APPENDIX I

Preliminary Water Quality Management Plan

For

Betty Ford Center Building Expansion,

Betty Ford Center Campus

39000 Bob Hope Drive,

Rancho Mirage, CA 92270

September 2019

Prepared For
Hazelden Betty Ford Foundation
15251 Pleasant Valley Road
Center City, MN 55012

Prepared by

Michael Baker International
75410 Gerald Ford Drive, Suite 100
Palm Desert, CA 92211
Daniel Koravos, P.E.

Project Specific
Preliminary Water Quality Management Plan

For: **Betty Ford Center Building Expansion, Betty Ford Center Campus**

39000 Bob Hope Drive, Rancho Mirage, CA 92270

DEVELOPMENT NO. **PARCEL 2 OF LLA 18-01**
PARCELS 2 AND 3 OF LLA 99-19

DESIGN REVIEW NO. **-**

Prepared for:

Hazelden Betty Ford Foundation
15251 Pleasant Valley Road
Center City, MN 55012
Telephone: 651-213-4232

Prepared by:

Daniel Koravos, P.E. Project Manager
Michael Baker International
75410 Gerald Ford Drive, Suite 100
Palm Desert CA 92211
Telephone: 760-346-7481

Daniel Koravos, PE

Original Date Prepared: September 2019

Revision Date(s): -

OWNER'S CERTIFICATION

This project-specific Water Quality Management Plan (WQMP) has been prepared for:

Hazelden Betty Ford Foundation
by **Michael Baker International**
for the project known as **Betty Ford Center Building Expansion** at **39000 Bob Hope Drive**.

This WQMP is intended to comply with the requirements of the **City of Rancho Mirage** in the County of Riverside, California for the **Betty Ford Center Building Expansion**, which includes the requirement for the preparation and implementation of a project-specific WQMP.

The undersigned, while owning the property/project described in the preceding paragraph, shall be responsible for the implementation of this WQMP and will ensure that this WQMP is amended as appropriate to reflect up-to-date conditions on the site. This WQMP will be reviewed with the facility operator, facility supervisors, employees, tenants, maintenance and service contractors, or any other party (or parties) having responsibility for implementing portions of this WQMP. At least one copy of this WQMP will be maintained at the project site or project office in perpetuity.

The undersigned is authorized to certify and to approve implementation of this WQMP. The undersigned is aware that implementation of this WQMP is enforceable under **City of Rancho Mirage, CA** Storm Water Ordinance (Municipal Code Title 15.64).

If the undersigned transfers its interest in the subject property/project, the undersigned shall notify the successor in interest of its responsibility to implement this WQMP.

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

ATTEST

____
Owner's Signature

____
Owner's Printed Name

____
Owner's Title/Position

____
Date

Hazelden Betty Ford Foundation
15251 Pleasant Valley Road
Center City, MN 55012
651-213-4232

____
Notary Signature

____
Printed Name

____
Title/Position

____
Date

THIS FORM SHALL BE NOTARIZED BEFORE ACCEPTANCE OF THE
FINAL PROJECT SPECIFIC WQMP

Contents

TABLES

APPENDICES

I. Project Description

Project Owner: **Hazelden Betty Ford Foundation**
15251 Pleasant Valley Road
Center City, MN 55012
651-213-4232

WQMP Preparer: Michael Baker International
75410 Gerald Ford Drive, Suite 100
Palm Desert, CA 92211
760-346-7481

Project Site Address:	**39000 Bob Hope Drive**
Planning Area/ Community Name/ Development Name:	**Rancho Mirage, CA 92270** **Betty Ford Center Building Expansion**
APN Number(s):	**685-280-016, -017, -028, and 685-270-017**
Latitude & Longitude:	**33°45’45.6” N, 116°23’54.4” W**
Receiving Water:	**Coachella Valley Storm Water Channel**
Project Site Size:	**25.43 Acres**

Standard Industrial Classification (SIC) Code: **8093**

Formation of Home Owners' Association (HOA)
or Property Owners Association (POA): Y ☐ N ☒

Additional Permits/Approvals required for the Project:

AGENCY	**Permit required**
State Department of Fish and Wildlife, Fish and Game Code §1602 Streambed Alteration Agreement	Y ☐ N☒
State Water Resources Control Board, Clean Water Act (CWA) Section 401 Water Quality Certification	Y ☐ N☒
US Army Corps of Engineers, CWA Section 404 permit	Y ☐ N☒
US Fish and Wildlife, Endangered Species Act Section 7 biological opinion	Y ☐ N☒
Statewide Construction General Permit Coverage	Y ☒ N☐
Statewide Industrial General Permit Coverage	Y ☐ N☒
Other *(please list in the space below as required)* City of Rancho Mirage Grading Permit	Y ☒ N☐
City of Rancho Mirage Building Permit	Y ☒ N☐

This report prepared by Michael Baker International for Hazelden Betty Ford Foundation, addresses the Betty Ford Center Building Expansion project. The project is located at 39000 Bob Hope Drive in the City of Rancho Mirage, County of Riverside. The site is 25.43 acres and is classified as hospital/medical. The expansion consists of 3 buildings, an entrance road, parking, 1 retention basin, and landscaped areas. Typical activities associated with this type of development include incoming and outgoing vehicle traffic, landscape irrigation and maintenance, and use of trash/recycle bins. The potential pollutants generated by this land use type include bacteria/virus, heavy metals, sediments, trash and debris, toxic organic compounds, oil and grease. See Appendix B for Project Vicinity Map, WQMP Site Plan, and Receiving Waters Map.

Appendix A of this project-specific WQMP includes a complete copy of the final Conditions of Approval. Appendix B of this project-specific WQMP includes:

a. A Vicinity Map identifying the project site and surrounding planning areas in sufficient detail; and

b. A Site Plan for the project. The Site Plan included as part of Appendix B depicts the following project features:

    - Location and identification of all structural BMPs, including Source Control, LID/Site Design and Treatment Control BMPs.
    - Landscaped areas.
    - Paved areas and intended uses (i.e., parking, outdoor work area, outdoor material storage area, sidewalks, patios, tennis courts, etc.).
    - Number and type of structures and intended uses (i.e., buildings, tenant spaces, dwelling units, community facilities such as pools, recreation facilities, tot lots, etc.).
    - Infrastructure (i.e., streets, storm drains, etc.) that will revert to public agency ownership and operation.
    - Location of existing and proposed public and private storm drainage facilities (i.e., storm drains, channels, basins, etc.), including catch basins and other inlets/outlet structures. Existing and proposed drainage facilities should be clearly differentiated.
    - Location(s) of Receiving Waters to which the project directly or indirectly discharges.
    - Location of points where onsite (or tributary offsite) flows exit the property/project site.
    - Delineation of proposed drainage area boundaries, including tributary offsite areas, for each location where flows exit the project site and existing site (where existing site flows are required to be addressed). Each tributary area should be clearly denoted.
    - Pre- and post-project topography.

Appendix I is a one-page form that summarizes pertinent information relative to this project-specific WQMP.

II. Site Characterization

Land Use Designation or Zoning: **Hospital/Medical**

Current Property Use: **Hospital/Medical Campus, Vacant**

Proposed Property Use: **Hospital/Medical Campus**

Availability of Soils Report: Y ☒ N ☐ *Note: A soils report is required if infiltration BMPs are utilized. Attach report in Appendix E.*

Phase 1 Site Assessment: Y ☐ N ☒ *Note: If prepared, attached remediation summary and use restrictions in Appendix H.*

Receiving Waters for Urban Runoff from Site

Receiving Waters	EPA Approved 303(d) List Impairments	Designated Beneficial Uses	Proximity to RARE Beneficial Use Designated Receiving Waters
Coachella Valley Storm Water Channel	Pathogens-TMDL Priority Medium	FRSH, REC I, REC II, WARM, WILD & RARE	1.2 Miles
Salton Sea	Nutrients-TMDL Priority High Salinity-TMDL Priority Low	FRSH, REC I, REC II, WARM, WILD & RARE	26.0 Miles

III. Pollutants of Concern

Table 1. Pollutant of Concern Summary

Pollutant Category	Potential for Project and/or Existing Site	Causing Receiving Water Impairment
Bacteria/Virus /Pathogens	YES	YES
Heavy Metals	YES	NO
Nutrients	NO	NO
Toxic Organic Compounds	YES	NO
Sediment/Turbidity	YES	NO
Trash & Debris	YES	NO
Oil & Grease	YES	NO

IV. Hydrologic Conditions of Concern

Local Jurisdiction Requires On-Site Retention of Urban Runoff:

Yes ☒ The project will be required to retain urban runoff onsite in conformance with local ordinance (See Table 6 of the WQMP Guidance document, "Local Land use Authorities Requiring Onsite Retention of Stormwater"). This section does not need to be completed; however, retention facility design details and sizing calculations must be included in Appendix F.

No ☐ This section must be completed.

This Project meets the following condition:

☐ **Condition A**: 1) Runoff from the Project is discharged directly to a publicly-owned, operated and maintained MS4 or engineered and maintained channel, 2) the discharge is in full compliance with local land use authority requirements for connections and discharges to the MS4 (including both quality and quantity requirements), 3) the discharge would not significantly impact stream habitat in proximate Receiving Waters, **and** 4) the discharge is authorized by the local land use authority.

☐ **Condition B**: The project disturbs less than 1 acre and is not part of a larger common plan of development that exceeds 1 acre of disturbance. The disturbed area calculation must include all disturbances associated with larger plans of development.

☐ **Condition C**: The project's runoff flow rate, volume, velocity and duration for the post-development condition do not exceed the pre-development condition for the 2-year, 24-hour and 10-year 24-hour rainfall events. This condition can be achieved by, where applicable, complying with the local land use authority's on-site retention ordinance, or minimizing impervious area on a site and incorporating other Site-Design BMP concepts and LID/Site Design BMPs that assure non-exceedance of pre-development conditions. This condition must be substantiated by hydrologic modeling methods acceptable to the local land use authority.

☐ **None:** Refer to Section 3.4 of the Whitewater River Region WQMP Guidance document for additional requirements.

Supporting engineering studies, calculations, and reports are included in Appendix C.

	2 year – 24 hour		10 year – 24 hour	
	Precondition	**Post-condition**	**Precondition**	**Post-condition**
Discharge (cfs)				
Velocity (fps)				
Volume (cubic feet)				
Duration (minutes)				

V. Best Management Practices

This project implements Best Management Practices (BMPs) to address the Pollutants of Concern that may potentially be generated from the use of the Project site plus existing site area(s). These BMPs have been selected and implemented to comply with Section 3.5 of the WQMP Guidance document, and consist of Site Design BMP concepts, Source Control, LID/Site Design and, if/where necessary, Treatment Control BMPs as described herein.

V.1 SITE DESIGN BMP CONCEPTS, LID/SITE DESIGN AND TREATMENT CONTROL BMPS

Local Jurisdiction Requires On-Site Retention of Urban Runoff:

Yes ☒ The project will be required to retain Urban Runoff onsite in conformance with local ordinance (See Table 6 of the WQMP Guidance document, "Local Land use Authorities Requiring Onsite Retention of Stormwater). **The LID/Site Design measurable goal has thus been met (100%), and Sections V.1.A and V.1.B do not need to be completed**; however, retention facility design details and sizing calculations must be included in Appendix F, and '100%' should be entered into Column 3 of Table 6 below.

No ☐ Section V.1 must be completed.

This section of the Project-Specific WQMP documents the LID/Site Design BMPs and, if/where necessary, the Treatment Control BMPs that will be implemented on the project to meet the requirements detailed within Section 3.5.1 of the WQMP Guidance document. Section 3.5.1 includes requirements to implement Site Design Concepts and BMPs, and includes requirements to address Pollutants of Concern with BMPs. Further, sub-section 3.5.1.1 specifically requires that Pollutants of Concern be addressed with LID/Site Design BMPs to the extent feasible.

LID/Site Design BMPs are those BMPs listed within Table 2 below which promote retention and/or feature a natural treatment mechanism; off-site and regionally-based BMPs are also LID/Site Design BMPs, and therefore count towards the measurable goal, if they fit these criteria. This project incorporates LID/Site Design BMPs to fully address the Treatment Control BMP requirement where and to the extent feasible. If and where it has been acceptably demonstrated to the local land use authority that it is infeasible to fully meet this requirement with LID/Site Design BMPs, Section V.1.B (below) includes a description of the conventional Treatment Control BMPs that will be substituted to meet the same requirements.

In addressing Pollutants of Concern, BMPs are selected using Table 2 below.

Table 2. BMP Selection Matrix Based Upon Pollutant of Concern Removal Efficiency (1)

(Sources: City of Rancho Mirage Flood Control & Water Conservation District Design Handbook for Low Impact Development Best Management Practices, dated September 2011, the Orange County Technical Guidance Document for Water Quality Management Plans, dated May 19, 2011, and the Caltrans Treatment BMP Technology Report, dated April 2010 and April 2008)

Pollutant of Concern	Landscape Swale[2, 3]	Landscape Strip[2, 3]	Biofiltration (with underdrain)[2, 3]	Extended Detention Basin[2]	Sand Filter Basin[2]	Infiltration Basin[2]	Infiltration Trench[2]	Permeable Pavement[2]	Bioretention (w/o underdrain)[2, 3]	Other BMPs Including Proprietary BMPs[4, 6]
Sediment & Turbidity	M	M	H	M	H	H	H	H	H	Varies by Product[5]
Nutrients	L/M	L/M	M	L/M	L/M	H	H	H	H	
Toxic Organic Compounds	M/H	M/H	M/H	L	L/M	H	H	H	H	
Trash & Debris	L	L	H	H	H	H	H	L	H	
Bacteria & Viruses (also: Pathogens)	L	M	H	L	M	H	H	H	H	
Oil & Grease	M	M	H	M	H	H	H	H	H	
Heavy Metals	M	M/H	M/H	L/M	M	H	H	H	H	

Abbreviations:
L: Low removal efficiency M: Medium removal efficiency H: High removal efficiency

Notes:

(1) Periodic performance assessment and updating of the guidance provided by this table may be necessary.

(2) Expected performance when designed in accordance with the most current edition of the document, "City of Rancho Mirage, Whitewater River Region Stormwater Quality Best Management Practice Design Handbook".

(3) Performance dependent upon design which includes implementation of thick vegetative cover. Local water conservation and/or landscaping requirements should be considered; approval is based on the discretion of the local land use authority.

(4) Includes proprietary stormwater treatment devices as listed in the CASQA Stormwater Best Management Practices Handbooks, other stormwater treatment BMPs not specifically listed in this WQMP (including proprietary filters, hydrodynamic separators, inserts, etc.), or newly developed/emerging stormwater treatment technologies.

(5) Expected performance should be based on evaluation of unit processes provided by BMP and available testing data. Approval is based on the discretion of the local land use authority.

(6) When used for primary treatment as opposed to pre-treatment, requires site-specific approval by the local land use authority.

V.1.A SITE DESIGN BMP CONCEPTS AND LID/SITE DESIGN BMPS

This section documents the Site Design BMP concepts and LID/Site Design BMPs that will be implemented on this project to comply with the requirements detailed in Section 3.5.1 of the WQMP Guidance document.

- Table 3 herein documents the implementation of the Site Design BMP Concepts described in sub-sections 3.5.1.3 and 3.5.1.4.
- Table 4 herein documents the extent to which this project has implemented the LID/Site Design goals described in sub-section 3.5.1.1.

***(NOTE: Sections V.1.A and V.1.B do not need to be completed since flow is retained onsite)**

Table 3. Implementation of Site Design BMP Concepts

Design Concept	Technique	Specific BMP	Included			Brief Reason for BMPs Indicated as No or N/A
			Yes	No	N/A	
Site Design BMP Concept 1	**Minimize Urban Runoff, Minimize Impervious Footprint, and Conserve Natural Areas** **(See WQMP Section 3.5.1.3)**	Conserve natural areas by concentrating or clustering development on the least environmentally sensitive portions of a site while leaving the remaining land in a natural, undisturbed condition.	☐	☐	☒	Site does not contain environmentally sensitive portions.
		Conserve natural areas by incorporating the goals of the Multi-Species Habitat Conservation Plan or other natural resource plans.	☐	☐	☒	Site does not include habitats for any species.
		Preserve natural drainage features and natural depressional storage areas on the site.	☒	☐	☐	
		Maximize canopy interception and water conservation by preserving existing native trees and shrubs, and planting additional native or drought tolerant trees and large shrubs.	☒	☐	☐	
		Use natural drainage systems.	☒	☐	☐	
		Where applicable, incorporate Self-Treating Areas	☐	☒	☐	Proposed basins will capture all runoff onsite.
		Where applicable, incorporate Self-Retaining Areas	☐	☒	☐	Proposed basins will capture all runoff onsite.
		Increase the building floor to area ratio (i.e., number of stories above or below ground).	☐	☒	☐	Open space areas are located throughout the site.
		Construct streets, sidewalks and parking lot aisles to minimum widths necessary, provided that public safety and a walkable environment for pedestrians are not compromised.	☒	☐	☐	
		Reduce widths of streets where off-street parking is available.	☐	☐	☒	Off-street public parking is not available onsite.
		Minimize the use of impervious surfaces, such as decorative concrete, in the landscape design.	☐	☒	☐	Impervious surfaces are implemented as needed for access to each unit.
		Other comparable and equally effective Site Design BMP concept(s) as approved by the local land use authority (Note: Additional narrative required to describe BMP and how it addresses site design concept).	☒	☐	☐	

Table 3. Site Design BMP Concepts (continued)

Design Concept	Technique	Specific BMP	Included			Brief Reason for Each BMP Indicated as No or N/A
			Yes	No	N/A	
Site Design BMP Concept 2	**Minimize Directly Connected Impervious Area (See WQMP Section 3.5.1.4)**	Design residential and commercial sites to contain and infiltrate roof runoff, or direct roof runoff to landscaped swales or buffer areas.	☒	☐	☐	
		Drain impervious sidewalks, walkways, trails, and patios into adjacent landscaping.	☒	☐	☐	
		Incorporate landscaped buffer areas between sidewalks and streets.	☒	☐	☐	
		Use natural or landscaped drainage swales in lieu of underground piping or imperviously lined swales.	☐	☒	☐	Underground piping is incorporated to prevent flooding in certain areas.
		Where soil conditions are suitable, use perforated pipe or gravel filtration pits for low flow infiltration.	☐	☒	☐	All flows are directed to designated locations with above and below ground basins.
		Maximize the permeable area by constructing walkways, trails, patios, overflow parking, alleys, driveways, low-traffic streets, and other low-traffic areas with open-jointed paving materials or permeable surfaces such as pervious concrete, porous asphalt, unit pavers, and granular materials.	☐	☒	☐	Proposed basins will capture all runoff onsite.
		Use one or more of the following:				
		Rural swale system: street sheet flows to landscaped swale or gravel shoulder, curbs used at street corners, and culverts used under driveways and street crossings.	☐	☒	☐	Rural swale system not implemented.
		Urban curb/swale system: street slopes to curb; periodic swale inlets drain to landscaped swale or biofilter.	☒	☐	☐	
		Dual drainage system: first flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder; high flows connect directly to MS4s.	☐	☒	☐	Grading does not allow for high flows to travel directly to BMPs at every catch basin.
		Other comparable and equally effective Site Design BMP concept(s) as approved by the local land use authority (Note: Additional narrative required to describe BMP and how it addresses site design concept).	☒	☐	☐	
		Use one or more of the following for design of driveways and private residential parking areas:				
		Design driveways with shared access, flared (single lane at street), or wheel strips (paving only under the tires).	☐	☐	☒	Driveways with shared access are not implemented.
		Uncovered temporary or guest parking on residential lots paved with a permeable surface, or designed to drain into landscaping.	☐	☐	☒	Permeable surfaces are not incorporated in parking areas.

Table 3. Site Design BMP Concepts (continued)

Design Concept	Technique	Specific BMP	Included Yes	Included No	Included N/A	Brief Reason for Each BMP Indicated as No or N/A
Site Design BMP Concept 2 (cont'd)	**Minimize Directly Connected Impervious Area** **(See WQMP Section 3.5.1.4)**	Other comparable and equally effective Site Design BMP concept(s) as approved by the local land use authority (Note: Additional narrative required to describe BMP and how it addresses site design concept).	☒	☐	☐	
		Use one or more of the following for design of parking areas:				
		Where landscaping is proposed in parking areas, incorporate parking area landscaping into the drainage design.	☒	☐	☐	
		Overflow parking (parking stalls provided in excess of the Permittee's minimum parking requirements) may be constructed with permeable pavement.	☐	☐	☒	Excess parking stall will not be permitted.
		Other comparable and equally effective Site Design BMP (or BMPs) as approved by the local land use authority (Note: Additional narrative required describing BMP and how it addresses site design concept).	☒	☐	☐	

Project Site Design BMP Concepts:

This project is located within the Betty Ford Center campus which has two existing retention basins. In addition to the existing retention basins, there is a proposed retention basin. This project will retain the 100% of the 100-year "pre-developed" and "post-developed" conditions. Hence, it satisfies the local ordinance requirement for 100% on-site retention for the 100-year, 24-hour storm event.

Alternative Project Site Design BMP Concepts:

N/A

Table 4. LID/Site Design BMPs Meeting the LID/Site Design Measurable Goal

(1) DRAINAGE SUB-AREA ID OR NO.	(2) LID/SITE DESIGN BMP TYPE* (See Table 2)	(3) POTENTIAL POLLUTANTS OF CONCERN WITHIN DRAINAGE SUB-AREA (Refer to Table 1)	(4) POTENTIAL POLLUTANTS WITHIN SUB-AREA CAUSING RECEIVING WATER IMPAIRMENTS (Refer to Table 1)	(5) EFFECTIVENESS OF LID/SITE DESIGN BMP AT ADDRESSING IDENTIFIED POTENTIAL POLLUTANTS (U, L, M, H/M, H; see Table 2)	(6) BMP MEETS WHICH DESIGN CRITERIA? (Identify as V_{BMP} OR Q_{BMP})	(7) TOTAL AREA WITHIN DRAINAGE SUB-AREA (Nearest 0.1 acre)
ALL	SC-10, 11, 30, 33, 34, 41, 43, 60, 61, 70, 72, 73, 75, 76	Oil & Grease, Trash & Debris, Toxic Organic Compounds, Heavy Metals, Bacteria/Virus/Pathogens	Bacteria/Virus/Pathogens	H	V_{BMP}	25.43
TOTAL PROJECT AREA TREATED WITH LID/SITE DESIGN BMPs (NEAREST 0.1 ACRE)						**25.43**

*** LID/Site Design BMPs listed in this table are those that completely address the 'Treatment Control BMP requirement' for their drainage sub-area.**

V.1.B TREATMENT CONTROL BMPS

Conventional Treatment Control BMPs shall be implemented to address the project's Pollutants of Concern as required in WQMP Section 3.5.1 where, and to the extent that, Section V.1.A has demonstrated that it is infeasible to meet these requirements through implementation of LID/Site Design BMPs.

☒ The LID/Site Design BMPs described in Section V.1.A of this project-specific WQMP completely address the 'Treatment Control BMP requirement' for the entire project site (and where applicable, entire existing site) as required in Section 3.5.1.1 of the WQMP Guidance document. Supporting documentation for the sizing of these LID/Site Design BMPs is included in Appendix F. ***Section V.1.B does not need to be completed**.

☐ The LID/Site Design BMPs described in Section V.1.A of this project-specific WQMP do **NOT** completely address the 'Treatment Control BMP requirement' for the entire project site (or where applicable, entire existing site) as required in Section 3.5.1.1 of the WQMP. ***Section V.1.B must be completed.**

The Treatment Control BMPs identified in this section are selected, sized and implemented to treat the design criteria of V_{BMP} and/or Q_{BMP} for all project (and if required, existing site) drainage sub-areas which were not fully addressed using LID/Site Design BMPs. Supporting documentation for the sizing of these Treatment Control BMPs is included in Appendix F.

Table 5: Treatment Control BMP Summary

(1) DRAINAGE SUB-AREA ID OR NO.	(2) TREATMENT CONTROL BMP TYPE* (See Table 2)	(3) POTENTIAL POLLUTANTS OF CONCERN WITHIN DRAINAGE SUB-AREA (Refer to Table 1)	(4) POTENTIAL POLLUTANTS WITHIN SUB-AREA CAUSING RECEIVING WATER IMPAIRMENTS (Refer to Table 1)	(5) EFFECTIVENESS OF TREATMENT CONTROL BMP AT ADDRESSING IDENTIFIED POTENTIAL POLLUTANTS (U, L, M, H/M, H; see Table 2)	(6) BMP MEETS WHICH DESIGN CRITERIA? (Identify as V_{BMP} OR Q_{BMP})	(7) TOTAL AREA WITHIN DRAINAGE SUB-AREA (Nearest 0.1 acre)
ALL	INFILTRATION BASIN	Oil & Grease, Trash & Debris, Toxic Organic Compounds, Heavy Metals, Bacteria/Virus/Pathogens	N/A (ALL RUNOFF RETAINED ONSITE)	H	V_{BMP}	25.43
	TOTAL PROJECT AREA TREATED WITH TREATMENT CONTROL BMPs (NEAREST 0.1 ACRE)					**25.43**

V.1.C MEASURABLE GOAL SUMMARY

This section documents the extent to which this project has met the measurable goal described in WQMP Section 3.5.1.1 of addressing 100% of the project's 'Treatment Control BMP requirement' with LID/Site Design BMPs. Projects required to retain Urban Runoff onsite in conformance with local ordinance are considered to have met the measurable goal; for these instances, '100%' is entered into Column 3 of the Table.

Table 6: Measurable Goal Summary

(1) Total Area Treated with LID/Site Design BMPs (Last row of Table 4)	(2) Total Area Treated with Treatment Control BMPs (Last row of Table 5)	(3) % of Treatment Control BMP Requirement addressed with LID/Site Design BMPs
25.43 AC	N/A	100%

V.2 SOURCE CONTROL BMPS

This section identifies and describes the Source Control BMPs applicable and implemented on this project.

Table 7. Source Control BMPs

BMP Name	Check One		If not applicable, state brief reason
	Included	Not Applicable	
Non-Structural Source Control BMPs			
Education for Property Owners, Operators, Tenants, Occupants, or Employees	☒	☐	
Activity Restrictions	☒	☐	
Irrigation System and Landscape Maintenance	☒	☐	
Common Area Litter Control	☒	☐	
Street Sweeping Private Streets and Parking Lots	☒	☐	
Drainage Facility Inspection and Maintenance	☒	☐	
Structural Source Control BMPs			
Storm Drain Inlet Stenciling and Signage	☒	☐	
Landscape and Irrigation System Design	☒	☐	
Protect Slopes and Channels	☒	☐	
Provide Community Car Wash Racks	☐	☒	No car wash racks
Properly Design*:			
Fueling Areas	☐	☒	No fueling areas
Air/Water Supply Area Drainage	☐	☒	No air/water supply area drainage area
Trash Storage Areas	☒	☐	
Loading Docks	☐	☒	No loading docks
Maintenance Bays	☐	☒	No maintenance bays
Vehicle and Equipment Wash Areas	☐	☒	No wash areas
Outdoor Material Storage Areas	☐	☒	No storage areas
Outdoor Work Areas or Processing Areas	☐	☒	No outdoor work or processing areas
Provide Wash Water Controls for Food Preparation Areas	☒	☐	

*Details demonstrating proper design must be included in Appendix F.

See attached Source Control BMP's for Implementation.

Non-Structural Source Control BMPs:

- Education for Property Owners, Operators, Tenants, Occupants, or Employees: Property owners will be informed of site specific storm water requirements and appropriate BMPs to follow.
- Activity Restrictions: As dictated by Property owners. In addition, Littering shall be prohibited. Blowing, sweeping or hosing debris into streets will not be permitted.
- Irrigation System and Landscape Maintenance: 24-hour onsite maintenance staff will provide ongoing irrigation system inspection and maintenance to ensure that timers and smart controllers are working as desired (SD-10, and SD-11, refer to Appendix C regarding maintenance and inspection requirements).
- Common Area Litter Control: 24-hour onsite maintenance staff will provide ongoing inspection of common areas to ensure that litter and trash are not excessive in common areas.
- Street Sweeping Private Streets and Parking Lots: 24-hour onsite maintenance staff will provide maintenance for streets and parking lots. Parking lots will be cleaned at least quarterly, including prior to the start of the rainy season (Oct.1st).
- Drainage Facility Inspection and Maintenance: POA will be responsible for retention basins. Regular inspection should occur before the wet season begins (September) and after the wet season (April) ends. Performance inspections should occur after rainfall events greater than 0.5 inches or any rainfall that fills the basins. Any structures that are observed to be damaged shall be repaired. Any sediment accumulation over 18" or fills 25 percent of the basin volume (whichever is greater) should be removed. Additionally, if there is standing water in the basin during the dry season, the basin should be drained. If the basin cannot be drained, or if standing water persists, notify vector control. Rodent infestation, trash, debris or litter present in the basins shall be monitored and removed (TC-11, TC-20, refer to Appendix C regarding maintenance and inspection requirements).

Structural Source Control BMPs:

- MS4 Stenciling and Signage: Stenciling and signage will be provided (where practical) and maintained for the onsite storm drains by the 24-hour onsite maintenance staff (SD-13, refer to Appendix C regarding maintenance and inspection requirements).
- Landscape and Irrigation System Design: Landscape and Irrigation shall be designed to meet the local drought tolerant requirements thus reducing overspray and unnecessary nuisance flows (SD-10, and SD-12, refer to Appendix C regarding maintenance and inspection requirements).
- Slope and Channel Protection: 24-hour onsite maintenance staff will stabilize disturbed slopes as quickly as possible, control and treat flows in landscaping and or/ other controls prior to reaching existing natural drainage systems, maintain native and drought tolerant vegetation of slopes, convey runoff safely from tops of slopes and 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 or slope (SD-13, refer to Appendix C regarding maintenance and inspection requirements).

Properly Design:

- Trash Storage Areas: The integrity of structural elements that are subject to damage (ie., screens, covers, and signs) will be maintained by the 24-hour onsite maintenance staff. Roofs, awnings, attached lids will be provided on all trash containers to minimize direct precipitation into containers. Use lined bins or dumpster to prevent leaking of liquid waste. Pave trash storage area with impervious surface to mitigate spills. Post signs on all dumpsters informing users that hazardous materials are not to be disposed of therein. Trash enclosures are elevated to prevent storm water runoff from entering (SD-32, refer to Appendix C regarding maintenance and inspection requirements).
- Wash Water Controls for Food Preparation Areas: Food establishments shall have either contained areas or sinks, each with connections to the sanitary sewer for disposal of wash waters containing kitchen and food wastes. If located outside, the contained areas or sinks shall also be structurally covered to prevent entry of Urban Runoff. Adequate signs shall be provided and appropriately placed stating the prohibition of discharging wash water to the MS4.

Appendix D includes copies of the educational materials (described in Section 3.5.2.1 of the WQMP Guidance document) that will be used in implementing this project-specific WQMP.

V.3 EQUIVALENT TREATMENT CONTROL BMP ALTERNATIVES

N/A

V.4 REGIONALLY-BASED BMPS

N/A

VI. Operation and Maintenance Responsibility for BMPs

Appendix G of this project-specific WQMP includes copies of CC&Rs, Covenant and Agreements, BMP Maintenance Agreement and/or other mechanisms used to ensure the ongoing operation, maintenance, funding, transfer and implementation of the project-specific WQMP requirements.

The retention basins will require operation and maintenance. 24-hour onsite maintenance staff will be available and responsible for maintaining the retention basins. Regular inspection should occur before the wet season begins (September) and after the wet season ends (April). Performance inspections should occur after rainfall events greater than 0.5 inches and after any rainfall that fills the basins. Any structures that are observed to be damaged shall be repaired. Any sediment accumulation over 18 inches or fills 25 percent of the basin volume (whichever is greater) shall be removed. Additionally, if there is standing water in the basin during dry weather, the basin should be drained. If the basin cannot be drained, or standing water persists, notify vector control. Rodent infestation, trash, debris or litter present in the basin shall be monitored and removed. Start-up dates correspond to completion of the development. The owner (who usually hires a maintenance company) will be the responsible party for all O&M activities, including inspections and record keeping for a minimum of 50 years. This maintenance company has not been appointed, nor will it be appointed during the entitlement phase.

Retention Basin (Infiltration BMP):

O and M Activities	Schedule and Frequency
1. Inspect all outlets to the Retention area. Make sure outlets are free of debris and sediment. Inspect outlets for sediment accumulation and clean and remove trash when encountered.	Inspect prior to the rainy season (September) and after the rainy season (April). Inspect prior and after all rain events.
2. Inspect Retention Basin (Infiltration BMP). Replace landscaping as needed within basins. Remove silt/blowsand, debris in basins.	Retention Basins should be kept clear of trash, debris and silt/blowsand buildup on a **weekly** basis. This should be given high priority.
3. Inspect Drywells located in each Retention facility. Remove silt/blowsand, debris in upper Drywell chambers.	Drywells should be kept clear of trash, debris and silt/blowsand buildup on a **monthly** schedule. This should be given high priority.

Drywell (Infiltration BMP):

O and M Activities	Schedule and Frequency
4. Inspect Drywells and remove silt/blowsand and debris.	Drywells should be kept clear of trash, debris and silt/blowsand buildup on a **monthly** schedule. This should be given high priority.

Irrigation System and Landscape:

O and M Activities	Schedule and Frequency
5. Inspect and repair broken sprinklers.	Inspect **weekly** and replace immediately
6. Repair broken water lines.	Inspect **daily** and repair immediately.
7. Inspect irrigated areas for signs of erosion and/ or discharge	Inspect **weekly** repair source of erosion or discharge immediately.

Street Sweeping Private Streets and Parking Lots:

O and M Activities	Schedule and Frequency
8. Inspect Storage Area for tracked sediment or blow sand. Visible sediment tracking should be swept immediately.	Inspect **monthly**. Sweeping operations should occur as needed.
9. Adjust brooms frequently; maximize efficiency of sweeping efforts	As needed.

Protect Slopes and Channels

O and M Activities	Schedule and Frequency
10. Inspect slopes	Inspect **monthly** to ensure that slopes and vegetation isn't disturbed, if they are repair immediately.

Trash Storage Areas:

O and M Activities	Schedule and Frequency
11. Inspect Trash Storage Area.	Inspect **daily**. Insure that the trash receptacles are emptied on a weekly basis. Recyclables should be separated from disposable trash.

Responsible Party: Hazelden Betty Ford Foundation
530 11th Street
Center City, MN 55012
Telephone: 651-213-4232
Contact: Steven Kronmiller

Note: Sediment, other pollutants, and all other waste shall be properly disposed of in a licensed landfill or by another appropriate disposal method in accordance with local, state, and federal regulations.

VII. Funding

The Property title holder shall carry primary responsibility for the initial funding of installations, design and implementation of site-specific BMP’s. Ongoing inspections, routine maintenance, and some instances of reactionary maintenance shall be funded by the property owner, in such that he will make an agreement with contractors, tenants, or other parties in direct access and knowledge of the property to pay for any and all aspects of the necessary maintenance and inspections.

Continued funding for ongoing inspections and maintenance shall be passed to any and all future title holders and awareness must be made of this obligation in conjunction with the title. In addition, any future property owners, managers, tenants, or contractors must be made aware of the sites structural BMP’s and have access to their associated educational materials that are to be kept on site, within the site’s respective building as well as held by the property owner, and title company or others who may possess the title or deed to the property.

Any amended versions of the funding declaration may be submitted to all applicable parties in the future, should such an action be warranted. All changes must be submitted for review by the Hazelden Betty Ford Foundation., as per their standards and requirements for altering this document.

Appendix G of this project-specific WQMP also includes copies of Covenants and Agreements, BMP Maintenance Agreement and/or other mechanisms used to ensure the ongoing operation, maintenance, funding, transfer and implementation of the project-specific WQMP requirements.

Property Owner:
Hazelden Betty Ford Foundation
15251 Pleasant Valley Road
Center City, MN 55012
Telephone: 651-213-4232
Contact Person: Steven Kronmiller

Appendix A

Conditions of Approval

Will be included in Final WQMP.

Appendix B

Vicinity Map, Project Location Map, Receiving Waters Map, WQMP Site Map

Figure 1. Vicinity Map

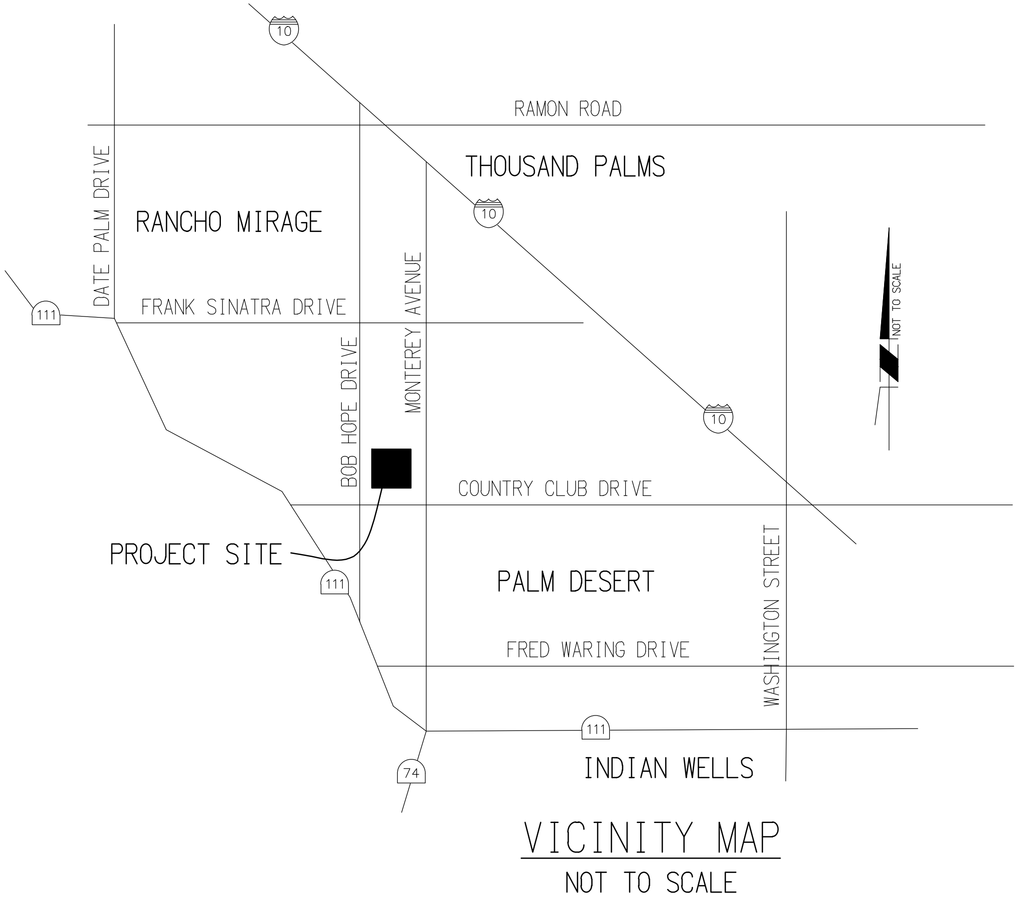
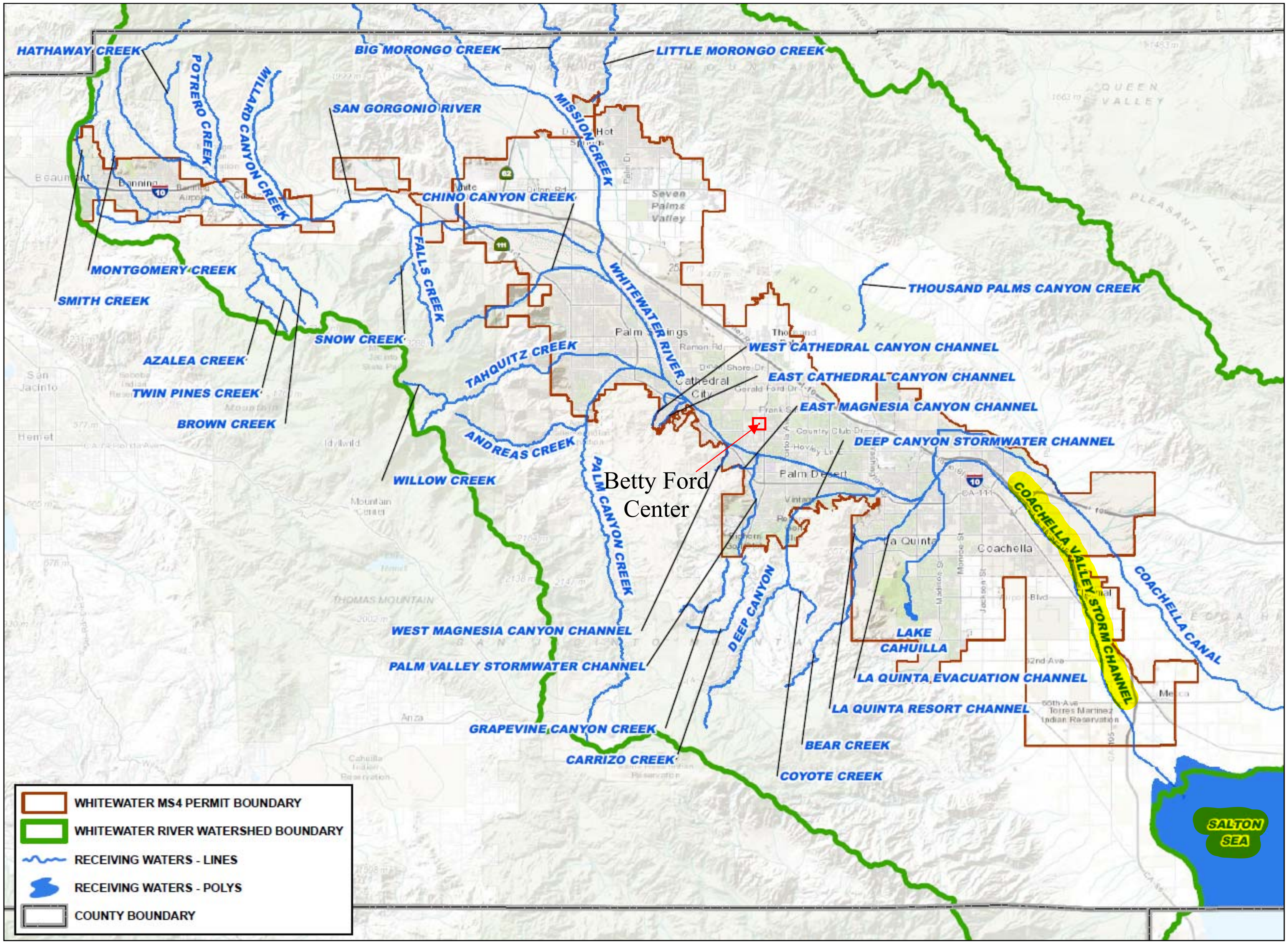


Figure 2. Project Location Map

Figure 3. Receiving Waters Map

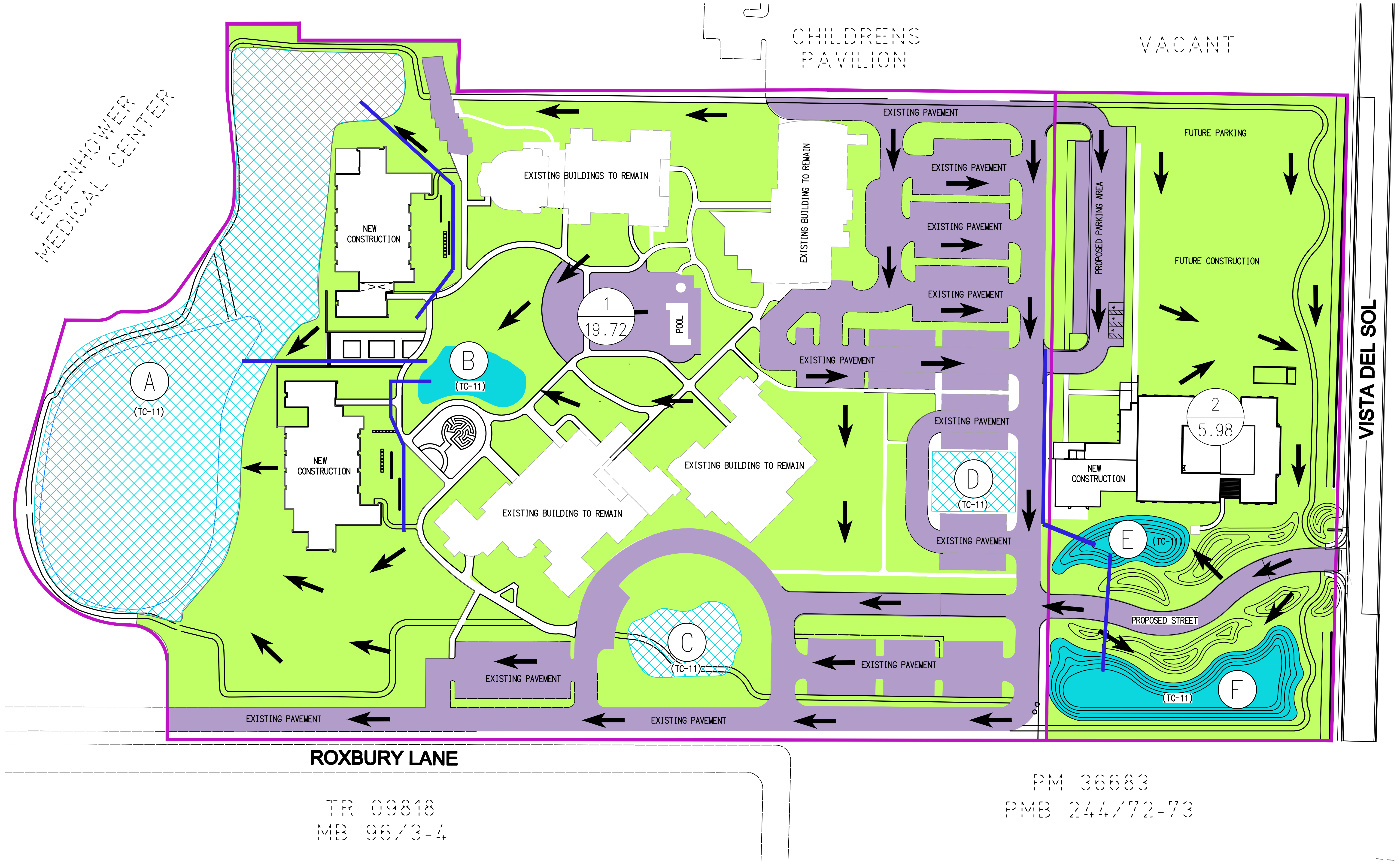


CITY OF RANCHO MIRAGE, COUNTY OF RIVERSIDE, STATE OF CALIFORNIA

BMP SITE MAP

BETTY FORD CENTER BUILDING EXPANSION

39000 Bob Hope Drive, Rancho Mirage, CA 92270



STRUCTURAL SOURCE CONTROL BMP

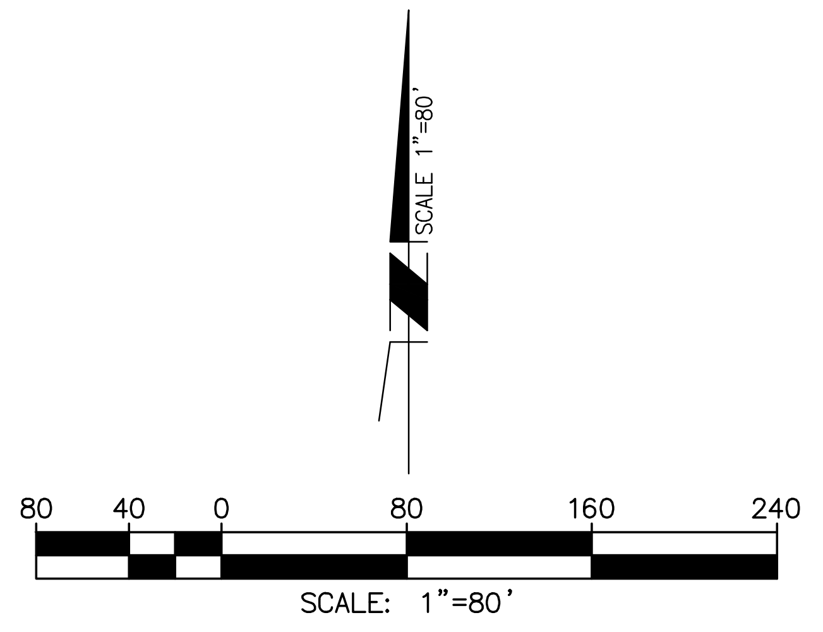
LANDSCAPE AND IRRIGATION SYSTEM DESIGN (LANDSCAPED AREAS) (SD-10, SD-12)

STORM DRAIN INLET STENCILING AND SIGNAGE (ALL INLETS) (SD-13)

TRASH ENCLOSURES (SD-32)

LEGEND

- — DRAINAGE BOUNDARY
- → FLOW PATH
- Ⓐ BASIN ID
- 1 / 25.43 SUBAREA DESIGNATION / AREA (ACRES)
- ■ PROPOSED INFILTRATION BASIN (TC-11)
- ▨ EXISTING INFILTRATION BASIN (TC-11)
- ● LANDSCAPE (SD-10, SD-12)
- ■ HARDSCAPE / PARKING / STREETS / WALKWAYS (SD-10, SD-11)
- — PROPOSED STORM DRAIN (SD-10, SD-13)
- — EXISTING STORM DRAIN (SD-10, SD-13)
- ▬ PROPOSED CATCH BASIN (SD-10, SD-13)
- ▬ EXISTING CATCH BASIN (SD-10, SD-13)



REVISIONS			
NO.	BY	DATE	REMARKS

PREPARED BY:

Michael Baker
INTERNATIONAL
75-410 Gerald Ford Drive, Suite 100
Palm Desert, CA 92211
Phone: (760) 346-7481
MBAKERINTL.COM

DESIGN BY DP
DRAWN BY DP
CHECKED BY PK
SCALE AS NOTED

BMP SITE MAP
PARCEL 2 OF LLA 18-01, PARCELS 2 AND 3 OF LLA 99-19
WITHIN THE CITY OF RANCHO MIRAGE, A PORTION OF SECTIONS T.5S, R.6E S.B.M, RIVERSIDE COUNTY, CALIFORNIA

FOR:

SHEET 1
OF 1 SHEETS
DATE 10/16/19
DRAWING

H:\PDATA\174831\CADD\LAND\EXHIBITS\174831-WQMP-DRAFT.DWG POPE, BILL 10/16/2019 10:42 AM

Appendix C

Refer to Drainage Study provided on a separate cover – Appendix F

Appendix D

Educational Materials

CASQA BMP Handbook

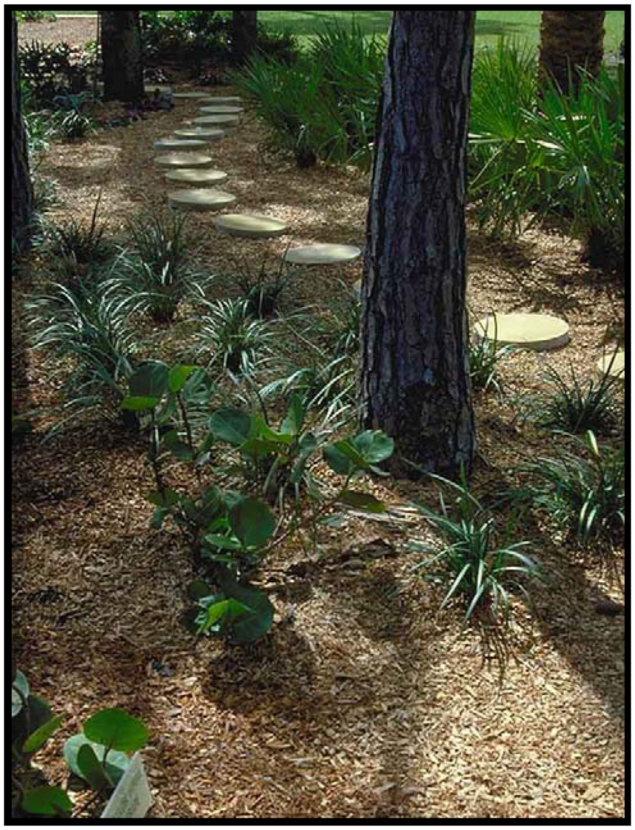
Source Control BMPs

SD-10 Site Design and Landscape Planning
SD-11 Roof Runoff Controls
SD-12 Efficient Irrigation
SD-13 Storm Drain Signage
SD-32 Trash Storage Areas

Treatment Control BMPs

TC-11 Infiltration Basin
TC-20 Wet Ponds

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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CALIFORNIA STORMWATER QUALITY ASSOCIATION

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.

Roof Runoff Controls SD-11

Rain Garden

Design Objectives

☑ Maximize Infiltration

☑ Provide Retention

☑ Slow Runoff

Minimize Impervious Land Coverage

Prohibit Dumping of Improper Materials

☑ Contain Pollutants

Collect and Convey

Description

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

Approach

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

Suitable Applications

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

Design Considerations

Designing New Installations

Cisterns or Rain Barrels

One method of addressing roof runoff is to direct roof downspouts to cisterns or rain barrels. A cistern is an above ground storage vessel with either a manually operated valve or a permanently open outlet. Roof runoff is temporarily stored and then released for irrigation or infiltration between storms. The number of rain barrels needed is a function of the rooftop area. Some low impact developers recommend that every house have at least 2 rain barrels, with a minimum storage capacity of 1000 liters. Roof barrels serve several purposes including mitigating the first flush from the roof which has a high volume, amount of contaminants, and thermal load. Several types of rain barrels are commercially available. Consideration must be given to selecting rain barrels that are vector proof and childproof. In addition, some barrels are designed with a bypass valve that filters out grit and other contaminants and routes overflow to a soak-away pit or rain garden.

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

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

Dry wells and Infiltration Trenches

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

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

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

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

Pop-up Drainage Emitter

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

Foundation Planting

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

Redeveloping Existing Installations

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

Supplemental Information

Examples

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

Other Resources

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

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

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

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.

- 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

CASQA
CALIFORNIA STORMWATER QUALITY ASSOCIATION

– 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

Design Objectives

Maximize Infiltration

Provide Retention

Slow Runoff

Minimize Impervious Land Coverage

Prohibit Dumping of Improper Materials

☑ Contain Pollutants

Collect and Convey

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.

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

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Infiltration Basin

TC-11

Design Considerations

- Soil for Infiltration
- Slope
- Aesthetics

Targeted Constituents

☑	Sediment	■
☑	Nutrients	■
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

Description

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

California Experience

Infiltration basins have a long history of use in California, especially in the Central Valley. Basins located in Fresno were among those initially evaluated in the National Urban Runoff Program and were found to be effective at reducing the volume of runoff, while posing little long-term threat to groundwater quality (EPA, 1983; Schroeder, 1995). Proper siting of these devices is crucial as underscored by the experience of Caltrans in siting two basins in Southern California. The basin with marginal separation from groundwater and soil permeability failed immediately and could never be rehabilitated.

Advantages

- Provides 100% reduction in the load discharged to surface waters.
- The principal benefit of infiltration basins is the approximation of pre-development hydrology during which a

significant portion of the average annual rainfall runoff is infiltrated and evaporated rather than flushed directly to creeks.

- If the water quality volume is adequately sized, infiltration basins can be useful for providing control of channel forming (erosion) and high frequency (generally less than the 2-year) flood events.

Limitations

- May not be appropriate for industrial sites or locations where spills may occur.
- Infiltration basins require a minimum soil infiltration rate of 0.5 inches/hour, not appropriate at sites with Hydrologic Soil Types C and D.
- If infiltration rates exceed 2.4 inches/hour, then the runoff should be fully treated prior to infiltration to protect groundwater quality.
- Not suitable on fill sites or steep slopes.
- Risk of groundwater contamination in very coarse soils.
- Upstream drainage area must be completely stabilized before construction.
- Difficult to restore functioning of infiltration basins once clogged.

Design and Sizing Guidelines

- Water quality volume determined by local requirements or sized so that 85% of the annual runoff volume is captured.
- Basin sized so that the entire water quality volume is infiltrated within 48 hours.
- Vegetation establishment on the basin floor may help reduce the clogging rate.

Construction/Inspection Considerations

- Before construction begins, stabilize the entire area draining to the facility. If impossible, place a diversion berm around the perimeter of the infiltration site to prevent sediment entrance during construction or remove the top 2 inches of soil after the site is stabililized. Stabilize the entire contributing drainage area, including the side slopes, before allowing any runoff to enter once construction is complete.
- Place excavated material such that it can not be washed back into the basin if a storm occurs during construction of the facility.
- Build the basin without driving heavy equipment over the infiltration surface. Any equipment driven on the surface should have extra-wide ("low pressure") tires. Prior to any construction, rope off the infiltration area to stop entrance by unwanted equipment.
- After final grading, till the infiltration surface deeply.
- Use appropriate erosion control seed mix for the specific project and location.

Performance

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

There remain some concerns about the potential for groundwater contamination despite the findings of the NURP and Nightingale (1975; 1987a,b,c; 1989). For instance, a report by Pitt et al. (1994) highlighted the potential for groundwater contamination from intentional and unintentional stormwater infiltration. That report recommends that infiltration facilities not be sited in areas where high concentrations are present or where there is a potential for spills of toxic material. Conversely, Schroeder (1995) reported that there was no evidence of groundwater impacts from an infiltration basin serving a large industrial catchment in Fresno, CA.

Siting Criteria

The key element in siting infiltration basins is identifying sites with appropriate soil and hydrogeologic properties, which is critical for long term performance. In one study conducted in Prince George's County, Maryland (Galli, 1992), all of the infiltration basins investigated clogged within 2 years. It is believed that these failures were for the most part due to allowing infiltration at sites with rates of less than 0.5 in/hr, basing siting on soil type rather than field infiltration tests, and poor construction practices that resulted in soil compaction of the basin invert.

A study of 23 infiltration basins in the Pacific Northwest showed better long-term performance in an area with highly permeable soils (Hilding, 1996). In this study, few of the infiltration basins had failed after 10 years. Consequently, the following guidelines for identifying appropriate soil and subsurface conditions should be rigorously adhered to.

- Determine soil type (consider RCS soil type 'A, B or C' only) from mapping and consult USDA soil survey tables to review other parameters such as the amount of silt and clay, presence of a restrictive layer or seasonal high water table, and estimated permeability. The soil should not have more than 30% clay or more than 40% of clay and silt combined. Eliminate sites that are clearly unsuitable for infiltration.

- Groundwater separation should be at least 3 m from the basin invert to the measured ground water elevation. There is concern at the state and regional levels of the impact on groundwater quality from infiltrated runoff, especially when the separation between groundwater and the surface is small.

- Location away from buildings, slopes and highway pavement (greater than 6 m) and wells and bridge structures (greater than 30 m). Sites constructed of fill, having a base flow or with a slope greater than 15% should not be considered.

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

- Base flow should not be present in the tributary watershed.

Secondary Screening Based on Site Geotechnical Investigation

- At least three in-hole conductivity tests shall be performed using USBR 7300-89 or Bouwer-Rice procedures (the latter if groundwater is encountered within the boring), two tests at different locations within the proposed basin and the third down gradient by no more than approximately 10 m. The tests shall measure permeability in the side slopes and the bed within a depth of 3 m of the invert.

- The minimum acceptable hydraulic conductivity as measured in any of the three required test holes is 13 mm/hr. If any test hole shows less than the minimum value, the site should be disqualified from further consideration.

- Exclude from consideration sites constructed in fill or partially in fill unless no silts or clays are present in the soil boring. Fill tends to be compacted, with clays in a dispersed rather than flocculated state, greatly reducing permeability.

- The geotechnical investigation should be such that a good understanding is gained as to how the stormwater runoff will move in the soil (horizontally or vertically) and if there are any geological conditions that could inhibit the movement of water.

Additional Design Guidelines

(1) Basin Sizing - The required water quality volume is determined by local regulations or sufficient to capture 85% of the annual runoff.

(2) Provide pretreatment if sediment loading is a maintenance concern for the basin.

(3) Include energy dissipation in the inlet design for the basins. Avoid designs that include a permanent pool to reduce opportunity for standing water and associated vector problems.

(4) Basin invert area should be determined by the equation:

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

where A = Basin invert area (m^2)

WQV = water quality volume (m^3)

k = 0.5 times the lowest field-measured hydraulic conductivity (m/hr)

t = drawdown time (48 hr)

(5) The use of vertical piping, either for distribution or infiltration enhancement shall not be allowed to avoid device classification as a Class V injection well per 40 CFR146.5(e)(4).

Maintenance

Regular maintenance is critical to the successful operation of infiltration basins. Recommended operation and maintenance guidelines include:

- Inspections and maintenance to ensure that water infiltrates into the subsurface completely (recommended infiltration rate of 72 hours or less) and that vegetation is carefully managed to prevent creating mosquito and other vector habitats.
- Observe drain time for the design storm after completion or modification of the facility to confirm that the desired drain time has been obtained.
- Schedule semiannual inspections for beginning and end of the wet season to identify potential problems such as erosion of the basin side slopes and invert, standing water, trash and debris, and sediment accumulation.
- Remove accumulated trash and debris in the basin at the start and end of the wet season.
- Inspect for standing water at the end of the wet season.
- Trim vegetation at the beginning and end of the wet season to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and regrade when the accumulated sediment volume exceeds 10% of the basin.
- If erosion is occurring within the basin, revegetate immediately and stabilize with an erosion control mulch or mat until vegetation cover is established.
- To avoid reversing soil development, scarification or other disturbance should only be performed when there are actual signs of clogging, rather than on a routine basis. Always remove deposited sediments before scarification, and use a hand-guided rotary tiller, if possible, or a disc harrow pulled by a very light tractor.

Cost

Infiltration basins are relatively cost-effective practices because little infrastructure is needed when constructing them. One study estimated the total construction cost at about $2 per ft (adjusted for inflation) of storage for a 0.25-acre basin (SWRPC, 1991). As with other BMPs, these published cost estimates may deviate greatly from what might be incurred at a specific site. For instance, Caltrans spent about $18/ft^3 for the two infiltration basins constructed in southern California, each of which had a water quality volume of about 0.34 ac.-ft. Much of the higher cost can be attributed to changes in the storm drain system necessary to route the runoff to the basin locations.

Infiltration basins typically consume about 2 to 3% of the site draining to them, which is relatively small. Additional space may be required for buffer, landscaping, access road, and fencing. Maintenance costs are estimated at 5 to 10% of construction costs.

One cost concern associated with infiltration practices is the maintenance burden and longevity. If improperly maintained, infiltration basins have a high failure rate. Thus, it may be necessary to replace the basin with a different technology after a relatively short period of time.

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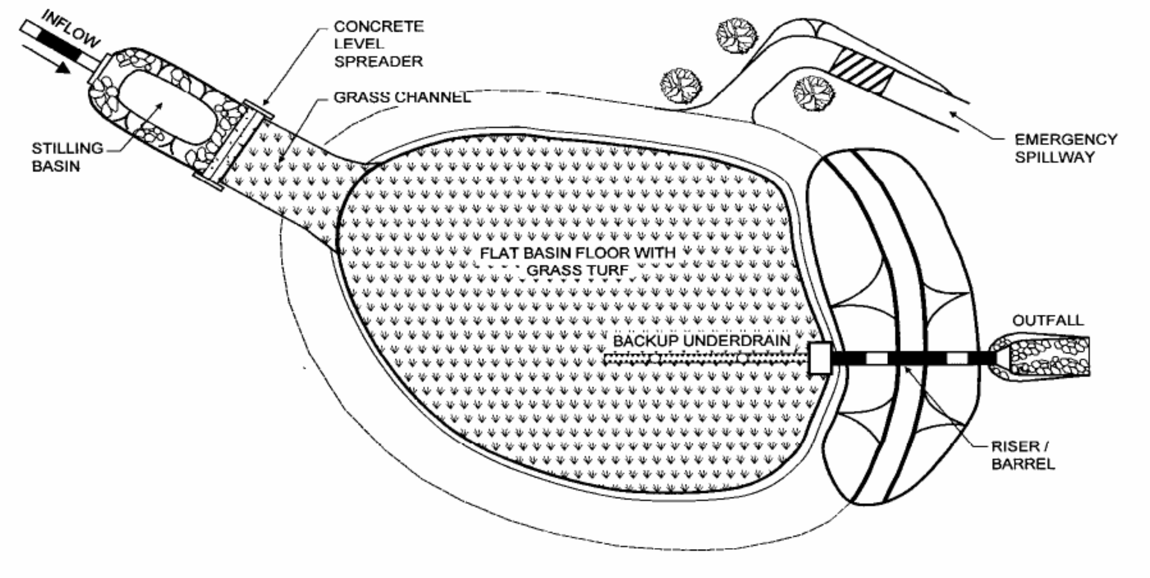
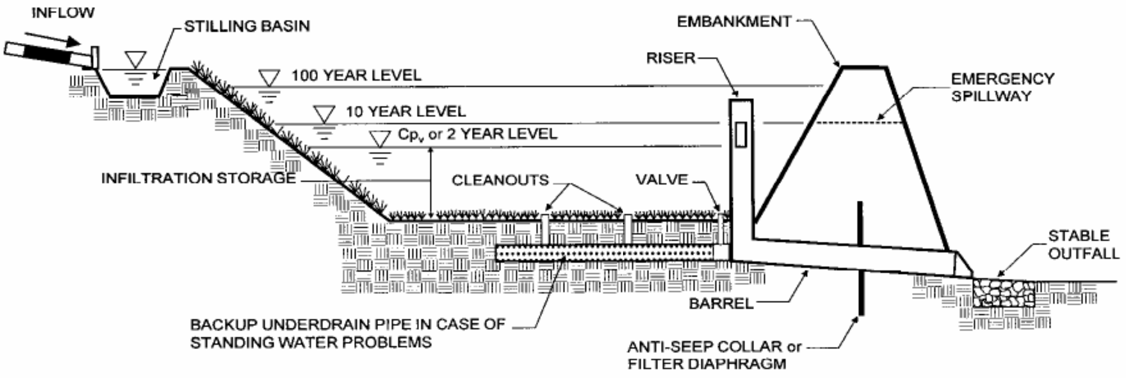


PLAN VIEW



PROFILE

Wet Ponds

TC-20

Design Considerations

- Area Required
- Slope
- Water Availability
- Aesthetics
- Environmental Side-effects

Targeted Constituents

☑	Sediment	■
☑	Nutrients	▲
☑	Trash	■
☑	Metals	■
☑	Bacteria	■
☑	Oil and Grease	■
☑	Organics	■

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

Description

Wet ponds (a.k.a. stormwater ponds, retention ponds, wet extended detention ponds) are constructed basins that have a permanent pool of water throughout the year (or at least throughout the wet season) and differ from constructed wetlands primarily in having a greater average depth. Ponds treat incoming stormwater runoff by settling and biological uptake. The primary removal mechanism is settling as stormwater runoff resides in this pool, but pollutant uptake, particularly of nutrients, also occurs to some degree through biological activity in the pond. Wet ponds are among the most widely used stormwater practices. While there are several different versions of the wet pond design, the most common modification is the extended detention wet pond, where storage is provided above the permanent pool in order to detain stormwater runoff and promote settling. The schematic diagram is of an on-line pond that includes detention for larger events, but this is not required in all areas of the state.

California Experience

Caltrans constructed a wet pond in northern San Diego County (I-5 and La Costa Blvd.). Largest issues at this site were related to vector control, vegetation management, and concern that endangered species would become resident and hinder maintenance activities.

Advantages

- If properly designed, constructed and maintained, wet basins can provide substantial aesthetic/recreational value and wildlife and wetlands habitat.

- Ponds are often viewed as a public amenity when integrated into a park setting.

- Due to the presence of the permanent wet pool, properly designed and maintained wet basins can provide significant water quality improvement across a relatively broad spectrum of constituents including dissolved nutrients.

- Widespread application with sufficient capture volume can provide significant control of channel erosion and enlargement caused by changes to flow frequency relationships resulting from the increase of impervious cover in a watershed.

Limitations

- Some concern about safety when constructed where there is public access.

- Mosquito and midge breeding is likely to occur in ponds.

- Cannot be placed on steep unstable slopes.

- Need for base flow or supplemental water if water level is to be maintained.

- Require a relatively large footprint

- Depending on volume and depth, pond designs may require approval from the State Division of Safety of Dams

Design and Sizing Guidelines

- Capture volume determined by local requirements or sized to treat 85% of the annual runoff volume.

- Use a draw down time of 48 hours in most areas of California. Draw down times in excess of 48 hours may result in vector breeding, and should be used only after coordination with local vector control authorities. Draw down times of less than 48 hours should be limited to BMP drainage areas with coarse soils that readily settle and to watersheds where warming may be detrimental to downstream fisheries.

- Permanent pool volume equal to twice the water quality volume.

- Water depth not to exceed about 8 feet.

- Wetland vegetation occupying no more than 25% of surface area.

- Include energy dissipation in the inlet design and a sediment forebay to reduce resuspension of accumulated sediment and facilitate maintenance.

- A maintenance ramp should be included in the design to facilitate access to the forebay for maintenance activities and for vector surveillance and control.

- To facilitate vector surveillance and control activities, road access should be provided along at least one side of BMPs that are seven meters or less in width. Those BMPs that have shoreline-to-shoreline distances in excess of seven meters should have perimeter road access on both sides or be designed such that no parcel of water is greater than seven meters from the road.

Construction/Inspection Considerations

- In areas with porous soils an impermeable liner may be required to maintain an adequate permanent pool level.
- Outlet structures and piping should be installed with collars to prevent water from seeping through the fill and causing structural failure.
- Inspect facility after first large storm to determine whether the desired residence time has been achieved.

Performance

The observed pollutant removal of a wet pond is highly dependent on two factors: the volume of the permanent pool relative to the amount of runoff from the typical event in the area and the quality of the base flow that sustains the permanent pool. A recent study (Caltrans, 2002) has documented that if the permanent pool is much larger than the volume of runoff from an average event, then displacement of the permanent pool by the wet weather flow is the primary process. A statistical comparison of the wet pond discharge quality during dry and wet weather shows that they are not significantly different. Consequently, there is a relatively constant discharge quality during storms that is the same as the concentrations observed in the pond during ambient (dry weather) conditions. Consequently, for most constituents the performance of the pond is better characterized by the average effluent concentration, rather than the "percent reduction," which has been the conventional measure of performance. Since the effluent quality is essentially constant, the percent reduction observed is mainly a function of the influent concentrations observed at a particular site.

The dry and wet weather discharge quality is, therefore, related to the quality of the base flow that sustains the permanent pool and of the transformations that occur to those constituents during their residence in the basin. One could potentially expect a wide range of effluent concentrations at different locations even if the wet ponds were designed according to the same guidelines, if the quality of the base flow differed significantly. This may explain the wide range of concentration reductions reported in various studies.

Concentrations of nutrients in base flow may be substantially higher than in urban stormwater runoff. Even though these concentrations may be substantially reduced during the residence time of the base flow in the pond, when this water is displaced by wet weather flows, concentrations may still be quite elevated compared to the levels that promote eutrophication in surface water systems. Consequently comparing influent and effluent nutrient concentrations during wet weather can make the performance seem highly variable.

Relatively small perennial flows may often substantially exceed the wet weather flow treated. Consequently, one should also consider the load reduction observed under ambient conditions when assessing the potential benefit to the receiving water.

Siting Criteria

Wet ponds are a widely applicable stormwater management practice and can be used over a broad range of storm frequencies and sizes, drainage areas and land use types. Although they have limited applicability in highly urbanized settings and in arid climates, they have few other restrictions. Wet basins may be constructed on- or off-line and can be sited at feasible locations along established drainage ways with consistent base flow. An off-line design is preferred. Wet basins are often utilized in smaller sub-watersheds and are particularly appropriate in areas with residential land uses or other areas where high nutrient loads are considered to be potential problems (e.g., golf courses).

Ponds do not consume a large area (typically 2–3 percent of the contributing drainage area); however, these facilities are generally large. Other practices, such as filters or swales, may be "squeezed" into relatively unusable land, but ponds need a relatively large continuous area. Wet basins are typically used in drainage basins of more than ten acres and less than one square mile (Schueler et al., 1992). Emphasis can be placed in siting wet basins in areas where the pond can also function as an aesthetic amenity or in conjunction with other stormwater management functions.

Wet basin application is appropriate in the following settings: (1) where there is a need to achieve a reasonably high level of dissolved contaminant removal and/or sediment capture; (2) in small to medium-sized regional tributary areas with available open space and drainage areas greater than about 10 ha (25 ac.); (3) where base flow rates or other channel flow sources are relatively consistent year-round; (4) in residential settings where aesthetic and wildlife habitat benefits can be appreciated and maintenance activities are likely to be consistently undertaken.

Traditional wet extended detention ponds can be applied in most regions of the United States, with the exception of arid climates. In arid regions, it is difficult to justify the supplemental water needed to maintain a permanent pool because of the scarcity of water. Even in semi-arid Austin, Texas, one study found that 2.6 acre-feet per year of supplemental water was needed to maintain a permanent pool of only 0.29 acre-feet (Saunders and Gilroy, 1997). Seasonal wet ponds (i.e., ponds that maintain a permanent pool only during the wet season) may prove effective in areas with distinct wet and dry seasons; however, this configuration has not been extensively evaluated.

Wet ponds may pose a risk to cold water systems because of their potential for stream warming. When water remains in the permanent pool, it is heated by the sun. A study in Prince George's County, Maryland, found that stormwater wet ponds heat stormwater by about 9°F from the inlet to the outlet (Galli, 1990).

Additional Design Guidelines

Specific designs may vary considerably, depending on site constraints or preferences of the designer or community. There are several variations of the wet pond design, including constructed wetlands, and wet extended detention ponds. Some of these design alternatives are intended to make the practice adaptable to various sites and to account for regional constraints and opportunities. In conventional wet ponds, the open water area comprises 50% or more of the total surface area of the pond. The permanent pool should be no deeper than 2.5 m (8 feet) and should average 1.2 – 2 m (4-6 feet) deep. The greater depth of this configuration helps limit the extent of the vegetation to an aquatic bench around the perimeter of the pond with a nominal depth of about 1 foot and variable width. This shallow bench also protects the banks from erosion, enhances habitat and aesthetic values, and reduces the drowning hazard.

The wet extended detention pond combines the treatment concepts of the dry extended detention pond and the wet pond. In this design, the water quality volume is detained above the permanent pool and released over 24 hours. In addition to increasing the residence time, which improves pollutant removal, this design also attenuates peak runoff rates. Consequently, this design alternative is recommended.

Pretreatment incorporates design features that help to settle out coarse sediment particles. By removing these particles from runoff before they reach the large permanent pool, the maintenance burden of the pond is reduced. In ponds, pretreatment is achieved with a sediment forebay. A sediment forebay is a small pool (typically about 10 percent of the volume of the permanent pool). Coarse particles remain trapped in the forebay, and maintenance is performed on this smaller pool, eliminating the need to dredge the entire pond.

There are a variety of sizing criteria for determining the volume of the permanent pool, mostly related to the water quality volume (i.e., the volume of water treated for pollutant removal) or the average storm size in a particular area. In addition, several theoretical approaches to determination of permanent pool volume have been developed. However, there is little empirical evidence to support these designs. Consequently, a simplified method (i.e., permanent pool volume equal to twice the water quality volume) is recommended.

Other design features do not increase the volume of a pond, but can increase the amount of time stormwater remains in the device and eliminate short-circuiting. Ponds should always be designed with a length-to-width ratio of at least 1.5:1, where feasible. In addition, the design should incorporate features to lengthen the flow path through the pond, such as underwater berms designed to create a longer route through the pond. Combining these two measures helps ensure that the entire pond volume is used to treat stormwater. Wet ponds with greater amounts of vegetation often have channels through the vegetated areas and contain dead areas where stormwater is restricted from mixing with the entire permanent pool, which can lead to less pollutant removal. Consequently, a pond with open water comprising about 75% of the surface area is preferred.

Design features are also incorporated to ease maintenance of both the forebay and the main pool of ponds. Ponds should be designed with a maintenance access to the forebay to ease this relatively routine (every 5–7 year) maintenance activity. In addition, ponds should generally have a drain to draw down the pond for vegetation harvesting or the more infrequent dredging of the main cell of the pond.

Cold climates present many challenges to designers of wet ponds. The spring snowmelt may have a high pollutant load and a large volume to be treated. In addition, cold winters may cause freezing of the permanent pool or freezing at inlets and outlets. Finally, high salt concentrations in runoff resulting from road salting, and sediment loads from road sanding, may impact pond vegetation as well as reduce the storage and treatment capacity of the pond.

One option to deal with high pollutant loads and runoff volumes during the spring snowmelt is the use of a seasonally operated pond to capture snowmelt during the winter and retain the permanent pool during warmer seasons. In this option, proposed by Oberts (1994), the pond has two water quality outlets, both equipped with gate valves. In the summer, the lower outlet is closed. During the fall and throughout the winter, the lower outlet is opened to draw down the permanent pool. As the spring melt begins, the lower outlet is closed to provide detention for the melt event. The manipulation of this system requires some labor and vigilance; a careful maintenance agreement should be confirmed.

Several other modifications may help to improve the performance of ponds in cold climates. Designers should consider planting the pond with salt-tolerant vegetation if the facility receives road runoff. In order to counteract the effects of freezing on inlet and outlet structures, the use of inlet and outlet structures that are resistant to frost, including weirs and larger diameter pipes, may be useful. Designing structures on-line, with a continuous flow of water through the pond, will also help prevent freezing of these structures. Finally, since freezing of the permanent pool can reduce the effectiveness of pond systems, it is important to incorporate extended detention into the design to retain usable treatment area above the permanent pool when it is frozen.

Summary of Design Recommendations

(1) Facility Sizing – The basin should be sized to hold the permanent pool as well as the required water quality volume. The volume of the permanent pool should equal twice the water quality volume.

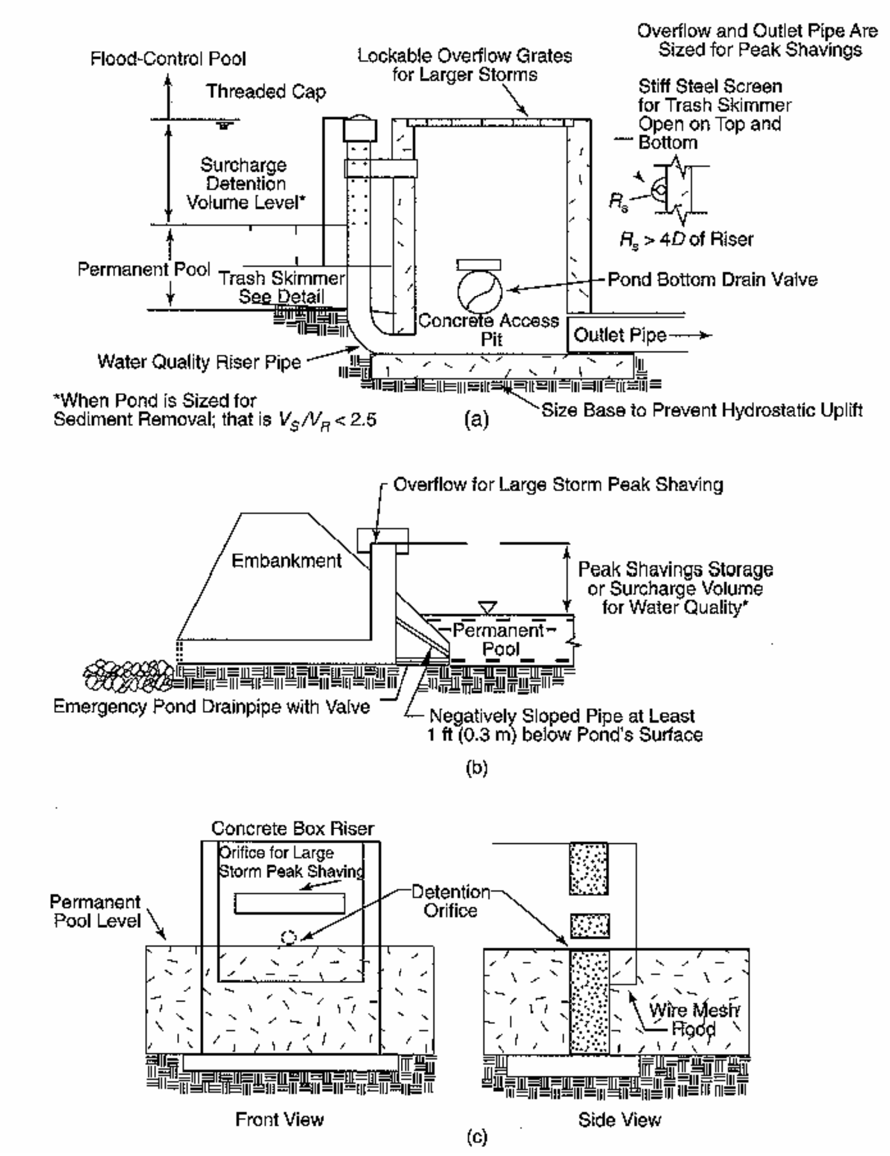
(2) Pond Configuration - The wet basin should be configured as a two stage facility with a sediment forebay and a main pool. The basins should be wedge-shaped, narrowest at the inlet and widest at the outlet. The minimum length to width ratio should be 1.5 where feasible. The perimeter of all permanent pool areas with depths of 4.0 feet or greater should be surrounded by an aquatic bench. This bench should extend inward 5-10 feet from the perimeter of the permanent pool and should be no more than 18 inches below normal depth. The area of the bench should not exceed about 25% of pond surface. The depth in the center of the basin should be 4 – 8 feet deep to prevent vegetation from encroaching on the pond open water surface.

(3) Pond Side Slopes - Side slopes of the basin should be 3:1 (H:V) or flatter for grass stabilized slopes. Slopes steeper than 3:1 should be stabilized with an appropriate slope stabilization practice.

(4) Sediment Forebay - A sediment forebay should be used to isolate gross sediments as they enter the facility and to simplify sediment removal. The sediment forebay should consist of a separate cell formed by an earthen berm, gabion, or loose riprap wall. The forebay should be sized to contain 15 to 25% of the permanent pool volume and should be at least 3 feet deep. Exit velocities from the forebay should not be erosive. Direct maintenance access should be provided to the forebay. The bottom of the forebay may be hardened (concrete) to make sediment removal easier. A fixed vertical sediment depth marker should be installed in the forebay to measure sediment accumulation.

(5) Outflow Structure - Figure 2 presents a schematic representation of suggested outflow structures. The outlet structure should be designed to drain the water quality volume over 24 hours with the orifice sized according to the equation presented in the Extended Detention Basin fact sheet. The facility should have a separate drain pipe with a manual valve that can completely or partially drain the pond for maintenance purposes. To allow for possible sediment accumulation, the submerged end of the pipe should be protected, and the drain pipe should be sized to drain the pond within 24 hours. The valve should be located at a point where it can be operated in a safe and convenient manner.

For on-line facilities, the principal and emergency spillways must be sized to provide 1.0 foot of freeboard during the 25-year event and to safely pass the 100-year flood. The embankment should be designed in accordance with all relevant specifications for small dams.



(6) Splitter Box - When the pond is designed as an off-line facility, a splitter structure is used to isolate the water quality volume. The splitter box, or other flow diverting approach, should be designed to convey the 25-year event while providing at least 1.0 foot of freeboard along pond side slopes.

(7) Vegetation - A plan should be prepared that indicates how aquatic and terrestrial areas will be vegetatively stabilized. Wetland vegetation elements should be placed along the aquatic bench or in the shallow portions of the permanent pool. The optimal elevation for planting of wetland vegetation is within 6 inches vertically of the normal pool elevation. A list of some wetland vegetation native to California is presented in Table 1.

Table 1 California Wetland Vegetation

Botanical Name	Common Name
BACCHARIS SALICIFOLIA	MULE FAT
FRANKENIA GRANDIFOLIA	HEATH
SALIX GOODINGII	BLACK WILLOW
SALIX LASIOLEPIS	ARROYO WILLOW
SAMUCUS MEXICANUS	MEXICAN ELDERBERRY
HAPLOPAPPUS VENETUS	COAST GOLDENBRUSH
DISTICHIS SPICATA	SALT GRASS
LIMONIUM CALIFORNICUM	COASTAL STATICE
ATRIPLEX LENTIFORMIS	COASTAL QUAIL BUSH
BACCHARIS PILULARIS	CHAPARRAL BROOM
MIMULUS LONGIFLORUS	MONKEY FLOWER
SCIRPUS CALIFORNICUS	BULRUSH
SCIRPUS ROBUSTUS	BULRUSH
TYPHA LATIFOLIA	BROADLEAF CATTAIL
JUNCUS ACUTUS	RUSH

Maintenance

The amount of maintenance required for a wet pond is highly dependent on local regulatory agencies, particular health and vector control agencies. These agencies are often extremely concerned about the potential for mosquito breeding that may occur in the permanent pool. Even though mosquito fish (*Gambusia affinis*) were introduced into a wet pond constructed by Caltrans in the San Diego area, mosquito breeding was routinely observed during inspections. In addition, the vegetation at this site became sufficiently dense on the bench around the edge of the pool that mosquito fish were unable to enter this area to feed upon the mosquito larvae. The vegetation at this site was particularly vigorous because of the high nutrient concentrations in the perennial base flow (15.5 mg/L NO3-N) and the mild climate, which permitted growth year round. Consequently, the vector control agency required an annual harvest of vegetation to address this situation. This harvest can be very expensive.

On the other hand, routine harvesting may increase nutrient removal and prevent the export of these constituents from dead and dying plants falling in the water. A previous study (Faulkner and Richardson, 1991) documented dramatic reductions in nutrient removal after the first several years of operation and related it to the vegetation achieving a maximum density. That content then decreases through the growth season, as the total biomass increases. In effect, the total amount of nutrients/m2 of wetland remains essentially the same from June through September, when the plants start to put the P back into the rhizomes. Therefore harvesting should occur between June and September. Research also suggests that harvesting only the foliage is less effective, since a very small percentage of the removed nutrients is taken out with harvesting.

Since wet ponds are often selected for their aesthetic considerations as well as pollutant removal, they are often sited in areas of high visibility. Consequently, floating litter and debris are removed more frequently than would be required simply to support proper functioning of the pond and outlet. This is one of the primary maintenance activities performed at the Central Market Pond located in Austin, Texas. In this type of setting, vegetation management in the area surrounding the pond can also contribute substantially to the overall maintenance requirements.

One normally thinks of sediment removal as one of the typical activities performed at stormwater BMPs. This activity does not normally constitute one of the major activities on an annual basis. At the concentrations of TSS observed in urban runoff from stable watersheds, sediment removal may only be required every 20 years or so. Because this activity is performed so infrequently, accurate costs for this activity are lacking.

In addition to regular maintenance activities needed to maintain the function of wet ponds, some design features can be incorporated to ease the maintenance burden. In wet ponds, maintenance reduction features include techniques to reduce the amount of maintenance needed, as well as techniques to make regular maintenance activities easier.

One potential maintenance concern in wet ponds is clogging of the outlet. Ponds should be designed with a non-clogging outlet such as a reverse-slope pipe, or a weir outlet with a trash rack. A reverse-slope pipe draws from below the permanent pool extending in a reverse angle up to the riser and establishes the water elevation of the permanent pool. Because these outlets draw water from below the level of the permanent pool, they are less likely to be clogged by floating debris.

Typical maintenance activities and frequencies include:

- Schedule semiannual inspections for burrows, sediment accumulation, structural integrity of the outlet, and litter accumulation.

- Remove accumulated trash and debris in the basin at the middle and end of the wet season. The frequency of this activity may be altered to meet specific site conditions and aesthetic considerations.

- Where permitted by the Department of Fish and Game or other agency regulations, stock wet ponds/constructed wetlands regularly with mosquito fish (*Gambusia spp.*) to enhance natural mosquito and midge control.

- Introduce mosquito fish and maintain vegetation to assist their movements to control mosquitoes, as well as to provide access for vector inspectors. An annual vegetation harvest in summer appears to be optimum, in that it is after the bird breeding season, mosquito fish can provide the needed control until vegetation reaches late summer density, and there is time for re-growth for runoff treatment purposes before the wet season. In certain cases, more frequent plant harvesting may be required by local vector control agencies.

- Maintain emergent and perimeter shoreline vegetation as well as site and road access to facilitate vector surveillance and control activities.
- Remove accumulated sediment in the forebay and regrade about every 5-7 years or when the accumulated sediment volume exceeds 10 percent of the basin volume. Sediment removal may not be required in the main pool area for as long as 20 years.

Cost

Construction Cost

Wet ponds can be relatively inexpensive stormwater practices; however, the construction costs associated with these facilities vary considerably. Much of this variability can be attributed to the degree to which the existing topography will support a wet pond, the complexity and amount of concrete required for the outlet structure, and whether it is installed as part of new construction or implemented as a retrofit of existing storm drain system.

A recent study (Brown and Schueler, 1997) estimated the cost of a variety of stormwater management practices. The study resulted in the following cost equation, adjusting for inflation:

$$C = 24.5^{V0.705}$$

where:

C = Construction, design and permitting cost;

V = Volume in the pond to include the 10-year storm (ft^3).

Using this equation, typical construction costs are:

$45,700 for a 1 acre-foot facility

$232,000 for a 10 acre-foot facility

$1,170,000 for a 100 acre-foot facility

In contrast, Caltrans (2002) reported spending over $448,000 for a pond with a total permanent pool plus water quality volume of only 1036 m^3 (0.8 ac.-ft.), while the City of Austin spent $584,000 (including design) for a pond with a permanent pool volume of 3,100 m^3 (2.5 ac.-ft.). The large discrepancies between the costs of these actual facilities and the model developed by Brown and Schueler indicate that construction costs are highly site specific, depending on topography, soils, subsurface conditions, the local labor, rate and other considerations.

Maintenance Cost

For ponds, the annual cost of routine maintenance has typically been estimated at about 3 to 5 percent of the construction cost; however, the published literature is almost totally devoid of actual maintenance costs. Since ponds are long-lived facilities (typically longer than 20 years), major maintenance activities are unlikely to occur during a relatively short study.

Caltrans (2002) estimated annual maintenance costs of $17,000 based on three years of monitoring of a pond treating runoff from 1.7 ha. Almost all the activities are associated with the annual vegetation harvest for vector control. Total cost at this site falls within the 3-5% range reported above; however, the construction costs were much higher than those estimated by Brown and Schueler (1997). The City of Austin has been reimbursing a developer about $25,000/yr for wet pond maintenance at a site located at a very visible location. Maintenance costs are mainly the result of vegetation management and litter removal. On the other hand, King County estimates annual maintenance costs at about $3,000 per pond; however, this cost likely does not include annual extensive vegetation removal. Consequently, maintenance costs may vary considerably at sites in California depending on the aggressiveness of the vegetation management in that area and the frequency of litter removal.

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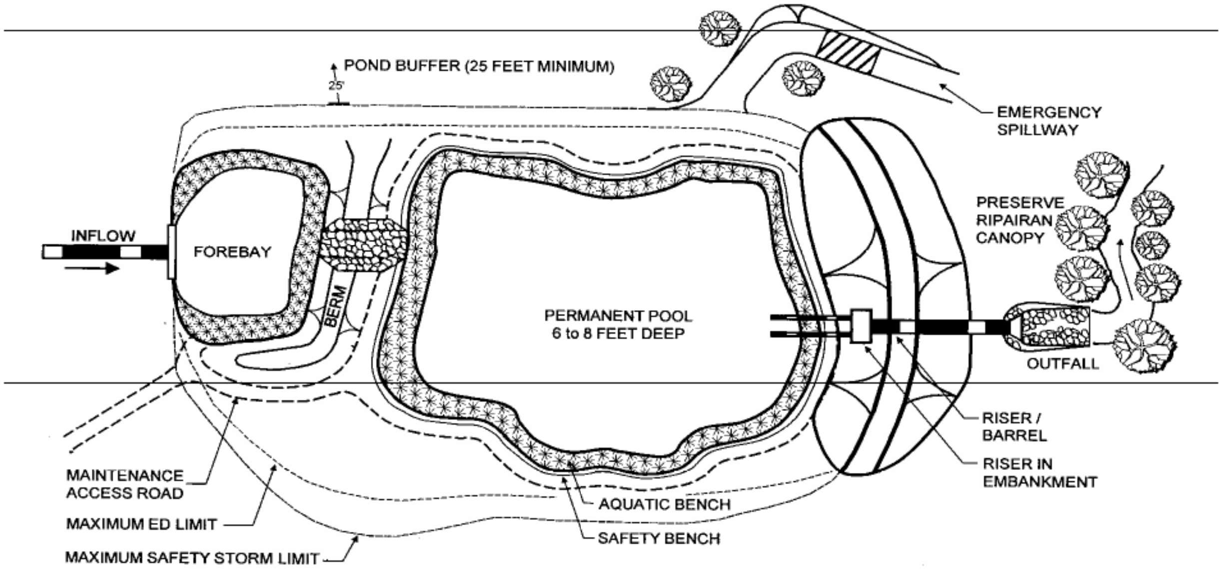
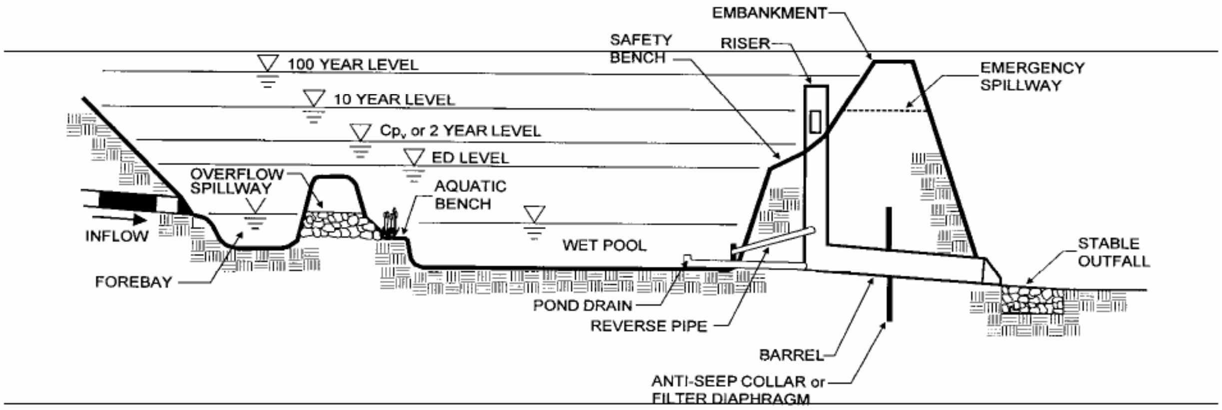


PLAN VIEW



PROFILE

Appendix E

Soils Report

BETTY FORD CENTER
C/O SMITH GROUP, INC.
444 SOUTH FLOWER STREET, SUITE 4700
LOS ANGELES, CALIFORNIA 90071

GEOTECHNICAL ENGINEERING AND SEISMIC HAZARD REPORT
BETTY FORD CENTER PROJECTS
39-000 BOB HOPE DRIVE
RANCHO MIRAGE, CALIFORNIA

June 28, 2007

File No.: 07123-06
07-06-804

Earth Systems
Southwest

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June 28, 2007

File No.: 07123-06
07-06-804

Betty Ford Center
c/o Smith Group, Inc.
444 South Flower Street, Suite 4700
Los Angeles, California 90071

Attention: Ms. Cynthia Keeffe

Subject: **Geotechnical Engineering and Seismic Hazards Report**

Project: **Betty Ford Center Projects**
39-000 Bob Hope Drive
Rancho Mirage, California

Dear Ms. Keeffe:

We take pleasure in presenting this geotechnical engineering and seismic hazards report prepared for the proposed projects at the existing Betty Ford Center located at 39-000 Bob Hope Drive, in the City of Rancho Mirage, Riverside County, California. The property is legally described as Assessor's Parcel Numbers [APNs] 685-270-010 and 685-280-014 through -017. We understand that proposed developments to the site consist of renovating 4 existing residence halls, the construction of a new cart house, the construction and renovation of a front door area to be located between the existing admission/nursing and observation/stabilization buildings, and the construction of a new RDT/Institute building.

This report presents our findings and recommendations for site grading and foundation design, incorporating the information provided to our office. The site is suitable for the proposed development, provided the recommendations in this report are followed in design and construction. In general, the upper soils should be compacted to improve bearing capacity and reduce the potential for differential settlement. The site is subject to strong ground motion from the San Andreas fault. This report should stand as a whole and no part of the report should be excerpted or used to the exclusion of any other part.

This report completes our scope of services in accordance with our agreement, dated March 27, 2007; and authorized on April 30, 2007. Other services that may be required, such as plan review and grading observation, are additional services and will be billed according to our Fee Schedule in effect at the time services are provided. Unless requested in writing, the client is responsible for distributing this report to the appropriate governing agency or other members of the design team.

We appreciate the opportunity to provide our professional services. Please contact our office if there are any questions or comments concerning this report or its recommendations.

Respectfully submitted,
EARTH SYSTEMS SOUTHWEST

Hongbin Huo

Hongbin Huo, Ph.D.
PE 71080

SER/hh/sls/ajf

Distribution: 6/Betty Ford Center
c/o Smith Group Inc.
1/RC File
2/BD File

Reviewed by,

Shelton L Stringer

Shelton L. Stringer
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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Earth Systems Southwest has prepared this executive summary solely to provide a general overview of the report. The report itself should be relied upon for information about the findings, conclusions, recommendations, and other concerns.

The site is located at 39-000 Bob Hope Drive in the City of Rancho Mirage, Riverside County, California. The proposed development will consist of renovating 4 existing residence halls, the construction of a new cart house, the construction and renovation of a front door area to be located between the existing admission/nursing and observation/stabilization buildings, and the construction of a new RDT/Institute building. We understand that the proposed structure will be concrete or wood-frame and stucco construction supported with perimeter wall foundations and concrete slabs-on-grade.

The proposed project may be constructed as planned, provided that the recommendations in this report are incorporated in the final design and construction. Site development will include renovation of the 4 existing residence halls, clearing and grubbing of vegetation, site grading, building pad preparation, underground utility installation, street and parking lot construction, construction of a new cart house, the construction and renovation of a front door area and concrete driveway and sidewalks placement. Based on the non-uniform nature and hydrocollapse potential of the near surface soils, remedial site grading is recommended to provide uniform support for the foundations.

We consider the most significant geologic hazard to the project to be the potential for moderate to severe seismic shaking that is likely to occur during the design life of the proposed structures. The project site is located in the highly seismic Southern California region within the influence of several fault systems that are considered to be active or potentially active. The site is located in Seismic Zone 4 of the 2001 California Building Code (CBC). Structures should be designed in accordance with the values and parameters given within the CBC. The seismic design parameters are presented in the following table and within the report.

SUMMARY OF RECOMMENDATIONS

Design Item	Recommended Parameter	Reference Section No.
Foundations		
Allowable Bearing Pressure Continuous wall footings Pad (Column) footings	 1,500 psf 2,000 psf	5.4
Foundation Type	Spread Footing	5.4
Bearing Materials	Engineered fill	
Allowable Passive Pressure	250 psf per foot	5.4
Active Pressure	35 pcf	5.6
At-rest Pressure	55 pcf	5.6
Allowable Coefficient of Friction	0.35	5.4
Soil Expansion Potential	Very low (EI<20)	3.1
Geologic and Seismic Hazards		
Liquefaction Potential	Negligible	3.4.2
Significant Fault and Magnitude	San Andreas, M7.7	3.4.3; 5.8
Fault Type	A	3.4.3; 5.8
Seismic Zone	4	3.4.3; 5.8
Soil Profile Type	S_D	3.4.3; 5.8
Near-Source Distance	10.8 km	3.4.3; 5.8
Near Source Factor, N_a	1.00	3.4.3; 5.8
Near Source Factor, N_v	1.17	3.4.3; 5.8
Pavement		
TI equal to 4.5	3.0" AC / 4.0" AB	5.9
TI equal to 5.0	3.0" AC / 4.0" AB	5.9
Slabs		
Building Floor Slabs	On engineered fill	5.5
Modulus of Subgrade Reaction	200 pci	5.5
Existing Site Conditions		
Existing Fill	N/A	
Soil Corrosivity	low sulfates low chlorides	5.7
Groundwater Depth	> 100 feet	3.2
Estimated Fill and Cut	3 feet – fill 3 feet – cut	1.1

The recommendations contained within this report are subject to the limitations presented in Section 6 of this report. We recommend that all individuals using this report read the limitations.

GEOTECHNICAL ENGINEERING AND
SEISMIC HAZARD REPORT
BETTY FORD CENTER PROJECTS
39-000 BOB HOPE DRIVE
RANCHO MIRAGE, CALIFORNIA

Section 1
INTRODUCTION

1.1 Project Description

This geotechnical engineering report has been prepared for the proposed projects at the existing Betty Ford Center located at 39-000 Bob Hope Drive, in the City of Rancho Mirage, Riverside County, California. The property is legally described as Assessor's Parcel Numbers [APNs] 685-270-010 and 685-280-014 through -017. We understand that proposed developments to the site consist of renovating 4 existing residence halls, the construction of a new cart house, the construction and renovation of a front door area to be located between the existing admission/nursing and observation/stabilization buildings, and the construction of a new RDT/Institute building.

The proposed new buildings will be one-story structures. We anticipate that the proposed structures will be of concrete or wood-frame and stucco construction and will be supported by conventional shallow continuous or pad footings.

Site development will include renovation of the 4 existing residence halls, clearing and grubbing of vegetation, site grading, building pad preparation, underground utility installation, street and parking lot construction, construction of a new cart house, the construction and renovation of a front door area and concrete driveway and sidewalks placement. Based on existing site topography and ground conditions, site grading is expected to consist of fills not exceeding 3 feet and cuts of about 3 feet.

We used maximum column loads of up to 50 kips and a maximum wall loading of 3 kips per linear foot as a basis for the foundation recommendations. All loading is assumed to be dead plus actual live load. If actual structural loading exceeds these assumed values, we would need to reevaluate the given recommendations.

1.2 Site Description

The proposed projects at the existing Betty Ford Center are located at 39-000 Bob Hope Drive, in the City of Rancho Mirage, Riverside County, California. The site location is shown on Figure 1 in Appendix A.

The project site presently consists of the existing Betty Ford Center. The planned future new RDT/Institute building is located to the east of the site and presently consists of vacant desert land.

There are underground utilities near and within the building area. These utility lines include, but are not limited to, domestic water, electric, sewer, telephone, cable, and irrigation lines.

1.3 Purpose and Scope of Work

The purpose for our services was to evaluate the site soil conditions and to provide professional opinions and recommendations regarding the proposed development of the site. The scope of work included the following:

- ➢ A general reconnaissance of the site.
- ➢ Shallow subsurface exploration by drilling 9 exploratory borings to depths ranging from approximately 15 to 50 feet below existing grade, and 2 cone penetrometer tests (CPT) to depths of 50 feet.
- ➢ Laboratory testing of selected soil samples obtained from the exploratory borings.
- ➢ A review of selected published technical literature pertaining to the site and previous geotechnical reports prepared for this site.
- ➢ An engineering analysis and evaluation of the acquired data from the exploration and testing programs.
- ➢ A summary of our findings and recommendations in this written report.

This report contains the following:

- ➢ Discussions on subsurface soil and groundwater conditions.
- ➢ Discussions on regional and local geologic conditions.
- ➢ Discussions on geologic and seismic hazards.
- ➢ Graphic and tabulated results of laboratory tests and field studies.
- ➢ Recommendations regarding:
  - Site development and grading criteria.
  - Excavation conditions and buried utility installations.
  - Structure foundation type and design.
  - Allowable foundation bearing capacity and expected total and differential settlements.
  - Concrete slabs-on-grade.
  - Lateral earth pressures and coefficients.
  - Mitigation of the potential corrosivity of site soils to concrete and steel reinforcement.
  - Seismic design parameters.
  - Preliminary pavement structural sections.

Not Contained in This Report: Although available through Earth Systems Southwest, the current scope of our services does not include:

- ➢ A corrosive study to determine cathodic protection of concrete or buried pipes.
- ➢ An environmental assessment.
- ➢ An investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or adjacent to the subject property.

The client did not direct ESSW to provide any service to investigate or detect the presence of moisture, mold, or other biological contaminates in or around any structure, or any service that was designed or intended to prevent or lower the risk or the occurrence of the amplification of the same. Client acknowledges that mold is ubiquitous to the environment, with mold amplification occurring when building materials are impacted by moisture. Client further acknowledges that site conditions are outside of ESSW's control and that mold amplification will likely occur or continue to occur in the presence of moisture. As such, ESSW cannot and shall not be held responsible for the occurrence or recurrence of mold amplification.

Section 2
METHODS OF INVESTIGATION

2.1 Field Exploration

Nine exploratory borings were drilled to depths ranging from approximately 15 to 50 feet below the existing ground surface to observe the soil profile and to obtain samples for laboratory testing. The borings were drilled on May 19 and 25, 2007 using 8-inch outside diameter hollow-stem augers, powered by a Simco 2800 truck-mounted drilling rig. The boring locations are shown on the boring location map, Figure 2, in Appendix A. The locations shown are approximate, established by pacing and sighting from existing topographic features.

Samples were obtained within the test borings using a Standard Penetration (SPT) sampler (ASTM D 1586) and a Modified California (MC) ring sampler (ASTM D 3550 with shoe similar to ASTM D 1586). The SPT sampler has a 2-inch outside diameter and a 1.38-inch inside diameter. The MC sampler has a 3-inch outside diameter and a 2.37-inch inside diameter. The samples were obtained by driving the sampler with a 140-pound automatic hammer, dropping 30 inches in general accordance with ASTM D 1586. Recovered soil samples were sealed in containers and returned to the laboratory. Bulk samples were also obtained from auger cuttings, representing a mixture of soils encountered at the depths noted.

The final logs of the borings represent our interpretation of the contents of the field logs and the results of laboratory testing performed on the samples obtained during the subsurface exploration. The final logs are included in Appendix A of this report. The stratification lines represent the approximate boundaries between soil types, although the transitions may be gradational.

Additional subsurface explorations were conducted on May 18, 2007 to advance 2 electric cone penetrometer (CPT) soundings to approximate depth of 50 feet. The soundings were made at the approximate locations shown on the CPT and Boring Location Map, Figure 2, in Appendix A. Interpretive logs of the CPT soundings are presented in Appendix A of this report.

The CPT exploration was conducted by hydraulically advancing an instrument Hogentogler 10 cm^2 conical probe into the ground at a ground rate of 2 cm per second using a 23-ton truck as a reaction mass. An electronic data acquisition system recorded a nearly continuous log of the resistance of the soil against the cone tip (Qc) and soil friction against the cone sleeve (Fs) as the probe was advanced. Empirical relationships (Robertson and Campanella, 1989) were applied to the data to give a nearly continuous profile of the soil stratigraphy. Interpretation of CPT data provides correlations for SPT blow count, phi (Φ) angle (soil friction angle), ultimate shear strength (Su) of clays, and soil type.

2.2 Laboratory Testing

Samples were reviewed along with field logs to select those that would be analyzed further. Those selected for laboratory testing include soils that would be exposed and used during grading and those deemed to be within the influence of the proposed structure. Test results are presented in graphic and tabular form in Appendix B of this report. The tests were conducted in general accordance with the procedures of the American Society for Testing and Materials (ASTM) or other standardized methods as referenced below. Our testing program consisted of the following:

- In-situ Moisture Content and Unit Dry Weight for the ring samples.
- Maximum density tests to evaluate the moisture-density relationship of typical soils encountered.
- Particle Size Analysis to classify and evaluate soil composition. The gradation characteristics of selected samples were made by hydrometer and sieve analysis procedures.
- Chemical Analyses (Soluble Sulfates and Chlorides, pH, and Electrical Resistivity) to evaluate the potential adverse effects of the soil on concrete and steel.

Section 3
DISCUSSION

3.1 Soil Conditions

The field exploration indicates that site soils in the existing Betty Ford Center area consist generally of compacted dense sand with silt and silty sand (Unified Soils Classification System symbols of SP-SM and SM). In the new RDT/Institute building area, the site soils consist generally of uncompacted medium dense sand with silt, silty sand and some silt (Unified Soils Classification System symbols of SP-SM, SM and ML).

The boring logs provided in Appendix A include more detailed descriptions of the soils encountered. The soils are visually classified to be in the very low expansion (EI < 20) category in accordance with Table 18A-I-B of the California Building Code. Site soils are classified as Type C in accordance with CalOSHA.

In arid climatic regions, granular soils may have a potential to collapse upon wetting. Collapse (hydroconsolidation) may occur when the soluble cements (carbonates) in the soil matrix dissolve, causing the soil to densify from its loose configuration from deposition. The hydroconsolidation potential is commonly mitigated by recompaction of a zone beneath building pads.

The site lies within a recognized blow sand hazard area. Fine particulate matter (PM_{10}) can create an air quality hazard if dust is blowing. Watering the surface, planting grass or landscaping, or placing hardscape normally mitigates this hazard.

3.2 Groundwater

Free groundwater was not encountered in the borings at about 50 feet during exploration. The depth to groundwater in the area is believed to be greater than 100 feet. Groundwater levels may fluctuate with precipitation, irrigation, drainage, regional pumping from wells, and site grading. Groundwater should not be a factor in design or construction at this site.

3.3 Geologic Setting

Regional Geology: The site lies within the Coachella Valley, a part of the Colorado Desert geomorphic province. A significant feature within the Colorado Desert geomorphic province is the Salton Trough. The Salton Trough is a large northwest-trending structural depression that extends approximately 180 miles from the San Gorgonio Pass to the Gulf of California. Much of this depression in the area of the Salton Sea is below sea level.

The Coachella Valley forms the northerly part of the Salton Trough. The Coachella Valley contains a thick sequence of Miocene to Holocene sedimentary deposits. Mountains surrounding the Coachella Valley include the Little San Bernardino Mountains on the northeast, foothills of the San Bernardino Mountains on the northwest, and the San Jacinto and Santa Rosa Mountains on the southwest. These mountains expose primarily Precambrian metamorphic and Mesozoic granitic rocks. The San Andreas fault zone within the Coachella Valley consists of the Garnet Hill fault, the Banning fault, and the Mission Creek fault that traverse along the northeast margin of the valley.

Local Geology: The project site is located approximately 230 feet above mean sea level in the central part of the Coachella Valley. The sediments within the valley consist of fine- to coarse-grained sands with interbedded clays, silts, gravels, and cobbles of aeolian (wind-blown), lacustrine (lake-bed), and alluvial (water-laid) origin. The depth to crystalline basement rock beneath the site is estimated to be in excess of 2000 feet (Envicom, 1976).

3.4 Geologic Hazards

Geologic hazards that may affect the region include seismic hazards (ground shaking, surface fault rupture, soil liquefaction, and other secondary earthquake-related hazards), slope instability, flooding, ground subsidence, and erosion. A discussion follows on the specific hazards to this site.

3.4.1 Seismic Hazards

Seismic Sources: Several active faults or seismic zones lie within 62 miles (100 kilometers) of the project site as shown on Table 1 in Appendix A. The primary seismic hazard to the site is strong ground shaking from earthquakes along the San Andreas and San Jacinto faults. The Maximum Magnitude Earthquake (M_{max}) listed is from published geologic information available for each fault (Cao et al., CGS, 2003). The M_{max} corresponds to the maximum earthquake believed to be tectonically possible.

Surface Fault Rupture: The project site does not lie within a currently delineated State of California, *Alquist-Priolo* Earthquake Fault Zone (Hart, 1997). Well-delineated fault lines cross through this region as shown on California Geological Survey (CGS) maps (Jennings, 1994); however, no active faults are mapped in the immediate vicinity of the site. Therefore, active fault rupture is unlikely to occur at the project site. While fault rupture would most likely occur along previously established fault traces, future fault rupture could occur at other locations.

Historic Seismicity: Six historic seismic events (5.9 M or greater) have significantly affected the Coachella Valley in the last 100 years. They are as follows:

- *Desert Hot Springs Earthquake* – On December 4, 1948, a magnitude 6.5 M_L (6.0M_W) earthquake occurred east of Desert Hot Springs. This event was strongly felt in the Palm Springs area.
- *Palm Springs Earthquake* – A magnitude 5.9 M_L (6.2M_W) earthquake occurred on July 8, 1986 in the Painted Hills, causing minor surface creep of the Banning segment of the San Andreas fault. This event was strongly felt in the Palm Springs area and caused structural damage, as well as injuries.
- *Joshua Tree Earthquake* – On April 22, 1992, a magnitude 6.1 M_L (6.1M_W) earthquake occurred in the mountains 9 miles east of Desert Hot Springs. Structural damage and minor injuries occurred in the Palm Springs area as a result of this earthquake.
- *Landers and Big Bear Earthquakes* – Early on June 28, 1992, a magnitude 7.5 M_S (7.3M_W) earthquake occurred near Landers, the largest seismic event in Southern California for 40 years. Surface rupture occurred just south of the town of Yucca Valley and extended some 43 miles toward Barstow. About three hours later, a magnitude 6.6 M_S (6.4M_W) earthquake occurred near Big Bear Lake. No significant structural damage from these earthquakes was reported in the Palm Springs area.
- *Hector Mine Earthquake* – On October 16, 1999, a magnitude 7.1M_W earthquake occurred on the Lavic Lake and Bullion Mountain faults north of Twentynine Palms. While this event was widely felt, no significant structural damage has been reported in the Coachella Valley.

Seismic Risk: While accurate earthquake predictions are not possible, various agencies have conducted statistical risk analyses. In 2002, the California Geological Survey (CGS) and the

United States Geological Survey (USGS) completed the latest generation of probabilistic seismic hazard maps. We have used these maps in our evaluation of the seismic risk at the site. The Working Group of California Earthquake Probabilities (WGCEP, 1995) estimated a 22% conditional probability that a magnitude 7 or greater earthquake may occur between 1994 and 2024 along the Coachella segment of the San Andreas fault.

The primary seismic risk at the site is a potential earthquake along the San Andreas fault. Geologists believe that the San Andreas fault has characteristic earthquakes that result from rupture of each fault segment. The estimated characteristic earthquake is magnitude 7.7 for the Southern Segment of the fault (USGS, 2002). This segment has the longest elapsed time since rupture of any part of the San Andreas fault. The last rupture occurred about 1690 AD, based on dating by the USGS near Indio (WGCEP, 1995). This segment has also ruptured on about 1020, 1300, and 1450 AD, with an average recurrence interval of about 220 years. The San Andreas fault may rupture in multiple segments, producing a higher magnitude earthquake. Recent paleoseismic studies suggest that the San Bernardino Mountain Segment to the north and the Coachella Segment may have ruptured together in 1450 and 1690 AD (WGCEP, 1995).

3.4.2 Secondary Hazards

Secondary seismic hazards related to ground shaking include soil liquefaction, ground subsidence, tsunamis, and seiches. The site is far inland, so the hazard from tsunamis is non-existent. At the present time, no water storage reservoirs are located in the immediate vicinity of the site. Therefore, hazards from seiches are considered negligible at this time.

Soil Liquefaction: Liquefaction is the loss of soil strength from sudden shock (usually earthquake shaking), causing the soil to become a fluid mass. In general, for the effects of liquefaction to be manifested at the surface, groundwater levels must be within 50 feet of the ground surface and the soils within the saturated zone must also be susceptible to liquefaction. The potential for liquefaction to occur at this site is considered negligible because the depth of groundwater beneath the site exceeds 100 feet. No free groundwater was encountered in our exploratory borings.

Ground Subsidence: The potential for seismically induced ground subsidence is considered to be low at the site. Dry sands tend to settle and densify when subjected to strong earthquake shaking. The amount of subsidence is dependent on relative density of the soil, ground motion, and earthquake duration. Uncompacted fill areas may be susceptible to seismically induced settlement.

Slope Instability: The site is relatively flat. Therefore, potential hazards from slope instability, landslides, or debris flows are considered negligible.

Flooding: The project site does not lie within a designated FEMA 100-year flood plain. The project site may be in an area where sheet flooding and erosion could occur. If significant changes are proposed for the site, appropriate project design, construction, and maintenance can minimize the site sheet flooding potential.

3.4.3 Site Acceleration and Seismic Coefficients

Site Acceleration: The potential intensity of ground motion may be estimated by the horizontal peak ground acceleration (PGA), measured in "g" forces. Included in Table 1 are deterministic estimates of site acceleration from possible earthquakes at nearby faults. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone.

Accelerations are also dependent upon attenuation by rock and soil deposits, direction of rupture, and type of fault. For these reasons, ground motions may vary considerably in the same general area. This variability can be expressed statistically by a standard deviation about a mean relationship.

The PGA alone is an inconsistent scaling factor to compare to the CBC Z factor and is generally a poor indicator of potential structural damage during an earthquake. Important factors influencing the structural performance are the duration and frequency of strong ground motion, local subsurface conditions, soil-structure interaction, and structural details.

The following table provides the probabilistic estimate of the PGA taken from the 2002 CGS/USGS seismic hazard maps.

Estimate of PGA from 2002 CGS/USGS Probabilistic Seismic Hazard Maps

Risk	Equivalent Return Period (years)	PGA (g) [1]
10% exceedance in 50 years	475	≈ 0.52

Notes:

[1] Based on a soft rock site, $S_{B/C}$, and soil amplification factor of 1.0 for Soil Profile Type S_D.

2001 CBC Seismic Coefficients: The California Building Code (CBC) seismic design criteria are based on a Design Basis Earthquake (DBE) that has an earthquake ground motion with a 10% probability of occurrence in 50 years. The PGA estimate given above is provided for information on the seismic risk inherent in the CBC design. The seismic and site coefficients given in Chapter 16 of the 2001 California Building Code are provided in Section 5.8 of this report and below.

2001 CBC Seismic Coefficients for Chapter 16 Seismic Provisions

			Reference
Seismic Zone:	4		Figure 16-2
Seismic Zone Factor, Z:	0.4		Table 16-I
Soil Profile Type:	S_D		Table 16-J
Seismic Source Type:	A		Table 16-U
Distance to Known Seismic Source:	10.8 km	= 6.7 miles	(San Andreas fault)
Near Source Factor, N_a:	1.00		Table 16-S
Near Source Factor, N_v:	1.17		Table 16-T
Seismic Coefficient, C_a:	0.44	$= 0.44N_a$	Table 16-Q
Seismic Coefficient, C_v:	0.75	$= 0.64N_v$	Table 16-R

Seismic Hazard Zones: The site lies in a low liquefaction potential zone designated by the 2003 Riverside County Integrated Project because of deep groundwater (>100 feet), and high susceptibility sediments. This portion of Riverside County has not been mapped by the California Seismic Hazard Mapping Act (Ca. PRC 2690 to 2699).

ASCE 7-05 (2006 IBC) Seismic Coefficients: The ASCE 7-05 and 2006 International Building Code (IBC) seismic and site coefficients are given in Appendix A. We understand that the California Building Standards Commission (CBSC) has adopted the 2006 IBC as the new model code, which adopts ASCE 7-05 by reference, for the scheduled revision to the 2007 California Building Code, effective January 1, 2008.

Section 4
CONCLUSIONS

The following is a summary of our conclusions and professional opinions based on the data obtained from a review of selected technical literature and the site evaluation.

General:

- From a geotechnical perspective, the site is suitable for the proposed development, provided the recommendations in this report are followed in the design and construction of this project.

Geotechnical Constraints and Mitigation:

- The primary geologic hazard is severe ground shaking from earthquakes originating on nearby faults. A major earthquake above magnitude 7 originating on the local segment of the San Andreas fault zone would be the critical seismic event that may affect the site within the design life of the proposed development. Engineered design and earthquake-resistant construction increase safety and allow development of seismic areas.
- The project site is in seismic Zone 4, is of soil profile Type S_D, and is about 10.8 km from a Type A seismic source as defined in the California Building Code. A qualified professional should design any permanent structure constructed on the site. The *minimum* seismic design should comply with the 2001 edition of the California Building Code.
- Ground subsidence from seismic events or hydroconsolidation is a potential hazard in the Coachella Valley area. Adherence to the grading and structural recommendations in this report should reduce potential settlement problems from seismic forces, heavy rainfall or irrigation, flooding, and the weight of the intended structures.
- The soils are susceptible to wind and water erosion. Preventative measures to reduce seasonal flooding and erosion should be incorporated into site grading plans. Dust control should also be implemented during construction. Site grading should be in strict compliance with the requirements of the South Coast Air Quality Management District (SCAQMD).
- Other geologic hazards, including fault rupture, liquefaction, seismically induced flooding, and landslides, are considered low or negligible on this site.
- The upper soils in the existing Betty Ford Center area consist generally of compacted dense sand with silt and silty sand and are suitable in their present condition to support structures, fill, and hardscape. The soils within the building and structural areas will require moisture conditioning, and recompaction to improve bearing capacity and reduce the potential for differential settlement from static loading. In the new RDT/Institute building area, the site soils consist generally of uncompacted medium dense sand with silt, silty sand and some silt and are unsuitable in their present condition to support structures, fill, and hardscape. The soils within the building and structural areas will require moisture conditioning, over-excavation and recompaction to improve bearing capacity and reduce the potential for differential settlement from static loading. Soils can be readily cut by normal grading equipment.

Section 5
RECOMMENDATIONS

SITE DEVELOPMENT AND GRADING

5.1 Site Development – Grading

A representative of Earth Systems Southwest (ESSW) should observe site clearing, grading, and the bottoms of excavations before placing fill. Local variations in soil conditions may warrant increasing the depth of recompaction and over-excavation.

Clearing and Grubbing: At the start of site grading, existing vegetation, trees, large roots, pavements, foundations, non-engineered fill, construction debris, trash, and abandoned underground utilities should be removed from the proposed building, structural, and pavement areas. The surface should be stripped of organic growth and removed from the construction area. Areas disturbed during clearing should be properly backfilled and compacted as described below.

Dust control should also be implemented during construction. Site grading should be in strict compliance with the requirements of the South Coast Air Quality Management District (SCAQMD).

Building Pad Preparation: Because of the relatively non-uniform and under-compacted nature of the site soils, we recommend recompaction of soils in the building area. The existing surface soils within the building pad and foundation areas should be moisture conditioned and verified for compaction at the existing Betty Ford Center area. But in the new RDT/Institute building area, the soils should be over-excavated to a minimum of 3 feet below existing grade or a minimum of 2 feet below the footing level (whichever is lower). The recompaction / over-excavation should extend for 5 feet beyond the outer edge of exterior footings. The bottom of the sub-excavation should be scarified, moisture conditioned, and recompacted to at least 90% relative compaction (ASTM D 1557) for an additional depth of 1-foot. Moisture penetration to near optimum moisture should extend at least 5 feet below existing grade and be verified by testing.

Auxiliary Structures Subgrade Preparation: Auxiliary structures such as garden or retaining walls should have the foundation subgrade prepared similar to the building pad recommendations given above. The lateral extent of the over-excavation needs to extend only 2 feet beyond the face of the footing.

Subgrade Preparation: In areas to receive fill, pavements, or hardscape, the subgrade should be scarified, moisture conditioned, and compacted to at least 90% relative compaction (ASTM D 1557) for a depth of 1 foot below finished subgrades. Compaction should be verified by testing.

Engineered Fill Soils: The native sandy soil is suitable for use as engineered fill and utility trench backfill, provided it is free of significant organic or deleterious matter. The native soil should be placed in maximum 8-inch lifts (loose) and compacted to at least 90% relative compaction (ASTM D 1557) near its optimum moisture content. Compaction should be verified by testing.

Imported fill soils (if needed) should be non-expansive, granular soils meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 3 inches and 5 to 35% passing the No. 200 sieve. The geotechnical engineer should evaluate the import fill soils before hauling to the site. However, because of the potential variations within the borrow source, import soil will not be prequalified by ESSW. The imported fill should be placed in lifts no greater than 8 inches in loose thickness and compacted to at least 90% relative compaction (ASTM D 1557) near optimum moisture content.

Shrinkage: The shrinkage factor for earthwork is expected to range from 10 to 20 percent for the upper excavated or scarified *site* soils. This estimate is based on compactive effort to achieve an average relative compaction of about 92% and may vary with contractor methods. Subsidence is estimated to range from 0.1 to 0.2 feet. Losses from site clearing and removal of existing site improvements may affect earthwork quantity calculations and should be considered.

Site Drainage: Positive drainage should be maintained away from the structures (5% for 5 feet minimum) to prevent ponding and subsequent saturation of the foundation soils. Gutters and downspouts should be considered as a means to convey water away from foundations if adequate drainage is not provided. Drainage should be maintained for paved areas. Water should not pond on or near paved areas.

5.2 Excavations and Utility Trenches

Excavations should be made in accordance with CalOSHA requirements. Our site exploration and knowledge of the general area indicates there is a potential for caving of site excavations (utilities, footings, etc.). Excavations within sandy soil should be kept moist, but not saturated, to reduce the potential of caving or sloughing. Where excavations over 4 feet deep are planned, lateral bracing or appropriate cut slopes of 1.5:1 (horizontal:vertical) should be provided. No surcharge loads from stockpiled soils or construction materials should be allowed within a horizontal distance measured from the top of the excavation slope and equal to the depth of the excavation.

Utility Trenches: Backfill of utilities within roads or public right-of-ways should be placed in conformance with the requirements of the governing agency (water district, public works department, etc.). Utility trench backfill within private property should be placed in conformance with the provisions of this report. In general, service lines extending inside of property may be backfilled with native soils compacted to a minimum of 90% relative compaction. Backfill operations should be observed and tested to monitor compliance with these recommendations.

5.3 Slope Stability of Graded Slopes

Unprotected, permanent graded slopes should not be steeper than 3:1 (horizontal:vertical) to reduce wind and rain erosion. Protected slopes with ground cover may be as steep as 2:1. However, maintenance with motorized equipment may not be possible at this inclination. Fill slopes should be overfilled and trimmed back to competent material. Slope stability calculations are not presented because of the expected minimal slope heights (less than 5 feet).

STRUCTURES

In our professional opinion, structure foundations can be supported on shallow foundations bearing on a zone of properly prepared and compacted soils placed as recommended in Section 5.1. The recommendations that follow are based on very low expansion category soils.

5.4 Foundations

Footing design of widths, depths, and reinforcing are the responsibility of the Structural Engineer, considering the structural loading and the geotechnical parameters given in this report.

A minimum footing depth of 12 inches below lowest adjacent grade should be maintained. A representative of ESSW should observe foundation excavations before placement of reinforcing steel or concrete. Loose soil or construction debris should be removed from footing excavations before placement of concrete.

Conventional Spread Foundations: Allowable soil bearing pressures are given below for foundations bearing on recompacted soils as described in Section 5.1. Allowable bearing pressures are net (weight of footing and soil surcharge may be neglected).

- Continuous wall foundations, 12-inch minimum width and 12 inches below grade:
  1500 psf for dead plus design live loads
  Allowable increases of 300 psf per each foot of additional footing width and 300 psf for each additional 0.5 foot of footing depth may be used up to a maximum value of 3000 psf.
- Isolated pad foundations, 2 x 2 foot minimum in plan and 18 inches below grade:
  2000 psf for dead plus design live loads
  Allowable increases of 200 psf per each foot of additional footing width and 400 psf for each additional 0.5 foot of footing depth may be used up to a maximum value of 3000 psf.

A one-third (⅓) increase in the bearing pressure may be used when calculating resistance to wind or seismic loads. The allowable bearing values indicated are based on the anticipated maximum loads stated in Section 1.1 of this report. If the anticipated loads exceed these values, the geotechnical engineer must reevaluate the allowable bearing values and the grading requirements.

Minimum reinforcement for continuous wall footings (as specified in the California Building Code) should be two No. 4 steel reinforcing bars, one placed near the top and one placed near the bottom of the footing. This reinforcing is not intended to supersede any structural requirements provided by the structural engineer.

Expected Settlement: Estimated total static settlement should be less than 1 inch, based on footings founded on firm soils as recommended. Differential settlement between exterior and interior bearing members should be less than ½ inch, expressed in a post-construction angular distortion ratio of 1:480 or less.

Frictional and Lateral Coefficients: Lateral loads may be resisted by soil friction on the base of foundations and by passive resistance of the soils acting on foundation walls. An allowable coefficient of friction of 0.35 of dead load may be used. An allowable passive equivalent fluid pressure of 250 pcf may also be used. These values include a factor of safety of 1.5. Passive resistance and frictional resistance may be used in combination if the friction coefficient is reduced by one-third. A one-third (⅓) increase in the passive pressure may be used when calculating resistance to wind or seismic loads. Lateral passive resistance is based on the assumption that backfill next to foundations is properly compacted.

5.5 Slabs-on-Grade

Subgrade: Concrete slabs-on-grade and flatwork should be supported by compacted soil placed in accordance with Section 5.1 of this report.

Vapor Retarder: In areas of moisture sensitive floor coverings, an appropriate vapor retarder should be installed to reduce moisture transmission from the subgrade soil to the slab. For these areas, an impermeable membrane (10-mil thickness) should underlie the floor slabs. The membrane should be covered with 2 inches of sand to help protect it during construction and to aid in concrete curing. The sand should be lightly moistened just prior to placing the concrete. Low-slump concrete should be used to help reduce the potential for concrete shrinkage. The effectiveness of the membrane is dependent upon its quality, the method of overlapping, its protection during construction, and the successful sealing of the membrane around utility lines.

The following minimum slab recommendations are intended to address geotechnical concerns such as potential variations of the subgrade and are not to be construed as superseding any structural design. The design engineer and/or project architect should ensure compliance with SB800 with regards to moisture and moisture vapor.

Slab Thickness and Reinforcement: Slab thickness and reinforcement of slabs-on-grade are contingent on the recommendations of the structural engineer or architect and the expansion index of the supporting soil. Based upon our findings, a modulus of subgrade reaction of approximately 200 pounds per cubic inch can be used in concrete slab design for the expected very low expansion subgrade.

Concrete slabs and flatwork should be a minimum of 4 inches thick (actual, not nominal). We suggest that the concrete slabs be reinforced with a minimum of No. 3 rebars at 18-inch centers, both horizontal directions, placed at slab mid-height to resist cracking. Concrete floor slabs may either be monolithically placed with the foundations or doweled after footing placement. The thickness and reinforcing given are not intended to supersede any structural requirements provided by the structural engineer. The project architect or geotechnical engineer should continually observe all reinforcing steel in slabs during placement of concrete to check for proper location within the slab.

Control Joints: Control joints should be provided in all concrete slabs-on-grade at a maximum spacing of 36 times the slab thickness (12 feet maximum on-center, each way) as recommended by American Concrete Institute (ACI) guidelines. All joints should form approximately square patterns to reduce the potential for randomly oriented contraction cracks. Contraction joints in the slabs should be tooled at the time of the pour or saw cut (¼ of slab depth) within 8 hours of concrete placement. Construction (cold) joints should consist of thickened butt joints with ½-inch dowels at 18-inches on center or a thickened keyed-joint to resist vertical deflection at the joint. All construction joints in exterior flatwork should be sealed to reduce the potential of moisture or foreign material intrusion. These procedures will reduce the potential for randomly oriented cracks, but may not prevent them from occurring.

Curing and Quality Control: The contractor should take precautions to reduce the potential of curling of slabs in this arid desert region using proper batching, placement, and curing methods. Curing is highly affected by temperature, wind, and humidity. Quality control procedures *may* be used, including trial batch mix designs, batch plant inspection, and on-site special inspection and testing. Typically, for this type of construction and using 2500-psi concrete, many of these quality control procedures are not required.

5.6 Retaining Walls

The following table presents lateral earth pressures for use in retaining wall design. The values are given as equivalent fluid pressures without surcharge loads or hydrostatic pressure.

Lateral Pressures and Sliding Resistance [1]	Granular Backfill
Passive Pressure	375 pcf - level ground
Active Pressure (cantilever walls) Use when wall is permitted to rotate 0.1 to 0.2% of wall height for granular backfill	35 pcf - level ground
At-Rest Pressure (restrained walls)	55 pcf - level ground
Dynamic Lateral Earth Pressure [2] Acting at 0.6H, Where H is height of backfill in feet	50 pcf
Base Lateral Sliding Resistance Dead load x Coefficient of Friction:	0.50

Notes:

[1] These values are ultimate values. A factor of safety of 1.5 should be used in stability analysis except for dynamic earth pressure where a factor of safety of 1.2 is acceptable.

[2] Dynamic pressures are based on the Mononobe-Okabe 1929 method, additive to active earth pressure. Walls retaining less than 6 feet of soil and not supporting inhabitable structures need not consider this increased pressure (reference: CBC Section 1630A.1.1.5).

Upward sloping backfill or surcharge loads from nearby footings can create larger lateral pressures. Should any walls be considered for retaining sloped backfill or placed next to foundations, our office should be contacted for recommended design parameters. Surcharge loads should be considered if they exist within a zone between the face of the wall and a plane projected 45 degrees upward from the base of the wall. The increase in lateral earth pressure should be taken as 35% of the surcharge load within this zone. Retaining walls subjected to traffic loads should include a uniform surcharge load equivalent to at least 2 feet of native soil.

Drainage: A backdrain or an equivalent system of backfill drainage should be incorporated into the retaining wall design. Our firm can provide construction details when the specific application is determined. Backfill immediately behind the retaining structure should be a free-draining granular material. Waterproofing should be according to the designer's specifications. Water should not be allowed to pond near the top of the wall. To accomplish this, the final backfill grade should be such that all water is diverted away from the retaining wall.

Backfill and Subgrade Compaction: Compaction on the retained side of the wall within a horizontal distance equal to one wall height should be performed by hand-operated or other lightweight compaction equipment. This is intended to reduce potential locked-in lateral pressures caused by compaction with heavy grading equipment. Foundation subgrade preparation should be as specified in Section 5.1.

5.7 Mitigation of Soil Corrosivity on Concrete

Selected chemical analyses for corrosivity were conducted on soil samples from the project site as shown in Appendix B. The native soils were found to have a low sulfate ion concentration (N.D. and 6 ppm) and a low chloride ion concentration (40 and 56 ppm). Sulfate ions can attack the cementitious material in concrete, causing weakening of the cement matrix and eventual deterioration by raveling. Chloride ions can cause corrosion of reinforcing steel. The California

Building Code does not require any special provisions for concrete for these low concentrations as tested. Normal concrete mixes may be used.

A minimum concrete cover of three (3) inches should be provided around steel reinforcing or embedded components exposed to native soil or landscape water. Additionally, the concrete should be thoroughly vibrated during placement.

Electrical resistivity testing of the soil suggests that the site soils may present a moderate potential for metal loss from electrochemical corrosion processes. Corrosion protection of steel can be achieved by using epoxy corrosion inhibitors, asphalt coatings, cathodic protection, or encapsulating with densely consolidated concrete.

The information provided above should be considered preliminary. These values can potentially change based on several factors, such as importing soil from another job site and the quality of construction water used during grading and subsequent landscape irrigation.

Earth Systems does not practice corrosion engineering. We recommend that a qualified corrosion engineer evaluate the corrosion potential on metal construction materials and concrete at the site to provide mitigation of corrosive effects, if further guidance is desired.

5.8 Seismic Design Criteria

This site is subject to strong ground shaking due to potential fault movements along the San Andreas and San Jacinto faults. Engineered design and earthquake-resistant construction increase safety and allow development of seismic areas. The *minimum* seismic design should comply with the 2001 edition of the California Building Code using the seismic coefficients given in the table below.

2001 CBC Seismic Coefficients for Chapter 16 Seismic Provisions

			Reference
Seismic Zone:	4		Figure 16-2
Seismic Zone Factor, Z:	0.4		Table 16-I
Soil Profile Type:	S_D		Table 16-J
Seismic Source Type:	A		Table 16-U
Distance to Known Seismic Source:	10.8 km =	6.7 miles	(San Andreas fault)
Near Source Factor, N_a:	1.00		Table 16-S
Near Source Factor, N_v:	1.17		Table 16-T
Seismic Coefficient, C_a:	0.44	$= 0.44N_a$	Table 16-Q
Seismic Coefficient, C_v:	0.75	$= 0.64N_v$	Table 16-R

The CBC seismic coefficients are based on scientific knowledge, engineering judgment, and compromise. If further information on seismic design is needed, a site-specific probabilistic seismic analysis should be conducted.

The intent of the CBC lateral force requirements is to provide a structural design that will resist collapse to provide reasonable life safety from a major earthquake, but may experience some structural and nonstructural damage. A fundamental tenet of seismic design is that inelastic yielding is allowed to adapt to the seismic demand on the structure. In other words, *damage is allowed.* The CBC lateral force requirements should be considered a *minimum* design. The owner and the designer should evaluate the level of risk and performance that is acceptable. Performance based criteria could be set in the design. The design engineer should exercise special care so that all components of the design are fully met with attention to providing a continuous load path. An adequate quality assurance and control program is urged during project construction to verify that the design plans and good construction practices are followed. This is especially important for sites lying close to the major seismic sources.

Estimated peak (mean plus one standard deviation) horizontal site accelerations based upon a probabilistic analysis (10% probability of occurrence in 50 years) is approximately 0.52 g for a stiff soil site. Actual accelerations may be more or less than estimated. Vertical accelerations are typically ⅓ to ⅔ of the horizontal accelerations, but can equal or exceed the horizontal accelerations, depending upon the local site effects and amplification.

5.9 Pavements

Since no traffic loading was provided by the design engineer or owner, we have assumed traffic loading for comparative evaluation. The design engineer or owner should decide the appropriate traffic conditions for the pavements. Maintenance of proper drainage is advised to prolong the service life of the pavements. Water should not pond on or near paved areas. The following table provides our preliminary recommendations for pavement sections. Final pavement sections recommendations should be based on design traffic indices and R-value tests conducted during grading after actual subgrade soils are exposed.

PRELIMINARY RECOMMENDED PAVEMENTS SECTIONS

R-Value Subgrade Soils - 50 (assumed) Design Method – CALTRANS 1995

Traffic Index (Assumed)	Pavement Use	Flexible Pavements		Rigid Pavements	
		Asphaltic Concrete Thickness (Inches)	Aggregate Base Thickness (Inches)	Portland Cement Concrete (Inches)	Aggregate Base Thickness (Inches)
4.5	Auto Parking Areas	3.0	4.0	4.0	4.0
5.0	Streets	3.0	4.0	5.0	4.0

Notes:

1. Asphaltic concrete should be Caltrans, Type B, ½-in. or ¾-in. maximum-medium grading and compacted to a minimum of 95% of the 75-blow Marshall density (ASTM D 1559) or equivalent.
2. Aggregate base should be Caltrans Class 2 (¾ in. maximum) and compacted to a minimum of 95% of ASTM D1557 maximum dry density near its optimum moisture.
3. All pavements should be placed on 12 inches of moisture-conditioned subgrade, compacted to a minimum of 90% of ASTM D 1557 maximum dry density near its optimum moisture.
4. Portland cement concrete should have a minimum of 3250 psi compressive strength at 28 days.
5. Equivalent Standard Specifications for Public Works Construction (Greenbook) may be used instead of Caltrans specifications for asphaltic concrete and aggregate base.

Section 6
LIMITATIONS AND ADDITIONAL SERVICES

6.1 Uniformity of Conditions and Limitations

Our findings and recommendations in this report are based on selected points of field exploration, laboratory testing, and our understanding of the proposed project. Furthermore, our findings and recommendations are based on the assumption that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil or groundwater conditions could exist between and beyond the exploration points. The nature and extent of these variations may not become evident until construction. Variations in soil or groundwater may require additional studies, consultation, and possible revisions to our recommendations.

Findings of this report are valid as of the issued date of the report. However, changes in conditions of a property can occur with passage of time, whether they are from natural processes or works of man, on this or adjoining properties. In addition, changes in applicable standards occur, whether they result from legislation or broadening of knowledge. Accordingly, findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of one year.

In the event that any changes in the nature, design, or location of structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions of this report are modified or verified in writing.

This report is issued with the understanding that the owner or the owner's representative has the responsibility to bring the information and recommendations contained herein to the attention of the architect and engineers for the project so that they are incorporated into the plans and specifications for the project. The owner or the owner's representative also has the responsibility to verify that the general contractor and all subcontractors follow such recommendations. It is further understood that the owner or the owner's representative is responsible for submittal of this report to the appropriate governing agencies.

As the Geotechnical Engineer of Record for this project, Earth Systems Southwest (ESSW) has striven to provide our services in accordance with generally accepted geotechnical engineering practices in this locality at this time. No warranty or guarantee is express or implied. This report was prepared for the exclusive use of the Client and the Client's authorized agents.

ESSW should be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. If ESSW is not accorded the privilege of making this recommended review, we can assume no responsibility for misinterpretation of our recommendations.

Although available through ESSW, the current scope of our services does not include an environmental assessment or an investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater, or air on, below, or adjacent to the subject property.

6.2 Additional Services

This report is based on the assumption that an adequate program of client consultation, construction monitoring, and testing will be performed during the final design and construction phases to check compliance with these recommendations. Maintaining ESSW as the geotechnical consultant from beginning to end of the project will provide continuity of services. *The geotechnical engineering firm providing tests and observations shall assume the responsibility of Geotechnical Engineer of Record.*

Construction monitoring and testing would be additional services provided by our firm. The costs of these services are not included in our present fee arrangements, but can be obtained from our office. The recommended review, tests, and observations include, but are not necessarily limited to, the following:

- Consultation during the final design stages of the project.
- A review of the building and grading plans to observe that recommendations of our report have been properly implemented into the design.
- Observation and testing during site preparation, grading, and placement of engineered fill as required by CBC Sections 1701 and 3317 or local grading ordinances.
- Consultation as needed during construction.

-o0o-

Appendices as cited are attached and complete this report.

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APPENDIX A

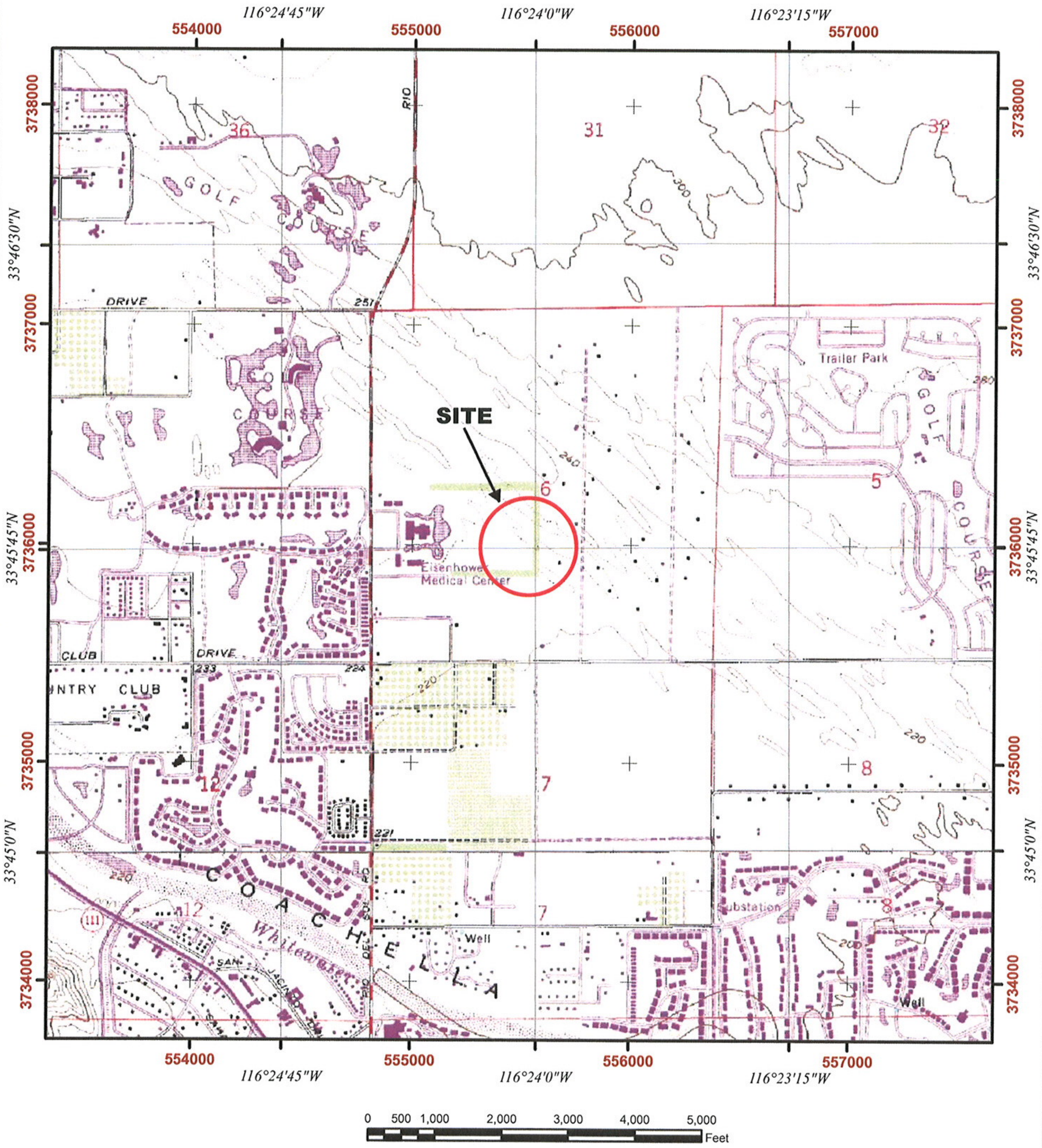


Figure 1
Site Location Map

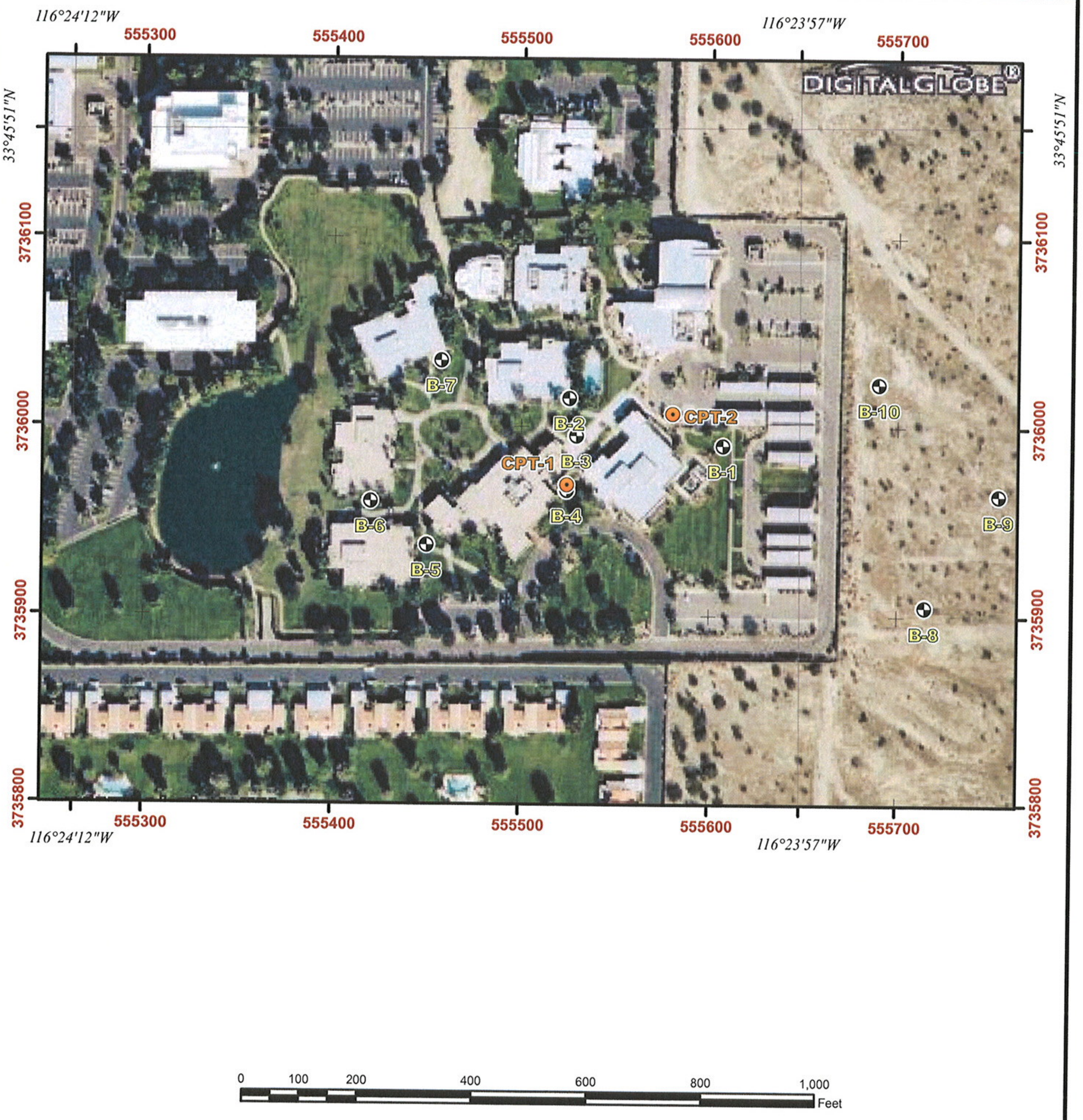
Betty Ford Center
39-000 Bob Hope Drive
Rancho Mirage, Riverside County, California

Earth Systems
Southwest

06/28/07

File No.: 07123-06

Reference: www.terraserver-usa.com



LEGEND

◐ Approximate Boring Location

⊙ Approximate CPT Location

Reference: www.globexplorer.com

Figure 2
Exploration Location Map

Betty Ford Center
39-000 Bob Hope Drive
Rancho Mirage, Riverside County, California

Earth Systems
Southwest

06/28/07

File No.: 07123-06

Table 1
Fault Parameters
& Deterministic Estimates of Mean Peak Ground Acceleration (PGA)

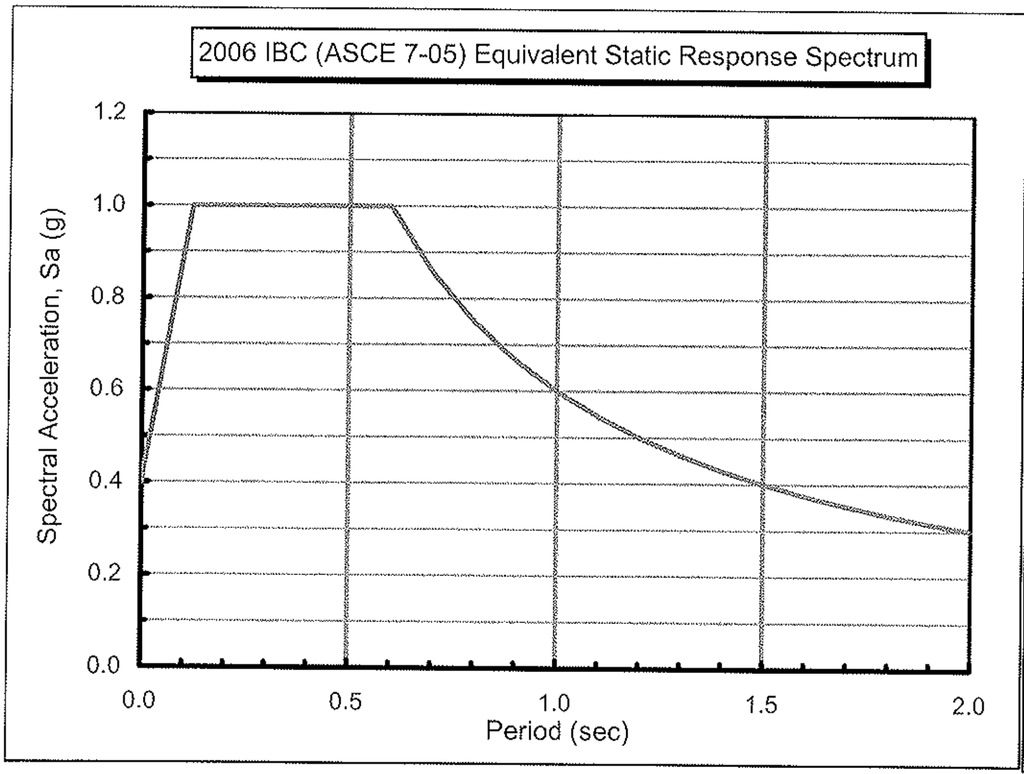
Fault Name or Seismic Zone	**Distance from Site (mi)**	**(km)**	**Fault Type**		**Maximum Magnitude Mmax (Mw)**	**Avg Slip Rate (mm/yr)**	**Avg Return Period (yrs)**	**Fault Length (km)**	**Mean Site PGA (g)**
Reference Notes: (1)			(2)	(3)	(4)	(2)	(2)	(2)	(5)
San Andreas - Banning Branch	**5.9**	9.5	SS	A	**7.2**	10	220	98	**0.37**
San Andreas - Southern	**6.7**	10.8	SS	A	**7.7**	24	220	199	**0.41**
San Andreas - Mission Crk. Branch	**7.4**	11.9	SS	A	**7.2**	25	220	95	**0.32**
Burnt Mtn.	**12.7**	20.4	SS	B	**6.5**	0.6	5000	21	**0.16**
Blue Cut	**13.1**	21.1	SS	C	**6.8**	1	760	30	**0.18**
Eureka Peak	**14.6**	23.5	SS	B	**6.4**	0.6	5000	19	**0.13**
San Jacinto (Hot Spgs - Buck Ridge)	**17.2**	27.6	SS	C	**6.5**	2	354	70	**0.12**
San Jacinto-Anza	**20.5**	32.9	SS	A	**7.2**	12	250	91	**0.15**
Morongo	**21.8**	35.1	SS	C	**6.5**	0.6	1170	23	**0.10**
San Jacinto-Coyote Creek	**22.0**	35.4	SS	B	**6.8**	4	175	41	**0.11**
Pinto Mountain	**23.7**	38.1	SS	B	**7.2**	2.5	499	74	**0.13**
Landers	**27.6**	44.5	SS	B	**7.3**	0.6	5000	83	**0.12**
San Jacinto-San Jacinto Valley	**29.7**	47.7	SS	B	**6.9**	12	83	43	**0.09**
Emerson So. - Copper Mtn.	**30.0**	48.3	SS	B	**7.0**	0.6	5000	54	**0.09**
North Frontal Fault Zone (East)	**32.3**	52.0	RV	B	**6.7**	0.5	1727	27	**0.10**
Pisgah-Bullion Mtn.-Mesquite Lk	**34.4**	55.4	SS	B	**7.3**	0.6	5000	89	**0.10**
Johnson Valley (Northern)	**38.4**	61.8	SS	B	**6.7**	0.6	5000	35	**0.06**
San Jacinto - Borrego	**40.7**	65.4	SS	B	**6.6**	4	175	29	**0.06**
Earthquake Valley	**41.5**	66.7	SS	B	**6.5**	2	351	20	**0.05**
Calico - Hidalgo	**41.8**	67.3	SS	B	**7.3**	0.6	5000	95	**0.08**
North Frontal Fault Zone (West)	**42.4**	68.2	RV	B	**7.2**	1	1314	50	**0.10**
Lenwood-Lockhart-Old Woman Sprgs	**42.9**	69.1	SS	B	**7.5**	0.6	5000	145	**0.09**
Elsinore-Julian	**43.1**	69.4	SS	A	**7.1**	5	340	76	**0.07**
Elsinore-Temecula	**44.2**	71.1	SS	B	**6.8**	5	240	43	**0.06**
Brawley Seismic Zone	**49.2**	79.2	SS	B	**6.4**	25	24	42	**0.04**
Helendale - S. Lockhardt	**49.8**	80.1	SS	B	**7.3**	0.6	5000	97	**0.07**
San Jacinto-San Bernardino	**51.0**	82.1	SS	B	**6.7**	12	100	36	**0.05**
Elsinore-Glen Ivy	**55.0**	88.6	SS	B	**6.8**	5	340	36	**0.05**
Elsinore-Coyote Mountain	**55.1**	88.7	SS	B	**6.8**	4	625	39	**0.05**
Elmore Ranch	**57.4**	92.4	SS	B	**6.6**	1	225	29	**0.04**
Cleghorn	**58.3**	93.8	SS	B	**6.5**	3	216	25	**0.04**
Superstition Mtn. (San Jacinto)	**59.9**	96.4	SS	B	**6.6**	5	500	24	**0.04**
Superstition Hills (San Jacinto)	**61.1**	98.4	SS	B	**6.6**	4	250	23	**0.04**

Notes:

1. Jennings (1994) and California Geologic Survey (CGS) (2003)
2. CGS (2003), SS = Strike-Slip, RV = Reverse, DS = Dip Slip (normal), BT = Blind Thrust
3. 2001 CBC, where Type A faults: Mmax > 7 & slip rate >5 mm/yr & Type C faults: Mmax <6.5 & slip rate < 2 mm/yr
4. CGS (2003)
5. The estimates of the mean Site PGA are based on the following attenuation relationships:
   Average of: (1) 1997 Boore, Joyner & Fumal; (2) 1997 Sadigh et al; (3) 1997 Campbell , (4) 1997 Abrahamson & Silva
   (mean plus sigma values are about 1.5 to 1.6 times higher)
   Based on Site Coordinates: 33.763 N Latitude, 116.401 W Longtude and Site Soil Type D

2006 International Building Code (IBC) & ASCE 7-05 Seismic Parameters

				IBC Reference	ASCE 7-05 Reference
Seismic Category:		**D**		Table 1616.3(1)	Table 11.6-1
Site Class:		**D**		Table 1615.1.1	Table 20.3-1
Latitude:		33.763	N		
Longitude:		-116.401	W		
Maximum Considered Earthquake (MCE) Ground Motion					
Short Period Spectral Response	S_S	**1.50**	**g**	Figure1615(3)	Figure 22-3
1 second Spectral Response	S_1	**0.60**	**g**	Figure1615(4)	Figure 22.4
Site Coefficient	F_a	1.00		Table 1615.1.2(1)	Table 11.4-1
Site Coefficient	F_v	1.50		Table 1615.1.2(2)	Table 11-4.2
	S_{MS}	1.50	g	$= F_a*S_S$	
	S_{M1}	0.90	g	$= F_v*S_1$	
Design Earthquake Ground Motion					
Short Period Spectral Reponse	S_{DS}	**1.00**	**g**	$= 2/3*S_{MS}$	
1 second Spectral Response	S_{D1}	**0.60**	**g**	$= 2/3*S_{M1}$	
	To	0.12	sec	$= 0.2*S_{D1}/S_{DS}$	
	Ts	0.60	sec	$= S_{D1}/S_{DS}$	
Seismic Importance Factor	I	1.00		Table 1604.5	Table 11.5-1



Period T (sec)	Sa (g)
0.00	0.40
0.05	0.65
0.12	1.00
0.20	1.00
0.30	1.00
0.60	1.00
0.70	0.86
0.80	0.75
0.90	0.67
1.00	0.60
1.10	0.55
1.20	0.50
1.30	0.46
1.40	0.43
1.50	0.40
1.60	0.38
1.70	0.35
1.80	0.33
1.90	0.32
2.00	0.30
2.20	0.27

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on ASTM Designations D 2487 and D 2488 (Unified Soil Classification System). Information on each boring log is a compilation of subsurface conditions obtained from the field as well as from laboratory testing of selected samples. The indicated boundaries between strata on the boring logs are approximate only and may be transitional.

SOIL GRAIN SIZE

U.S. STANDARD SIEVE

12" 3" 3/4" 4 10 40 200

BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		COARSE	FINE	COARSE	MEDIUM	FINE		

305 76.2 19.1 4.76 2.00 0.42 0.074 0.002

SOIL GRAIN SIZE IN MILLIMETERS

RELATIVE DENSITY OF GRANULAR SOILS (GRAVELS, SANDS, AND NON-PLASTIC SILTS)

Very Loose	*N=0-4	RD=0-30	Easily push a 1/2-inch reinforcing rod by hand
Loose	N=5-10	RD=30-50	Push a 1/2-inch reinforcing rod by hand
Medium Dense	N=11-30	RD=50-70	Easily drive a 1/2-inch reinforcing rod with hammer
Dense	N=31-50	RD=70-90	Drive a 1/2-inch reinforcing rod 1 foot with difficulty by a hammer
Very Dense	N>50	RD=90-100	Drive a 1/2-inch reinforcing rod a few inches with hammer

*N=Blows per foot in the Standard Penetration Test at 60% theoretical energy. For the 3-inch diameter Modified California sampler, 140-pound weight, multiply the blow count by 0.63 (about 2/3) to estimate N. If automatic hammer is used, multiply a factor of 1.3 to 1.5 to estimate N. RD=Relative Density (%). C=Undrained shear strength (cohesion).

CONSISTENCY OF COHESIVE SOILS (CLAY OR CLAYEY SOILS)

Very Soft	*N=0-1	*C=0-250 psf	Squeezes between fingers
Soft	N=2-4	C=250-500 psf	Easily molded by finger pressure
Medium Stiff	N=5-8	C=500-1000 psf	Molded by strong finger pressure
Stiff	N=9-15	C=1000-2000 psf	Dented by strong finger pressure
Very Stiff	N=16-30	C=2000-4000 psf	Dented slightly by finger pressure
Hard	N>30	C>4000	Dented slightly by a pencil point or thumbnail

MOISTURE DENSITY

Moisture Condition: An observational term; dry, damp, moist, wet, saturated.
Moisture Content: The weight of water in a sample divided by the weight of dry soil in the soil sample expressed as a percentage.
Dry Density: The pounds of dry soil in a cubic foot.

MOISTURE CONDITION

Dry....................Absence of moisture, dusty, dry to the touch
Damp................Slight indication of moisture
Moist.................Color change with short period of air exposure (granular soil)
Below optimum moisture content (cohesive soil)
Wet....................High degree of saturation by visual and touch (granular soil)
Above optimum moisture content (cohesive soil)
Saturated..........Free surface water

RELATIVE PROPORTIONS

Trace............minor amount (<5%)
with/some......significant amount
modifier/and...sufficient amount to influence material behavior (Typically >30%)

PLASTICITY

DESCRIPTION	FIELD TEST
Nonplastic	A 1/8 in. (3-mm) thread cannot be rolled at any moisture content.
Low	The thread can barely be rolled.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit.
High	The thread can be rerolled several times after reaching the plastic limit.

LOG KEY SYMBOLS

▮	Bulk, Bag or Grab Sample
▯	Standard Penetration Split Spoon Sampler (2" outside diameter)
▩	Modified California Sampler (3" outside diameter)
▧	No Recovery

GROUNDWATER LEVEL

▼	Water Level (measured or after drilling)
▽	Water Level (during drilling)

Terms and Symbols used on Boring Logs

Earth Systems
Southwest

MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS More than 50% of material is larger than No. 200 sieve size	GRAVEL AND GRAVELLY SOILS More than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS < 5% FINES	░	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
			▒	GP	Poorly-graded gravels, gravel-sand mixtures. Little or no fines
		GRAVELS WITH FINES > 12% FINES	▥	GM	Silty gravels, gravel-sand-silt mixtures
			▩	GC	Clayey gravels, gravel-sand-clay mixtures
	SAND AND SANDY SOILS More than 50% of coarse fraction passing No. 4 sieve	CLEAN SAND (Little or no fines) < 5%	░	SW	Well-graded sands, gravelly sands, little or no fines
			▒	SP	Poorly-graded sands, gravelly sands, little or no fines
		SAND WITH FINES (appreciable amount of fines) > 12%	▥	SM	Silty sands, sand-silt mixtures
			▨	SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS 50% or more of material is smaller than No. 200 sieve size	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	▥	ML	Inorganic silts and very fine sands, rock flour, silty low clayey fine sands or clayey silts with slight plasticity
			▨	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			▥	OL	Organic silts and organic silty clays of low plasticity
		LIQUID LIMIT GREATER THAN 50	▥	MH	Inorganic silty, micaceous, or diatomaceous fine sand or silty soils
			▨	CH	Inorganic clays of high plasticity, fat clays
			▨	OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			▒	PT	Peat, humus, swamp soils with high organic contents
VARIOUS SOILS AND MAN MADE MATERIALS			▦		Fill Materials
MAN MADE MATERIALS			■		Asphalt and concrete

Soil Classification System

Earth Systems
Southwest

Earth Systems
Southwest

79811B Country Club Drive, Bermuda Dunes, CA 92203
Phone (760) 345-1588, Fax (760) 345-7315

Boring No: B-1

Project Name: 39-000 Bob Hope Drive, Rancho Mirage, CA
File Number: 07123-06
Boring Location: See Figure 2

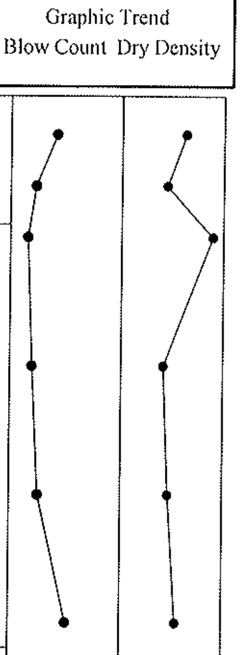
Drilling Date: May 19, 2007
Drilling Method: 8" Hollow Stem Auger
Drill Type: Simco 2800 Auto Hammer
Logged By: Dirk Wiggins

Page 1 of 1

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type Bulk	Sample Type SPT	Sample Type MOD Calif.	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0						SM			SILTY SAND: moderate yellowish brown, medium dense, damp to moist, fine to medium grained
			■	4,11,18			108	5	
			■	4,7,9			97	5	
5			■	4,5,6		SP-SM	124	5	SAND WITH SILT: pale yellowish brown, medium dense to dense, moist to damp, fine to medium grained
10			■	3,6,8			95	6	
15			■	6,8,10			98	6	
20			■	9,16,20			103	5	
25									Total Depth 21.5 feet No Groundwater Encountered
30									
35									
40									
45									
50									
55									
60									



Boring No: B-2

Project Name: 39-000 Bob Hope Drive, Rancho Mirage, CA
File Number: 07123-06
Boring Location: See Figure 2

Drilling Date: May 19, 2007
Drilling Method: 8" Hollow Stem Auger
Drill Type: Simco 2800 Auto Hammer
Logged By: Dirk Wiggins

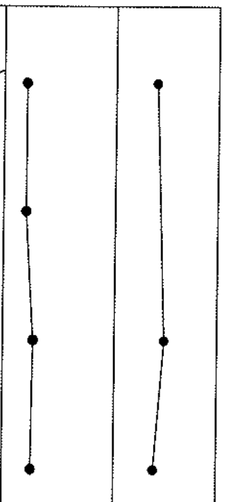
Page 1 of 1

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type Bulk	Sample Type SPT	Sample Type MOD Calif.	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0		◨		---		SM			SILTY SAND: pale to moderate yellowish brown, loose to medium dense, moist, fine grained
			■	4,6,8		SP-SM	94	5	SAND WITH SILT: pale yellowish brown, medium dense, moist, fine to medium grained, root matter, black micas visible
5									
			⧄	4,6,8					No Recovery
10									
			■	6,9,10			99	7	
15									
			■	5,7,11			93	3	
20									Total Depth 19 feet No Groundwater Encountered
25									
30									
35									
40									
45									
50									
55									
60									

Graphic Trend
Blow Count Dry Density



Boring No: B-3

Project Name: 39-000 Bob Hope Drive, Rancho Mirage, CA
File Number: 07123-06
Boring Location: See Figure 2

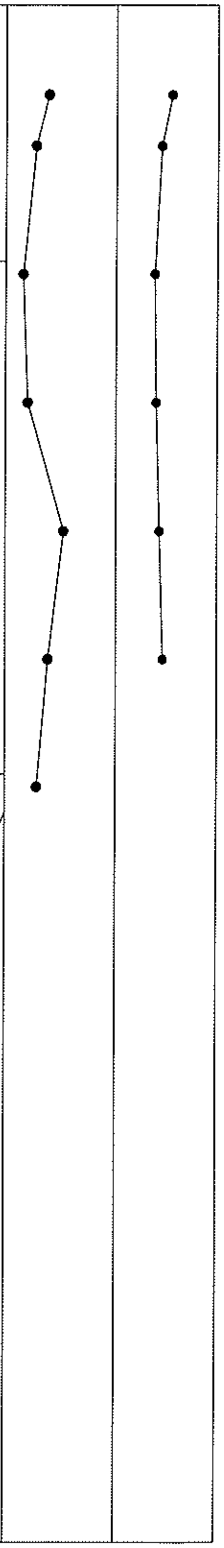
Drilling Date: May 19, 2007
Drilling Method: 8" Hollow Stem Auger
Drill Type: Simco 2800 Auto Hammer
Logged By: Dirk Wiggins

Page 1 of 1

Depth (Ft.)	Sample Type Bulk	Sample Type SPT	Sample Type MOD Calif.	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0						SM			SILTY SAND: pale to moderate yellowish brown, dense to medium dense, wet to moist, fine to medium grained
			■	10,16,21			103	6	
5			■	6,8,11			97	6	
10			■	3,5,6		SP-SM	93	7	SAND WITH SILT: pale yellowish brown, medium dense to dense, damp, fine to medium grained, black micas visible
15			■	3,7,7			94	6	
20			■	8,14,23			96	3	
25			■	7,13,14			98	5	
30		◧		6,6,7		SM			SILTY SAND: moderate to pale yellowish brown, dense to medium dense, damp, fine grained

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Graphic Trend
Blow Count Dry Density



Total Depth 31.5 feet
No Groundwater Encountered
Hand Augered to 3 feet

Boring No: B-4

Project Name: 39-000 Bob Hope Drive, Rancho Mirage, CA
File Number: 07123-06
Boring Location: See Figure 2

Drilling Date: May 19, 2007
Drilling Method: 8" Hollow Stem Auger
Drill Type: Simco 2800 Auto Hammer
Logged By: Dirk Wiggins

Page 1 of 1

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type Bulk	Sample Type SPT	Sample Type MOD Calif.	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units	Graphic Trend Blow Count	Graphic Trend Dry Density
0											
5											
10									Boring was substituted with CPT 1		
15											
20											
25											
30											
35											
40											
45											
50											
55											
60											

Earth Systems
Southwest
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Phone (760) 345-1588, Fax (760) 345-7315

Boring No: B-5

Project Name: 39-000 Bob Hope Drive, Rancho Mirage, CA
File Number: 07123-06
Boring Location: See Figure 2

Drilling Date: May 19, 2007
Drilling Method: 8" Hollow Stem Auger
Drill Type: Simco 2800 Auto Hammer
Logged By: Dirk Wiggins

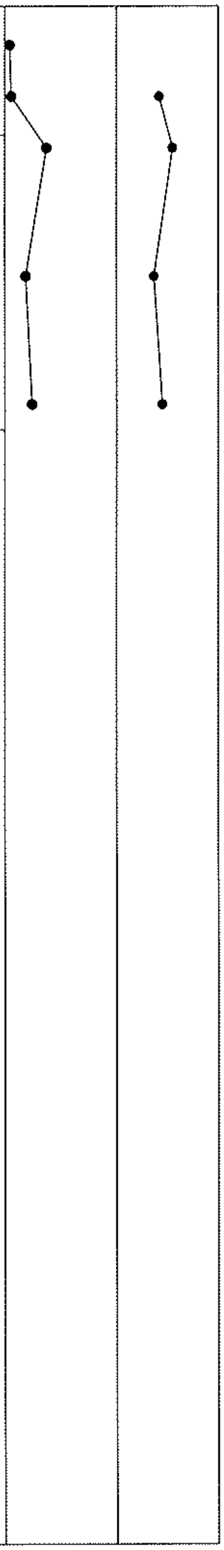
Page 1 of 1

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Penetration Resistance (Blows/6")	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
	SM			SILTY SAND: dark yellowish brown, loose, moist, fine to medium grained
1,1,1,				
2,2,2		95	15	
6,10,16	SP-SM	103	9	SAND WITH SILT: pale yellowish brown, medium dense, moist, fine to medium grained, lenses of silty sand, micas visible
3,5,8		92	4	
6,8,9		97	5	

Total Depth 16.5 feet
No Groundwater Encountered



Boring No: B-6

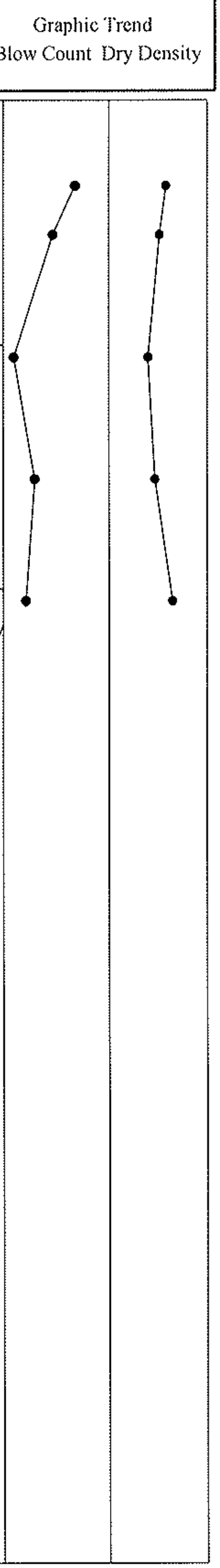
Project Name: 39-000 Bob Hope Drive, Rancho Mirage, CA
File Number: 07123-06
Boring Location: See Figure 2

Drilling Date: May 19, 2007
Drilling Method: 8" Hollow Stem Auger
Drill Type: Simco 2800 Auto Hammer
Logged By: Dirk Wiggins

Page 1 of 1

Depth (Ft.)	Sample Type Bulk	Sample Type SPT	Sample Type MOD Calif.	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	**Description of Units** Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.
0						SM			SILTY SAND: moderate yellowish brown, dense to medium dense, damp to moist, fine to medium grained
			■	9,18,30			105	8	
5			■	8,16,17			101	11	
10			■	2,3,4		SP-SM	94	11	SAND WITH SILT: pale yellowish brown, loose to medium dense, moist, fine to medium grained, trace coarse grained
15			■	5,8,13			98	6	
20			■	6,7,8		SM	109	7	SILTY SAND: pale to moderate yellowish brown, medium dense, moist, fine to medium grained
25									
30									
35									
40									
45									
50									
55									
60									

Total Depth 21.5 feet
No Groundwater Encountered
Hand Augered to 3 feet



Boring No: B-7

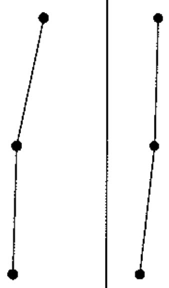
Project Name: 39-000 Bob Hope Drive, Rancho Mirage, CA
File Number: 07123-06
Boring Location: See Figure 2

Drilling Date: May 19, 2007
Drilling Method: 8" Hollow Stem Auger
Drill Type: Simco 2800 Auto Hammer
Logged By: Dirk Wiggins

Page 1 of 1

Depth (Ft.)	Sample Type Bulk	Sample Type SPT	Sample Type MOD Calif.	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.
0						SM			SILTY SAND: dark yellowish brown, loose to medium dense, moist, medium grained
5			■	8,14,16			100	9	
10			■	5,6,7		SP-SM	98	6	SAND WITH SILT: pale yellowish brown, medium dense, moist to damp, fine to medium grained, micas visible
15			■	3,5,6			90	6	
20									Total Depth 16.5 feet No Groundwater Encountered Hand Augered to 5 feet

Graphic Trend
Blow Count Dry Density



Boring No: B-8

Project Name: 39-000 Bob Hope Drive, Rancho Mirage, CA
File Number: 07123-06
Boring Location: See Figure 2

Drilling Date: May 25, 2007
Drilling Method: 8" Hollow Stem Auger
Drill Type: Simco 2800 Auto Hammer
Logged By: Richard Howe

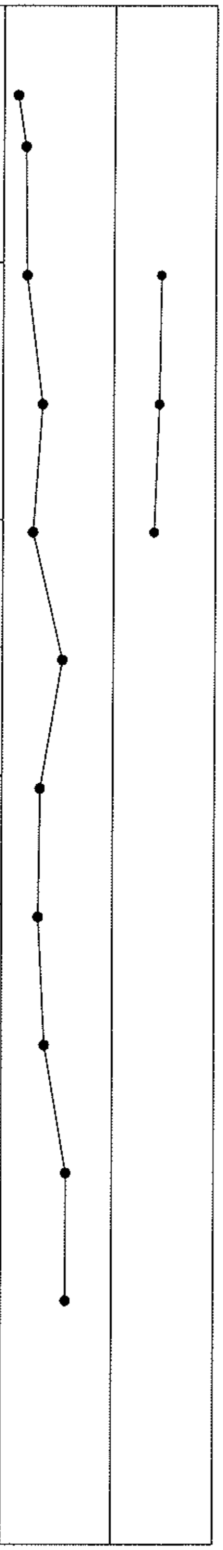
Page 1 of 1

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type Bulk	Sample Type SPT	Sample Type MOD Calif.	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0						SP-SM			SAND WITH SILT: light brown, loose to medium dense, dry, fine to medium grained, blowsand
			▧	3,3,6					No Recovery
5			▧	3,7,7					No Recovery
10			■	3,7,8		SM	98	1	SILTY SAND: moderate yellowish gray, medium dense, dry to damp, fine grained
15			■	6,11,14			97	1	pale yellowish brown
20			■	4,10,9		SM	94	1	SILTY SAND: pale yellowish gray, medium dense, moist, fine to medium grained, no recovery in lower 2 rings
25		◧		11,12,13		SM			SILTY SAND: pale yellowish brown, medium dense, moist, fine grained
30		◧		2,7,9		ML			SILT: light brown, medium dense, moist, trace fine grained sand
35		◧		4,6,9		SM			SILTY SAND: light yellowish brown, medium dense, moist, lenses of silt or layers
40		◧		6,8,10					yellowish brown, very fine to fine grained, 2" silt layer in middle of spoon
45		◧		11,12,15		SM/ML			SILTY SAND TO SANDY SILT: ligth brown, medium dense, moist, very fine to fine grained
50		◧		5,12,15		SM			SILTY SAND: light grayish brown, medium dense, moist, trace silt lenses at lower 2"
55									Total Depth 51.5 feet No Groundwater Encountered
60									

Graphic Trend
Blow Count Dry Density



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Southwest
79811B Country Club Drive, Bermuda Dunes, CA 92203
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Boring No: B-9

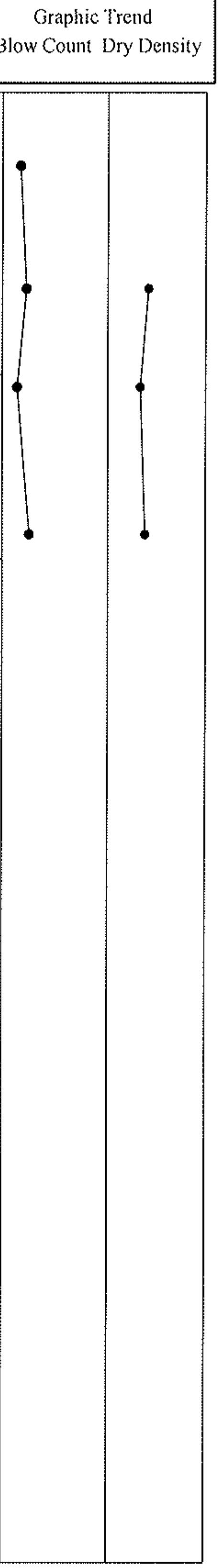
Project Name: 39-000 Bob Hope Drive, Rancho Mirage, CA
File Number: 07123-06
Boring Location: See Figure 2

Drilling Date: May 25, 2007
Drilling Method: 8" Hollow Stem Auger
Drill Type: Simco 2800 Auto Hammer
Logged By: Richard Howe

Page 1 of 1

Depth (Ft.)	Sample Type Bulk	Sample Type SPT	Sample Type MOD Calif.	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0	■				⁘	SP-SM			SAND WITH SILT: light brown, medium dense, dry, fine to medium grained, blowsand
	■		▨	3,4,8	⁘				No Recovery
5					⁘				
			■	6,7,9	⁘		95	1	grayish brown, dry to damp
10					⁘				
			■	3,4,6	⁘	SP-SM	90	2	SAND WITH SILT: olive gray to olive brown, loose, damp, fine grained
15					⁘				
			■	5,8,10	⁘		93	1	yellowish brown to olive gray, medium dense
20									
									Total Depth 19 feet No Groundwater Encountered
25									
30									
35									
40									
45									
50									
55									
60									

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.



Boring No: B-10

Project Name: 39-000 Bob Hope Drive, Rancho Mirage, CA
File Number: 07123-06
Boring Location: See Figure 2

Drilling Date: May 25, 2007
Drilling Method: 8" Hollow Stem Auger
Drill Type: Simco 2800 Auto Hammer
Logged By: Richard Howe

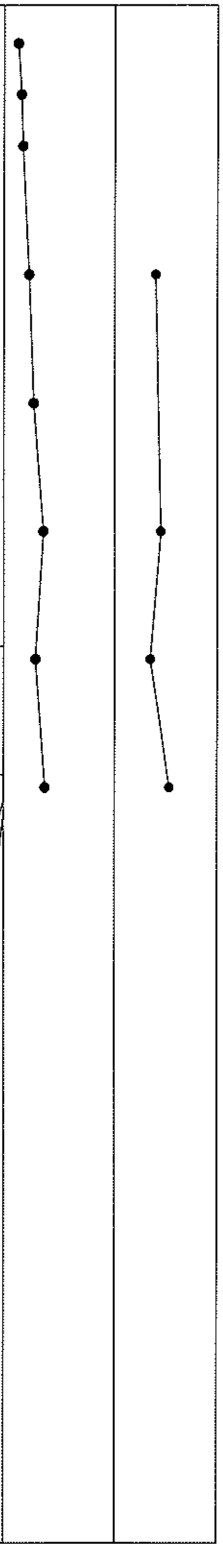
Page 1 of 1

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type: Bulk	Sample Type: SPT	Sample Type: MOD Calif.	Penetration Resistance (Blows/6")	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0					SP-SM			SAND WITH SILT: light yellowish brown, medium dense, dry, fine to medium grained
			▨	2,4,5				
			▨	3,4,7				No Recovery at 1, 3 and 5 feet
5			▨	3,5,7				
10			■	4,6,10		94	1	yellowish to grayish brown, dry to damp, fine grained, poor recovery
15			■	5,8,11		---	0	
20			■	5,12,13		97	0	
25			■	5,8,12	SM	91	1	SILTY SAND: yellowish brown to light olive gray, medium dense, dry to damp, fine grained
30			■	5,15,21	SP-SM	102	1	SAND WITH SILT: light olive gray, medium dense, damp, fine to medium grained
					SM			SILTY SAND: light yellowish brown, medium dense, damp, fine grained
40								Total Depth 31.5 feet No Groundwater Encountered

Graphic Trend



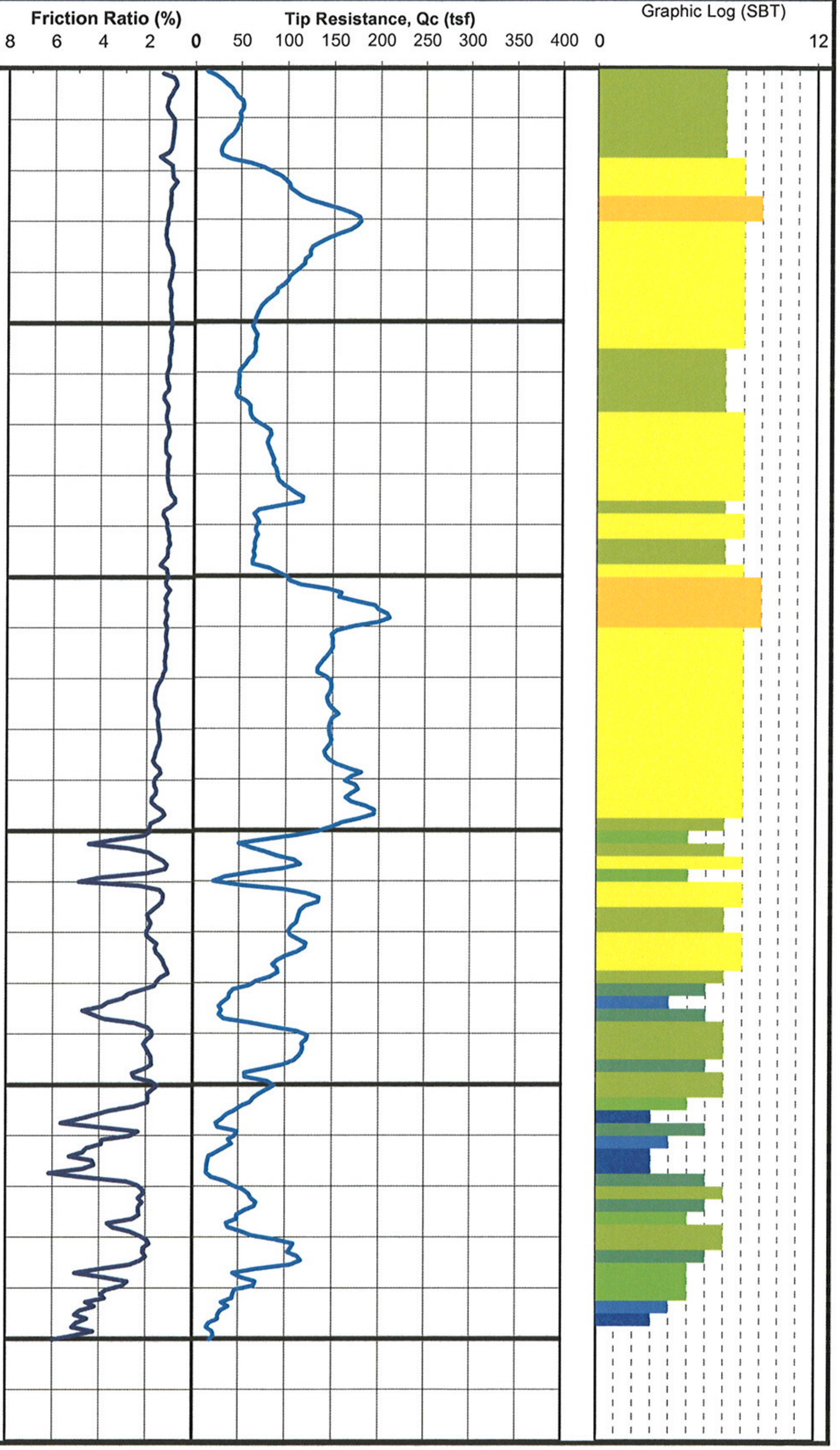
Earth Systems Southwest

CPT No: CPT-1
Project Name: Betty Ford Center Projects
Project No.: 07123-06
Location: See Site Exploration Plan

CPT Vendor:
Truck Mounted Electric
Cone with 23-ton reaction
Date: 6/26/2007

Interpreted Soil Stratigraphy Robertson & Campanella ('89)	Density/Consistency
Silty Sand to Sandy Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Sand to Silty Sand	dense
Sand	dense
Sand to Silty Sand	dense
Sand to Silty Sand	dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Silty Sand to Sandy Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand	medium dense
Sand	dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sandy Silt to Clayey Silt	medium dense
Sandy Silt to Clayey Silt	medium dense
Sand to Silty Sand	medium dense
Silty Sand to Sandy Silt	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Clayey Silt to Silty Clay	very stiff
Silty Sand to Sandy Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Sandy Silt to Clayey Silt	loose
Clayey Silt to Silty Clay	hard
Silty Clay to Clay	very stiff
Clayey Silt to Silty Clay	very stiff
Sandy Silt to Clayey Silt	loose
Sandy Silt to Clayey Silt	hard
Silty Sand to Sandy Silt	medium dense
Clayey Silt to Silty Clay	hard
Silty Clay to Clay	very stiff

End of Sounding @ 50.2 feet



Earth Systems
Southwest

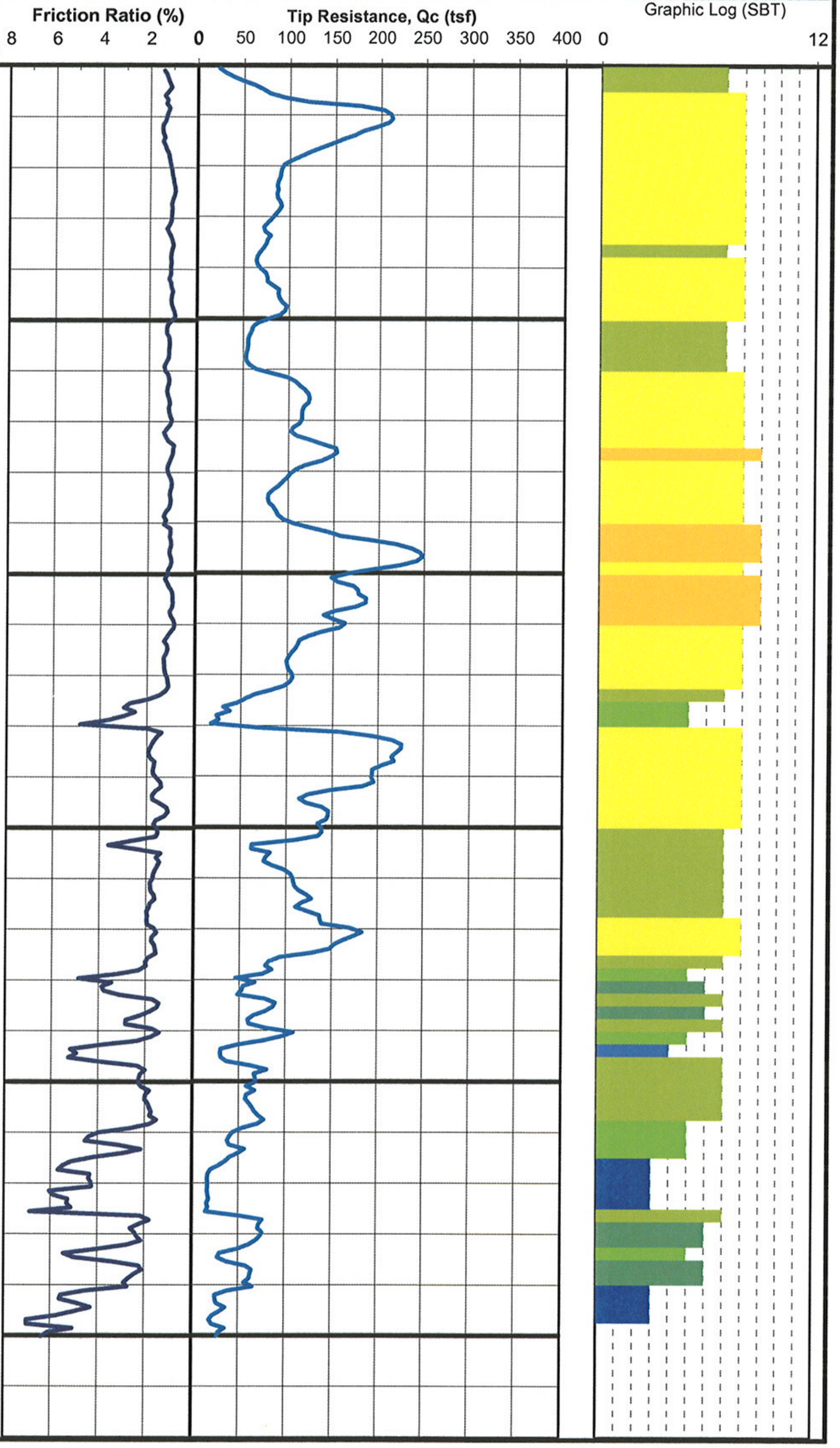
CPT No: CPT-2
Project Name: Betty Ford Center Projects
Project No.: 07123-06
Location: See Site Exploration Plan

CPT Vendor: Truck Mounted Electric Cone with 23-ton reaction
Date: 6/26/2007

DEPTH (FEET)

Interpreted Soil Stratigraphy Robertson & Campanella ('89)	Density/Consistency
Silty Sand to Sandy Silt	medium dense
Sand to Silty Sand	very dense
Sand to Silty Sand	very dense
Sand to Silty Sand	dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Silty Sand to Sandy Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sand	dense
Sand	dense
Sand	dense
Sand	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Silty Sand to Sandy Silt	medium dense
Clayey Silt to Silty Clay	very stiff
Sand to Silty Sand	dense
Sand to Silty Sand	dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Silty Sand to Sandy Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Sand to Silty Sand	medium dense
Sand to Silty Sand	medium dense
Sandy Silt to Clayey Silt	medium dense
Sandy Silt to Clayey Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Clayey Silt to Silty Clay	hard
Silty Sand to Sandy Silt	medium dense
Silty Sand to Sandy Silt	medium dense
Sandy Silt to Clayey Silt	medium dense
Clayey Silt to Silty Clay	hard
Clay	very stiff
Clay	stiff
Silty Sand to Sandy Silt	medium dense
Clayey Silt to Silty Clay	hard
Sandy Silt to Clayey Silt	hard
Clay	very stiff

End of Sounding @ 50.2 feet



APPENDIX B

Laboratory Test Results

File No.: 07123-06

Lab No.: 07-0367

June 28, 2007

UNIT DENSITIES AND MOISTURE CONTENT

ASTM D2937 & D2216

Job Name: Betty Ford Center @ Rancho Mirage

Sample Location	Depth (feet)	Unit Dry Density (pcf)	Moisture Content (%)	USCS Group Symbol
B1	1	108	5	SM
B1	3	97	5	SM
B1	5	124	5	SP-SM
B1	10	95	6	SP-SM
B1	15	98	6	SP-SM
B1	20	103	5	SP-SM
B2	2.5	94	5	SM
B2	12.5	99	7	SP-SM
B2	17.5	93	3	SP-SM
B3	3	103	6	SM
B3	5	97	6	SM
B3	10	93	7	SP
B3	15	94	6	SP-SM
B3	20	96	3	SP-SM
B3	25	98	5	SP-SM
B5	3	95	15	SM
B5	5	103	9	SM
B5	10	92	4	SP-SM
B5	15	97	5	SP-SM

UNIT DENSITIES AND MOISTURE CONTENT

ASTM D2937 & D2216

Job Name: Betty Ford Center @ Rancho Mirage

Sample Location	Depth (feet)	Unit Dry Density (pcf)	Moisture Content (%)	USCS Group Symbol
B6	3	105	8	SM
B6	5	101	11	SM
B6	10	94	11	SP-SM
B6	15	98	6	SP-SM
B6	20	109	7	SP-SM
B7	5	100	9	SM
B7	10	98	6	SM
B7	15	90	6	SP-SM
B8	10	98	1	SM
B8	15	97	1	SM
B8	20	94	1	SM
B9	7.5	95	1	SP-SM
B9	12.5	90	2	SP-SM
B9	17.5	93	1	ML
B10	10	94	1	SP-SM
B10	15	---	0	SP-SM
B10	20	97	0	SP-SM
B10	25	91	1	SM
B10	30	102	1	SP-SM

File No.: 07123-06
Job Name: Betty Ford Center @ Rancho Mirage
Lab Number: 07-0367

June 28, 2007

AMOUNT PASSING NO. 200 SIEVE

ASTM D 1140

Sample Location	Depth (feet)	Fines Content (%)	USCS Group Symbol
B1	1	7	SP-SM
B3	10	2	SP
B9	12.5	8	SP-SM

File No.: 07123-06
Lab No.: 07-0367

June 28, 2007

PARTICLE SIZE ANALYSIS

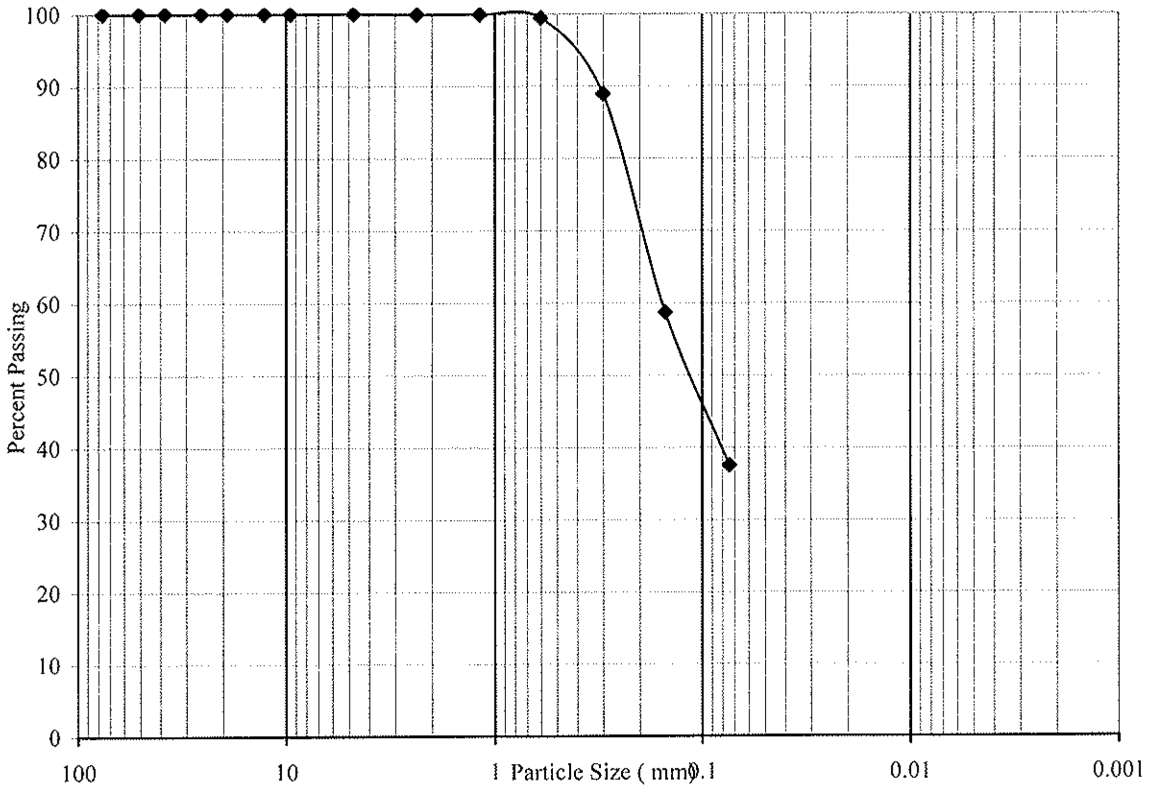
ASTM D-422

Job Name: Betty Ford Center @ Rancho Mirage
Sample ID: **B5 @ 1-4 feet**
Description: **Pale Yellowish Brown Silty Fine Sand (SM)**

Sieve Size	Percent Passing
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
#4	100
#8	100
#16	100
#30	99
#50	89
#100	59
#200	38

% Gravel:	**0**
% Sand:	**62**
% Silt:	**31**
% Clay (3 micron):	**7**

(Clay content by short hydrometer method)



EARTH SYSTEMS SOUTHWEST

June 28, 2007

PARTICLE SIZE ANALYSIS

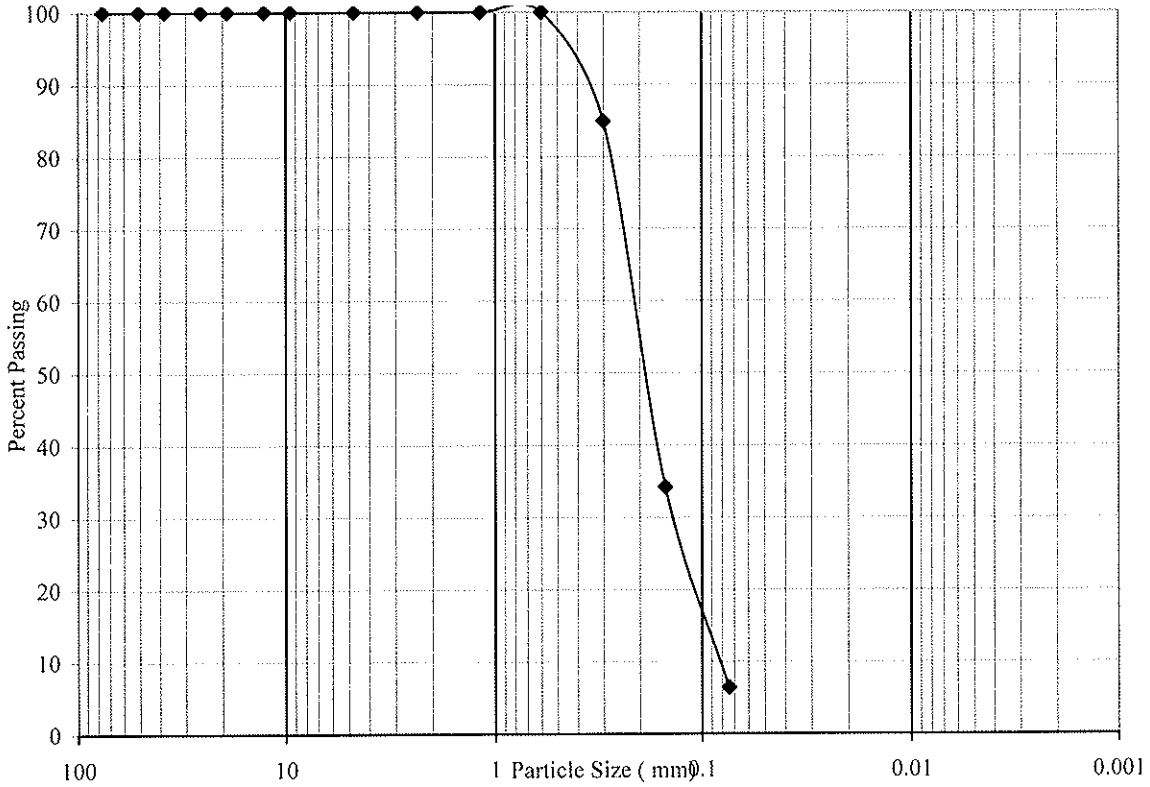
ASTM D-422

Job Name: Betty Ford Center @ Rancho Mirage
Sample ID: **B9 @ 1-5 feet**
Description: **Yellowish Brown Sand w/Silt (SP-SM)**

Sieve Size	Percent Passing
1-1/2"	100
1"	100
3/4"	100
1/2"	100
3/8"	100
#4	100
#8	100
#16	100
#30	100
#50	85
#100	34
#200	6

% Gravel:	**0**
% Sand:	**94**
% Silt:	**2**
% Clay (3 micron):	**4**

(Clay content by short hydrometer method)



File No.: 07123-06

Lab No.: 07-0367

June 28, 2007

MAXIMUM DENSITY / OPTIMUM MOISTURE

ASTM D 1557-91 (Modified)

Job Name: Betty Ford Center @ Rancho Mirage

Sample ID: 1

Location: B5 @ 1-4 feet

Description: Pale Yellowish Brown Silty Fine Sand (SM)

Procedure Used: A

Preparation Method: Moist

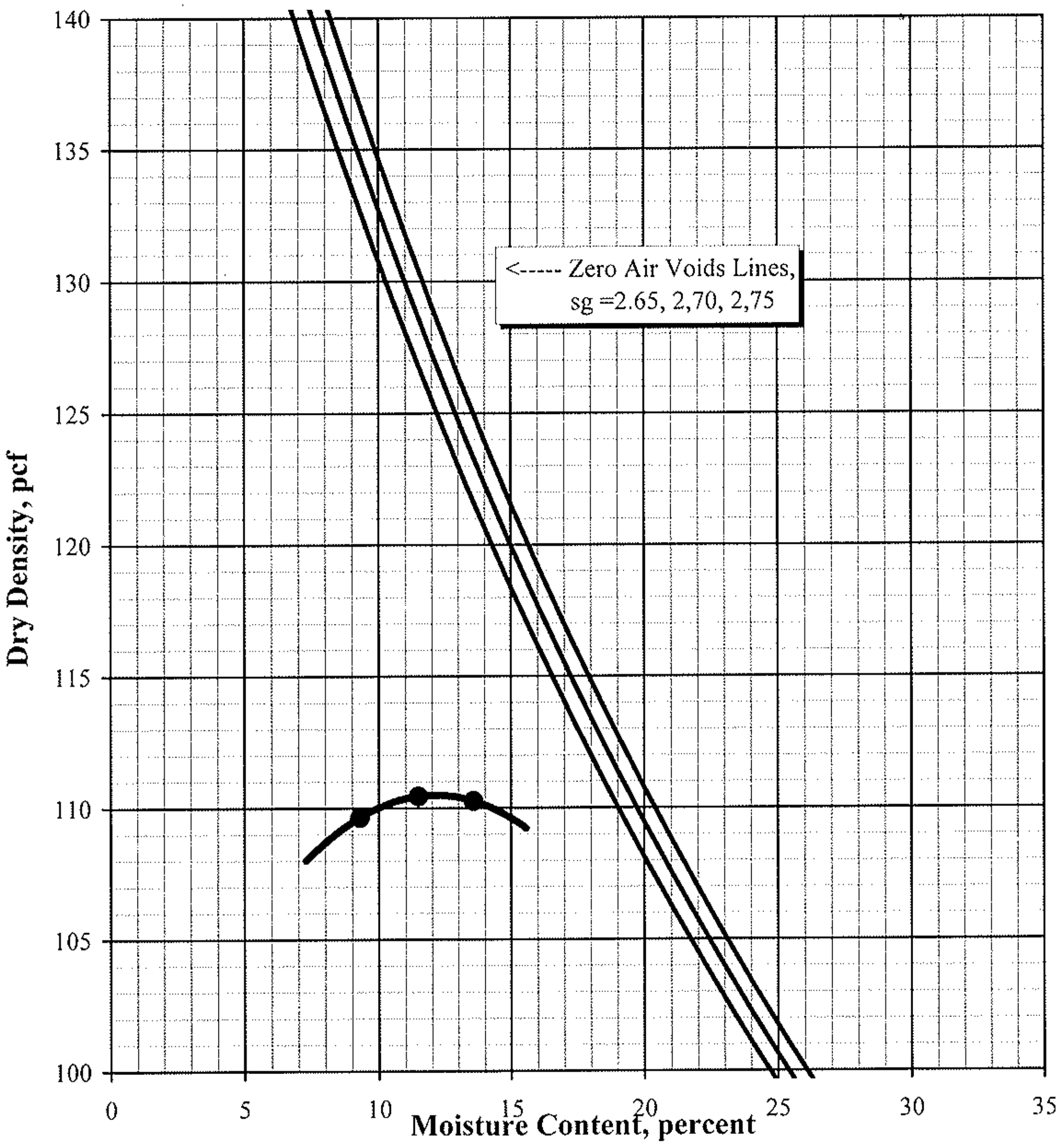
Rammer Type: Mechanical

Lab Numbe 07-0367

Maximum Density: **110.5 pcf**

Optimum Moisture: **12%**

Sieve Size	% Retained
3/4"	0.0
3/8"	0.0
#4	0.0



File No.: 07123-06 June 28, 2007
Lab No.: 07-0367

MAXIMUM DENSITY / OPTIMUM MOISTURE

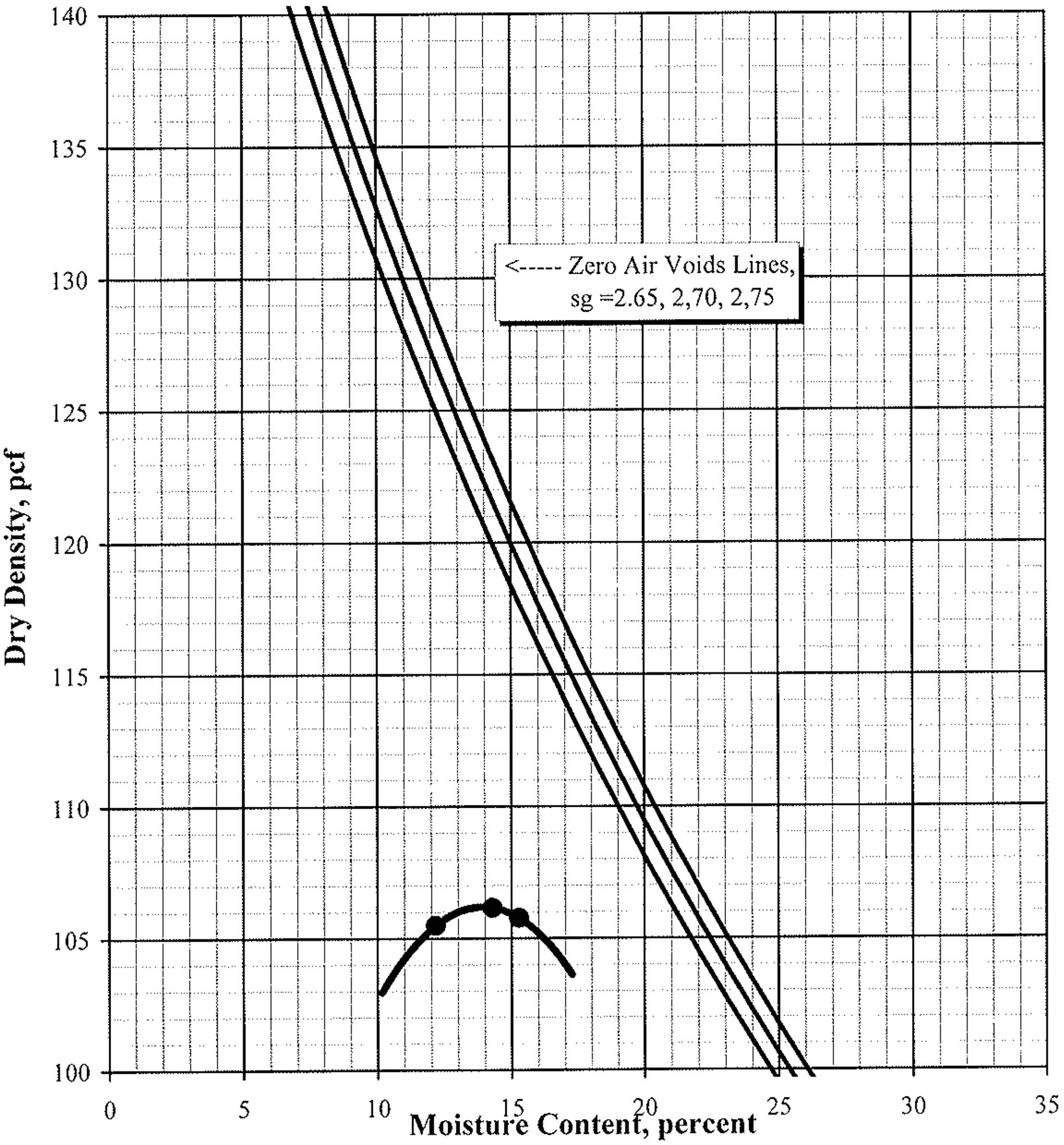
ASTM D 1557-91 (Modified)

Job Name: Betty Ford Center @ Rancho Mirage
Sample ID: 2
Location: B9 @ 1-5 feet
Description: Yellowish Brown Sand w/Silt (SP-SM)

Procedure Used: A
Preparation Method: Moist
Rammer Type: Mechanical
Lab Numbe 07-0367

Maximum Density: **106 pcf**
Optimum Moisture: **14%**

Sieve Size	% Retained
3/4"	0.0
3/8"	0.0
#4	0.0



File No.: 07123-06
Lab No.: 07-0367

June 28, 2007

SOIL CHEMICAL ANALYSES

Job Name: Betty Ford Center @ Rancho Mirage
Job No.: 07123-06

Sample ID:	B5	B9		
Sample Depth, feet:	1-4	1-5	DF	RL
Sulfate, mg/Kg (ppm):	**N.D.**	**6**	1	0.50
Chloride, mg/Kg (ppm):	**40**	**56**	1	0.20
pH, (pH Units):	**7.40**	**7.45**	1	0.41
Resistivity, (ohm-cm):	**2,900**	**2,350**	N/A	N/A
Conductivity, (μmhos-cm):			1	2.00

Note: Tests performed by Subcontract Laboratory:
Surabian AG Laboratory
105 Tesori Drive
Palm Desert, California 92211 Tel: (760) 200-4498

DF: Dilution Factor
RL: Reporting Limit

General Guidelines for Soil Corrosivity

Chemical Agent	Amount in Soil	Degree of Corrosivity
Soluble Sulfates	0 -1000 mg/Kg (ppm) [0-.1%]	Low
	1000 - 2000 mg/Kg (ppm) [0.1-0.2%]	Moderate
	2000 - 20,000 mg/Kg (ppm) [0.2-2.0%]	Severe
	> 20,000 mg/Kg (ppm) [>2.0%]	Very Severe
Resistivity	1-1000 ohm-cm	Very Severe
	1000-2000 ohm-cm	Severe
	2000-10,000 ohm-cm	Moderate
	10,000+ ohm-cm	Low

Appendix F

Structural BMP and/or Retention Facility Sizing Calculations and Design Details

Per Section V.1 of this report:
Since the project will be required to retain urban runoff onsite in conformance with local ordinance (see Table 6, Permittees Requiring Onsite Retention of Stormwater, of the Whitewater River Region WQMP),
Site Design and Treatment Control BMPs are not required.

This project is located within the Betty Ford Center campus which has two existing retention basins. In addition to the existing retention basins, there is a proposed retention basin. This project will retain the 100% of the 100-year “pre-developed” and “post-developed” conditions. Hence, it satisfies the local ordinance requirement for 100% on-site retention for the 100-year, 24-hour storm event. There are no significant changes in the runoff retention of the site, due to this project.

Appendix G

AGREEMENTS – CC&RS, COVENANT AND AGREEMENTS, BMP MAINTENANCE AGREEMENTS AND/OR OTHER MECHANISMS FOR ENSURING ONGOING OPERATION, MAINTENANCE, FUNDING AND TRANSFER OF REQUIREMENTS FOR THIS PROJECT-SPECIFIC WQMP

Will be included in Final WQMP.

Appendix H

PHASE 1 ENVIRONMENTAL SITE ASSESSMENT – SUMMARY OF SITE REMEDIATION CONDUCTED AND USE RESTRICTIONS

COMPLIANCE WITH CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)

No further environmental review is required.

Appendix I

PROJECT-SPECIFIC WQMP SUMMARY DATA FORM

Project-Specific WQMP Summary Data Form

Applicant Information	
Name and Title	Bill Pope, PE, Project Manager
Company	Michael Baker International
Phone	760-776-6131
Email	BILLPOPE@mbakerintl.com
Project Information	
Project Name (as shown on project application/project-specific WQMP)	Betty Ford Center Building Expansion
Street Address	39000 Bob Hope Drive, Rancho Mirage, CA 92270
Nearest Cross Streets	Bob Hope Drive and Country Club Drive
Municipality (City or Unincorporated County)	City of Rancho Mirage
Zip Code	92270
Tract Number(s) and/or Assessor Parcel Number(s)	APN's: 685-280-016, -017, -028, and 685-270-017
Other (other information to help identify location of project)	

Indicate type of project.	**Priority Development Projects (Use an "X" in cell preceding project type):**	
		SF hillside residence; impervious area ≥ 10,000 sq. ft.; Slope ≥ 25%
		SF hillside residence; impervious area ≥ 10,000 sq. ft.; Slope ≥ 10% & erosive soils
		Commercial or Industrial ≥ 100,000 sq. ft.
		Automotive repair shop
		Retail Gasoline Outlet disturbing > 5,000 sq. ft.
		Restaurant disturbing > 5,000 sq. ft.
		Home subdivision ≥ 10 housing units
	X	Parking lot ≥ 5,000 sq. ft. or ≥ 25 parking spaces

Date Project-Specific WQMP Submitted	September 2019
Size of Project Area (nearest 0.1 acre)	25.43 Acres
Will the project replace more than 50% of the impervious surfaces on an existing developed site?	Yes
Project Area managed with LID/Site Design BMPs (nearest 0.1 acre)	25.43 acres (100-year volume on-site retention)
Are Treatment Control BMPs required?	No
Is the project subject to onsite retention by ordinance or policy?	Yes
Did the project meet the 100% LID/Site Design Measurable Goal?	Yes
Name of the entity that will implement, operate, and maintain the post-construction BMPs	Hazelden Betty Ford Foundation
Contact Name	Steven Kronmiller
Street or Mailing Address	15251 Pleasant Valley Road, F02 P.O. Box 11
City	Center City, MN
Zip Code	55012
Phone	651-213-4232
Space Below for Use by City/County Staff Only	
Preceding Information Verified by (consistent with information in project-specific WQMP)	**Name:** **Date:**
Date Project-Specific WQMP Approved:	
Data Entered by	**Name:** **Date:**

Other Comments	