has been rampant in northeastern areas, as attested to by the abundance of trash and debris scattered throughout the properties. Numerous dirt roads cross these private properties, which presumably function as firebreaks. These dirt roads have allowed for heavy vehicle access in areas that would have otherwise been inaccessible due to heavy concentrations of brush and trees. Compared to the northeast properties, the eastern 5-acre parcel is sparsely vegetated.

Taken as a whole, the roughly 600-acre site is relatively flat, draining gently to the south. Plant growth currently consists of an assortment of native grasses and brush, very heavy in some areas, as well as a fair number of mature trees occurring mostly in the north and west (off the airport property). Easton Avenue runs east-west through the northern quarter of the site.

2.2 Air Photo Review

We have reviewed historic aerial photographs for evidence of previous site use. In 1938, the site was essentially undeveloped and in a relatively natural state, with the exception of a few dirt roads crossing the site (including what would later become Linden Avenue). Much of the area surrounding the site appears to have been used for agriculture at that time. By 1953, a rough dirt runway appears at the southeast portion of the site. Some of the site was being used for agriculture at this time, and a few small structures were

present on what are now known as Alder Avenue and Laurel Avenue. Several structures were present in the southern-most portion of the site on what would later become a vineyard. These structures are assumed to be associated with the then fledgling airport. In 1977, the runway had been moved to its present location and paved. Agriculture in the northern portion of the site had ceased. Additionally, the buildings in the southern-most area had been replaced with vineyards. Several new hangar-type buildings were present at the airport, and the areas outside of the airport had been extensively plowed. Several more structures were present near Alder Avenue and Laurel Avenue, although the area was still largely vacant. A small house was present at the northeast corner of the site, surrounded by trees. During this time, the area surrounding the site was still dominated by agriculture, although some tract housing can be seen to the east. Ayala Drive was also present at this time. In 1985, several new buildings were present on the airport property, including the Sheriff's facility, and the runway had been extended somewhat. The power station just south of Highland Avenue was also present, and additional dirt roads had been cut on the western portion of the site. In 1995, the runway had been modified to include an additional taxiway. Several new hangars had been constructed on the eastern portion of the site. The house on the northeastern portion of the site was gone, although the trees remained. The southern portion of the site continued to be used for agriculture. In 2002, the site appeared much as it does today. By this time, most of the surrounding area to the north, south, and east had been converted to tract housing. Easton Street and the 210 Freeway are not present in the air photographs until sometime after 2002.

2.3 Site Geology

The site is located in the northern Peninsular Ranges Geomorphic Province of southern California within the central portion of the San Bernardino Valley. This is a geologically complex area where the relatively northwest-moving Peninsular Range Province meets the relatively south-moving Transverse Ranges Province. The San Bernardino Valley in the site vicinity is underlain by alluvial sediments eroded from granitic rocks in the local mountains. Strike-slip faults, such as the San Jacinto Fault Zone, dominate the structure of the Peninsular Ranges. The trace of the active San Andreas Fault System, approximately 10½ kilometers to the northeast, separates the valley from the rugged San Bernardino Mountains. The active San Jacinto Fault Zone is present about 2 kilometers to the northeast, and the active Cucamonga fault is located about 6½ kilometers to the northwest. The San Andreas, San Jacinto, and Cucamonga faults have experienced significant activity in the recent geologic past.

Based on available regional geologic maps, the site and surroundings are underlain by young alluvial fan deposits of the Lytle Creek fan, consisting of unconsolidated, gray,

sand and silty sand with cobbles and boulders (Morton, 2003, Morton and Matti, 2001). These deposits have been eroded from the adjacent mountains and have been transported to the site. Cretaceous-age granitic basement rock is expected to underlay the alluvial soil at depth.

2.4 Subsurface Soil Conditions

Based upon our review of pertinent geotechnical literature and our current subsurface exploration, the site is underlain by alluvial fan deposits. The soil encountered within our exploratory borings and test pits generally consisted of loose to medium dense sand with non-plastic silt and gravel, and occasional cobble- and boulder-size constituents. Rock greater than 8 inches in largest dimension comprised roughly 5 to 10 percent of the soil mass encountered across the site, and comprised as much as 15 to 20 percent locally. Rocks greater than 12 inches generally comprise less than 2 percent of the soil mass across the site. Very little soil variability was observed across the site, although the soils encountered do appear to become slightly coarser toward the north and the east. We expect the soil will increase in density with depth. Soils were generally dry to slightly moist. The near-surface soils encountered had relatively low moisture content (dry to damp) which did not increase significantly with depth. The moisture content of the upper 10 feet ranged from less than 1 percent to 4 percent, and was typically on the order of 2 percent.

Approximately 2 to 3 feet of artificial fill was identified in Test Pit TP-12 (just east of the north-south runway), but was not encountered in any of our other borings or test pits. The fill in this area is probably associated with construction of nearby flatwork (runways, tarmac, etc.). Artificial fill is likely to be present locally throughout the site, particularly near developed areas and other areas that have been subject to grading in the past. Relatively deep artificial fill will likely be associated with buried underground structures such as septic systems and underground storage tanks. In addition, we understand that a relatively deep excavation (on the order of 20 to 30 feet) was excavated as part of an environmental investigation of suspected leaking underground fuel tanks (Richard Scanlan, 2005, personal communication). This excavation resulted in the removal of the tanks. The exact depth and lateral extent of this excavation is not known, however the approximate location of the deep removals is indicated on the *Geotechnical Map*, Figure 2.

2.4.1 Compressible and Collapsible Soil

Soil compressibility refers to a soil's potential for settlement when subjected to increased loads, such as from a fill surcharge or structures. Based on our investigation, the upper 5 feet of soil is generally considered to be slightly compressible.

Collapse potential refers to the potential settlement of a soil under existing loads upon being wetted. The coarse, loose nature of the subsurface soil precluded us from obtaining a relatively undisturbed soil sample suitable for collapse testing. However, based on the type of soil encountered and our experience in the area, the potential for significant collapse is considered low.

2.4.2 Expansive Soils

Based on the type of encountered soil (sand and gravel with trace non-plastic silt) and our experience in the area, the soils exposed at pad grade are expected to exhibit a very low expansion potential.

2.4.3 Sulfate Content

Water-soluble sulfates in soil can react adversely with concrete. However, concrete in contact with soil containing sulfate concentrations of less than 0.10 percent are considered to have negligible sulfate exposure (UBC, 1997 edition, Chapter 19).

Five near-surface soil samples were tested for soluble sulfate content. The result of these tests indicated a sulfate content of 0.01 or less percent by weight, indicating negligible sulfate exposure. As such, the soils exposed at pad grade are not expected to pose a significant potential for sulfate reaction with concrete.

2.4.4 Resistivity, Chloride and pH

Soil corrosivity to ferrous metals can be estimated by the soil's pH level, electrical resistivity, and chloride content. In general, soil having a minimum resistivity less than 2,000 ohm-cm is considered corrosive. Soil with a chloride content of 500 ppm or more is considered corrosive to ferrous metals.

As a screening for potentially corrosive soil, five representative soil samples were tested for minimum resistivity, chloride content, and pH level. The tests indicated chloride contents generally on the order of 51 ppm, pH values ranging from 5.3 to 5.9, and minimum resistivities ranging from 6,200 to 35,000 ohm-cm. Based on the test results, the majority of the onsite soil is considered mildly corrosive to ferrous metals. However, laboratory test results for one sample collected from the EJA property (Boring B-20, Bag-1 at 0-5 feet) indicated a chloride content of 730 ppm, indicating that the soil tested is severely corrosive to ferrous metals.

2.5 Groundwater

Based on our review of regional groundwater data (CDWR, 2000), groundwater is expected to be on the order of 300 feet below the ground surface in the general site vicinity. USGS groundwater monitoring wells located nearby have recently recorded groundwater depths on the order of 450 feet below existing grade (Richard Scanlan, 2005, Personal Communication). As such, groundwater is not expected to be a constraint to the proposed development.

2.6 Faulting and Seismicity

The two principal seismic considerations for most sites in southern California are surface rupture along active fault traces and damage to structures due to seismically induced ground shaking. An active fault is one that has moved in the Holocene (last 11,000 years). The closest mapped potentially active fault is the San Jacinto Fault Zone, located approximately 2 kilometers northeast of the site. The San Jacinto Fault Zone is a right-lateral, strike-slip fault with an average slip rate of 12 mm pear year (±6 mm) and a maximum moment magnitude of 6.7 Mw (Cao et al, 2003). Other known regional active faults that could affect the site include the Cucamonga, San Andreas, and Cleghorn, among others. The largest and most active fault in southern California, the San Andreas Fault System, is located approximately 10½ kilometers northeast of the site.

No active or potentially active faults have been previously mapped across the project site and the site is not located within a current Alquist-Priolo Earthquake Fault Zone (CGS, 2000). The potential for fault ground rupture at the site is considered very low.

The site is likely to be subjected to strong ground shaking during the life of the project (Petersen and Wesnousky, 1994, Petersen et al., 1996). To evaluate the ground motion and a peak level of ground acceleration that the project is likely to experience, we utilized a probabilistic analysis approach. The probabilistic approach to forecasting future ground

motion at the site estimates the expected peak ground acceleration level that has a 10 percent probability of exceedance over the approximate lifetime of the project (commonly assumed at 50 years). This approach takes into account the historical seismicity of the region, the nature of nearby active faults, their distance to the site, records of previous historical earthquakes, and the site-specific response characteristics (Petersen et al., 1996).

The computer program FRISKSP (Blake, 2000) was used for the analysis. Attenuation relationships used in the computer analysis were developed by Abrahamson and Silva (1997) for soil, Campbell (1997 and 2000) for alluvium, and Sadigh et al. (1997) for deep soil deposits. The analysis indicated an average value for peak horizontal ground acceleration (PHGA) with a 10 percent probability of exceedance in 50 years of 0.96g. Hazard deaggregation indicates that the predominant earthquake magnitude is approximately 6.5 (Mw) at a distance on the order of 2 kilometers.

PHGA for the site was also estimated using California Geologic Survey (CGS) Probabilistic Seismic Hazards Mapping Ground Motion data (CGS, 2003), which utilizes a probabilistic seismic hazard analysis approach based on currently available earthquake and fault information. Based on information from the CGS, the PHGA with a 10 percent probability of being exceeded in 50 years is estimated to be approximately 0.86g.

2.7 Secondary Seismic Hazards

Liquefaction Potential

Liquefaction is the loss of soil strength or stiffness due to a buildup of excess pore-water pressure during strong ground shaking. Liquefaction is associated primarily with loose (low density), granular, saturated soil. Effects of severe liquefaction can include sand boils, excessive settlement, bearing capacity failures, and lateral spreading.

Regional groundwater maps and groundwater data indicate that shallow groundwater conditions do not exist locally, nor have they existed historically. As such, the site is not considered susceptible to liquefaction.

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 can be non-uniformly distributed, resulting in differential settlement.

We have evaluated the potential for seismically induced settlement using the simplified method set forth by Tokimatsu and Seed (1987). Based on this preliminary study, the potential total settlement resulting from seismic loading is estimated to be less than 1 inch. Differential settlement due to seismic loading is expected to be on the order of ½ inch over a horizontal distance of 40 feet.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon this study, we conclude that the proposed residential and commercial development is feasible from a geotechnical standpoint. No severe geologic or soil-related hazards or constraints that would preclude development of the site have been found during the course of this study. However, additional geotechnical review, evaluation and investigation may be required based on the final development plans.

3.1 General Earthwork and Grading

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

Site Preparation

Prior to construction, the site should be cleared of vegetation, trash, and debris. Trees and heavy brush should be removed and grubbed out, and the excavations should be backfilled with compacted fill. Any underground obstructions onsite should be removed. The resulting cavities should be properly backfilled and compacted. Efforts should be made to locate any 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. A high-pressure jet fuel line and several water lines presently cross the site; we assume that these lines will be protected in place. In addition, any uncontrolled or undocumented artificial fill should be removed.

Overexcavation and Recompaction

To reduce the potential for adverse differential settlement of the proposed structures, the underlying subgrade soil should be prepared in such a manner that a uniform response to the applied loads is achieved. The soil within residential pads should be overexcavated and recompacted to a minimum depth of 2 feet below the bottom of footings or 3 feet below the existing grade, whichever is greater. Remedial grading in areas where commercial/retail structures are planned should be based on the size and types of structures planned. However, for initial planning purposes the soil within pads intended to support commercial/retail structures should be overexcavated and recompacted to a minimum depth of 3 feet below the bottom of footings or 4 feet below the existing grade, whichever is greater. The overexcavation and recompaction should extend a minimum lateral distance of 4 feet from the footings. Local conditions may require that deeper

overexcavation be performed; such areas should be evaluated by Leighton and Associates during grading.

Areas outside the overexcavation limits of the pads planned for asphalt or concrete pavement and flatwork and areas to receive fill should be overexcavated or scarified to a minimum depth of 12 inches below the existing ground surface or 12 inches below the proposed finish grade, 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.

Fill Placement and Compaction

The onsite soil is generally suitable for use as compacted structural fill, provided it is free of debris, significant organic material, and oversized material. Any soil to be placed as fill, whether onsite or imported material, should be accepted by Leighton and Associates.

All fill soil should be placed in thin, loose lifts, moisture-conditioned, as necessary, to optimum moisture content or slightly above, and compacted to a minimum 90 percent relative compaction as determined by ASTM Test Method D1557. Aggregate base for pavement should be compacted to a minimum of 95 percent relative compaction.

Oversized Materials

It is anticipated that significant quantities of oversized material (particles greater than 12 inches) requiring special handling for disposal may be encountered locally during construction. Oversize material between 12 inches and 24 inches may be placed in areas of deep fill at depths below anticipated excavations (i.e. footings, pools, utility trenches, future developments, etc). Material greater than 24 inches should be disposed of, either as landscape material or by removal from the site. Alternatively, oversize material may be crushed and mixed with soil to be used as fill. Specific recommendations for placing oversized material should be provided during the grading and foundation plan review stage and again during grading based on field conditions.

When placing fill with significant quantities or rock, it is essential that complete flooding occurs during grading to wash finer particles of soil into the voids between the rock.

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 natural ground is moisture-conditioned and densified to receive fill. Field and laboratory data used in our calculations included laboratory-measured maximum dry densities for soil types encountered at the subject site and the measured in-place densities of soils encountered. We estimate the following earth volume changes will occur during grading:

Shrinkage	Approximately 5 to 10 percent
Subsidence	Approximately 0.1 foot

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.

3.2 Foundations

Based on our preliminary investigation and our experience in the region, conventional shallow or post-tensioned slab foundations may be used to support the loads of one- to three-story, frame-type structures. Commercial/retail structures may be supported on conventional shallow spread footings. Overexcavation and recompaction of the footing subgrade soil should be performed as detailed in Section 3.1. For planning purposes, a very low soil expansion potential may be assumed. The soil Expansion Index should be evaluated near the end of grading.

Conventional Shallow Foundations

Based on our preliminary investigation, the footings for 1-story residential structures should have a minimum embedment depth of 12 inches, with a minimum width of 24 and 12 inches for isolated and continuous footings, respectively. The footings for 2- to 3-story residential structures and commercial/retail buildings should have a minimum embedment depth of 18 inches, with a minimum width of 24 and 15 inches for isolated and continuous footings, respectively.

An allowable bearing capacity of 2,500 psf may be used for preliminary design, based on the minimum embedment depth and width. The allowable bearing value may be increased by 300 psf per foot increase in depth or width to a maximum allowable bearing

pressure of 4,500 psf. The allowable bearing pressure is for the total dead load and frequently applied live loads.

The 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 0.35. The passive resistance may be computed using an equivalent fluid pressure of 350 pounds per cubic foot (pcf), assuming there is constant contact between the footing and undisturbed soil.

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.

Footing reinforcement should be designed by the structural engineer.

Post-Tensioned Slab Foundations

As an alternative to conventional spread footings, post-tension slab foundation systems can be used. Post-tension slab foundations should be designed by the project structural engineer. The following table provides post-tension slab design information for soil with a very low expansion potential.

Post-Tension Foundation Design Recommendations		
Very Low Expansion		
Edge Moisture Variation Distance, e_m	Center Lift	5.5 feet
	Edge Lift	2.5 feet
Differential Swell, Y_m	Center Lift	1.0 inch
	Edge Lift	0.4 inch
Modulus of subgrade Reaction		120 pci

Exterior footings (thickened edges) should have a minimum depth of 12 inches below the lowest adjacent soil grade and a minimum width of 12 inches. These footings may be designed for a maximum allowable bearing pressure of 2,500 pounds per square foot. The allowable bearing capacity may be increased by one-third for short-term loading.

These recommendations are based on preliminary data. Additional testing of the soil present near finish grade should be conducted near the end of grading for final foundation design information. Local agencies, the structural engineer or the Uniform Building Code may have requirements that are more stringent.

Foundation Settlement

The recommended allowable bearing capacity is generally based on a total allowable, post construction settlement of 1 inch. Differential settlement is estimated at ½ inch over a horizontal distance of 30 feet. Since settlement is a function of footing size and contact bearing pressure, differential settlement can be expected between adjacent columns or walls where a large differential loading condition exists. These settlement estimates should be reevaluated by Leighton and Associates when foundation plans for the proposed structures become available.

3.3 Slab-On-Grade

Concrete slabs subjected to special loads should be designed by the structural engineer. Where conventional light floor loading conditions exist, the following minimum recommendations, which are based on a very low soil expansion potential, should be used:

- A minimum slab thickness of 4 inches (nominal). Reinforcement steel should be designed by the structural engineer, but as a minimum should be No. 3 rebar placed at 24 inches on center for conventional slabs-on-grade. Reinforcement should be positioned within the middle third of the slab thickness.

- A moisture barrier consisting of 10-mil Visqueen (or equivalent) placed below slabs where moisture-sensitive floor coverings or equipment is planned. The moisture barrier should be covered with a minimum of 2 inches of sand.

- The subgrade soil should be moisture conditioned to at least optimum moisture content to a minimum depth of 12 inches prior to placing the moisture barrier, steel, post-tensioned cables, or concrete.

The use of reinforcement or post-tensioned cables in slabs and foundations can generally reduce the potential for concrete cracking. However, minor cracking of the concrete as it cures, due to drying and shrinkage, is normal and should be expected. 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. The use of low slump concrete can reduce the potential for shrinkage cracking.

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

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 Uniform Building Code (UBC). The following data should be considered for the seismic analysis of the subject site:

Seismic Design Parameters	
Seismic Source	San Jacinto Fault
Distance	Approximately 2 km
Seismic Source Type (UBC, Table 16-U):	B
Seismic Zone Factor, Z (UBC, Table 16-I):	0.4
Soil Profile Type (UBC, 16-J):	S_D
Near-Source Factor N_a (UBC, Table 16-S):	1.3
Source Factor N_v (UBC, Table 16-T):	1.6

3.5 Retaining Walls

We recommend that retaining walls be backfilled with onsite, 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 up to 6 feet tall:

Static Equivalent Fluid Weight (pcf)	
Conditions	Level Backfill
Active	35
At-Rest	55
Passive	350 (Maximum of 3,500 psf)

The above values do not contain an appreciable factor of safety, so the structural engineer should apply the applicable factors of safety and/or load factors during design.

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.

Passive pressure is used to compute soil resistance to lateral structural movement. In addition, for sliding resistance, a frictional resistance coefficient of 0.35 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.

Retaining wall footings should have a minimum width of 12 inches and a minimum embedment of 12 inches below the lowest adjacent grade. An allowable bearing capacity of 2,500 psf may be used for retaining wall footing design, based on the minimum footing width and depth. This bearing value may be increased by 300 psf per foot increase in width or depth to a maximum allowable bearing pressure of 4,500 psf. Retaining walls constructed at, or near the top of slopes, or mid-slope walls should have minimum depth of embedment such that there is a minimum of 7 feet (measured horizontally) between the bottom, outside edge of the footing and the face of the descending slope.

3.6 Pavement Design

Based on the design procedures outlined in the current Caltrans Highway Design Manual, and a preliminary design R-value of 60 for the subgrade, preliminary flexible pavement section recommendations are presented in the following table 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 conducted near the completion of street grading.

PAVEMENT SECTION THICKNESS		
Traffic Index	Asphaltic Concrete (AC) Thickness (feet)	Class 2 Aggregate Base (AB) Thickness (feet)
6 or less	0.25	0.35
7	0.30	0.35

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.

All pavement construction should be performed in accordance with the Standard Specifications for Public Works Construction. Field inspection 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.

3.7 Temporary Excavations

All temporary excavations, including utility trenches, retaining wall excavations, etc. 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 structure should be properly shored to maintain support of the structure.

Typical cantilever shoring should be designed based on the active fluid pressure presented in the retaining wall section. 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 21H, 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.

3.8 Trench Backfill

Utility-type trenches onsite can be backfilled with the onsite material, provided it is free of debris 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 jetting. 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.

3.9 Surface Drainage

Surface drainage should be designed to be directed away from foundations and toward approved drainage devices or streets. Irrigation of landscaping should be controlled to maintain, as much as possible, a consistent moisture content sufficient to provide healthy plant growth without overwatering.

3.10 Cement Type 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. Common Type II cement may be used for concrete construction onsite and the concrete should be designed in accordance with Table 19-A-4 of the Uniform Building Code.

Based on our laboratory testing, the onsite soil is considered mildly corrosive to ferrous metals. The corrosion information presented in this report should be provided to your underground utility subcontractors.

3.11 Additional Geotechnical Investigation and Services

The preliminary geotechnical recommendations presented in this report are based on subsurface conditions as interpreted from limited subsurface explorations and limited laboratory testing. The 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. In addition, approximately 65 acres were not accessible to us during this investigation. As such, additional geotechnical investigation and analysis will be required based on final development plans and available site access. Leighton and Associates 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. The conclusions and preliminary recommendations presented herein should be reviewed and verified by Leighton and Associates 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.

PROJECT SITE

B - 22 T.D. = 3'
TP - 9 T.D. = 10'
B - 4 T.D. = 21½'
B - 21 T.D. = 6'
B - 20 T.D. = 7'
B - 19 T.D. = 13'
B - 3 T.D. = 21½'
TP - 19 T.D. = 10'
B - 18 Refusal @ 7½'
TP - 10 T.D. = 10½'
B - 9 Refusal @ 7'
TP - 20 T.D. = 10'
B - 8 T.D. = 21½'
TP - 16 T.D. = 11'
B - 17 T.D. = 21½'
TP - 8 T.D. = 11'
B - 7 T.D. = 21½'
TP - 14 T.D. = 10'
TP - 15 T.D. = 11½'
TP - 6 T.D. = 11'
TP - 7 T.D. = 10'
B - 6 T.D. = 21½'
B - 13 T.D. = 21½'
TP - 13 T.D. = 10'
TP - 3 T.D. = 10'
B - 16 T.D. = 20'
TP - 17 T.D. = 10'
B - 1 T.D. = 21½'
TP - 18 T.D. = 10'
TP - 2 T.D. = 10½'
B - 12 T.D. = 21½'
B - 14 T.D. = 21½'
B - 23 T.D. = 4'
B - 24 T.D. = 21½'
TP - 4 T.D. = 10'
TP - 12 T.D. = 10'
TP - 1 T.D. = 10'
TP - 5 T.D. = 10'
B - 11 T.D. = 20½'
B - 10 T.D. = 21'
B - 2 T.D. = 21½'
B - 5 Refusal @ 8½'
TP - 11 T.D. = 12'
B - 15 T.D. = 21½'

Rialto Airport

30 — 210 Freeway — 30

Alder Avenue — Laurel Ave — Riverside — Rialto — Leiske Dr — Ayala Dr — Fitzgerald Ave — Baseline Rd

APPROXIMATE LOCATION OF DEEP TANK REMOVALS

2005 Eagle Aerial — 92336

Legend

B - 24 / T.D. = 21½' — Approximate location of boring with total depth in feet

TP - 20 / T.D. = 12' — Approximate location of test pit with total depth in feet

Rialto Municipal Airport Property

Private Property with Access, 11-2005

Private Property with Access, 7-2006

Private Property, No Access

Leighton

GEOTECHNICAL MAP

PROPOSED 600-ACRE RESIDENTIAL AND COMMERCIAL DEVELOPMENT

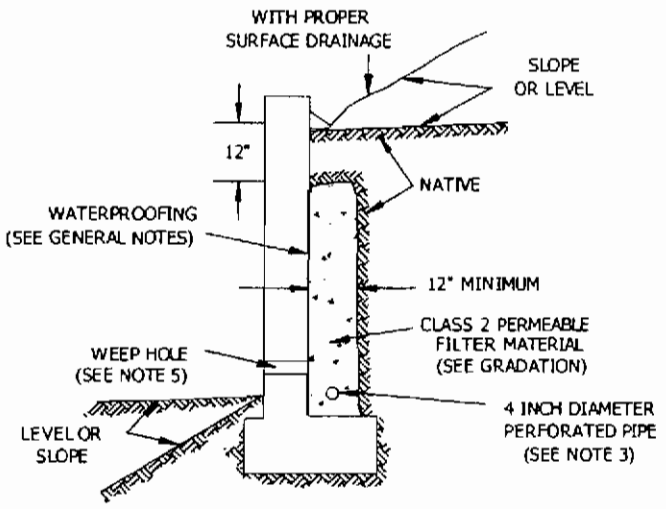
Southwest of the 210 Freeway and Alder Avenue, Including the Rialto Municipal Airport, Rialto, California

Project No.: 021751-001
Scale: No Scale
Date: July 2006

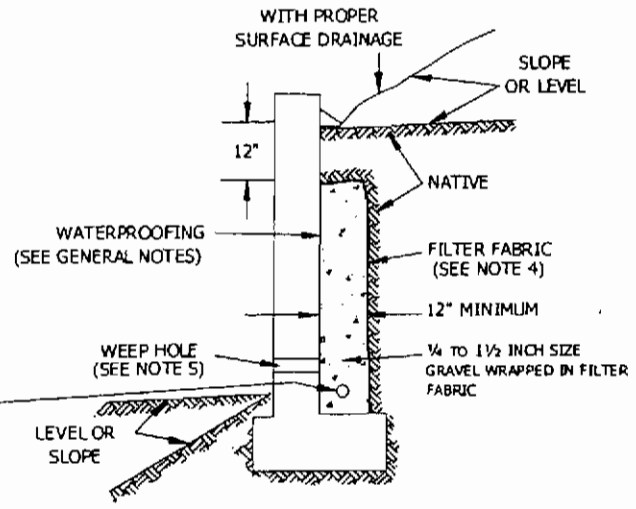
Figure 2

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

OPTION 1: PIPE SURROUNDED WITH CLASS 2 PERMEABLE MATERIAL



OPTION 2: GRAVEL WRAPPED IN FILTER FABRIC



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

Figure 3

APPENDIX A

APPENDIX A

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Aerial Photographs Reviewed

Date	Flight	Frame	Scale	Agency
06/03/1938	AXL-42	N/A	N/A	USDA
01/31/1953	N/A	N/A	N/A	USDA
09/19/1977	N/A	N/A	N/A	Teledyne
01/18/1985	N/A	N/A	N/A	Aerial Map Industries
02/25/1986	C-450	151	1:24,000	SBCFC
10/07/1995	N/A	N/A	N/A	USGS
06/06/2002	N/A	N/A	N/A	USGS

APPENDIX B

GEOTECHNICAL BORING LOG B-1

Date 8-26-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. 2R Drilling **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log (N — S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION (Logged By DAG; Sampled By DAG)	Type of Tests
	0			B-1					@ 0' Silty SAND, light brown, dry, fine grained, non-plastic, scattered rounded gravel to 3 inches, trace cobble to 10 inches	SA 44:44:12 MD CR
				R-1	20 30 33		1.1	SW-SM	@ 2½' SAND with silt and gravel, light brown, dry, fine to coarse grained, dense, subangular gravel to 2 inches, rock fragments, non-plastic silt	
	5			R-2	14 32 50/6"		1.1	SW-SM	@ 5' SAND with silt and gravel, light brown, slightly moist, fine to coarse grained, very dense	
	10			R-3	25 13 50/4½"	118.9	2.3	SW-SM	@ 10' SAND with silt and gravel, moderate brown, moist, fine to coarse grained, very dense, gravel to 3 inches, cobble fragments, non-plastic silt	
	15			S-1	15 33 40			SW	@ 15' SAND with gravel, moderate yellowish brown, moist, fine to coarse grained, very dense, rounded gravel to 1 inch, some non-plastic silt	
	20			S-2	10 12 14			SW-SM	@ 20' SAND with silt and gravel, moderate yellowish brown, moist, fine to coarse grained, dense, gravel to 1 inch, non-plastic silt	
	25								Total depth 21½ feet No groundwater Boring backfilled with soil cuttings	
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-2

Date 8-26-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. 2R Drilling **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Logged By DAG

Sampled By DAG

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								@ 0' Silty SAND, light brown, dry, fine grained, non-plastic silt, scattered gravel on surface	
				R-1	10 14 16	117.9	1.9	SW	@ 2½' SAND with gravel, light brown, slightly moist, fine to coarse grained, medium dense, rounded gravel to 1 inch, trace non-plastic silt	
	5			R-2	25 45 50/5½"	135.6	3.2	SW	@ 5' SAND with gravel, light brown, slightly moist, fine to coarse grained, very dense, rounded gravel to 3 inches, trace clay	
	10			R-3	20 43 50/4"		2.5	SW-SM	@ 10' SAND with silt and gravel, moderate yellowish brown, moist, fine to coarse grained very dense, subrounded gravel to ½ inch, non-plastic silt	
	15			S-1	9 24 45			SW-SM	@ 15' SAND with silt and gravel, moderate yellowish brown, moist, fine to coarse grained, very dense, rounded gravel to 1 inch, non-plastic silt, some fractured gravel	
	20			S-2	15 18 26			SW-SM	@ 20' SAND with silt and gravel, moderate yellowish brown, moist, fine to coarse grained, very dense, rounded gravel to 1 inch, non-plastic silt	
	25								Total depth 21½ feet No groundwater Boring backfilled with soil cuttings	
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-3

Date 8-26-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. 2R Drilling **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Logged By DAG

Sampled By DAG

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								@ 0' Silty SAND, light brown, dry, fine grained, non-plastic silt, trace gravel to 1 inch	
				R-1	8 12 19				@ 2½' No recovery	
	5			R-2	16 43 50/6"				@ 5' No recovery	
	10			R-3	50/5"				@ 10' No recovery	
	15			S-1	5 5 3			SM	@ 15' Silty SAND, moderate brown, moist, fine grained, medium dense, low to non-plastic silt, some medium and coarse sand, trace fine gravel	
	20			S-2	10 33 41			SP-SM	@ 20' SAND with silt and gravel, moderate brown, moist, fine to medium grained, very dense, gravel to 1 inch, some coarse sand, fractured rock, non-plastic silt	
									Total depth 21½ feet No groundwater Boring backfilled with soil cuttings	
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-4

Date 8-26-05 **Sheet** 1 of 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. 2R Drilling **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION (Logged By DAG; Sampled By DAG)	Type of Tests
	0			B-1				SM	@ 0' Silty SAND, light brown, slightly moist, fine grained, non-plastic, some medium sand, scattered gravel on surface	RV
				R-1	17 19 46		2.1	SW-SM	@ 2½' SAND with silt and gravel, light brown, moist, fine to coarse grained, dense, gravel to 3 inches, non-plastic silt	
	5			R-2	36 50/5"		1.7	SW-SM	@ 5' SAND with silt and gravel, light brown, moist, fine to coarse grained, very dense, gravel to 3 inches, non-plastic silt	
	10			R-3	23 50/6"	126.8	1.9	SW-SM	@ 10' SAND with silt and gravel, light brown, moist, fine to coarse grained, very dense, angular gravel to 3 inches, non-plastic silt	
	15			S-1	5 13 7			SW-SM	@ 15' SAND with silt and gravel, light brown, moist, fine to coarse grained, dense, angular gravel to 3 inches, non-plastic silt	
								ML	@ 16½' Sandy SILT, moderate brown, moist, low to non-plastic, stiff, fine sand, micaceous	
	20			S-2	17 24 50/6"			SW-SM	@ 20' SAND with silt and gravel, moderate brown, moist, fine to coarse grained, very dense, subrounded to subangular gravel to 1 inch, non-plastic silt	
	25								Total depth 21½ feet No groundwater Boring backfilled with soil cuttings	
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-5

Date 8-26-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. 2R Drilling **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								Logged By TDL Sampled By TDL	
				B-1					@ 0' Silty SAND, light brown, slightly moist, fine grained, non-plastic silt	
				R-1	7 20 24		1.8	SM	@ 2½' Silty SAND, light brown, slightly moist, fine grained, dense, non-plastic silt	
	5			R-2	32 26 31		0.8	SW	@ 5' SAND with gravel, pale brown, dry, fine to coarse grained, gravel to 2 inches, dense, cobble fragments	
	10								Refusal at 8½ feet No groundwater Boring backfilled with soil cuttings	
	15									
	20									
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-6

Date 8-26-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. 2R Drilling **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Logged By TDL

Sampled By TDL

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								@ 0' Silty SAND, light brown, moist, fine grained, non-plastic silt	
				R-1	27 22 39		2.2	SW-SM	@ 2½' SAND with silt and gravel, moderate yellowish brown, moist, fine to coarse grained, dense, gravel to 3 inches, non-plastic silt	
	5			R-2	14 20 16		1.9	SW-SM	@ 5' SAND with silt and gravel, moderate yellowish brown, moist, fine to coarse grained, dense, gravel to 3 inches, some cobble to 4 inches, non-plastic silt	
	10			R-3	48 36 50/6"	124.3	1.8	SW	@ 10' SAND with gravel, brown, moist, fine to coarse grained, very dense, gravel to 3 inches	
	15			S-1	6 14 15		2.7	SW	@ 15' SAND with gravel, brown, moist, fine to coarse grained, dense, angular gravel to 1 inch	
	20			S-2	12 21 50/5½"		3.8	SW	@ 20' SAND with gravel, brown, moist, fine to coarse grained, very dense, gravel up to 2 inches	
									Total depth 21½ feet No groundwater Boring backfilled with soil cuttings	
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
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LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-7

Date 8-26-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. 2R Drilling **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
		N S							**Logged By** TDL **Sampled By** TDL	
	0								@ 0' Silty SAND, yellowish brown, slightly moist, fine grained, non-plastic silt	
				R-1	10 13 16				@ 2½' No recovery	
	5			R-2	19 25 30		1.5	SW	@ 5' SAND with gravel, dark yellowish brown, slightly moist, fine to coarse grained, dense, gravel to 3 inches, cobble fragments	
	10			R-3	11 50/5½"		0.7	SW	@ 10' SAND with gravel, dark brown, slight moist, fine to coarse grained, very dense, gravel to 3 inches	
	15			S-1	18 32 20			SW	@ 15' SAND with gravel, dark brown, moist, fine to coarse grained, dense, angular gravel to 1 inch	
	20			S-2	13 23 50/5"			SW-SM	@ 20' SAND with silt and gravel, moderate brown, moist, fine to coarse grained, very dense, gravel to 1 inch	
									Total depth 21½ feet No groundwater Boring backfilled with soil cuttings	
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-8

Date 8-26-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. 2R Drilling **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Logged By TDL

Sampled By TDL

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								@ 0' Silty SAND, light brown, dry, fine grained, some gravel, non-plastic silt	
				R-1	16 27 27			SW-SM	@ 2½' SAND with silt and gravel, pale brown, dry to slightly moist, fine to coarse grained, dense, gravel to 3 inches	
	5			R-2	9 25 25		1.7	SW-SM	@ 5' SAND with silt and gravel, moderate yellowish brown, dry to slightly moist, fine to coarse grained, dense, gravel to 3 inches	
	10			R-3	4 6 12		4.0	SW-SM	@ 10' SAND with silt and gravel, moderate yellowish brown, moist, fine to coarse grained, dense, gravel to 2 inches	
	15			S-1	8 10 19		4.6	SW-SM	@ 15' SAND with silt and gravel, moderate yellowish brown, moist, fine to coarse grained, dense, fine gravel	
	20			S-2	15 20 24			SM	@ 20' Silty SAND, moderate brown, moist, fine to coarse grained, very dense, some gravel, non-plastic silt	
									Total depth 21½ feet No groundwater Boring backfilled with soil cuttings	
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-9

Date 8-26-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. 2R Drilling **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log (N — S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								Logged By TDL Sampled By TDL	
				B-1					@ 0' Silty SAND, dark brown, dry to slightly moist, fine grained, non-plastic silt	SA 7:64:29 RV CR
				R-1	14 20 37		1.4	SM	@ 2½' Silty SAND with gravel, brown, slightly moist, fine to coarse grained, dense, gravel to 1 inch	
	5			R-2	22 34 42		1.5	SM	@ 5' Silty SAND with gravel, moderate brown, moist, fine to coarse grained, very dense, gravel to 2 inches	
									Refusal at 7 feet No groundwater Boring backfilled with soil cuttings	
	10									
	15									
	20									
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-10

Date 8-29-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. Martin Drilling Corporation **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Logged By DAG

Sampled By DAG

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0	N S							@ 0' Silty SAND, moderate yellowish brown, slightly moist, fine grained, non-plastic silt, scattered gravel to 2 inches on surface	
				R-1	4 18 25	115.3	2.2	SW-SM	@ 2½' SAND with silt and gravel, moderate yellowish brown, moist, fine to medium grained, dense, rounded gravel to 3 inches, non-plastic silt	
	5			R-2	13 20 35		2.3	SW	@ 5' SAND with gravel, moderate yellowish brown, moist, fine to coarse grained, dense, rounded gravel to 3 inches	
	10			R-3	21 34 40	128.5	2.2	SW	@ 10' SAND with gravel, moderate brown, moist, fine to coarse grained, rounded gravel to 2 inches, very dense, trace non-plastic silt	
	15			S-1	2 5 6			SM	@ 15' Silty SAND, moderate brown, moist, fine grained, trace rounded gravel to ½ inch, medium dense, non-plastic silt	
	20			S-2	8 50/6"			SW-SM	@ 20' SAND with silt and gravel, moderate yellowish brown, moist, fine to medium grained, very dense, subangular gravel to 2 inches, non-plastic silt	
									Total depth 21 feet No groundwater Boring backfilled with soil cuttings	
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-11

Date 8-29-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. Martin Drilling Corporation **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Logged By DAG

Sampled By DAG

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								@0' ASPHALT, 1½ inches asphalt (poor condition), no base @ 1½" Silty SAND, dark yellowish brown, moist, fine grained, non-plastic silt, tracc gravel to 1 inch	
				R-1	12 17 18		2.2	SW-SM	@ 2½' SAND with silt and gravel, moderate yellowish brown, moist, fine to coarse grained, medium dense, subangular gravel to 3 inches, cobble fragments, non-plastic silt	
	5			R-2	9 17 29		1.3	SW	@ 5' SAND with gravel, moderate yellowish brown, moist, medium to coarse grained, dense, rounded granitic gravel to 2 inches	
	10			R-3	50/3"				@ 10' No recovery	
	15			S-1	29 50/5½"		3.1	SW	@ 15' SAND with gravel, abundant fractured gravel and cobble	
	20			S-2	50/6"			SW	@ 20' SAND with gravel, light brown, moist, abundant gravel	
									Total depth 20½ feet No groundwater Boring backfilled with soil cuttings and patched with cold asphalt	
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-12

Date 8-29-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. Martin Drilling Corporation **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Logged By DAG

Sampled By DAG

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0			B-1				SM	@ 0' Silty SAND, moderate yellowish brown, moist, fine grained, non-plastic silt	MD
				R-1	11 29 50/6"			SM	@ 2½' Silty SAND, moderate yellowish brown, moist, fine grained, very dense, non-plastic silt	
								SW	@ 3½' SAND with gravel, light brown, moist, fine to coarse grained, gravel to 3 inches	
	5			R-2	23 29 27	122.4	1.7	SW	@ 5' SAND with gravel, light brown, moist, fine to coarse grained, dense, grades to gravel	
	10			R-3	16 50/6"		1.9	SW-SM	@ 10' SAND with silt and gravel, light brown, moist, fine to coarse grained, very dense, subrounded gravel to 4 inches, non-plastic silt	
	15			S-1	50/5½"		1.1	SW	@ 15' SAND with gravel, light brown, fine grained, very dense, rock fragments	
	20			S-2	22 25 29			SW-SM	@ 20' SAND with silt and gravel, light brown, moist, fine to coarse grained, very dense, gravel to ½ inches, trace cobble fragments, non-plastic silt	
									Total depth 21½ feet No groundwater Boring backfilled with soil cuttings	
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-13

Date 8-29-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. Martin Drilling Corporation **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Logged By DAG

Sampled By DAG

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								@ 0' Silty SAND, moderate orange brown, slightly moist, fine grained, non-plastic silt, scattered gravel to 4 inches on surface	
				R-1	23 50/5½"		1.1	SW-SM	@ 2½' SAND with silt and gravel, light brown, slightly moist, fine to coarse grained, very dense, angular gravel to 3 inches, non-plastic silt	
	5			R-2	11 26 43		1.2	SW-SM	@ 5' SAND with silt and gravel, light brown, moist, fine to medium grained, some coarse sand, very dense, abundant rounded gravel to 2 inches, non-plastic silt	
	10			R-3	6 14 17	126.6	3.4	SW	@ 10' SAND with gravel, moderate brown, moist, fine to medium grained, some coarse sand, medium dense, gravel to 2 inches	
	15			S-1	12 14 19			SW	@ 15' SAND with gravel, moderate yellowish brown, moist, fine to medium grained, some coarse sand, very dense, rounded gravel to 1 inch, trace non-plastic silt	
	20			S-2	18 20 26			SW	@ 20' SAND with gravel, moderate yellowish brown, moist, fine to medium grained, some coarse sand, very dense, rounded gravel to 1 inch, trace non-plastic silt	
	25								Total depth 21½ feet No groundwater Boring backfilled with soil cuttings	
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-14

Date 8-29-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. Martin Drilling Corporation **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
									Logged By DAG **Sampled By** DAG	
	0								@ 0' SAND with silt and gravel, light brown, dry, fine grained, gravel to 2 inches, non-plastic silt, scattered gravel and cobble to 6 inches	
				R-1	7 18/6"				@ 2½' No recovery	
	5			R-2	23 32 49		0.7	SW-SM	@ 5' SAND with silt and gravel, light brown, moist, fine to medium grained, some coarse sand, very dense, non-plastic silt, rounded gravel and fractured rock to 3 inches	
	10			R-3	40 50/6"				@ 10' No recovery	
	15			S-1	33 50/6"			SW-SM	@ 15' SAND with silt and gravel, light brown, moist, fine to medium grained, very dense, gravel to 1 inch, sample not collected	
	20			S-2	17 33 35			SP-SM	@ 20' SAND with silt and gravel, light brown, moist, fine to coarse grained, very dense, gravel and fractured rock to 2 inches, non-plastic silt	
									Total depth 21½ feet No groundwater Boring backfilled with soil cuttings	
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-15

Date 8-29-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. Martin Drilling Corporation **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION (Logged By DAG; Sampled By DAG)	Type of Tests
	0			B-1					@ 0' Silty SAND, light brown, dry, fine grained, non-plasticity silt, some fine gravel	SA 30:56:14 CR
				R-1	8 20 32		1.1	SM	@ 2½' Silty SAND with gravel, moderate yellowish brown, slightly moist, fine to medium grained, some coarse sand, dense, gravel up to 1½ inch, non-plastic silt	
	5			R-2	19 26 27		1.2	SW-SM	@ 5' SAND with silt and gravel, moderate yellowish brown, slightly moist, fine to medium grained, some coarse sand, dense, gravel to 3 inches, non-plastic silt	
	10			R-3	11 25 37	131.3	1.8	SW	@ 10' SAND with gravel, moderate yellowish brown, moist, fine to coarse grained, dense, rounded gravel to 2 inches, trace non-plastic silt	
	15			S-1	14 17 30			SW-SM	@ 15' SAND with silt and gravel, light brown, moist, fine to coarse grained, very dense, gravel to 1 inch, fractured rock	
	20			S-2	15 27 28			SW	@ 20' SAND with gravel, moderate yellowish brown, moist, fine to medium grained, some coarse sand, very dense, gravel to ½ inch, trace non-plastic silt	
									Total depth 21½ feet No groundwater Boring backfilled with soil cuttings	
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-16

Date 8-29-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. Martin Drilling Corporation **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								**Logged By** DAG **Sampled By** DAG	
									@ 0' SAND with silt and gravel, moderate yellowish brown, slightly moist, fine to medium grained, gravel to 2 inches, scattered cobble and boulder to 2 feet dia. on surface	
				R-1	9 14 19		1.6	SW-SM	@ 2½' SAND with silt and gravel, moderate yellowish brown, moist, fine to coarse grained, medium dense, rounded gravel to 2 inches, non-plastic silt	
	5			R-2	17 23 26	125.5	1.6	SW	@ 5' SAND with gravel, moderate yellowish brown, moist, fine to coarse grained, dense, subrounded gravel to 3 inches	
	10			R-3	50/4"				@ 10' No recovery	
	15			S-1	50/5½"				@ 15' No recovery	
									@ 20' No recovery	
	20			S-2	25/2"				Total depth 20 feet No groundwater Boring backfilled with soil cuttings	
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-17

Date 8-29-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. Martin Drilling Corporation **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Logged By DAG

Sampled By DAG

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								@ 0' SAND with gravel, abundant subrounded gravel and cobble on surface to 8 inches	
				R-1	25 50/4½"		1.0	GW	@ 2½' Sandy GRAVEL, subrounded to subangular gravel to 3 inches, fine to medium grained sandy matrix, decomposed granitic clast, fractured rock, very dense	
	5			R-2	18 28 36		2.2	SW	@ 5' SAND with gravel, moderate yellowish brown, moist, fine to coarse grained, dense, gravel to 1½ inches	
	10			R-3	16 50/6"	121.3	2.8	SW	@ 10' SAND with gravel, moderate yellowish brown, moist, fine to coarse grained, very dense, rounded gravel to 2 inches	
	15			S-1	10 17 24			SW-SM	@ 15' SAND with silt and gravel, moderate yellowish brown, moist, fine to medium grained, some coarse sand, very dense, gravel to 1 inch, fractured rocks, non-plastic silt	
	20			S-2	18 34 32			SW-SM	@ 20' SAND with silt and gravel, moderate yellowish brown, moist, fine to medium grained, some coarse sand, very dense, gravel to ½ inch, fractured rocks, non-plastic silt	
	25								Total depth 21½ feet No groundwater Boring backfilled with soil cuttings	
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
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LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-18

Date 8-29-05 **Sheet** 1 **of** 1

Project Lewis / Rialto **Project No.** 021751-001

Drilling Co. Martin Drilling Corporation **Type of Rig** CME 75

Hole Diameter 8" **Drive Weight** 140 lb Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								**Logged By** DAG **Sampled By** DAG	
									@ 0' SAND with gravel, light brown, dry, scattered rounded gravel and cobble to 12 inches, most < 8 inches	
				R-1	9 17 24			SW	@ 2½' SAND with gravel, light brown, slightly moist, fine to coarse grained, dense, rounded gravel to 2 inches	
	5			R-2	50/6"				@ 5½' Refusal (move hole 3 feet over) @ 7' Refusal	
									Refusal at 5½ feet, move hole over 3 feet Refusal at 7 feet No groundwater Boring backfilled with soil cuttings	
	10									
	15									
	20									
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
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LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-19

Date 7-12-06 **Sheet** 1 **of** 1

Project Lewis FJA Rialto **Project No.** 021751-002

Drilling Co. Redman Drilling **Type of Rig** CME-75

Hole Diameter 8" **Drive Weight** 140 lbs. Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Logged By Kaustav Bose

Sampled By Kaustav Bose

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								@ 0' **Alluvium (Qal):** Silty SAND, fine to coarse sand, trace sub-rounded gravel to 1½ inch, non-plastic fines, loose, dry, very pale orange	
				R-1	19 32 50/1"		0.7	SM	@ 2½' SAND with silt and gravel, fine to medium grained, some coarse sand, 10 percent non-plastic silt, 26 percent sub-rounded gravel to 2 inches, very dense, dry, very pale orange	SA
	5			R-2	15 17 24		1.8	SM	@ 5' Silty SAND with gravel, fine to medium grained, some coarse sand, non-plastic fines, some fine to medium angular gravel to 2½ inches, dense, grayish yellow green, dry	
	10			R-3	16 34 50/2"	131.0	3.1	SP	@ 10' Gravelly SAND, trace non-plastic fines, fine to coarse grained, fine to medium angular gravel, very dense, slightly moist, grayish yellow green @ 13' Rounded gravel to 3 inches in soil cuttings, difficult drilling, refusal at 13 feet	
	15								**Refusal at 13 Feet** **No Groundwater Encountered** **Boring Backfilled With Soil Cuttings**	
	20									
	25									
	30									

SAMPLE TYPES:

- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON

GEOTECHNICAL BORING LOG B-20

Date 7-12-06 **Sheet** 1 **of** 1

Project Lewis FJA Rialto **Project No.** 021751-002

Drilling Co. Redman Drilling **Type of Rig** CME-75

Hole Diameter 8" **Drive Weight** 140 lbs. Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								**Logged By** Kaustav Bose **Sampled By** Kaustav Bose	
				Bag-1					@ 0' **Alluvium (Qal):** Silty SAND, fine to coarse sand, trace sub-rounded gravel to 1½ inch, non-plastic fines, loose, dry, very pale orange	MD CR
				R-1	13 10 10		0.6	SM	@ 2½' Silty SAND with gravel, trace non-plastic fines, fine to coarse grained, fine to medium sub-rounded gravel to 1½ inches, medium dense, dry, yellowish gray	
	5			R-2	32 50/2"				@ 5' No Recovery, coarse angular gravel greater than 3 inches blocked sampler at the tip @ 7' Gravel to 2 inches in cuttings, difficult drilling, refusal at 7 feet	
	10								**Refusal at 7 Feet** **No Groundwater Encountered** **Boring Backfilled With Soil Cuttings**	
	15									
	20									
	25									
	30									

SAMPLE TYPES:
- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE

LEIGHTON

GEOTECHNICAL BORING LOG B-21

Date 7-12-06 **Sheet** 1 **of** 1

Project Lewis FJA Rialto **Project No.** 021751-002

Drilling Co. Redman Drilling **Type of Rig** CME-75

Hole Diameter 8" **Drive Weight** 140 lbs. Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
		N S							**Logged By** Kaustav Bose **Sampled By** Kaustav Bose	
	0			B-1					@ 0' **Alluvium (Qal):** Silty SAND, fine to coarse sand, trace sub-rounded gravel to 1½ inch, non-plastic fines, loose, dry, very pale orange	
				R-1	13 10 10		1.3	SM	@ 2½' Silty SAND with gravel, non-plastic fines, fine to medium grained, trace coarse sand, fine to medium rounded gravel to 1½ inches, medium dense, dry, greenish gray	
	5			R-2	32 50/2"		1.9	SM	@ 3' to 4' Fine to medium rounded gravel to 2½ inches, drilling get tougher @ 5' Silty SAND with gravel, non-plastic fines, fine to coarse grained, fine to medium rounded gravel to 1 inch, medium dense, dry, greenish gray @ 7' Fine to medium angular gravel to 2 inches in cuttings, difficult drilling, refusal at 8 feet	
	10								**Refusal at 8 Feet** **No Groundwater Encountered** **Boring Backfilled With Soil Cuttings**	
	15									
	20									
	25									
	30									

SAMPLE TYPES:
- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
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LEIGHTON

GEOTECHNICAL BORING LOG B-22

Date 7-12-06 **Sheet** 1 **of** 1

Project Lewis FJA Rialto **Project No.** 021751-002

Drilling Co. Redman Drilling **Type of Rig** CME-75

Hole Diameter 8" **Drive Weight** 140 lbs. Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0			B-1					**Logged By** Kaustav Bose **Sampled By** Kaustav Bose	
									@ 0' **Alluvium (Qal):** Silty SAND, fine to coarse sand, trace sub-rounded gravel to 1½ inch, non-plastic fines, loose, dry, very pale orange	
				R-1	17 34 29		1.4	SM	@ 2½' Silty SAND with gravel, trace non-plastic fines, fine to medium grained, some coarse sand, fine to medium sub-angular gravel to 1¼ inches, dense, dry, greenish yellowish gray	
	5			R-2	15 50/2"				@ 5' No Recovery, soil too gravelly to be retained in sampler	
									@ 7' Angular chips of basaltic rock in cutting to 3 inches, difficult drilling, refusal at 6 feet	
									Refusal at 7 Feet **No Groundwater Encountered** **Boring Backfilled With Soil Cuttings**	
	10									
	15									
	20									
	25									
	30									

SAMPLE TYPES:

S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

TYPE OF TESTS:

DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
Col COLLAPSE
CR CORROSION
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LEIGHTON

GEOTECHNICAL BORING LOG B-23

Date 7-12-06 **Sheet** 1 **of** 1

Project Lewis Leiske Rialto **Project No.** 021751-003

Drilling Co. Redman Drilling **Type of Rig** CME-75

Hole Diameter 8" **Drive Weight** 140 lbs. Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0			Bag-1 R-1	7 21 25		1.1	SM	**Logged By** Kaustav Bose **Sampled By** Kaustav Bose @ 0' **Alluvium (Qal):** Silty SAND, fine to coarse sand, trace rounded gravel to 4 inches, non-plastic fines, loose, dry, pale grayish brown @ 2' Silty SAND with gravel, non-plastic fines, fine to medium grained, fine to medium angular gravel to 2 inches, medium dense, dry, yellowish gray @ 3' Fine to medium angular gravel to 2 inches in cuttings, broken pieces of basaltic rock to 6 inches, difficult drilling, refusal at 3 feet **Total Depth = 4 feet** **No Groundwater Encountered** **Boring Backfilled With Soil Cuttings**	MD
	5									
	10									
	15									
	20									
	25									
	30									

SAMPLE TYPES:

S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE

TYPE OF TESTS:

DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
Col COLLAPSE
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON

GEOTECHNICAL BORING LOG B-24

Date 7-12-06 **Sheet** 1 **of** 1

Project Lewis Leiske Rialto **Project No.** 021751-003

Drilling Co. Redman Drilling **Type of Rig** CME-75

Hole Diameter 8" **Drive Weight** 140 lbs. Automatic Hammer **Drop** 30"

Elevation Top of Hole ' **Location** See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per Six Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								**Logged By** Kaustav Bose **Sampled By** Kaustav Bose	
				Bag-1					@ 0' **Alluvium (Qal):** Silty SAND, fine to coarse sand, trace rounded gravel to 4 inches, non-plastic fines, loose, dry, pale grayish brown	CR
				R-1	18 26 35	112.2	2.0	SM	@ 2' Silty SAND with gravel, fine to medium sand, trace coarse sand, non-plastic, fine to medium rounded gravel less than 1½ inch, medium dense, light yellowish brown, gray	DS
	5			R-2	20 30 37			SM	@ 5' Silty SAND with gravel, fine to medium sand, trace coarse sand, non-plastic, fine to medium rounded gravel less than 1½ inch, medium dense, light yellowish brown, gray	
	10			R-3	24 36 41	116.9	3.9	SM	@ 10' Silty SAND with gravel, fine to medium grained, trace coarse sand, non-plastic fines, rounded gravel to 1 inch, dense, tan, dry	
	15			R-4	23 50/4"	122.5	4.1	SM	@ 15' Silty SAND with gravel, fine to coarse sand, traces of broken pieces of gravel, fragmented granite, fine to medium rounded gravel to 1½ inches, very dense, yellow grayish brown, dry	
	20			R-5	13 50/5"	126.8	3.5	ML	@20' Sandy SILT, fine to medium sand, trace coarse sand, non-plastic fines, trace fine to medium sub-rounded gravel to 1 inch, very dense, light greenish brown, dry to slightly moist	
	25								**Total Depth = 21½ feet** **No Groundwater Encountered** **Boring Backfilled With Soil Cuttings**	
	30									

SAMPLE TYPES:
- S SPLIT SPOON
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- Col COLLAPSE
- CR CORROSION
- SA SIEVE ANALYSIS
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LEIGHTON

Test Pit TP-1

Date Excavated: September 1, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	1.0	SM	Silty SAND, olive brown, slightly moist, fine to medium grained, slightly cemented, gravel to 2.5 inches, rootlets.	Alluvium	B-1	0-1		
					B-2	1-5		
1.0	10.0	SW	Gravelly SAND with cobble and boulder, yellowish brown, dry to slightly moist, fine to coarse grained, subrounded gravel up to 3 inches, become moist below 5 feet. Matrix: 30% - 40% 3" - 8"; 10% - 15% 8" - 12"; 1% - 5% 12" - 18"					

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-2

Date Excavated: September 1, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	2.0	SM	Silty SAND, olive brown, dry to slightly moist, fine to medium grained, some subrounded gravel to 3 inches, slightly cemented, trace cobble, rootlets.	Alluvium	B-1	2-6		
2.0	6.5	SM	Silty SAND, olive brown, moist, fine grained, trace coarse subrounded gravel to 3.5 inches, slightly cemented, rootlets.					
6.5	10.5	SW	SAND with gravel, brown, moist, fine to coarse grained, subrounded gravel to 3 inches, subrounded cobble to 8 inches. Matrix: 30% - 40% 3" - 8"; 10% - 15% 8" - 12"; 1% - 5% 12" - 18"					

Total Depth: 10.5 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-3

Date Excavated: September 1, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	4.5	SW	SAND with gravel, brown, dry, fine to coarse grained, fine to coarse subrounded gravel, weakly cemented, rootlets. Matrix: 40% - 45% 3"- 8" 15% - 25% 8" - 12" 5% - 10% 12" - 18"	Alluvium				
4.5	8.5	SW-SM	SAND with silt and gravel, brown, dry, fine to coarse grained, fine to coarse subrounded gravel, weakly cemented, rootlets. Matrix: 40% - 45% 3"- 8" 15% - 25% 8" - 12" 5% - 10% 12" - 18"					
8.5	10.0	SW-SM	SAND with silt and gravel, brown, dry to slightly moist, fine to coarse grained, slightly cemented, fine to coarse gravel.					

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-4

Date Excavated: September 1, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	3.5	SM	Silty SAND with Gravel, brown, dry, fine to medium grained, some coarse grained, gravel up to 3 inches, rootlets. Matrix: 5% - 10% 3"- 8" 0% - 1% 8" - 12" 0% - 1% 12" - 18"	Alluvium	B-1	3.5-10		
3.5	10.0	SW	Gravelly SAND, yellowish brown, slightly moist, fine to coarse grained, fine to coarse subrounded gravel, some silt. Matrix: 30% - 40% 3"- 8" 5% - 10% 8" - 12" 0% - 5% 12" - 18"					

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-5

Date Excavated: September 1, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	2.0	SP-SM	SAND with silt and gravel, brown, dry, fine grained, medium to coarse subrounded gravel, some cobbles, some boulders, rootlets.	Alluvium				
2.0	10.0	SW	Gravelly SAND with trace silt, light brown, slightly moist to dry, fine to coarse grained, fine to coarse subrouned gravel, rootlets. Matrix: 20% - 35% 3"- 8" 10% - 15% 8" - 12" 1% - 5% 12" - 18"	Alluvium				

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-6

Date Excavated: September 1, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	4.5	SM	Silty SAND, brown, dry, fine to medium grained, some coarse grained, trace gravel to 2 inches, non-plastic silt, rootlets.	Alluvium				
4.5	6.0	SW-SM	SAND wit silt and gravel, yellowish brown, slightly moist, fine to coarse grained, fine to coarse subrounded gravel, some silt. Matrix: 20% - 30% 3"- 8" 5% - 10% 8" - 12" 0% - 2% 12" - 18"	Alluvium				
6.0	11.0	SW	SAND with gravel, yellowish brown, slightly moist, fine to coarse grained, fine to coarse gravel. Matrix: 20% - 30% 3"- 8" 5% - 10% 8" - 12" 0% - 2% 12" - 18"	Alluvium				

Total Depth: 11 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-7

Date Excavated: September 1, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	2.0	SM	Silty SAND, brown, dry, fine to medium grained, some subrounded gravel to 3 inches, some cobbles to 8 inches, some boulder to 18 inches, rootlets.	Alluvium				
2.0	10.0	SW	SAND with gravel, yellowish brown, slightly moist, fine to coarse grained, fine to coarse subrounded gravel, become moist below 5 feet. Matrix: 20% - 30% 3"- 8" 10% - 15% 8" - 12" 1% - 5% 12" - 18"					

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-8

Date Excavated: September 1, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	0.8	SM	Silty SAND, brown, dry, fine to medium grained, some gravel to 3 inches, trace cobble, rootlets.	Alluvium	B-1	0.8-6		
0.8	6.0	SW	SAND with gravel, brown, moist, fine to coarse grained, fine to coarse gravel, rootlets. Matrix: 20% - 25% 3"- 8" 5% - 10% 8" - 12" 0% - 2% 12" - 18"					
6.0	11.0	SW	SAND wit gravel, brown, highly moist, fine to coarse grained, fine to coarse gravel, rootlets. Matrix: 20% - 25% 3"- 8" 5% - 10% 8" - 12" 0% - 2% 12" - 18"					

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-9

Date Excavated: September 1, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	2.0	SM	Silty SAND, brown, dry, fine to medium grained, trace subrounded gravel to 3 inches, weakly cemented, rootlets.	Alluvium	B-1	0-2		
2.0	3.0	SM	Silty SAND, brown, dry, fine to medium grained, some coarse grained, weakly cemented, some coarse gravel, some cobbles to 8 inches, rootlets.					
3.0	10.0	SW	SAND with gravel, moderate brown, slightly moist to dry, fine to coarse grained, fine to coarse gravel. Matrix: 20% - 30% 3" - 8" 10% - 15% 8" 12" 1% - 5% 12" - 18"					

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-10

Date Excavated: September 1, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	4.5	SM	Silty SAND, brown, dry, fine to medium grained, trace coarse gravel to 3 inches, rootlets.	Alluvium				
4.5	6.5	SW	SAND with gravel, moderate brown, slightly moist, fine to coarse grained, fine to coarse subrounded gravel. Matrix: 10% - 15% 3" - 8" 1% - 2% 8" - 12"					
6.5	10.5	SW	SAND with gravel, moderate brown, moist to highly moist, fine to coarse grained, fine to coarse subrounded Matrix: 10% - 15% 3" - 8" 1% - 2% 8" - 12"					

Total Depth: 10.5 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-11

Date Excavated: September 2, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	2.0	SM	Silty SAND, brown, dry, fine to medium grained, some subrounded gravel to 3 inches, non-plastic silt, rootlets.	Alluvium	B-1	10-12		
2.0	3.5	SW-SM	SAND with silt and gravel, dry, fine to coarse grained, brown, fine to coarse gravel, some cobble to 5 inches. Matrix: 10% - 15% 3" - 8" 2% - 5% 8" 12" 0% - 2% 12" - 18"					
3.5	10.0	SW	SAND with gravel, yellowish brown, moist, fine to coarse grained, fine to coarse gravel. Matrix: 10% - 15% 3" - 8" 2% - 5% 8" 12" 0% - 2% 12" - 18"					
10.0	12.0	SC	Clayey SAND, brown, wet, fine grained, trace coarse grained, non-plastic clay.					

Total Depth: 12 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-12

Date Excavated: September 2, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	2.5	SM	Silty SAND, brown, dry, fine to medium grained, some gravel to 3 inches, 0.5 inch of asphalt, 1inch of base, rootlets.	Afu	B-1	6-10		
					B-2	6-10		
2.5	6.0	SW	SAND with gravel, pale brown, dry, fine to medium grained, fine to coarse gravel. Matrix: 20% - 25% 3" - 8" 5% - 15% 8" - 12"	Alluvium				
6.0	10.0	SP	WEST: SAND, pale brown, highly moist, fine to medium grained, some coarse grained, some gravel to 2 inches.					
		SC-SM	EAST: Silty SAND / Clayey SAND, reddish brown, very moist, fine to medium grained, trace coarse grained, some gravel up to 2 inches.					

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-13

Date Excavated: September 2, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	2.0	SM	Silty SAND, brown, dry, fine to medium grained, some subrounded gravel to 3 inches, some cobbles to 8 inches, rootlets.	Alluvium				
2.0	9.0	SW	SAND with gravel, gray brown, slightly moist to moist, fine to coarse grained, fine to coarse gravel, become moist below 6 feet. Matrix: 30% - 35% 3" - 8" 10% - 15% 8" - 12" 1% - 2% 12" - 18"					
9.0	10.0	SM	Silty SAND, reddish brown, highly moist, fine to coarse grained, some gravel to 2 inches, some cobble to 8 inches.					

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-14

Date Excavated: September 2, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	2.5	SM	Silty SAND, brown, dry, weakly cemented, fine to medium grained, some subrounded gravel to 2 inches, rootlets.	Alluvium				
2.5	4.0	SW-SM	SAND with silt and gravel, brown, dry, fine to medium grained, fine to coarse subrounded gravel, some cobbles.					
4.0	10.0	SW	SAND with gravel, gray brown, dry, fine to coarse grained, fine to coarse gravel, subangular to subrounded gravel. Matrix: 20% - 30% 3" - 8" 1% - 5% 8" - 12"					

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-15

Date Excavated: September 2, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	2.0	SM	Silty SAND, brown, dry, fine to medium grained, some coarse grained, some subrounded gravel to 2 inches, rootlets.	Alluvium				
2.0	3.5	SW-SM	SAND with silt and gravel, moderate brown, dry, fine to coarse grained, fine to coarse gravel, some cobbles to 5 inches.					
3.5	11.5	SW	SAND with gravel, brown, dry, fine to coarse grained, fine to coarse gravel, become moist below 5 feet. Matrix: 10% - 15% 3" - 8" 1% - 5% 8" - 12"					

Total Depth: 11.5 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-16

Date Excavated: September 2, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	2.5	SW-SM	SAND with silt and gravel, brown, dry, fine to coarse grained, fine to coarse gravel, rootlets.	Alluvium				
2.5	11.0	SW	SAND with gravel, gray brown, dry to slightly moist, fine to coarse grained, fine to coarse subrounded gravel, rootlets, become moist below 6 feet. Matrix: 15% - 20% 3" - 8" 2% - 5% 8" - 12" 0% - 1% 12" - 18"					

Total Depth: 11 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-17

Date Excavated: September 2, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	2.0	SW-SM	SAND with silt and gravel, gray brown, dry, fine to medium grained, some coarse sand, medium to coarse subrounded gravel, rootlets. Matrix: 15% - 20% 3" - 8" 5% - 10% 8" - 12" 1% - 2% 12" - 18"	Alluvium				
2.0	10.0	SW	SAND with gravel, brown, slightly moist to moist, fine to coarse grained, fine to coarse gravel, become moist below 3 feet. Matrix: 15% - 25% 3" - 8" 5 % - 10% 8" - 12" 1% - 2% 12" - 18"					

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-18

Date Excavated: September 2, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	2.5	SM	Silty SAND with gravel, dark brown, dry, fine to medium grained, some coarse grained, gravel up to 3 inches, rootlets.	Alluvium				
2.5	7.0	SW	SAND with gravel, gray brown to brown, dry to slightly moist, fine to coarse grained, fine to coarse subrounded gravel. Matrix: 20% - 25% 3" - 8" 5% - 10% 8" - 12" 0% -2% 12" - 18"					
7.0	10.0	SW-SM	SAND with silt and gravel, light brown, moist, fine to coarse grained, fine to coarse gravel, non-plastic silt. Matrix: 20% - 25% 3" - 8" 1% - 5% 8" - 12"					

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-19

Date Excavated: September 2, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	2.5	SM	Silty SAND, brown, dry, fine to medium grained, some subrounded gravel to 3 inches, few cobbles to 8 inches, rootlets.	Alluvium				
2.5	10.0	SW	SAND with gravel, gray brown, dry, fine to coarse grained, fine to coarse gravel, become moist below 7.5 feet. Matrix: 20% - 25% 3" - 8" 5 % - 10% 8" - 12" 0% - 1% 12" - 18"					

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

Test Pit TP-20

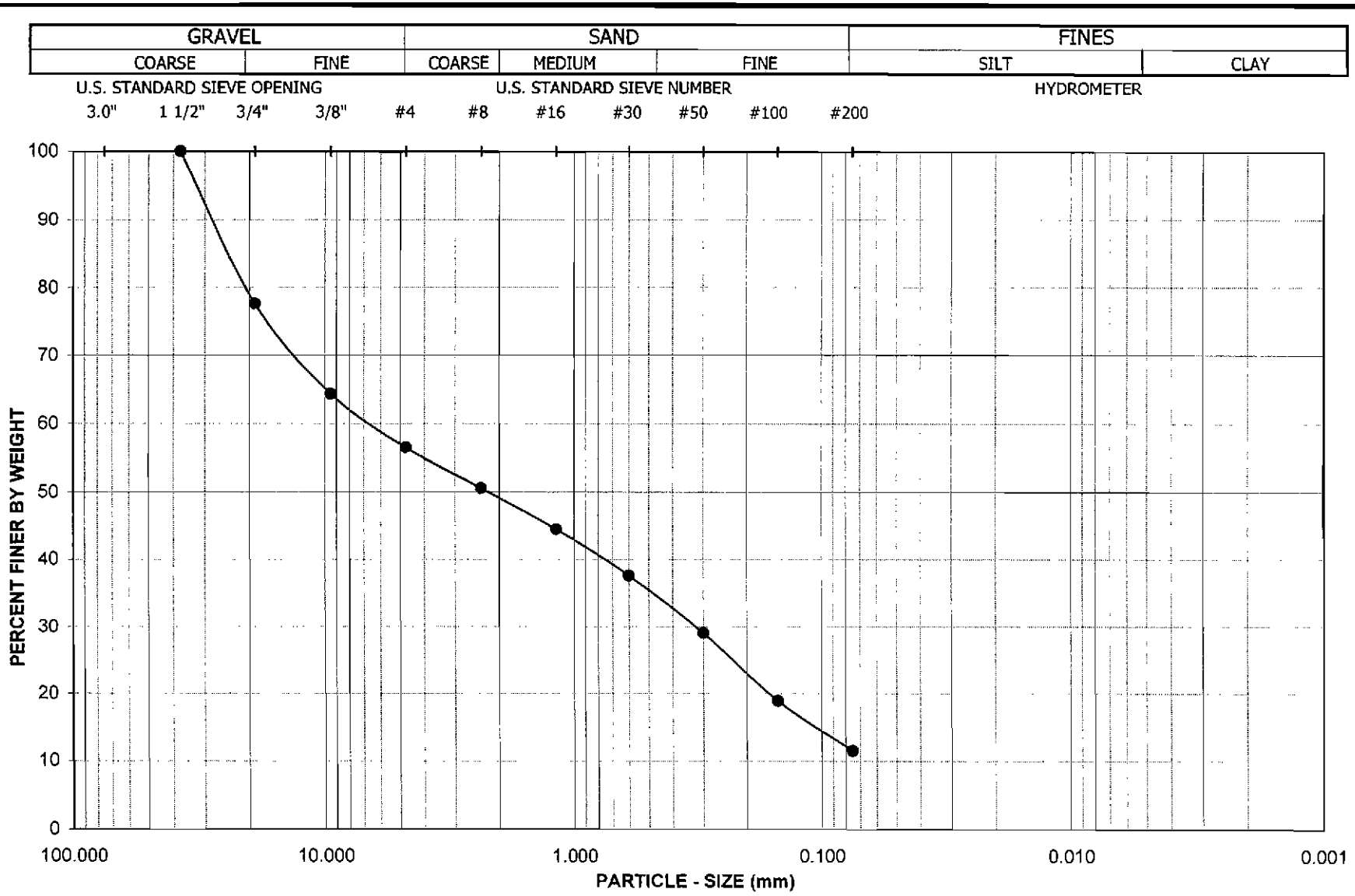
Date Excavated: September 2, 2005 — Logged By: TDL

Location: Lewis / Rialto Airport — Sampled By: TDL

Depth (feet) Top	Depth (feet) Bottom	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample Number	Depth (feet)	Density, Dry (pcf)	Moisture (%)
0.0	1.5	SM	Silty SAND, brown, dry, fine to medium grained, some gravel up to 3 inches, rootlets.	Alluvium				
1.5	3.5	SW	SAND with gravel, gray brown, dry, fine to coarse grained, fine to coarse gravel, subangular to subrounded gravel. Matrix: 10% - 15% 3" - 8" 1% - 5% 8" - 12" 0% -1% 12" - 18"					
7.0	10.0	SW	SAND with gravel, gray brown, moist, fine to coarse grained, fine to coarse gravel, subangular to subrounded gravel, become highly moist to wet below 7 feet. Matrix: 10% - 15% 3" - 8" 1% - 5% 8" - 12" 0% -1% 12" - 18"					

Total Depth: 10 feet
No groundwater encountered.
Test pit backfilled, tamped with bucket, wheel rolled at surface.

APPENDIX C



Project Name: Lewis / Rialto

Project No.: 021751-001

Exploration No.: B-1 Sample No.: B-1

Depth (feet): 0-5 Soil Type : (SP-SM)g

Soil Identification: Olive Poorly-graded Sand with Silt and Gravel (SP-SM)g

GR:SA:FI : (%) 44 : 44 : 12

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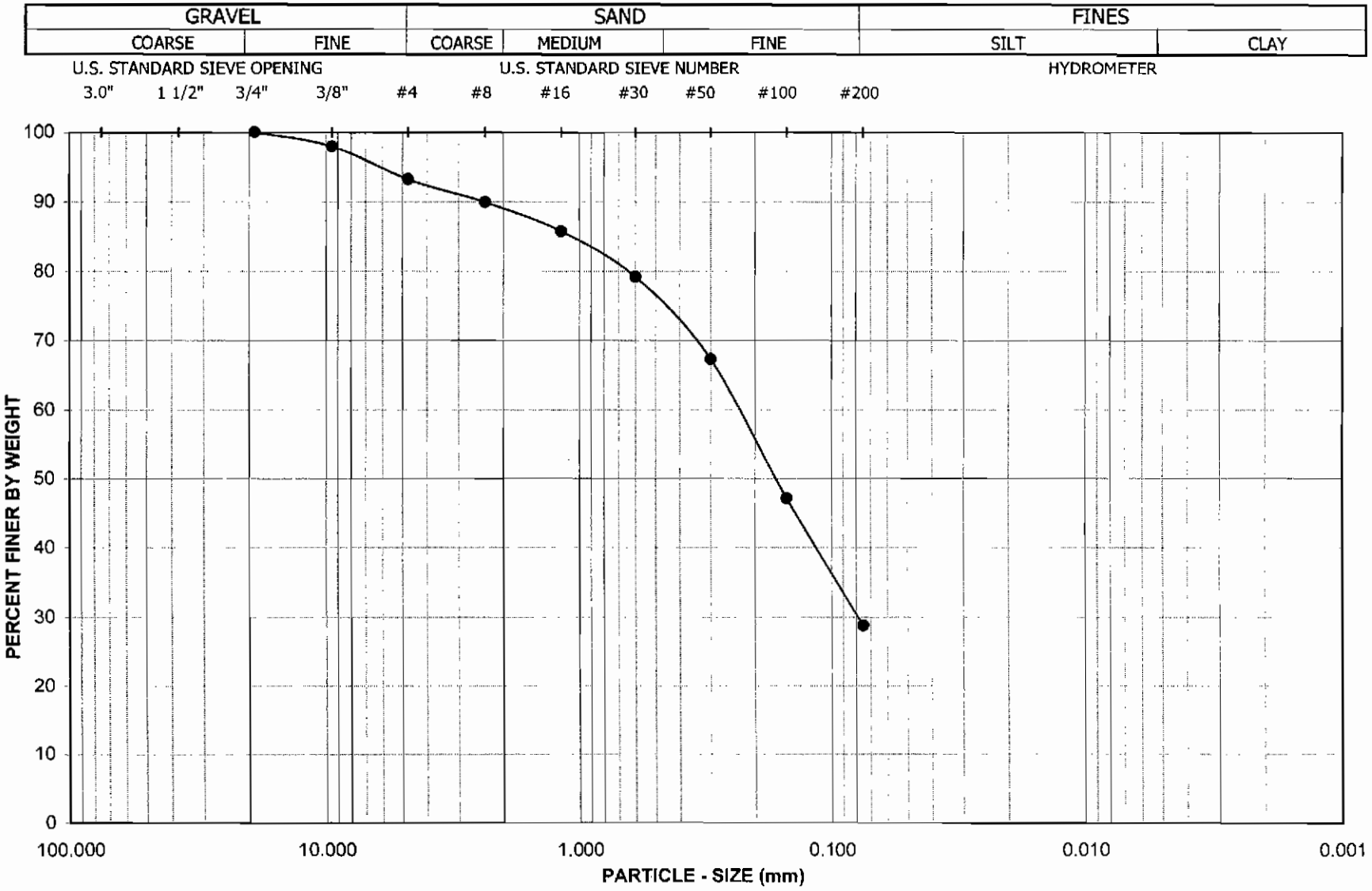
PARTICLE - SIZE DISTRIBUTION ASTM D 422

Sep-05



Project Name: Lewis / Rialto

Project No.: 021751-001

Exploration No.: B-9 Sample No.: B-1

Depth (feet): 0-5 Soil Type : (SM)

Soil Identification: Olive Brown Silty Sand (SM)

GR:SA:FI : (%) 7 : 64 : 29

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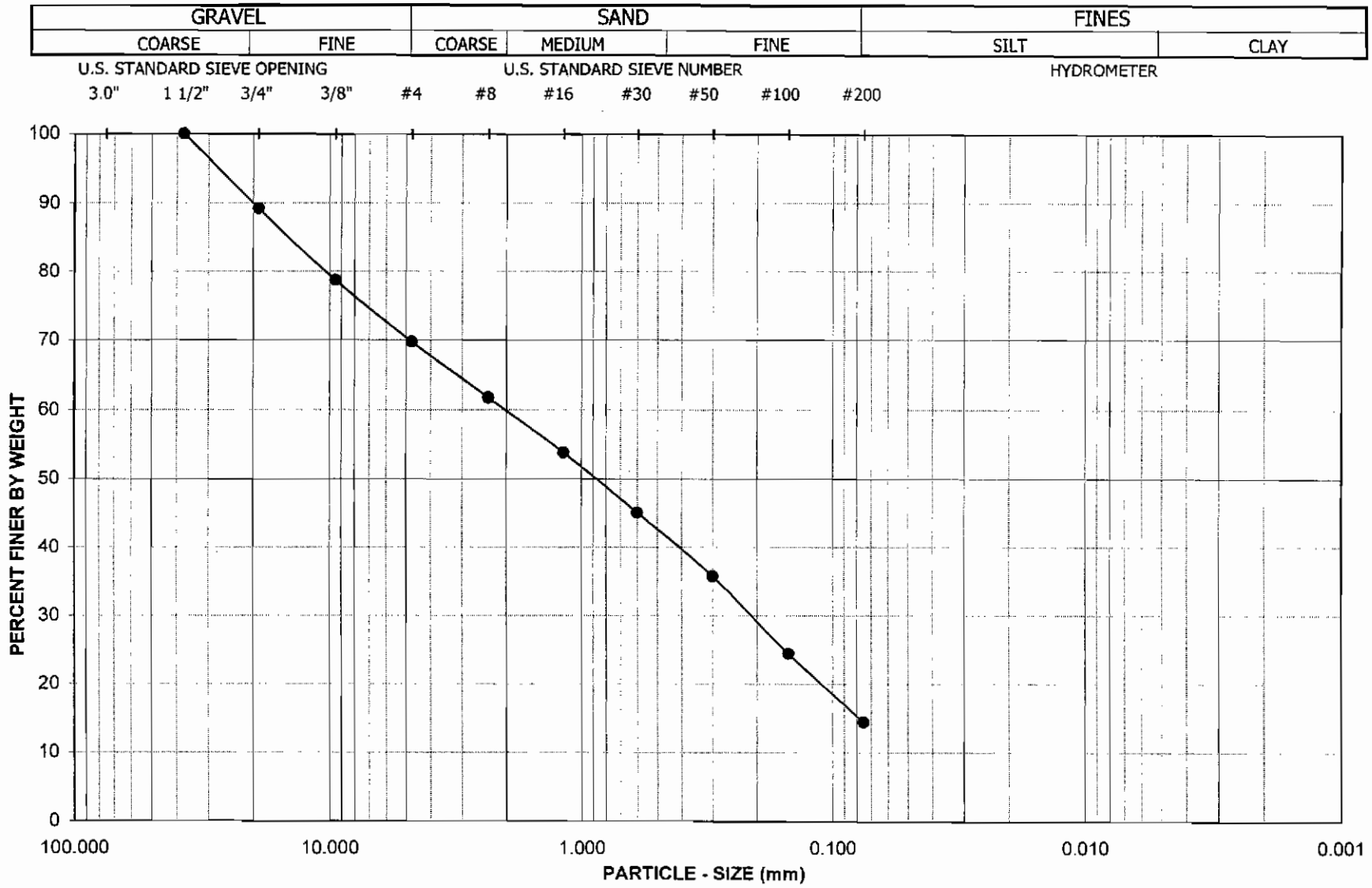
PARTICLE - SIZE DISTRIBUTION ASTM D 422

Sep-05



Project Name: Lewis / Rialto

Project No.: 021751-001

Exploration No.: B-15 Sample No.: B-1

Depth (feet): 0-5 Soil Type : (SM)g

Soil Identification: Olive Brown Silty Sand with Gravel (SM)g

GR:SA:FI : (%) 30 : 56 : 14

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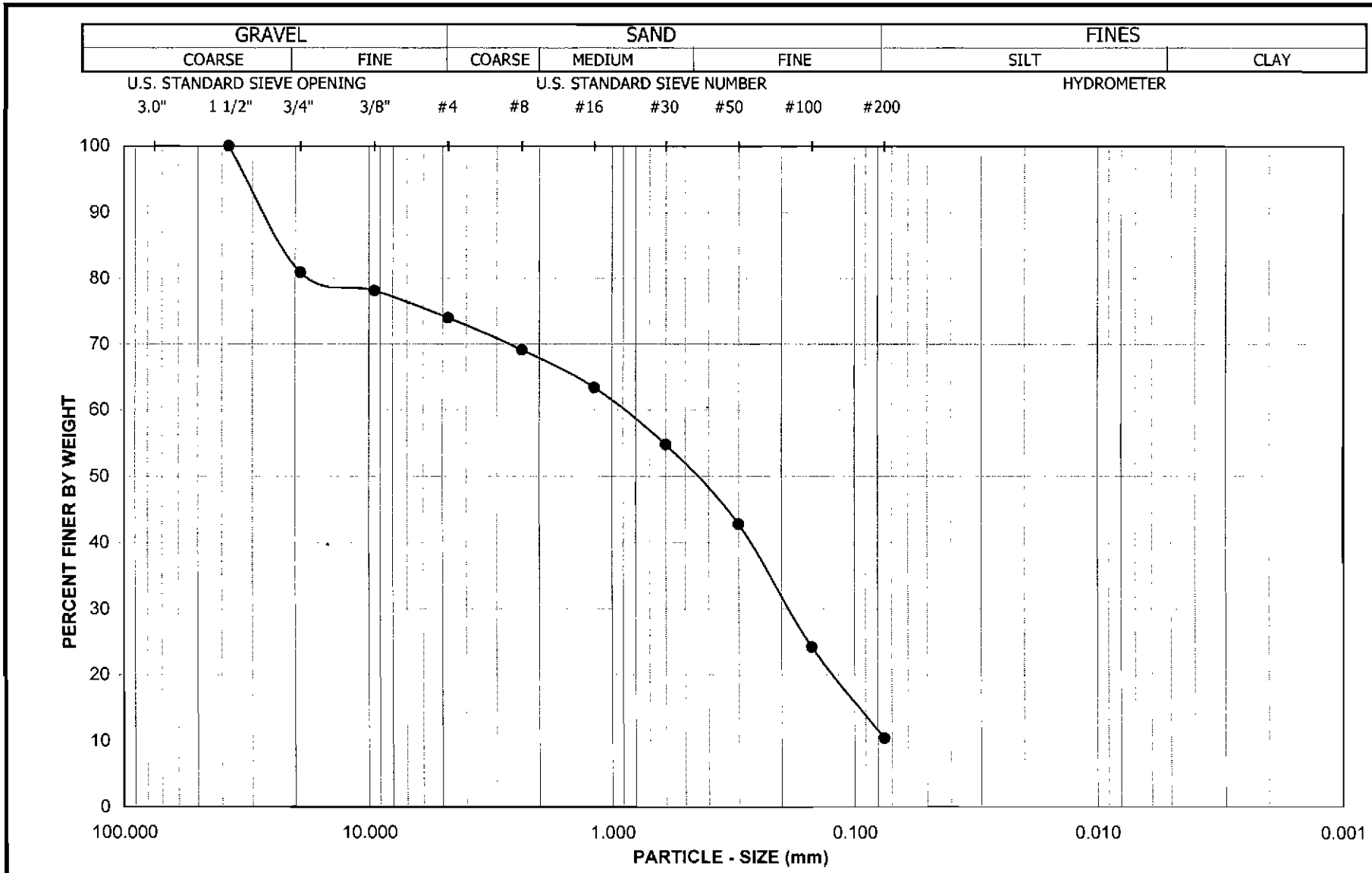
PARTICLE - SIZE DISTRIBUTION ASTM D 422

Sep-05



Project Name: Lewis EJA Rialto

Project No.: 021751-002

Exploration No.: B-19 Sample No.: R-1

Depth (feet): 2.0 Soil Type : (SP-SM)g

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

GR:SA:FI : (%) 26 : 64 : 10

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

Jul-06

Leighton

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Lewis / Rialto	Tested By :	GEB	Date:	09/09/05
Project No.:	021751-001	Input By :	JHW	Date:	09/20/05
Boring No.:	B-1	Depth (ft.)	0-5		
Sample No. :	B-1				
Soil Identification:	Olive 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	12.5
#3/8	
#4	

Rammer Weight (lb.) = 10.0

Height of Drop (in.) = 18.0

Mold Volume (ft^3) 0.07514

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	7373.0	7541.0	7711.0	7701.0		
Weight of Mold (g)	2812.0	2812.0	2812.0	2812.0		
Net Weight of Soil (g)	4561.0	4729.0	4899.0	4889.0		
Wet Weight of Soil + Cont. (g)	1408.60	1149.20	1120.80	1266.30		
Dry Weight of Soil + Cont. (g)	1385.80	1108.50	1058.70	1169.10		
Weight of Container (g)	73.90	82.50	76.60	76.80		
Moisture Content (%)	1.74	3.97	6.32	8.90		
Wet Density (pcf)	133.8	138.7	143.7	143.4		
Dry Density (pcf)	131.5	133.5	135.2	131.7		

Maximum Dry Density (pcf) 135.0

Corrected Dry Density (pcf) 138.5

Optimum Moisture Content (%) 6.5

Corrected Moisture Content (%) 6.0

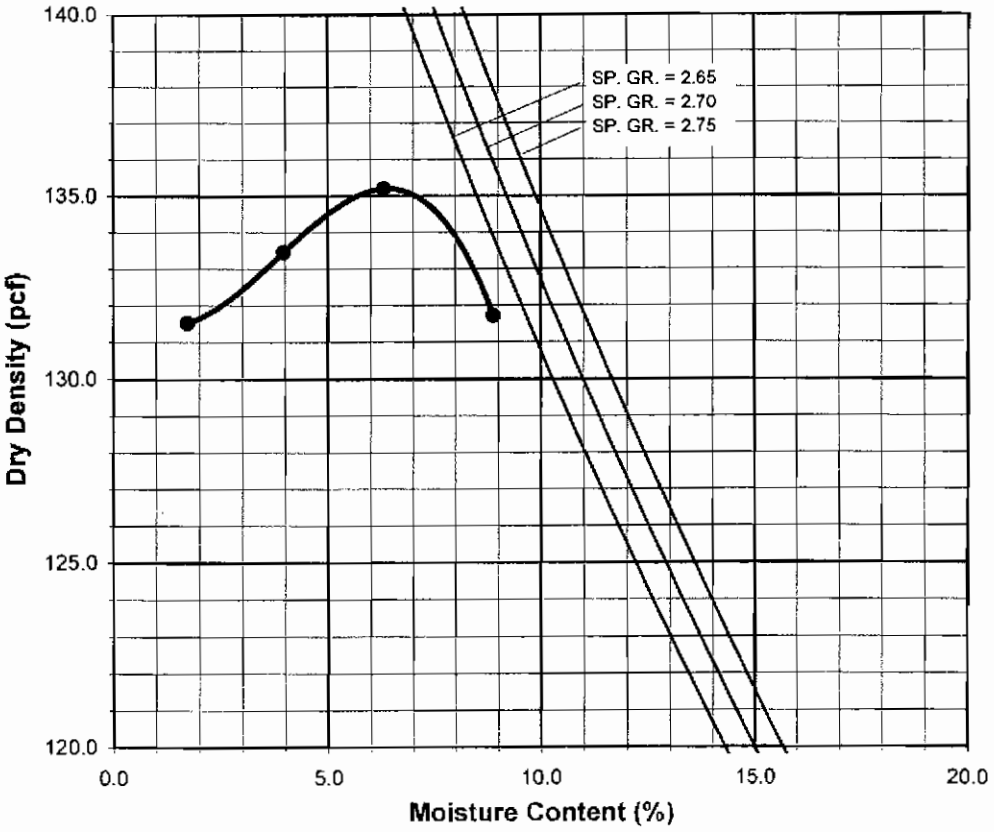
☐ **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

☐ **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:
44:44:12
GR:SA:FI

Atterberg Limits:
LL,PL,PI



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MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Lewis / Rialto	Tested By :	GEB	Date:	09/19/05
Project No.:	021751-001	Input By :	JHW	Date:	09/20/05
Boring No.:	B-12	Depth (ft.)	0-5		
Sample No. :	B-1				
Soil Identification:	Brown Silty Sand with Gravel (SM)g				

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

Scalp Fraction (%)	
#3/4	10.9
#3/8	
#4	

Rammer Weight (lb.) = 10.0

Height of Drop (in.) = 18.0

Mold Volume (ft^3) 0.07514

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	7495.0	7713.0	7613.0			
Weight of Mold (g)	2812.0	2812.0	2812.0			
Net Weight of Soil (g)	4683.0	4901.0	4801.0			
Wet Weight of Soil + Cont. (g)	1124.10	1138.30	1236.10			
Dry Weight of Soil + Cont. (g)	1076.20	1065.40	1135.60			
Weight of Container (g)	76.00	73.40	74.50			
Moisture Content (%)	4.79	7.35	9.47			
Wet Density (pcf)	137.4	143.8	140.9			
Dry Density (pcf)	131.1	134.0	128.7			

Maximum Dry Density (pcf) 134.0

Corrected Dry Density (pcf) 137.0

Optimum Moisture Content (%) 7.0

Corrected Moisture Content (%) 6.5

☐ **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

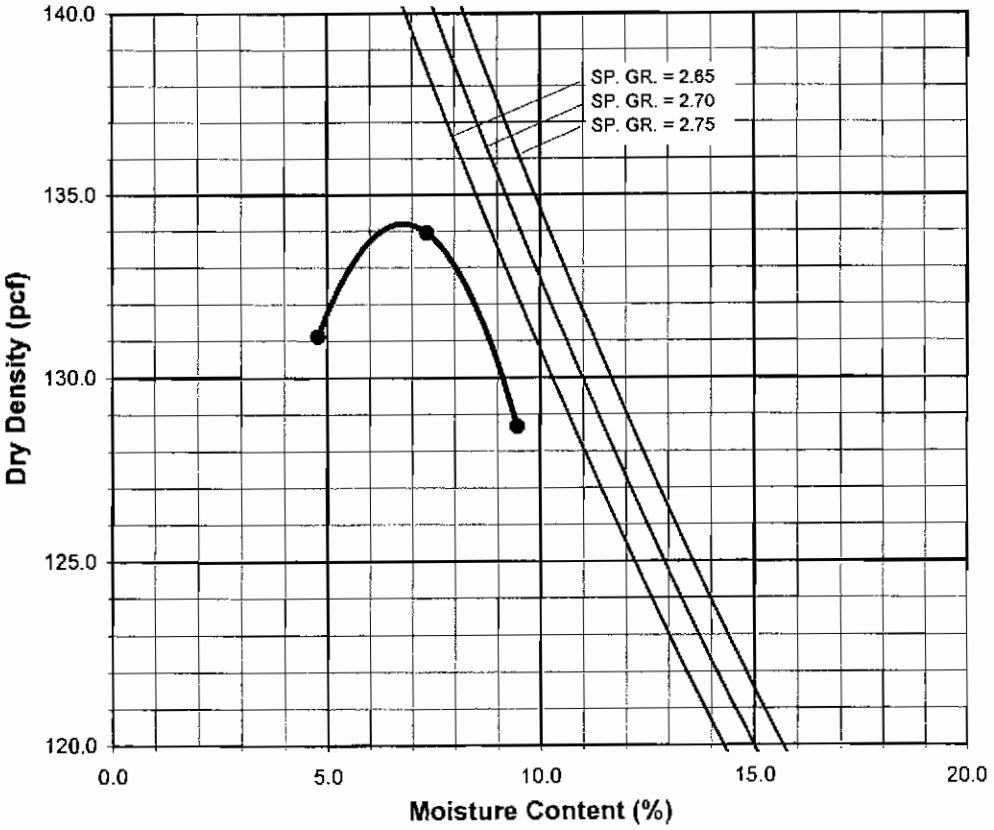
☒ **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



Leighton

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Lewis EJA Rialto	Tested By :	GEB	Date:	07/24/06
Project No.:	021751-002	Input By :	LF	Date:	07/25/06
Boring No.:	B-20	Depth (ft.)	0-5		
Sample No. :	Bag-1				
Soil Identification:	Brown silty sand with gravel (SM)g				

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

Scalp Fraction (%)	
#3/4	23.0
#3/8	
#4	

Rammer Weight (lb.) = 10.0

Height of Drop (in.) = 18.0

Mold Volume (ft^3) 0.07514

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	7017.0	7285.0	7486.0	7417.0		
Weight of Mold (g)	2812.0	2812.0	2812.0	2812.0		
Net Weight of Soil (g)	4205.0	4473.0	4674.0	4605.0		
Wet Weight of Soil + Cont. (g)	547.20	599.60	656.10	862.80		
Dry Weight of Soil + Cont. (g)	532.80	570.50	611.30	789.90		
Weight of Container (g)	77.10	75.90	76.50	76.20		
Moisture Content (%)	3.16	5.88	8.38	10.21		
Wet Density (pcf)	123.4	131.2	137.1	135.1		
Dry Density (pcf)	119.6	123.9	126.5	122.6		

Maximum Dry Density (pcf) 126.5

Corrected Dry Density (pcf) 134

Optimum Moisture Content (%) 8.0

Corrected Moisture Content (%) 6.5

☐ **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

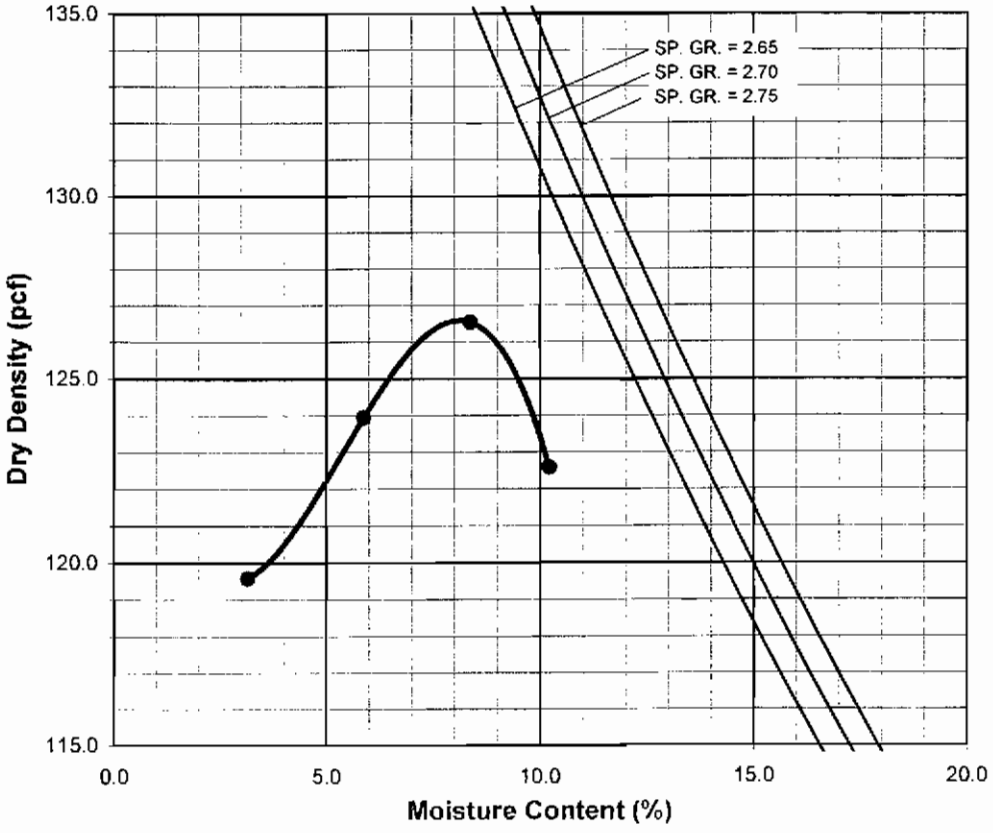
☒ **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



Leighton

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Lewis EJA Rialto	Tested By :	GEB	Date:	07/24/06
Project No.:	021751-003	Input By :	LF	Date:	07/25/06
Boring No.:	B-23	Depth (ft.)	0-5		
Sample No. :	Bag-1				
Soil Identification:	Brown silty sand with gravel (SM)g				

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

Scalp Fraction (%)	
#3/4	35.0
#3/8	
#4	

Rammer Weight (lb.) = 10.0

Height of Drop (in.) = 18.0

Mold Volume (ft^3) 0.07514

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	7297.0	7503.0	7427.0			
Weight of Mold (g)	2812.0	2812.0	2812.0			
Net Weight of Soil (g)	4485.0	4691.0	4615.0			
Wet Weight of Soil + Cont. (g)	822.90	760.40	782.70			
Dry Weight of Soil + Cont. (g)	782.10	709.60	715.30			
Weight of Container (g)	72.80	75.10	76.80			
Moisture Content (%)	5.75	8.01	10.56			
Wet Density (pcf)	131.6	137.6	135.4			
Dry Density (pcf)	124.4	127.4	122.5			

Maximum Dry Density (pcf) 127.5

Corrected Dry Density (pcf) 139.5

Optimum Moisture Content (%) 8.0

Corrected Moisture Content (%) 5.5

☐ **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

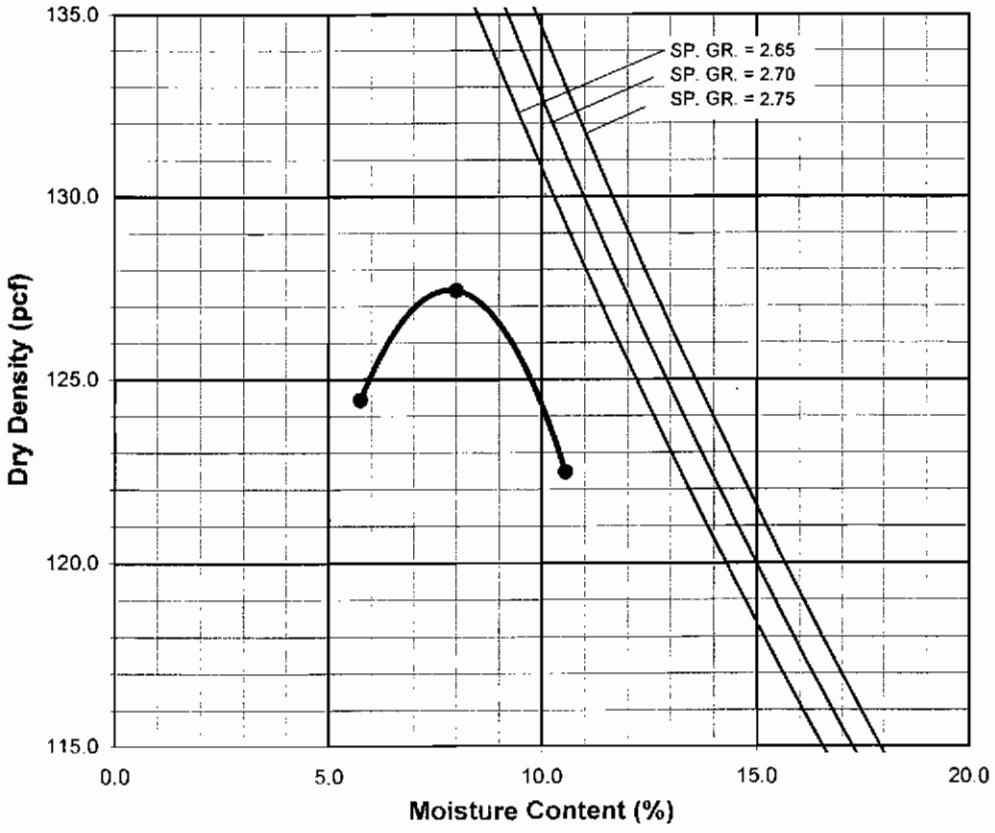
☒ **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

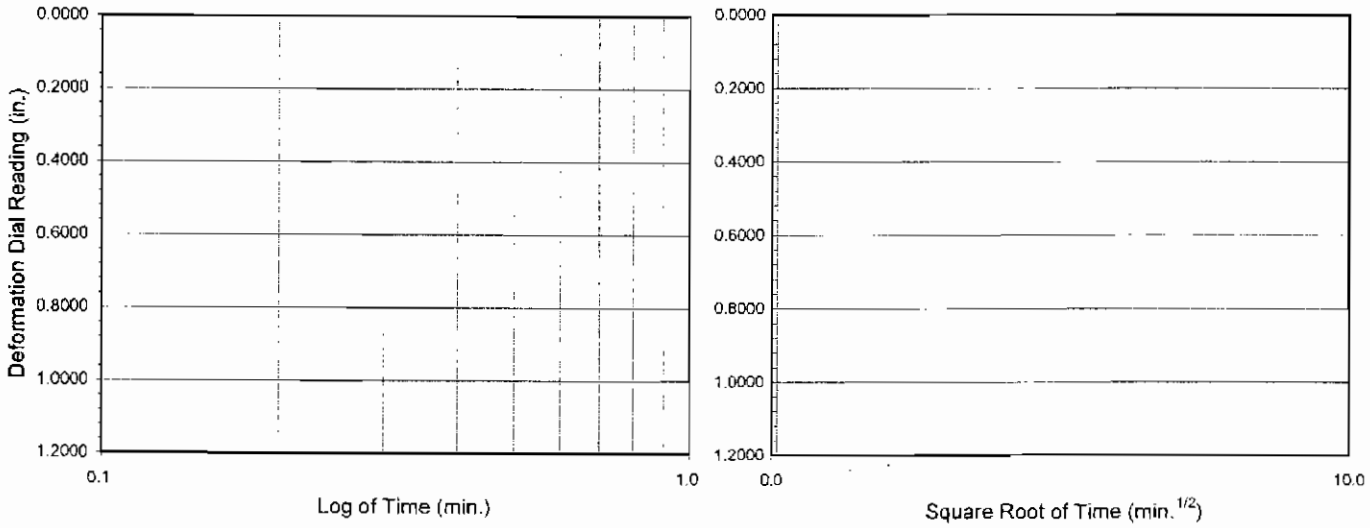
GR:SA:FI

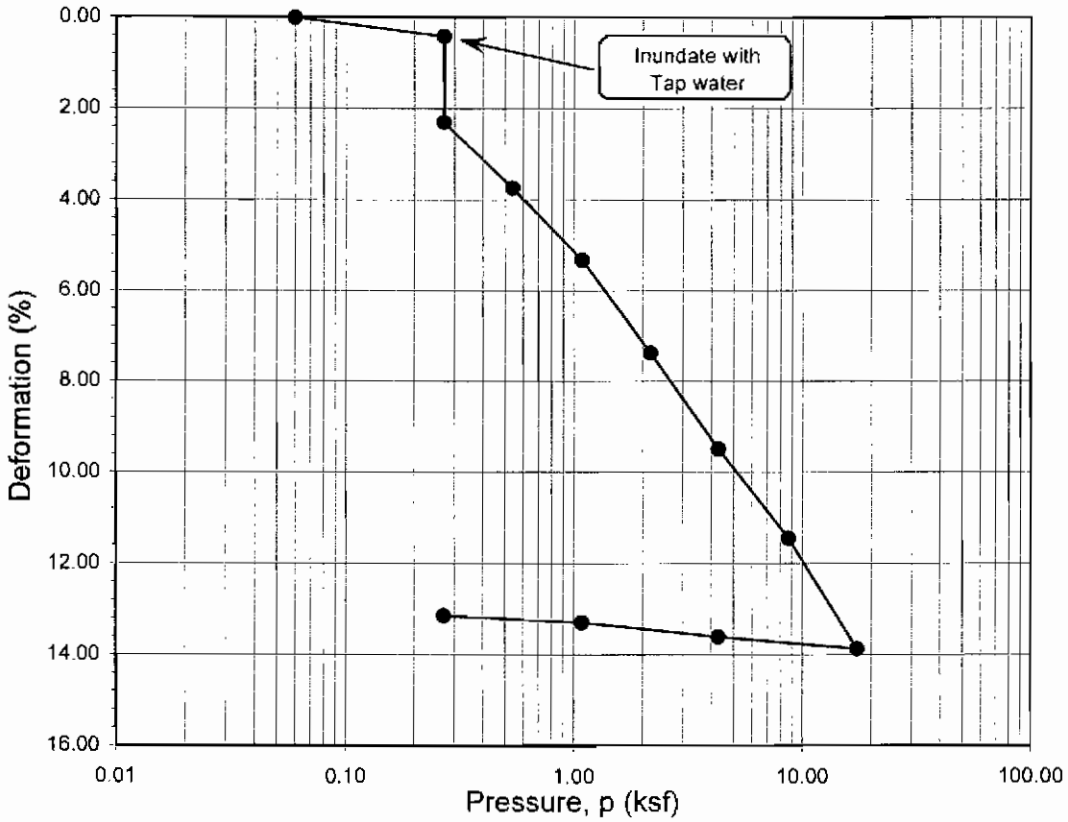
Atterberg Limits:

LL,PL,PI



No Time Readings





Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
B-24	**R-1**	**2**	**2.0**	**11.3**	**114.4**	**129.1**	**0.473**	**0.280**	**11**	**100**

Soil Identification: Brown silty sand with gravel (SM)g

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
(ASTM D 2435)

Project No.: 021751-003

Lewis EJA Rialto

07-06

Leighton

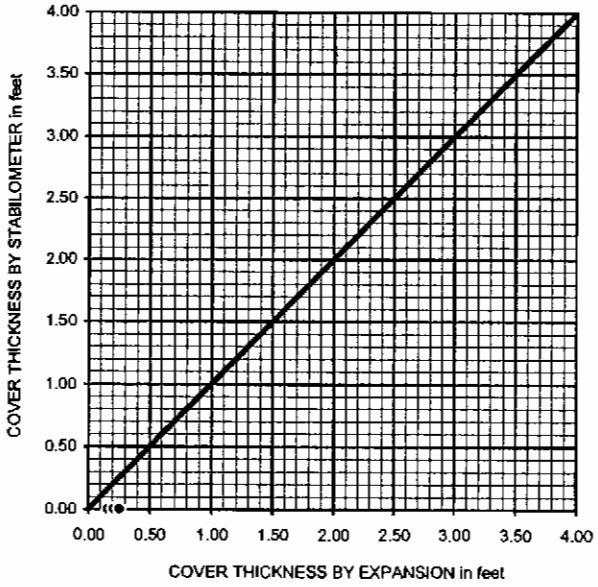
R-VALUE TEST RESULTS

PROJECT NAME:	Lewis / Rialto	PROJECT NUMBER:	021751-001
SAMPLE NUMBER:	B-1	SAMPLE LOCATION:	B-4 0-5'
SAMPLE DESCRIPTION:	SM	TECHNICIAN:	SCF
		DATE SAMPLED	8/26/2005

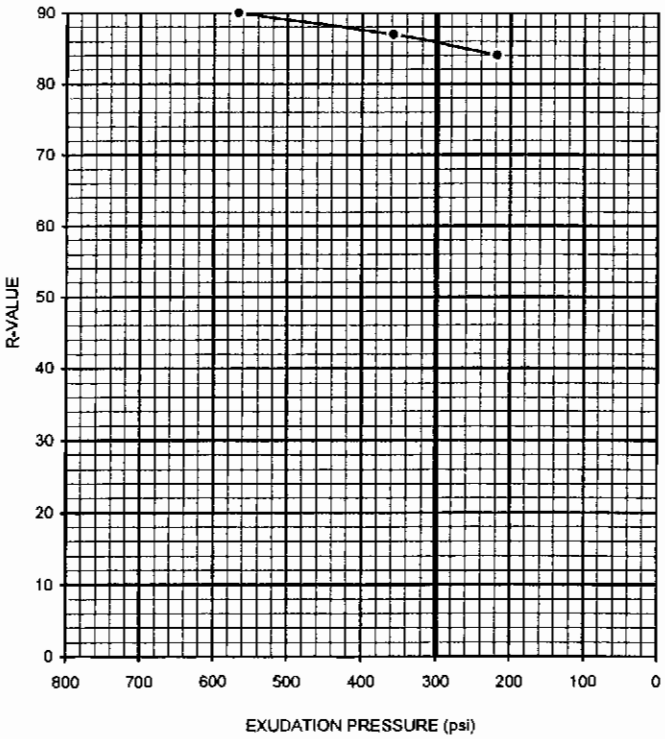
TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION %	7.7	8.1	8.5
HEIGHT OF SAMPLE, Inches	2.45	2.50	2.51
DRY DENSITY, pcf	129.4	130.7	130.7
COMPACTOR PRESSURE, psi	350	350	350
EXUDATION PRESSURE, psi	566	357	218
EXPANSION, Inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	12	15	18
TURNS DISPLACEMENT	3.52	3.59	3.69
R-VALUE UNCORRECTED	90	87	84
R-VALUE CORRECTED	90	87	84

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.16	0.21	0.26
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION:	100
R-VALUE BY EXUDATION:	86
EQUILIBRIUM R-VALUE:	86

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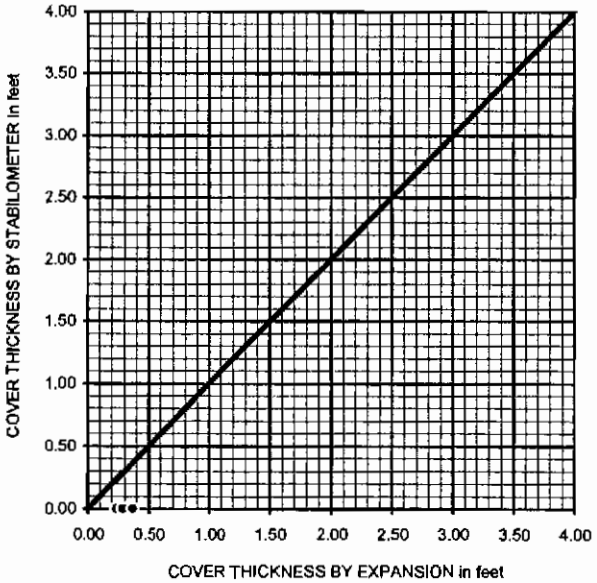
R-VALUE TEST RESULTS

PROJECT NAME:	Lewis / Rialto	PROJECT NUMBER:	021751-001
SAMPLE NUMBER:	B-1	SAMPLE LOCATION:	B-9 0-5'
SAMPLE DESCRIPTION:	SM	TECHNICIAN:	SCF
		DATE SAMPLED	8/26/2005

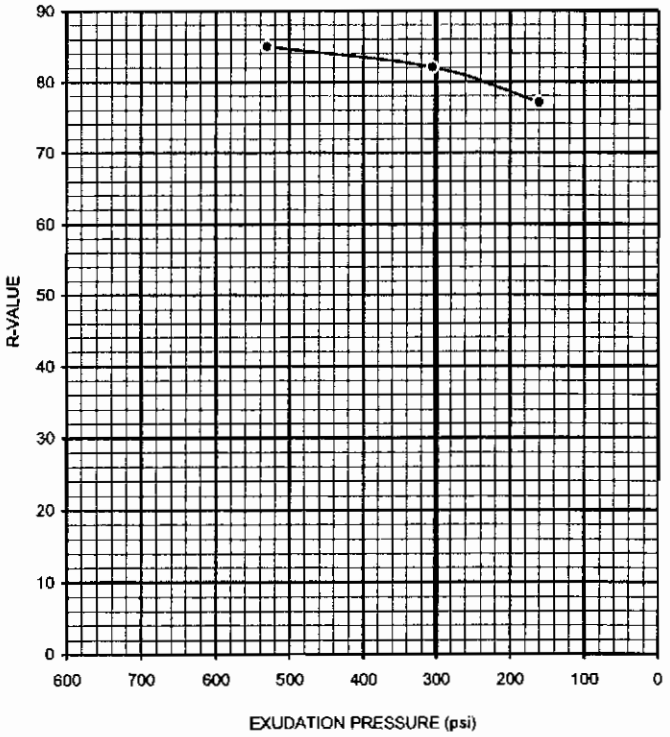
TEST SPECIMEN	a	b	c
MOISTURE AT COMPACTION %	10.1	10.5	11.0
HEIGHT OF SAMPLE, Inches	2.45	2.57	2.43
DRY DENSITY, pcf	119.7	119.7	120.2
COMPACTOR PRESSURE, psi	350	350	350
EXUDATION PRESSURE, psi	530	304	160
EXPANSION, Inches x 10exp-4	0	0	0
STABILITY Ph 2,000 lbs (160 psi)	17	20	24
TURNS DISPLACEMENT	3.62	3.79	3.93
R-VALUE UNCORRECTED	85	82	78
R-VALUE CORRECTED	85	82	77

DESIGN CALCULATION DATA	a	b	c
GRAVEL EQUIVALENT FACTOR	1.0	1.0	1.0
TRAFFIC INDEX	5.0	5.0	5.0
STABILOMETER THICKNESS, ft.	0.24	0.29	0.37
EXPANSION PRESSURE THICKNESS, ft.	0.00	0.00	0.00

EXPANSION PRESSURE CHART



EXUDATION PRESSURE CHART



R-VALUE BY EXPANSION:	100
R-VALUE BY EXUDATION:	82
EQUILIBRIUM R-VALUE:	82

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SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

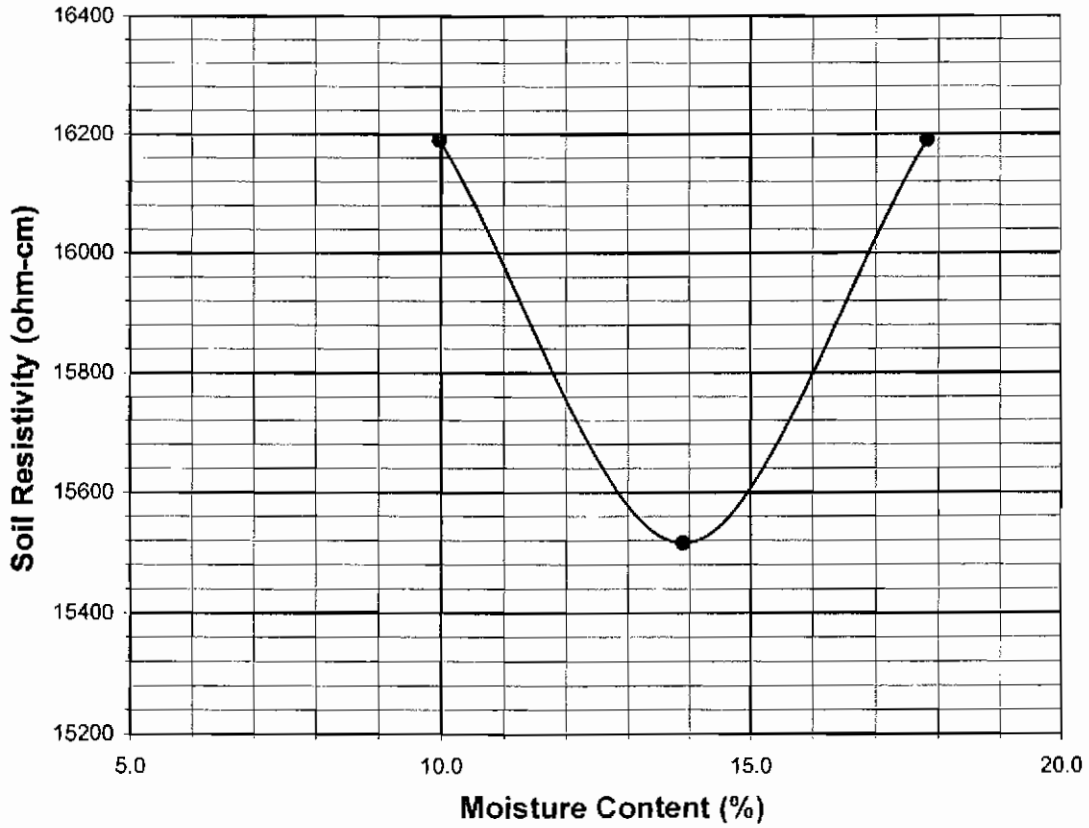
Project Name: Lewis / Rialto
Project No. : 021751-001
Boring No.: B-1
Sample No. : B-1
Soil Identification: Olv (SP-SM)g

Tested By : VJ Date: 09/09/05
Data Input By: JHW Date: 09/20/05
Depth (ft.) : 0-5

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	100	9.97	2400	16190
2	150	13.90	2300	15516
3	200	17.83	2400	16190
4				
5				

Moisture Content (%) (MCi)	2.12
Wet Wt. of Soil + Cont. (g)	230.18
Dry Wt. of Soil + Cont. (g)	226.80
Wt. of Container (g)	67.26
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
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	
15516	**13.9**	**88**	**51**	**5.90**	**21.2**



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SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

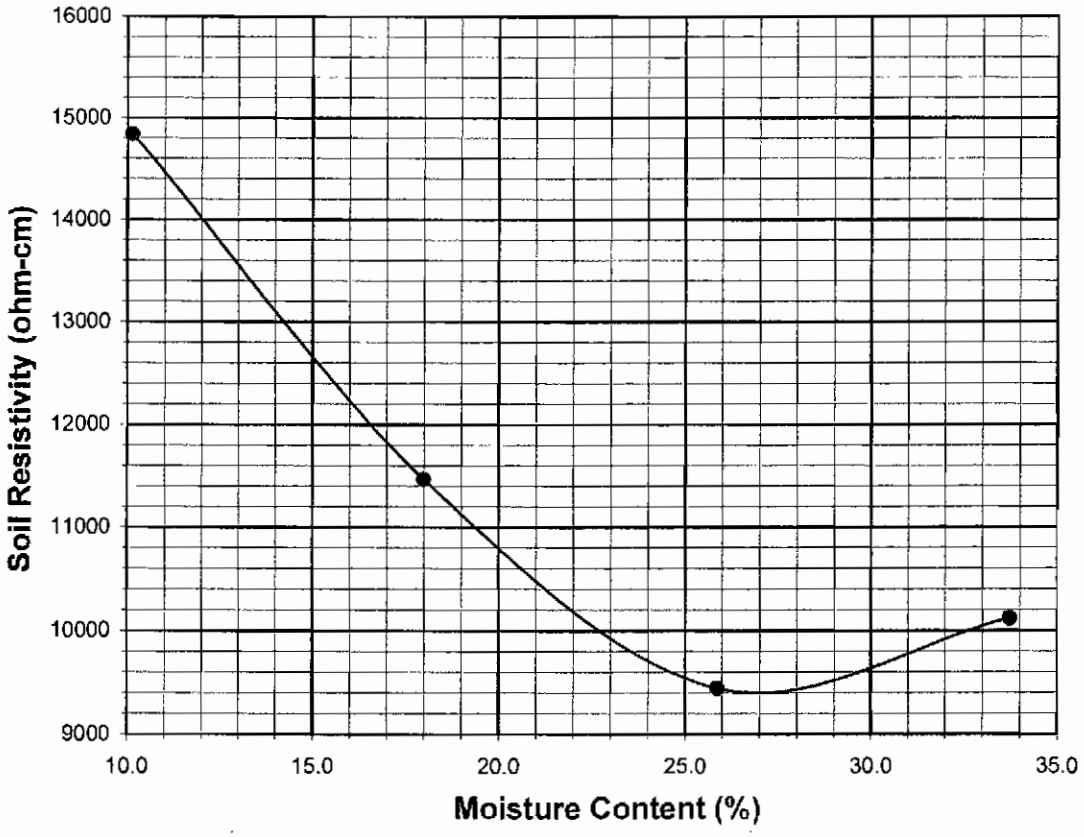
Project Name: Lewis / Rialto
Project No. : 021751-001
Boring No.: B-9
Sample No. : B-1
Soil Identification: Olv Brn (SM)

Tested By : VJ Date: 09/13/05
Data Input By: JHW Date: 09/20/05
Depth (ft.) : 0-5

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	100	10.13	2200	14841
2	200	18.00	1700	11468
3	300	25.87	1400	9444
4	400	33.74	1500	10119
5				

Moisture Content (%) (MCi)	2.27
Wet Wt. of Soil + Cont. (g)	219.61
Dry Wt. of Soil + Cont. (g)	216.23
Wt. of Container (g)	67.21
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
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	
9400	**27.0**	**80**	**51**	**5.59**	**21.1**



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SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

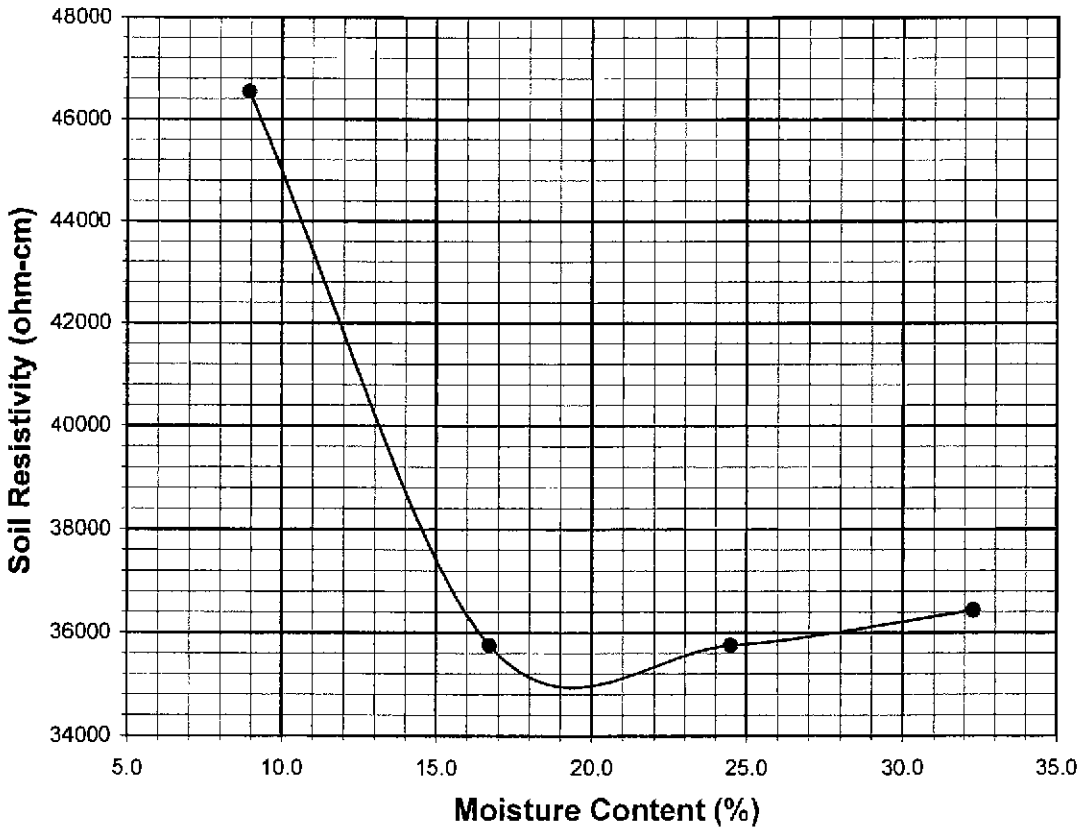
Project Name: Lewis / Rialto
Project No. : 021751-001
Boring No.: B-15
Sample No. : B-1
Soil Identification: Olv Brn (SM)g

Tested By : VJ Date: 09/13/05
Data Input By: JHW Date: 09/20/05
Depth (ft.) : 0-5

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	100	8.94	6900	46547
2	200	16.72	5300	35754
3	300	24.50	5300	35754
4	400	32.29	5400	36428
5				

Moisture Content (%) (MCi)	1.16
Wet Wt. of Soil + Cont. (g)	234.50
Dry Wt. of Soil + Cont. (g)	232.69
Wt. of Container (g)	76.59
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
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	
35000	**19.5**	**75**	**51**	**5.77**	**20.8**



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SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

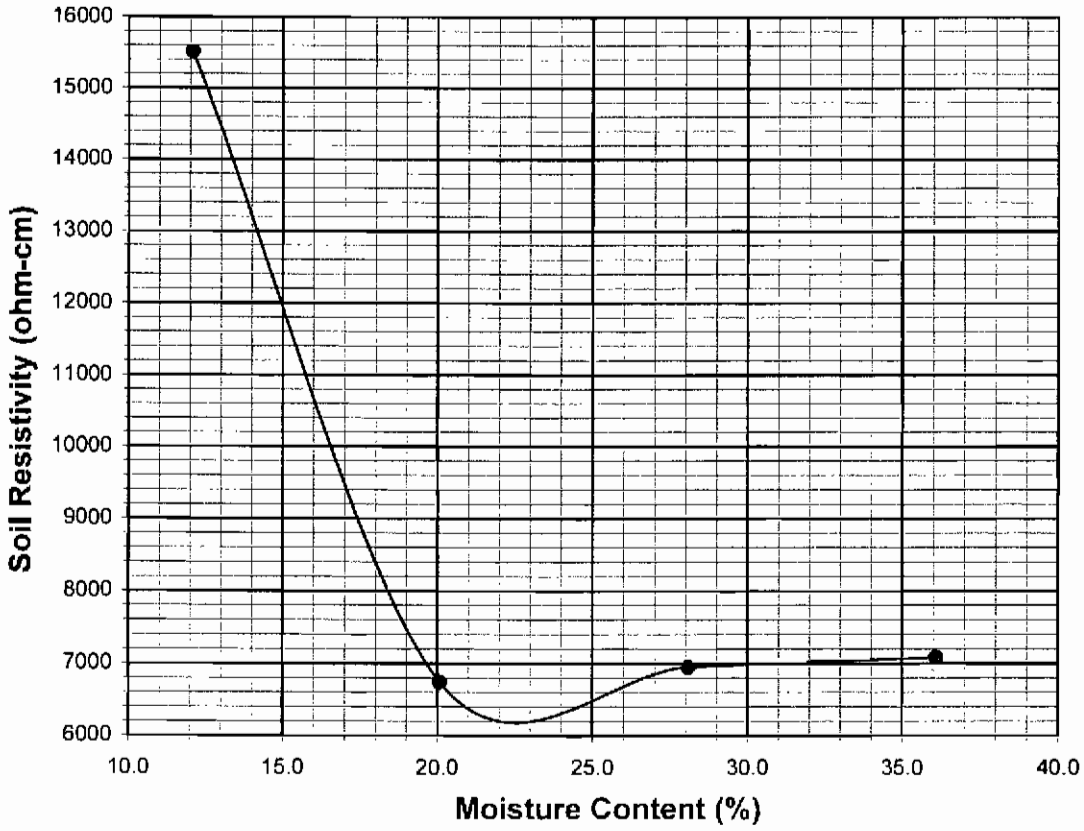
Project Name: Lewis EJA Rialto
Project No. : 021751-002
Boring No.: B-20
Sample No. : Bag-1
Soil Identification: (SM)g

Tested By : VJ Date: 07/24/06
Data Input By: LF Date: 07/26/06
Depth (ft.) : 0-5

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	100	12.08	2300	15516
2	200	20.09	1000	6746
3	300	28.09	1030	6948
4	400	36.10	1050	7083
5				

Moisture Content (%) (MCi)	4.08
Wet Wt. of Soil + Cont. (g)	235.88
Dry Wt. of Soil + Cont. (g)	228.98
Wt. of Container (g)	59.66
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
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	
6200	**22.5**	**94**	**730**	**5.79**	**21.0**



Leighton

SOIL RESISTIVITY TEST

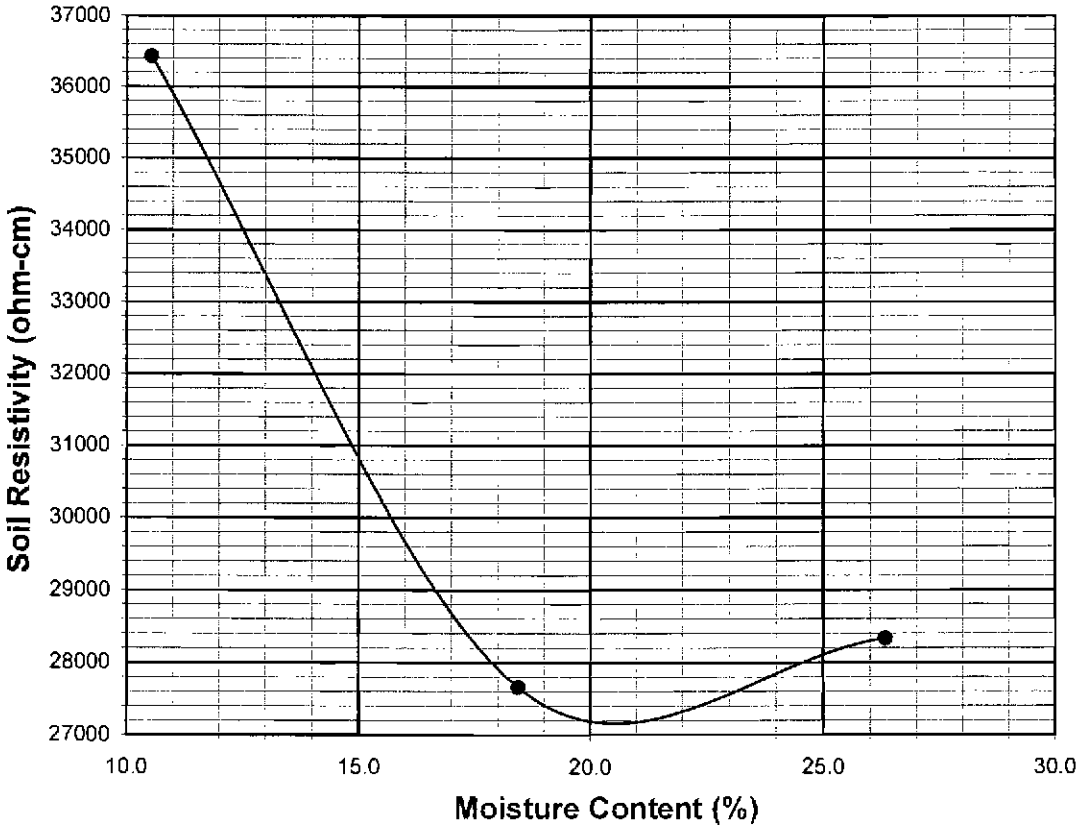
DOT CA TEST 532 / 643

Project Name:	Lewis EJA Rialto		Tested By :	VJ	Date: 07/18/06
Project No. :	021751-003		Data Input By:	LF	Date: 07/21/06
Boring No.:	B-24		Depth (ft.) :	0-5	
Sample No. :	Bag-1				
Soil Identification:	(GP-GM)s				

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	100	10.54	5400	36428
2	200	18.44	4100	27659
3	300	26.33	4200	28333
4				
5				

Moisture Content (%) (MCi)	2.64
Wet Wt. of Soil + Cont. (g)	200.26
Dry Wt. of Soil + Cont. (g)	196.63
Wt. of Container (g)	59.34
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
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	
27200	**20.5**	**106**	**51**	**5.32**	**20.8**



APPENDIX D

APPENDIX D

LEIGHTON AND ASSOCIATES, INC.

GENERAL EARTHWORK AND GRADING SPECIFICATIONS FOR ROUGH GRADING

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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.

APPENDIX F

HYDROLOGIC CONDITIONS OF CONCERN EXEMPTION DOCUMENTATION

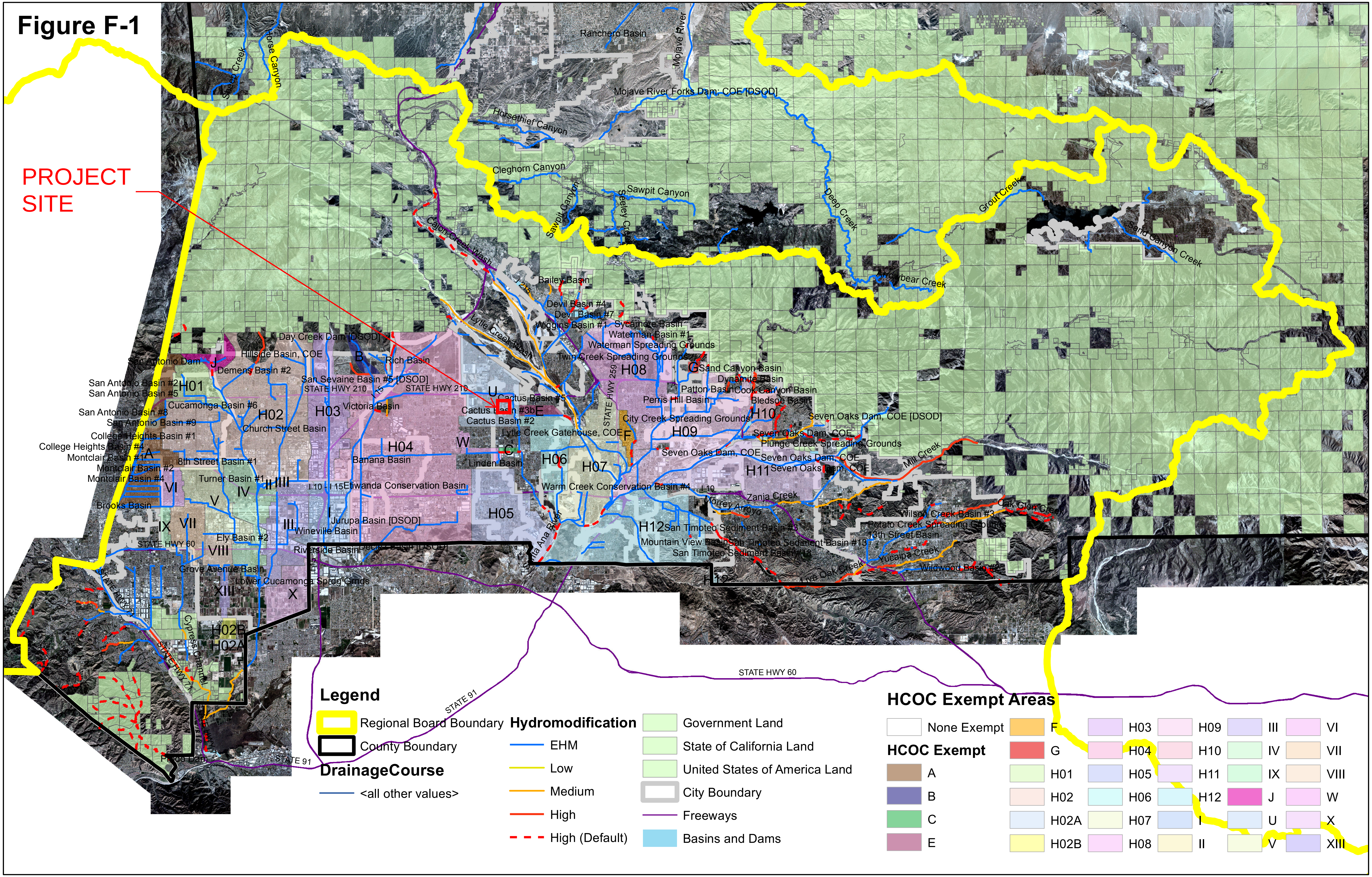
Figure F-1
PROJECT SITE
Ranchero Basin
Mojave River
Horse Canyon
Mojave River Forks Dam, COE [DSOD]
Horsethief Canyon
Cleghorn Canyon
Sawpit Canyon
Deep Creek
Grout Creek
Bailey Basin
Devil Basin #4
Devil Basin #7
Wiggins Basin #1
Sycamore Basin
Waterman Basin #1
Waterman Spreading Grounds
Twin Creek Spreading Grounds
Day Creek Dam [DSOD]
Hillside Basin, COE
Rich Basin
San Antonio Dam
Demens Basin #2
San Sevaine Basin #5 [DSOD]
STATE HWY 210
San Antonio Basin #2
San Antonio Basin #5
Cucamonga Basin #6
San Antonio Basin #8
San Antonio Basin #9
Victoria Basin
Church Street Basin
College Heights Basin #1
College Heights Basin #4
Montclair Basin #1
Montclair Basin #2
Montclair Basin #4
8th Street Basin #1
Turner Basin #1
Banana Basin
Linden Basin
Cactus Basin #5
Cactus Basin #3b
Cactus Basin #2
Lytle Creek Gatehouse, COE
Sand Canyon Basin
Dynamite Basin
Patton Basin
Cook Canyon Basin
Perris Hill Basin
Bledsoe Basin
City Creek Spreading Grounds
Seven Oaks Dam, COE [DSOD]
Seven Oaks Dam, COE
Plunge Creek Spreading Grounds
Mill Creek
Zanja Creek
Etiwanda Conservation Basin
Warm Creek Conservation Basin #4
Brooks Basin
Jurupa Basin [DSOD]
Wineville Basin
Ely Basin #2
Riverside Basin
STATE HWY 60
Grove Avenue Basin
Lower Cucamonga Sprdg Grnds
San Timoteo Sediment Basin #3
Mountain View Basin
San Timoteo Sediment Basin #13
Wilson Creek Basin #3
Potato Creek Spreading Grounds
13th Street Basin
Yucaipa Creek
Wildwood Basin
Oak Glen Creek
Prado Dam
STATE 91
Cypress Channel
H01
H02
H02A
H02B
H03
H04
H05
H06
H07
H08
H09
H10
H11
H12
Legend
Regional Board Boundary
County Boundary
DrainageCourse
<all other values>
Hydromodification
EHM
Low
Medium
High
High (Default)
Government Land
State of California Land
United States of America Land
City Boundary
Freeways
Basins and Dams
HCOC Exempt Areas
None Exempt
HCOC Exempt
A
B
C
E
F
G
H01
H02
H02A
H02B
H03
H04
H05
H06
H07
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H09
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XIII

Hydromodification

A.1 Hydrologic Conditions of Concern (HCOC) Analysis

HCOC Exemption:

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

2. **Pre = Post**: The runoff flow rate, volume and velocity for the post-development condition of the Priority Development Project do not exceed the pre-development (i.e, naturally occurring condition for the 2-year, 24-hour rainfall event utilizing latest San Bernardino County Hydrology Manual.

    a. Submit a substantiated hydrologic analysis to justify your request.

3. **Diversion to Storage Area**: The drainage areas that divert to water storage areas which are considered as control/release point and utilized for water conservation.

    a. See Appendix F for the HCOC Exemption Map and the on-line Watershed Geodatabase (http://sbcounty.permitrack.com/wap) for reference.

4. **Less than One Acre**: The Priority Development Project disturbs less than one acre. The Co-permittee has the discretion to require a Project Specific WQMP to address HCOCs on projects less than one acre on a case by case basis. The project disturbs less than one acre and is not part of a common plan of development.

5. **Built Out Area**: The contributing watershed area to which the project discharges has a developed area percentage greater than 90 percent.

    a. See Appendix F for the HCOC Exemption Map and the on-line Watershed Geodatabase (http://sbcounty.permitrack.com/wap) for reference.

Summary of HCOC Exempted Area

	HCOC Exemption reasoning				
	1	2	3	4	5
Area					
A			X		X
B			X		
C					X
E			X		
F					X
G			X		X
H01	X		X		
H02	X		X		
H02A	X		X		
H02B			X		
H03			X		
H04	X		X		
H05	X				
H06			X		
H07	X				
H08	X		X		
H09	X				
H10	X		X		
H11	X		X		
H12	X				
J			X		
U			X		
W			X		
I			X		
II			X		
III					X
IV			X		X
V			X*		
VI					X
VII					X
VIII			X		
IX					X
X			X		
XIII			X		

*Detention/Conservation Basin