Geosyntec consultants

2100 Main Street, Suite 150
Huntington Beach, California 92648
PH 714.969.0800
FAX 714.969.0820
www.geosyntec.com

19 April 2010

Mr. Hans Kernkamp
General Manager-Chief Engineer
Riverside County Waste Management Department
14310 Frederick Street
Moreno Valley, California 92553

Subject: Proposal for Geological and Geotechnical Services
Lamb Canyon and Badlands Sanitary Landfills
Riverside County, California

Dear Mr. Kernkamp:

GENERAL

Geosyntec Consultants (Geosyntec) is pleased to submit to Riverside County Waste Management Department (Department) this proposal to provide geological and geotechnical services for two projects referred to as:

- The construction of Liner System, Phase 2, Stage 4 (P2S4) Expansion, at the Lamb Canyon Sanitary Landfill (Lamb Canyon Project); and
- The construction of Liner System, Canyon 4, Phase 3 (C4P3) Expansion, at the Badlands Sanitary Landfill (Badlands Project).

The scope, schedule and cost presented in this proposal have been developed in accordance with the Request for Proposal (RFP) dated 25 March 2010, our visit of both sites on 13 April 2010, our discussion of relevant project issues with the site managers, and our knowledge of both sites accumulated over the past ten years.

This Proposal is organized in following sections:

- Company Qualifications and References
- Personnel Qualifications
- Subconsultants Qualifications
- Site Knowledge Demonstration
- Proposed Scope of Services (Including Proposed Approach)

- Approach to Handling Unforeseen Difficulties
- Workers Compensation Insurance and General Liability Insurance
- Cost and Contractual Terms
- Statement of Conformance and Commitment
- Closure/Signature Page

Per RFP requirements, the proposed scope of services is organized and cost estimates are provided in a manner such that each task can be evaluated separately.

COMPANY QUALIFICATIONS AND REFERENCES

General

Geosyntec is known as the industry leader in solid waste landfill siting, design, permitting, and construction monitoring. Moreover, most of the landfill design practices and performance monitoring standards in place today were developed by Geosyntec and its employees. Geosyntec introduced modern QA/QC practice into the US in 1983, and established the first geosynthetic-interface testing laboratory the same year. Our relevant company experience spans over 2,000 landfill projects conducted over the past 27 years that the company has been in existence.

Due to the overwhelming overall company experience in landfill engineering, we are presenting herein, in graphical form, only our company landfill experience in California. This experience is shown in Figure 1 below (and include as Attachment A-1), where each dot indicates a landfill that Geosyntec has worked on. Also shown in Figure 1 are the jurisdictional boundaries of the California Regional Water Quality Control Boards (RWQCBs). Again, for the same reason of overwhelming information, we are listing in Table 1 (included as Attachment A-2) only relevant projects that our company has worked on within Region 8 (Santa Ana), the regulatory agency that will be reviewing successful bidders work products.

Given that we worked on over 29 landfills within Region 8, we are providing relevant project descriptions only for canyon landfills (such as the Lamb Canyon and Badlands landfills), and for the projects of similar scope as required by the RFP. These project descriptions are enclosed in Attachment A-4.

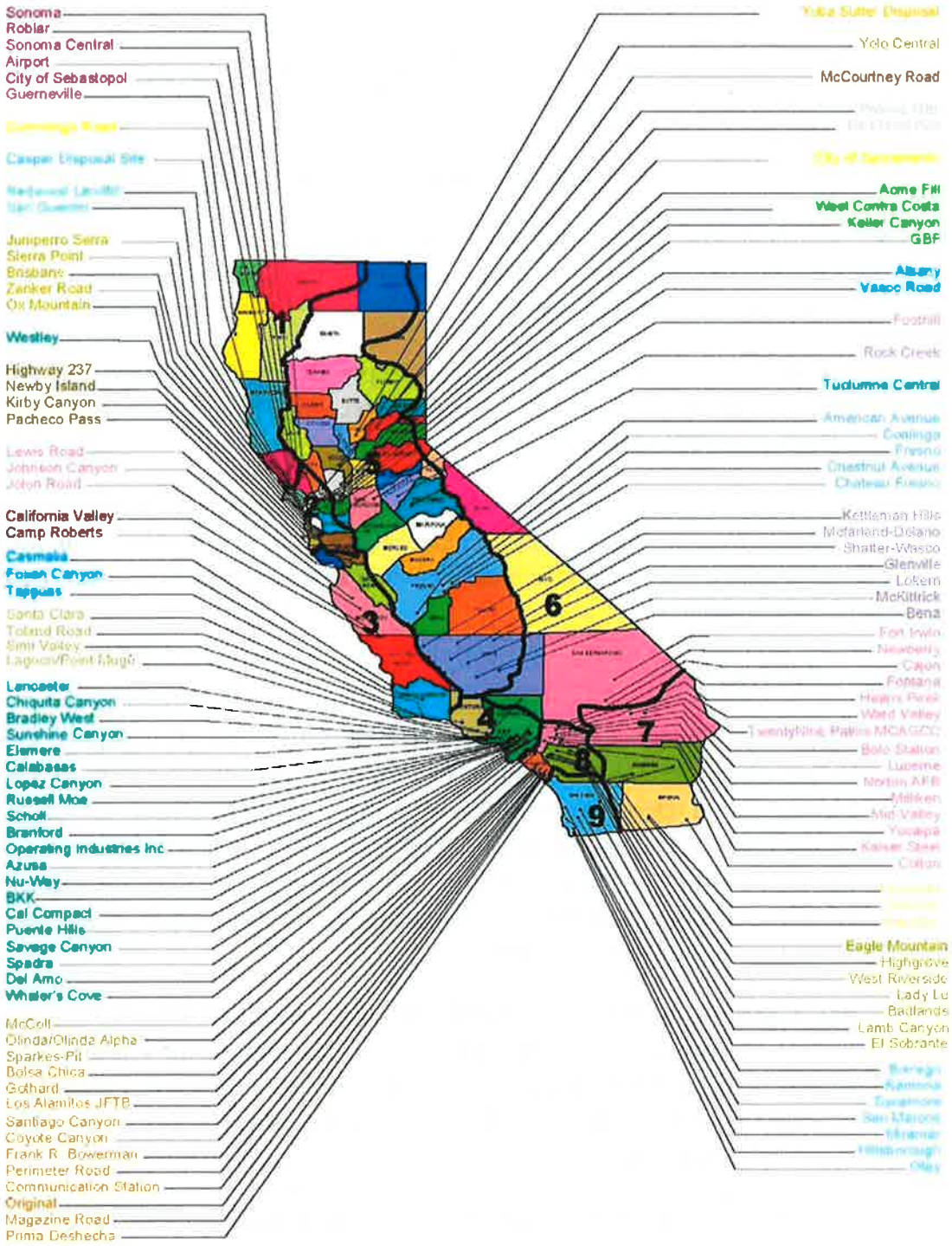


Figure 1: Geosyntec Representative Landfill Experience in California

Additional information presented in this proposal, which demonstrates relevant qualifications of Geosyntec includes:

- Geosyntec's landfill-specific brochure (enclosed in Attachment A-3).
- A list of over 11 technical reports prepared by our company for the Lamb Canyon and Badlands Landfills (see the "Site Knowledge Demonstration" Section of this proposal); and
- A list of over 84 landfills that our proposed Project Manager, Dr. Neven Matasovic, P.E., G.E. has worked on (see the "Personnel Qualification" Section and Attachment B-3).

Please also visit Geosyntec's web site, where additional information on our company, company offices (over 40 world-wide), employees (over 750, out of which over 100 are based in our southern California locations, including Riverside and Huntington Beach), and our project experience.

Company References

1. **Mr. Imad Guirguis, P.E.;** Tel: (951) 955-1299. Mr. Guirguis is former Project (Engineering) Manager for the Badlands landfill (now with RCWMD, Flood Control Department) and has worked with Geosyntec on numerous projects related to Badlands landfill (C3P1 and C4P2) with scopes ranging from geological investigations, to bucket auger drilling, landslide back analysis, laboratory testing, regulatory interface, QA/QC for liner repair and waste-on-waste liner design and construction.

2. **Mr. George Ker, P.E., G.E.**; (949) 728-3042. Mr. Ker is Project Manager for Orange County Waste & Recycling Prima Deshecha Zone 4 project that is similar in scope to the Lamb Canyon and Badlands Projects. Geosyntec is currently working on the Zone 4 project and Dr. Matasovic is responsible for the stability evaluations.

3. **Mr. John Haines, P.E.**; (805) 882-3627. Mr. Haines is Project Manager for the Santa Barbara County Public Works Department Tajiguas Landfill. The landfill construction ongoing at Tajiguas is similar in scope and size to the Lamb Canyon and Badlands Projects. Geosyntec recently completed geologic

mapping, in-grading monitoring, stability evaluations, and QA/QC services for the Tajiguas Landfill Phase IIA and IIB phases of development. Both Mr. Conkle (QA/QC) and Dr. Matasovic worked on these projects.

PERSONNEL QUALIFICATIONS

General

Geosyntec believes that it will be advantageous to the Department to select a consultant able to commit a team which can complete all of the requested services, including Geotechnical Services (Service A) on both landfills, Geological Services (Service B) at the Lamb Canyon landfill, and Construction QA/QC Services (Service C) at both landfills. Accordingly, Geosyntec has assembled a team of qualified professionals to support the above listed services. The proposed organization of our team is outlined in Figure 2 (see a larger copy of this organizational chart enclosed in Attachment B-1) and is explained below. Information on the sub-consultants (Geosynthetic, Interface Shear, and Geotechnical Laboratories) is provided in subsequent section ("Subconsultant Qualifications" Section).

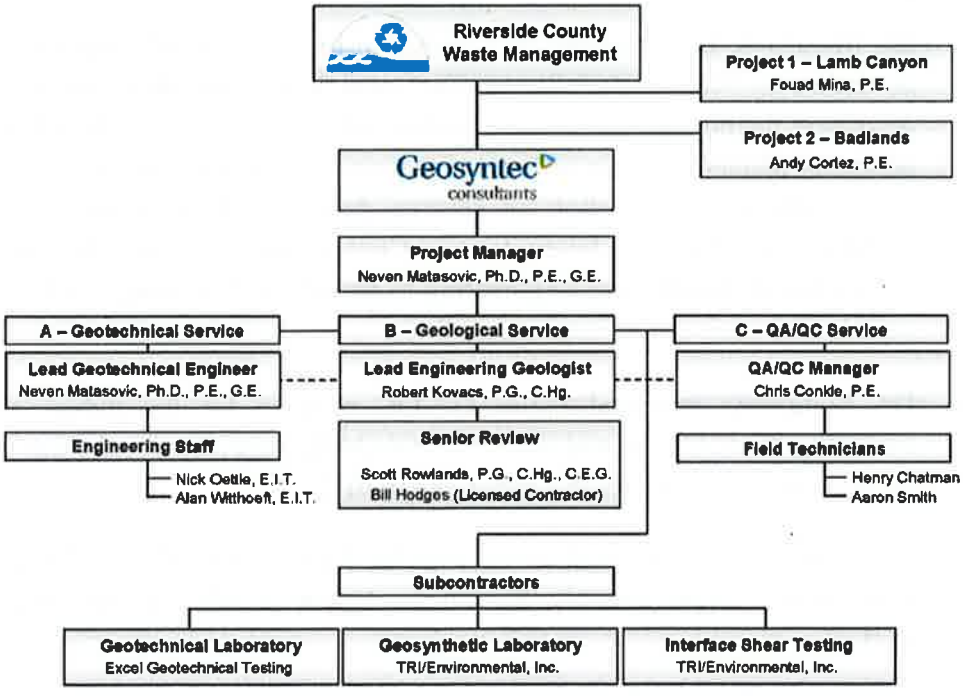


Figure 2 – Geosyntec Team Organization Chart

Key Team Members

Geosyntec commits **Dr. Neven Matasovic, P.E., G.E.**, as: (i) overall Project Manager; (ii) Lead Geotechnical Engineer responsible for stability evaluations; and (iii) the Department's primary point of contact throughout the project. We believe that Dr. Matasovic is uniquely qualified to fulfill all of the three positions as:

- Dr. Matasovic has served as the Project Manager on over 100 landfill-related projects, including over 16 projects for the Department. These projects included Geotechnical Investigation and design (12 projects for the Department), Geological Investigations (6 for the Department; overlap with Geotechnical Investigation), and Construction QA/QC Services (4 for the Department).

- Dr. Matasovic was technical lead on over 120 landfill-related projects, including over 16 for the Department. The work products of all of these 16 projects for the Department were approved by the Santa Ana RWQCB in a remarkably short time and with no comments. Dr. Matasovic developed working relationship with Department's project managers that will be responsible for both Projects.

- Dr. Matasovic is recognized as a technical leader in landfill design. He is a co-author of the United States Environmental Protection Agency (EPA) guidance document on seismic design of landfills has authored over 70 technical papers on static and seismic design of landfills, and will present the state-of-the art presentation on seismic design of lined waste containment facilities at the 4th International Conference on Soil Dynamic and Geotechnical Earthquake Engineering to be held in San Diego in May of this year (paper enclosed in Attachment B-4).

- Dr. Matasovic managed major QA/QC projects for the public agencies, including the $500,000 and the $750,000 QA/QC projects for the Los Angeles County Sanitation Districts Calabasas Landfill.

Dr. Matasovic's resume is enclosed, along with his Landfill Experience Table of over 80 relevant projects, in Attachment B (Resume in Attachment B-2; Experience table in Attachment B-3).

Dr. Matasovic will be assisted by **Mr. Robert Kovacs, P.G.**, and **Mr. Chris Conkle, P.E.**, in the following functions:

Mr. Robert Kovacs, P.G., C.Hg. will serve as a Lead Geologist. His scope of work will be limited to Geologic mapping of the Lamb Canyon P2S4, interpretation of the results of the past geologic investigations within the Badlands Landfill C4P3, and in-grading monitoring at both landfills upon exposure of the final grades immediately prior to the liner constructions. Mr. Kovacs' hydrogeological experience will be utilized should seeps be observed at the Lamb Canyon Landfill (as they were during the P2S2 construction) or elsewhere. We note that in 2009 Mr. Kovacs successfully completed three geologic projects at the Badlands Landfill (Geologic Mapping of the Future Stockpile Area and Geologic Mapping in support of the Canyon 6 Stockpile Area) and is hence very familiar with the site and Department's requirements and practices. A detailed resume outlining Mr. Kovacs' qualifications and experience is enclosed in Attachment B-2.

Mr. Chris Conkle, P.E. will serve as the QA/QC Manager. Mr. Conkle recently completed two similar QA/QC projects for the Santa Barbara County (Tajiguas Landfill). Both projects involved construction of the composite base and side -slope liner systems of almost identical configurations as proposed for the Lamb Canyon and Badlands Projects. Moreover, the landfill configuration of the Tajiguas Landfill (canyon landfill) is similar to those of Badlands and Lamb Canyon landfills, and the issues requiring mitigation (seeps and high winds) are comparable. Mr. Conkle is familiar with the Department's sites and practices as he recently (in 2009) helped with the stability evaluation of the permanent detention/sedimentation basin at the Badlands Landfill.

Mr. Conkle is Registered Professional Engineer in California, holds a M.S. degree from the University of California, Berkeley, and has over 6 years of local experience. Mr. Conkle had significant experience in landfill engineering, landfill QA/QC and geotechnical engineering in general. A detailed resume outlining Mr. Conkle's qualifications and experience is enclosed in Attachment B-2.

Peer Reviewers, Support Staff, and Field Technicians

With exception of Geologic Mapping and some aspects of design drawings, all work products will be peer reviewed and stamped/sealed by Dr. Neven Matasovic, P.E., G.E. Geologic maps, cross sections, and other work products generated by Mr. Kovacs will be peer-reviewed by both Dr. Matasovic and **Mr. Scott Rowlands, C.E.G.** Mr. Rowlands is an experienced Certified Engineering Geologist (C.E.G.) and Certified Hydrogeologist (C.Hg.) with over 20 years of local experience. Mr. Rowlands recently (in 2009) reviewed Mr. Kovacs' work products generated during three geologic projects

at the Badlands Landfill (Geologic Mapping of the Future Stockpile Area and Geologic Mapping in support of the Canyon 6 Stockpile Area) and is hence familiar with the site and Department's requirements and practices.

Mr. Bill Hodges of Geosyntec's Riverside office will review the design drawings for constructability. Mr. Hodges is Licensed Contractor, and worked as a contractor in southern California for over 20 years. Geosyntec believes that Mr. Hodge's review will significantly minimize the potential for change orders during the construction. A detailed resume outlining Mr. Rowlands' and Mr. Hodge's qualifications and experience is enclosed in Attachment B-2.

During execution of RFP "Service A" (Geotechnical Services at Lamb Canyon and Badlands Projects), Dr. Matasovic will be assisted by **Mr. Nick Oettle** and **Mr. Alan Witthoeft**. Both engineers report to Dr. Matasovic and have supported him on similar assignments, including the recently completed (in 2009) series of slope stability assessment projects at the Badlands Landfill (C4P2 Interim Waste Fill Plan; Future Stockpile Area; and Canyon 6 Stockpile Area). Detailed resumes outlining Mr. Oettle's and Mr. Witthoeft's qualifications and experience are enclosed in Attachment B-2.

In the performance of RFP "Service C" (QA/QC Services at Lamb Canyon and Badlands Projects) Mr. Conkle will be supported by senior field technicians **Mr. Henry Chatman** and **Mr. Aaron Smith**. Both Mr. Chatman and Mr. Smith have established multiple-year track records as Geosyntec's on-site QA/QC representatives. Their combined experience includes QA/QC services at over 8 landfill sites in southern California and on many other successfully completed and ongoing construction projects. Detailed resumes outlining Mr. Chatman's and Mr. Smith's qualifications and experience are enclosed in Attachment B-2.

We note that, should the need arise (e.g., should both QA/QC projects occur concurrently and require in-grading monitoring at the same time, or if geosynthetics installation overlaps with earthworks at one or both sites), Geosyntec can, on short notice, assign additional staff from a pool of over 100 locally available engineers, geologists, and technicians.

SUBCONSULTANT QUALIFICATIONS

Geosynthetics conformance testing and interface shear strength testing are proposed to be performed by **TRI Environmental, Inc.** During its history of over 30 years in the industry, TRI Environmental, Inc. has established itself as the premier provider of geosynthetics testing laboratory services. Geosyntec has a long-standing relationship

with TRI Environmental, Inc. and has subcontracted this firm in the past for many projects requiring geosynthetics testing. A statement of qualifications and a certificate of accreditation by the Geosynthetic Institute are enclosed in Attachment C-1.

Soil testing is proposed to be conducted by **Excel Geotechnical Testing Laboratory**. Excel Geotechnical Testing Laboratory was established by Geosyntec in 1983. In 2000, the ownership of the laboratory was formally transferred to Dr. Nader Rad, P.E., the lab manager, but Geosyntec continued to use the laboratory for soil testing laboratory services. Excel Geotechnical Testing Laboratory will support Geosyntec during the course of the QA/QC services, and other geotechnical testing services, if required. A detailed statement of qualifications is enclosed in Attachment C-2.

SITE KNOWLEDGE DEMONSTRATION

Geosyntec has been continuously working with the Department for over 10 years and is very familiar with both sites. Nevertheless, as a part of this proposal solicitation, Geosyntec reviewed relevant site information, including twelve (12) relevant geotechnical, geological, and Quality Control/ Quality Assurance (QA/QC) reports prepared by Geosyntec. (Note: not all reports prepared by Geosyntec are listed below.) Reviewed reports reviewed by Geosyntec include:

Lamb Canyon Project:

Geosyntec [2005], "Static and Seismic Stability Assessment Report, Interim Fill *Three* Stability Evaluation – Changed Condition (Underdrain), Phase 2 Stage 2 Expansion," Lamb Canyon Landfill, Riverside County, California," *Letter Report*, Geosyntec Consultants, Huntington Beach, California, 15 p. (plus Appendices).

Geosyntec [2004a], "Static and Seismic Stability Assessment Report, Interim Fill *Two* Stability Evaluation – Changed Condition (Underdrain), Phase 2 Stage 2 Expansion," Lamb Canyon Landfill, Riverside County, California," *Letter Report*, Geosyntec Consultants, Huntington Beach, California, 13 p. (plus Appendices).

Geosyntec [2004b], "Underdrain System – Hydraulic Conductivity Testing Program Results, Phase 2 Stage 2 Expansion," Lamb Canyon Landfill, Riverside County, California," *Letter Report*, Geosyntec Consultants, Huntington Beach, California, 13 p. (plus Appendices).

Geosyntec [2003], "Static and Seismic Stability Assessment of Phase 2 Stage 2 Expansion," Lamb Canyon Landfill, Riverside County, California," *Technical Report*, Geosyntec Consultants, Huntington Beach, California, 39 p. (plus Appendices).

Badlands Project:

Geosyntec [2009], "Static and Seismic Stability Assessment, Canyon 4, Phase 2 Interim Waste Fill Plan, Badlands Landfill, Riverside County, California," *Letter Report*, Geosyntec Consultants, Huntington Beach, California, 21 October, 9 p. (plus Appendices).

Geosyntec [2009], "Preliminary Cut Slope Evaluation, Canyon 6 Stockpile Area, Badlands Landfill, Riverside County, California," *Letter Report*, Geosyntec Consultants, Huntington Beach, California, 22 October, 11 p. (plus Appendices).

Geosyntec [2009], "Slope Stability Evaluation, Future Stockpile Area, Badlands Landfill, Riverside County, California," *Letter Report*, Geosyntec Consultants, Huntington Beach, California, 19 October, 9 p. (plus Appendices).

Geosyntec [2009], "Supplemental Static and Seismic Slope Stability Assessment Report, Interim Waste Fill Stability Evaluation, Modified Waste Fill Plan," *Letter Report*, Geosyntec Consultants, Huntington Beach, California, 15 September, 5 p. (plus Appendices).

Geosyntec [2007], "Shear Testing of Engineered Fill Material, Proposed Detention/Sedimentation Basin Slopes, Badlands Landfill, Riverside County, California," Letter Report, Geosyntec Consultants, Huntington Beach, California, 16 April, 5 p. (plus Appendices).

Geosyntec [2006], "Supplemental Static and Seismic Slope Stability Assessment Report, Interim Waste Fill Stability Evaluation, Modified Waste Fill Plan," Letter Report, Geosyntec Consultants, Huntington Beach, California, 15 September, 5 p. (plus Appendices).

Geosyntec [2002a], "Final Report Static and Seismic Waste Mass/ Liner Stability Assessment, Badland Landfill Final Buildout," Technical Report, Geosyntec Consultants, Huntington Beach, California, 17 April, 26 p. (plus Appendices).

Geosyntec [2002b], "Final Report Static and Seismic Waste Mass/ Liner Stability Assessment, Badlands Landfill Canyon 4 Phase 2 expansion," Technical Report, Geosyntec Consultants, Huntington Beach, California, 11 July, 48 p. (plus Appendices).

With the references cited above, all of which were prepared by Geosyntec and subsequently approved by the California Regional Water Quality Control Board (RWQCB), Santa Ana Region (Santa Ana RWQCB), we demonstrate:

- Our familiarity with both sites;
- Our continuous involvement at both sites;
- Our familiarity with the local Santa Ana RWQCB, their personnel (Jo Anne Amos) and their approval process; and
- Our ability to have our reports approved by the Santa Ana RWQCB in minimal turnaround time, with no comments.

We also note that:

- All of the above listed reports were completed on-time and on budget; and
- All of the above listed reports were produced as part of projects managed by Dr. Neven Matasovic, the same project manager committed for this solicitation.

PROPOSED SCOPE OF SERVICES

General

Per the RFP requirements, the proposed scope of services is organized in a manner that can be evaluated separately.

Service A: Geotechnical Services

Service A-1: Lamb Canyon Project

Service A-2: Badlands Project

Service B: Geological Services

Service B: Lamb Canyon Project

Service C: Construction QA/QC Services

Service C-1: Lamb Canyon Project

Service C-2: Badlands Project

The cost estimates are provided in a separate Section of this Proposal, and are incorporated in the forms provided by the Department.

Service A-1: Lamb Canyon Geotechnical Services

In accordance with the RFP requirements, Geosyntec proposes to conduct the following services:

Task 1 - Laboratory Testing for On-Site Materials (Lamb Canyon)

- Geosyntec will perform laboratory maximum dry density and optimum moisture content tests (Modified Proctor Compaction Test - ASTM D1557) on samples of soil proposed to be used as engineered fill material.
- Geosyntec will perform particle size analysis (ASTM D422) on samples of soil proposed to be used as engineered fill or protective soil.

- Geosyntec will prepare and submit a test summary report to the Department, including all test results and recommendations. The report recommendations will address the feasibility and necessary processing/placement procedures relating to the use of on-site material as engineered fill or protective soil.

Geosyntec Approach and Proposed Cost Savings to the Department: In order to minimize the cost to the Department, the representative samples will be collected by Geosyntec Geologist during his visit to the site to conduct geologic mapping. The benefits of this approach are as follows: (i) no separate site visit is required to recover the samples; and (ii) Geosyntec Geologist is more qualified to recover representative samples (and/or to create a composite sample) than an engineering technician that would normally perform this task. Hence, we are confident that we would provide the best characterization of site soils at a minimum cost. Should the maximum particle size become issue in establishing suitability of on-site soils for use as protective soil layer, we will recommend a zoned fill, as we did at the Badlands Landfill during the C2P2 project. This zoned fill approach, pioneered by Geosyntec, was approved by the Santa Ana RWQCB.

Task 2 - Subsurface Investigation (Lamb Canyon)

- Geosyntec understands that, if it is determined that further subsurface investigation is required for performing the stability analysis of cut slopes, the Department may request that Geosyntec performs subsurface investigation work within areas of concern. If required, Geosyntec is ready to perform a subsurface investigation by advancing soil borings up to a depth of approximately 90 feet in areas where an off-road drill rig will be required. Geosyntec understands that, if needed, the Department will provide reasonable grading efforts to construct access roads for soil boring locations. If drilling, sampling, or logging is performed, Geosyntec will prepare and submit logs including, but not limited to: soil classification, geologic data, moisture content, dry density, and blow counts as part of the final stability analysis report.

Geosyntec Approach and Proposed Cost Savings to the Department: Geosyntec reviewed the geotechnical and geological reports prepared for the site, including our Geotechnical report prepared in 2003. We also visited the site on 13 April 2010 and observed site conditions. Based upon our previous experience with this site and other sites in the same and/or similar geologic conditions, Geosyntec maintains that the

stability of cut slopes is governed by the orientation of bedding and material properties of bedding seams.

Given that the site is rough-graded almost to grade, i.e., that the formational materials are exposed and bedding attitudes can be verified by geologic mapping, and given that results of extensive laboratory testing performed under the supervision of a qualified consultant are available, it is our professional opinion that no drilling, sampling and geotechnical laboratory testing is required to demonstrate the stability of cut slopes, if graded as planned at 2H:1V (Horizontal: Vertical).

Based upon the results of our preliminary slope stability analysis conducted for this solicitation, Geosyntec believes that the currently proposed 2H: 1V (Horizontal: Vertical) cut slopes can be locally steepened to 1.5H: 1.0 V, and hence that the waste disposal volume (air space) can be increased relative to the current plan. This can be achieved by taking into account that the cut slopes are temporary slopes (i.e., slopes that will be buttressed by waste within three years), and hence can be designed for Static factor of Safety (FS) of 1.3 and no seismic loading. (It is not likely that the design seismic event occurs in a relatively short time of up to 3 years). Geosyntec utilized and had approved this approach by the Santa Ana RWQCB at the Badlands and El Sobrante landfills in the past 5 years.

Task 3 - Design Selection (Lamb Canyon)

- Geosyntec understands that the proposed expansion projects will be constructed in compliance with the pertinent requirements of CFR Title 40 Subtitle D and CCR Title 27. The currently approved bottom and side-slope liner systems for both the Lamb Canyon landfill are documented in three corresponding Waste Discharge Requirements (WDRs) for the facilities. The liner system preferred by the Department is outlined in the RFP. Geosyntec understands, however, that the Department may elect to use any of the approved liner system designs.

- As a part of this Task, Geosyntec will review the approved liner systems and site specific conditions for each site and recommend a design solution for each facility. The recommended design may include design changes that result in the most economical (considering landfill airspace and constructability). Prior to further stability analysis work, the recommended design solution shall be reviewed by and approved by the Department, in advance and in writing. It should be noted that any recommendations that are not currently permitted in

the WDRs will need to be processed as a permit revision and may affect the timeframes contained in this RFP.

Geosyntec Approach and Proposed Cost Savings to the Department: Geosyntec has already reviewed and discussed the currently preferred liner systems with the Department. However, Geosyntec foresees two possibilities where work on this task may be required: (i) should the results of the stability evaluations indicate that stability criteria are not achieved, but could be achieved with slightly higher interface shear strength parameters; and (ii) should the Santa Ana RWQCB change its current position and disallow encapsulated GCL on the landfill floor. The first option will be addressed by recommending to the Department to consider a structured geomembrane as opposed to currently and commonly used textured geomembrane (e.g., to use AGRU Microspike™ geomembrane which has higher shear resistance). The second issue is mentioned because the Los Angeles RWQCB last month changed its position on the subject and now requires Waste Management's Simi Valley landfill to place CCL at the base of current expansion, despite the fact that all previous expansions have GCL at the base. Should this change happen, Geosyntec will assist the Department in finding the best solution.

Task 4 - Stability Analysis (Lamb Canyon)

- The interface shear strengths between the different layers of the proposed liner system will be established by Geosyntec after completion of Tasks 1, 2, and 3. Geosyntec understands that, at that time, the final QA/QC report for the completed P2S3 (Lamb Canyon) and expansions will be available for review, including the results of the conformance interface testing of composite liner interfaces. Based upon the results of that testing, shear strength parameters for current cell design will be established.

- Geosyntec will perform static and seismic analysis of the design side-slopes within the Phase 2, Stage 4 expansion proposed grading limits. Up to 3 stability analysis iterations will be performed to account for potential subgrade changes.

- Geosyntec will perform static and seismic stability analysis for the liner subgrade as well as the liner system on subgrade. Preliminary cross-sections for the project have already been developed by the Department and were attached to the RFP. Geosyntec understands that the Department will provide additional cross-sections upon request, and reserves the right to direct the Department on where to cut these cross sections. Geosyntec's proposed scope

of work allows for 3 iterations to accommodate for potential changes to the subgrade plan, refuse fill plan, and liner system design.

- Following the completion of the engineering analysis, Geosyntec will prepare and submit a final report for the expansion project with geotechnical recommendations for the proposed excavation and refuse fill plans. The report will include the appropriate maps, cross-sections, design criteria, calculations, and any other necessary supporting documents needed for a comprehensive design and construction of the proposed expansion.

- Geosyntec will provide project management and coordination and generate final reports for both projects including results, recommendations, findings and documentation.

- Geosyntec's proposed scope allows for a meeting with CRWQCB staff, if necessary, to review and/or defend the criteria used in the stability analysis.

Geosyntec Approach and Proposed Cost Savings to the Department: Lamb Canyon Landfill is 2.7 miles from a major fault (San Jacinto Fault) and hence the stability at this site is governed by the seismic loading. The parameters for design of waste containment facilities have been previously evaluated by Geosyntec in 2003 (for P2S2) when a relatively high bedrock Peak Horizontal Ground Acceleration (PHGA) of 0.60 g was established. In the mean time, new (NGA) models for evaluation of PHGA have been developed. A presentation on the NGA models that Dr. Matasovic recently made for the State Water Boards, that described these NGA models, is attached as Attachment D. As a part of work on this proposal, Geosyntec re-evaluated the PHGA using these NGA models. The preliminary results indicate that PHGA evaluated using the NGA models is approximately 0.40 g, i.e., at least 33% lower than previously evaluated. The impact of this reevaluation of PHGA is significant, as it will allow for a less conservative seismic stability of interim waste fill assessment. We note that recently (in 2009), Geosyntec re-evaluated design ground motions for the Badlands landfill using this new NGA model and reduced design acceleration by approximately 30 percent, resulting in significant savings to the Department. This work at the Badlands landfill was approved by the Santa Ana RWQCB.

Cut slopes represent a temporary stage of landfill development. As explained before, no seismic stability evaluation of these cut slopes is required.

Task 5 - Technical Review of Contract Document Details (Lamb Canyon)

- Upon the Department's completion of the construction contract documents, Geosyntec will provide technical review and comments for specification sections (earthwork, drainage layer, LCRS and geosynthetic material sections only), QA/QC plan, and plan details related to the installation of the liner and LCRS system.

Geosyntec Approach and Proposed Cost Savings to the Department: Geosyntec commits Mr. Bill Hodges for this task. Mr. Hodges, of Geosyntec's Riverside office is a former contractor. Mr. Hodges will provide technical review of bid documents created by the Department after incorporation of the recommendation provided in the stability report. This review will include: (i) design drawings; (ii) select specifications (earthwork, drainage layer, LCRS and geosynthetic material only); and (iii) QA/QC plan. Geosyntec believes that this approach will minimize a potential for change orders during construction and hence result in significant savings to the Department.

Service A-2: Badlands Geotechnical Services

In accordance with the RFP requirements, Geosyntec proposes to conduct the following services:

Task 1 - Laboratory Testing for On-Site Materials (Badlands Landfill)

- Geosyntec will perform laboratory maximum dry density and optimum moisture content tests (Modified Proctor Compaction Test - ASTM D1557) on samples of soil proposed to be used as engineered fill material.

- Geosyntec will perform particle size analysis (ASTM D422) on samples of soil proposed to be used as engineered fill or protective soil.

- Geosyntec will prepare and submit a test summary report to the Department, including all test results and recommendations. The report recommendations will address the feasibility and necessary processing/placement procedures relating to the use of on-site material as engineered fill or protective soil.

Geosyntec Approach and Proposed Cost Savings to the Department: In order to minimize the cost to the Department, the representative samples will be collected by Geosyntec Project Manager during his visit to the site to conduct project kick-off meeting. The benefits of this approach are as follows: (i) no separate site visit is required to recover the samples; and (ii) Geosyntec Project Manager is more qualified to recover representative samples (and/or to create a composite sample) than an

engineering technician that would normally perform this task. Hence, we are confident that we would provide the best characterization of site soils at a minimum cost. Should the maximum particle size become issue in establishing suitability of on-site soils for use as protective soil layer, we will recommend a zoned fill, as we previously did at this site during the C2P2 project. This zoned fill approach, pioneered by Geosyntec, was approved by the Santa Ana RWQCB.

Task 2 - Subsurface Investigation (Badlands Landfill)

- Geosyntec understands that, if it is determined that further subsurface investigation is required for performing the stability analysis of cut slopes, the Department may request that Geosyntec performs subsurface investigation work within areas of concern. If required, Geosyntec is ready to perform a subsurface investigation by advancing soil borings up to a depth of approximately 90 feet in areas where an off-road drill rig will be required. Geosyntec understands that, if needed, the Department will provide reasonable grading efforts to construct access roads for soil boring locations. If drilling, sampling, or logging is performed, Geosyntec will prepare and submit logs including, but not limited to: soil classification, geologic data, moisture content, dry density, and blow counts as part of the final stability analysis report.

Geosyntec Approach and Proposed Cost Savings to the Department: Geosyntec reviewed the geotechnical and geological reports prepared for the site. (This included all reports prepared by Geosyntec, but GRS&A [1991], "Geologic Evaluation of Faulting, Badlands Landfill Expansion," Geologic Report, Gary S. Rasmussen & Associates, Inc., San Bernardino, California.) We also visited the site on 13 April 2010 and observed site conditions. Based upon our previous experience with this site and other sites in the same and/or similar geologic conditions, Geosyntec maintains that the stability of cut slopes is governed by the orientation of bedding and material properties of bedding seams. Given that the site is rough-graded almost to grade, i.e., that the formational materials are exposed and bedding attitudes can be verified by geologic mapping, and given that results of extensive laboratory testing directed and performed by Geosyntec are available, it is our professional opinion that no drilling, sampling and geotechnical laboratory testing is required to demonstrate the stability of cut slopes, if graded as planned at 2H:1V (Horizontal: Vertical).

Based upon the results of our preliminary slope stability analysis conducted for this solicitation, Geosyntec believes that the currently proposed 2H: 1V (Horizontal:

Vertical) cut slopes can be locally steepened to 1.5H: 1.0 V, and hence that the waste disposal volume (air space) can be increased relative to the current plan. This can be achieved by taking into account that the cut slopes are temporary slopes (i.e., slopes that will be buttressed by waste within three years), and hence can be designed for Static factor of Safety (FS) of 1.3 and no seismic loading (It is not likely that the design seismic event occurs in a relatively short time of up to 3 years). Geosyntec utilized and had approved this approach by the Santa Ana RWQCB at the Badlands and El Sobrante landfills in the past 5 years.

Task 3 - Design Selection (Badlands Landfill)

- Geosyntec understands that the proposed expansion projects will be constructed in compliance with the pertinent requirements of CFR Title 40 Subtitle D and CCR Title 27. The currently approved bottom and side-slope liner systems for Badlands landfill are documented in three corresponding Waste Discharge Requirements (WDRs) for the facilities. The liner system preferred by the Department is outlined in the RFP. Geosyntec understands, however, that the Department may elect to use any of the approved liner system designs.

- As a part of this Task, Geosyntec will review the approved liner systems and site specific conditions for each site and recommend a design solution for each facility. The recommended design may include design changes that result in the most economical (considering landfill airspace and constructability). Prior to further stability analysis work, the recommended design solution shall be reviewed by and approved by the Department, in advance and in writing. It should be noted that any recommendations that are not currently permitted in the WDRs will need to be processed as a permit revision and may affect the timeframes contained in this RFP.

Geosyntec Approach and Proposed Cost Savings to the Department: Geosyntec already reviewed and discussed the currently preferred liner systems with the Department. However, Geosyntec foresees two possibilities where work on this task may be required: (i) should the results of the stability evaluations indicate that stability criteria are not achieved, but could be achieved with slightly higher interface shear strength parameters; and (ii) should the Santa Ana RWQCB change its current position and disallow encapsulated GCL on the landfill floor. The first option will be addressed by recommending to the Department to consider a structured geomembrane as opposed to currently and commonly used textured geomembrane (e.g., to use AGRU Microspike

geomembrane which has higher shear resistance). The second issue is mentioned because the Los Angeles RWQCB last month changed its position on the subject and now requires Waste Management's Simi Valley landfill to place CCL at the base of current expansion, despite the fact that all previous expansions have GCL at the base. Should this change happen, Geosyntec will assist the Department in finding the best solution.

Task 4 - Stability Analysis (Badlands Landfill)

- The interface shear strengths between the different layers of the proposed liner system will be established by Geosyntec after completion of Tasks 1, 2, and 3. Geosyntec understands that, at that time, the final QA/QC report for the completed C4P2 (Badlands) expansion will be available for review, including the results of the conformance interface testing of composite liner interfaces. Based upon the results of that testing, shear strength parameters for current cell design will be established.

- Geosyntec will perform static and seismic analysis of the design side-slopes within the Canyon 4 Phase 3 expansion proposed grading limits. Up to 3 stability analysis iterations will be performed to account for potential subgrade changes.

- Geosyntec will perform static and seismic stability analysis for the liner subgrade as well as the liner system on subgrade. Preliminary cross-sections for the project have already been developed by the Department and were attached to the RFP. Geosyntec understands that the Department will provide additional cross-sections upon request, and reserves the right to direct the Department on where to cut these cross sections. Geosyntec proposed scope of work allows for 3 iterations to accommodate for potential changes to the subgrade plan, refuse fill plan, and liner system design.

- Following the completion of the engineering analysis, Geosyntec will prepare and submit a final report for the expansion project with geotechnical recommendations for the proposed excavation and refuse fill plans. The report will include the appropriate maps, cross-sections, design criteria, calculations, and any other necessary supporting documents needed for a comprehensive design and construction of the proposed expansion.

- Geosyntec will provide project management and coordination and generate final reports for both projects including results, recommendations, findings and documentation.

- Geosyntec's proposed scope allows for a meeting with CRWQCB-SAR staff, if necessary, to review and/or defend the criteria used in the stability analysis.

Geosyntec Approach and Proposed Cost Savings to the Department: Having performed essentially all stability evaluations for the Badlands Landfill over past 10 years, Geosyntec is very familiar with the site, site practices, materials, regulators, and regulatory approval process. Furthermore, as a part of the last set of stability evaluations, Geosyntec updated the seismic parameters for the site what allowed placement of additional waste over the previously approved C4P2 interim waste fill configuration. Therefore, demonstration of the stability for the current C4P3 is a routine task for Geosyntec, and hence we believe that we can achieve it at a minimal cost to the Department.

We do, however, foresee a technical issue related to construction of the soil buttress at the toe of C4P2 that require accommodation of a box concrete culvert for a temporary drainage. These issues are related to uneven settlement and piping potential around and at the box culvert. Geosyntec dealt with such issues at other southern California landfill sites (e.g., at the Calabasas Landfill and Prima Deshecha landfill), and also at the Badlands during the construction of the permanent Detention/Sedimentation basin last year, and is ready to develop mitigation measures, incorporate them into the stability assessment, and otherwise assist the Department in preparation of the adequate bid documents.

Task 5 - Technical Review of Contract Document Details (Badlands Landfill)

- Upon the Department's completion of the construction contract documents, Geosyntec will provide technical review and comments for specification sections (earthwork, drainage layer, LCRS and geosynthetic material sections only), QA/QC plan, and plan details related to the installation of the liner and LCRS system.

Geosyntec Approach and Proposed Cost Savings to the Department: Geosyntec commits Mr. Bill Hodges for this task. Mr. Hodges, of Geosyntec's Riverside office is a former contractor. Mr. Hodges will provide technical review of bid documents created by the Department after incorporation of the recommendation provided in the stability report. This review will include: (i) design drawings; (ii) select specifications

(earthwork, drainage layer, LCRS and geosynthetic material only); and (iii) QA/QC plan. Geosyntec believes that this approach will minimize a potential for change orders during construction and hence result in significant savings to the Department.

Service B: Geological Services (Lamb Canyon Landfill)

Task 1 - Geologic Mapping (Lamb Canyon Landfill)

- Geosyntec will perform geologic observations, logging, and mapping of all areas in which excavation activities have taken place within the proposed P2S4 grading limits in order to provide a continuous record of geologic conditions.

Geosyntec Approach and Proposed Cost Savings to the Department: Geosyntec has already reviewed geologic information within the proposed P2S4 grading and discussed it internally. We identified several data gaps (locations where additional bedding attitudes may be required, or where the apparent bedding attitudes need to be confirmed) and will devote special attention to these locations during the course of our mapping program. In particular, we will devote special attention to one of the landslides in the immediate vicinity of the site, confirm its extent and geometry, and convey that information to geotechnical engineers for back-analysis. We note that the back analysis of existing landslides is the most reliable way to estimate the material parameters along the bedding planes that control the stability of these formational materials.

Based upon our understanding of the site, site formational materials, previous work, and our experience, we assume that the field work will last three days, while review and processing of information will require one week.

Task 2 - Project Management & Report Preparation (Lamb Canyon Landfill)

- Geosyntec will prepare and submit geologic maps and cross-sections documenting observed geologic conditions and provide grading plan recommendations in a final report. Geologic mapping performed for previous excavation operations within P2S4 and for the overall Phase 2 Expansion is already on file with Geosyntec and has been reviewed by Geosyntec personnel. Geologic data from previous mapping studies, which is within the P2S4 grading limits, will be included on the geologic maps to be produced by Geosyntec.

Service C: Construction QA/QC Tasks (Lamb Canyon and Badlands Landfills)

Task 1 - Construction Observation and Field Testing

- Geosyntec will provide full-time observation and field testing for the following activities: engineered fill placement, LPL processing and placement; geosynthetic liner subgrade preparation, material deliveries, liner system installation, drainage layer construction, anchor trench backfill, and protective soil screening and placement in accordance with the QA/QC Plan. Furthermore, Geosyntec will provide part-time observation and field testing for access road and drainage structure construction in accordance with the QA/QC Plan. Tasks will include, but are not limited to: staff, transportation, testing equipment, generating daily reports, weekly meeting attendance, supplies, and per diem costs.

Task 2 - Project QA/QC Management and Reports

- Geosyntec will provide QA/QC management and generate reports as specified in the QA/QC plan. Geosyntec's QA/QC manager will attend pre-construction and weekly construction progress meetings.

Task 3 - Laboratory Testing

- Geosyntec will perform and document laboratory testing as specified in the QA/QC plan.

Task 4 - Certification and As-Built Report

- Geosyntec will provide certification of compliance with the technical specifications per the contract documents and preparation of an as-built report for the construction of the Phase 2, Stage 4 expansion at the Lamb Canyon Sanitary Landfill and the Canyon 4, Phase 3 expansion at the Badlands Sanitary Landfill. Separate reports must be created for each expansion project. The reports will be prepared and signed by California Registered Civil Engineer.

Geosyntec Approach and Proposed Cost Savings to the Department: Geosyntec considers the above outlined QA/QC services routine services. We conduct these services based upon the industry standards, and beyond. For example, over the years, we developed an automated, portable data acquisition system to log in the field all

seams, destructive test samples, and tests. We have also developed a cost-tracking system which the QA/QC project manager uses to compare the project budget to the actual amount expended in real time. We use this information to inform our clients on a frequent basis of the financial status of the project and make any required adjustments to staffing.

To further demonstrate our experience with the QA/QC work at canyon landfill sites, we developed the entire section to handling unforeseen difficulties that is presented below.

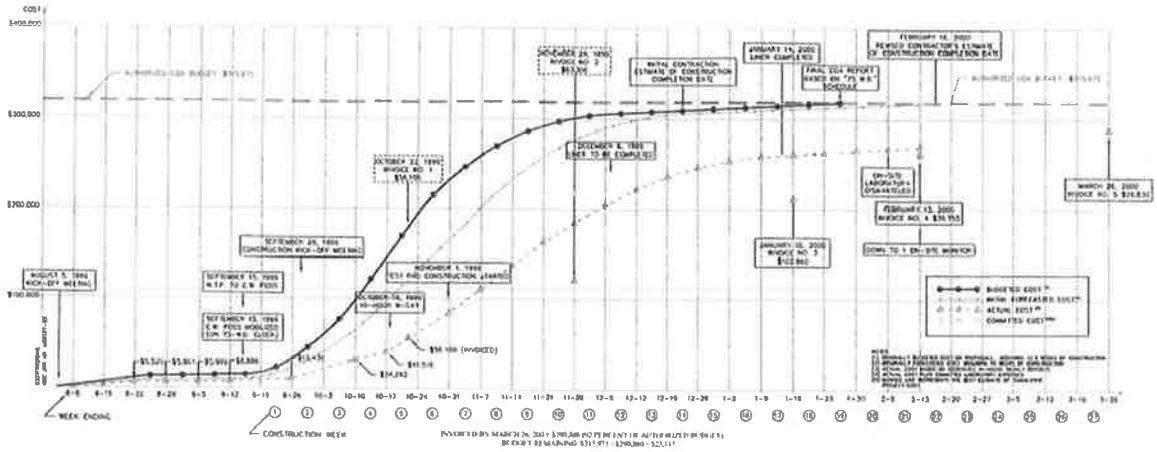


Figure 3 – Sample QA/QC Project Cost Tracking by Geosyntec

GEOSYNTEC APPROACH TO HANDLING UNFORESEEN DIFFICULTIES (SERVICES C-1 AND C-2, LAMB CANYON AND BADLANDS LANDFILLS)

General

Geosyntec recognizes that QA/QC services during construction are essential to the success of a project. Every project has site-specific and general construction issues which must be addressed by the QA/QC personnel. Geosyntec is familiar with the construction components and requirements of the project. Geosyntec is also familiar with the P2S3 (Lamb Canyon) and C4P2 (Badlands) composite liner termination details, the repair of which Geosyntec supervised.

Geosyntec has identified several site-specific and general QA/QC issues which may arise during construction of both Projects. The identification of these issues is based upon Geosyntec's extensive design and QA/QC experience with Title 27/Subtitle D liner systems. These issues have been successfully resolved by Geosyntec's project team personnel on similar projects in the past. To facilitate your review of this section, we grouped the issues in three groups, and explained the resolution, as follows:

Site-Specific Construction Issues

Based on our previous work at the southern California landfills, site-specific QA/QC issues that may arise during construction include:

Issue: *Monitoring the installation of geosynthetics on steep slopes (1.5H: 1V); monitoring and sampling of geosynthetics on steep side slopes is challenging.*

Geosyntec's QA/QC personnel will make use of mountaineering equipment, if necessary, to scale steep slope areas and inspect the entire liner system surface.

Issue: *Hydration of the geosynthetic clay liner (GCL); hydration of the GCL can significantly affect the shear strength of the material and the material interfaces.*

Geosyntec's QA/QC personnel will monitor the GCL installation to assess whether the GCL has been hydrated prior to installation of the geomembrane. The Contractor will be directed to remove all hydrated GCL.

Issue: *Wrinkling of the side-slope geomembrane; due to downslope movements and temperature variations, large wrinkles may develop in the HDPE geomembrane.*

Geosyntec will review the entire HDPE geomembrane surface prior to covering the geomembrane for the presence of excessive wrinkles; wrinkles deemed excessive by the Lead QA/QC Monitor will be worked out in a controlled manner or removed and replaced. Geosyntec can, at the Department's request, recommend construction methods and sequencing to reduce the potential for wrinkles.

Issue: *High winds, occasionally present at the Lamb Canyon and Badlands Landfills, can dislodge and damage geosynthetics materials that are not anchored and secured properly.*

Geosyntec's QA/QC personnel will observe that anchoring of the liner is provided and can, with the Department's approval, suggest deployment methods that minimize the impact of the deployed geosynthetic materials to the prevailing winds. Geosyntec personnel can, at the Department's request, review Contractor submittals to evaluate the adequacy of the proposed anchor system.

Issue: *Temporarily exposed edges of the composite liner system can allow surface water to migrate underneath the geosynthetic materials during periods of precipitation.*

Geosyntec QA/QC personnel will monitor exposed edges of the composite liner for surface water intrusion. Geosyntec's QA/QC personnel can, with the Department's approval, suggest methods to route surface water away from exposed edges of the composite liner system and recommend techniques to protect the edges from the influx of water.

Issue: *Tight schedule for report completion; a draft of the final Construction Certification report is required within 20 calendar days of completion of field work.*

Geosyntec will use its GeoSmart™ data collection system to expedite collection and reporting of the large volume of data from the geosynthetics installation and to facilitate and expedite completion of the report. On the recently completed

Tajiguas Landfill Phase IIB (Santa Barbara County), Geosyntec completed the QA/QC report within 14 working days of completion of construction activities.

Site-Specific Technical Issues

Based on our current work at the Lamb Canyon and Badlands Landfills, site-specific technical issues that may arise during construction include:

Issue: *The results of conformance interface testing indicate that specified shear strength is not achieved at all normal stresses specified in the interface testing program.*

This scenario is not likely, as the quality of the HDPE geomembrane and GCL will be verified by in-plant sampling/MQC testing and the fact that the same laboratory that did the testing during the design stage of the project will perform the conformance testing. However, understanding the sensitive nature of this project, Geosyntec will be prepared for such a scenario and ship larger-than-required quantities of geosynthetic and soil materials to the interface testing laboratory. This will enable repeating the test(s) on a short notice should a need arise. Should the test(s) fail again, Geosyntec will quickly repeat the stability analysis with shear strength reduced **only** in the stress range in which the test failed and demonstrate that the stability requirements set during the design stage of this project are still met. Geosyntec notes that the analysis can be conducted quickly and economically as the relevant files already exist in Geosyntec. The results of the analysis (if conducted) will be documented in a brief letter report and, upon review by the District, submitted to the Santa Ana RWQCB for approval.

Issue: *The results of conformance interface testing indicate that, at different confining stress levels, the shear plane occurs at the distinct composite liner interfaces (e.g., at low confining stress, the failure occurs along the HDPE/geotextile interface, while at the higher confining stresses the failure is due to internal shear strength of GCL).*

This is a common situation that may occur when composite interfaces are tested subject to broad range of confining stress in the "sandwich test." Geosyntec successfully communicated this issue to the several Water Boards, including the Santa Ana RWQCB. The issue was always quickly resolved when Geosyntec

explained that, in the "sandwich test," interface with the lowest **peak**, not **residual** shear strength is identified, that the landfill stability is evaluated based upon the residual shear strength, and that the design Factor of Safety is higher than 1.0 and consequently, that the shear stress at the interface is far from the corresponding shear strength.

General Construction Issues

Geosyntec's general experience in QA/QC for landfill construction indicates the following issues may be of importance:

Issue: *Delays in contractor submittals and materials procurement can result in project delays.*

Geosyntec will develop a list of necessary submittals from the contractor along with a "critical path" schedule for submittals and material procurement and delivery. Geosyntec will notify the Department's Project Manager one week in advance.

Issue: *Delays in sampling and testing of geosynthetic materials can hold up a project or can put work at risk if deployment occurs prior to approval of the materials.*

Geosyntec (i.e., geosythetics lab representative on behalf of Geosyntec) will sample geosynthetic materials in the manufacturing facility with no materials allowed on-site unless approved on the basis of in-plant sampling.

Issue: *Geosynthetic materials shipped to the site do not correspond to the inventory for which conformance test results and manufacturers certifications are provided.*

Geosyntec will compile a spreadsheet inventory of geosynthetic materials identified in the manufacturer's submittals. This spreadsheet will be used to record deliveries, sampling, conformance testing, and deployment.

Issue: *Presence of dirt in the HDPE geomembrane seam area can result in discontinuous and lower strength seams.*

Geosyntec will monitor that contractor's seaming personnel clean the seaming area prior to seaming, especially on windy days.

Issue: *Excessive roller pressure for fusion seams can result in low seam strength.*

Geosyntec will observe the outside of the seam for areas where excessive extruded material at the exterior of the seam may indicate excessive roller pressure.

Issue: *The use of "single" spools in the seaming of geotextiles can result in the unraveling of entire seam lengths.*

Geosyntec will monitor field seaming activities to ensure that "double" spool seams are used for the geotextiles.

Issue: *Turnaround times for laboratory tests results can cause construction delays.*

Geosyntec has a strong relationship with the laboratories presented in this Proposal and will be able to ensure that the laboratories will meet the project schedule.

WORKERS COMPENSATION INSURANCE AND GENERAL LIABILITY INSURANCE

During the course of our work, our standard insurance coverage will be in effect, including General Liability Insurance ($1,000,000 per occurrence and $2,000,000 aggregate), Professional Liability (Errors and Omission; $2,000,000) coverage, and Automobile Liability ($1,000,000 combined single limit), as well as the Worker's Compensation insurance. The policies have already being modified by endorsements, and are included in Attachment E.

SCHEDULE

Geosyntec requires one week upon receipt of formal notice to proceed to start working on this project. Geosyntec estimates that it will take approximately six[1] weeks to complete the scope of the work outlined herein for Services A-1 and B-1 (Lamb Canyon Project), and up to five weeks to complete the scope of the work outlined herein for

[1] Two weeks to meet with RCWMD and schedule field work, 1 week for field work, 2 weeks for engineering evaluations, and 1 week to write the report.

Services A-2 (Badlands Project). The signed and sealed final report will be sent to the Department no later than a week after receiving the comments on the draft report. We recently delivered the work product of the similar scope (Badlands Landfill, Stockpile 6 and Canyon 2P2 Interim Fill Stability Evaluation) to the Department in this timeframe.

For the scope of the work outlined herein for Services C-1 and C-2 (QA/QC Services at both sites), we will develop a detailed schedule upon review of the Contractor's schedule and submit it to the Department for review and approval.

COST AND CONTRACTUAL TERMS

Geosyntec estimates that the cost to execute the above described scope of work (Services A-1, A-2, B, C-1, and C-2) will not exceed **$562,753**. A detailed cost estimate based on the cost tables provided in the RFP is provided in Attachment F-1. Geosyntec's 2010 Rate Schedule used to develop these cost estimates is included in Attachment F-2.

Geosyntec proposes to provide the services discussed on the terms dictated by the RFP. These terms dictate compensation using a hybrid of lump sum, unit rate, and time and materials compensation. The proposed budget includes the labor and materials believed necessary to complete the work scope described in the proposal. Any deviation from this work scope resulting from additional requests by the Department, new information or other considerations may result in modification of the work scope. Out of scope work requested by the Department will be billed on a time and materials basis in accordance with the enclosed Rate Schedule.

STATEMENT OF CONFORMANCE AND COMMITMENT

Geosyntec makes the following commitments to RCWMD:

- All work tasks identified in the Request for Proposal (RFP) and this proposal will be performed in accordance with the provisions stated in each document.

- During the course of our work, our standard insurance coverage will be in effect, including General Liability coverage ($1,000,000/ $2,000,000), Professional Liability (Errors and Omission; $2,000,000) coverage, and Automobile Liability ($1,000,000), as well as the Worker's Compensation

insurance. The policies will be modified by endorsement(s), as requested in the RFP.

- We will adhere to the schedule and budget. The budget will not be exceeded unless the scope of services or schedule changes. Changes in the scope or schedule requiring additional budget will not be made without prior approval of RCWMD.

- At least one of the QA/QC Monitors identified above is to be consistently present at the site for the entire duration of the project. Unless the project is significantly delayed, the individuals identified in this proposal will be the key personnel assigned to the project. We will not substitute personnel without prior approval of the RCWMD.

- We are aware of the "prevailing wage" requirements and have incorporated them into our cost proposal.

- We will provide RCWMD with professional services consistent with the standards of the profession. Our internal quality control program requires that every project deliverable be peer reviewed by a senior member of the firm with appropriate experience and qualifications prior to submittal to the client.

CLOSURE

Upon receipt of written acknowledgement of the acceptance of the proposed work, Geosyntec will initiate performance of the services described herein. Should you have any questions or need additional information please do not hesitate to contact the undersigned.

Sincerely,

Chris Conkle, P.E.
Project Engineer

Neven Matasovic, Ph.D., P.E., G.E.
Associate

Geosyntec
consultants

List of Attachments

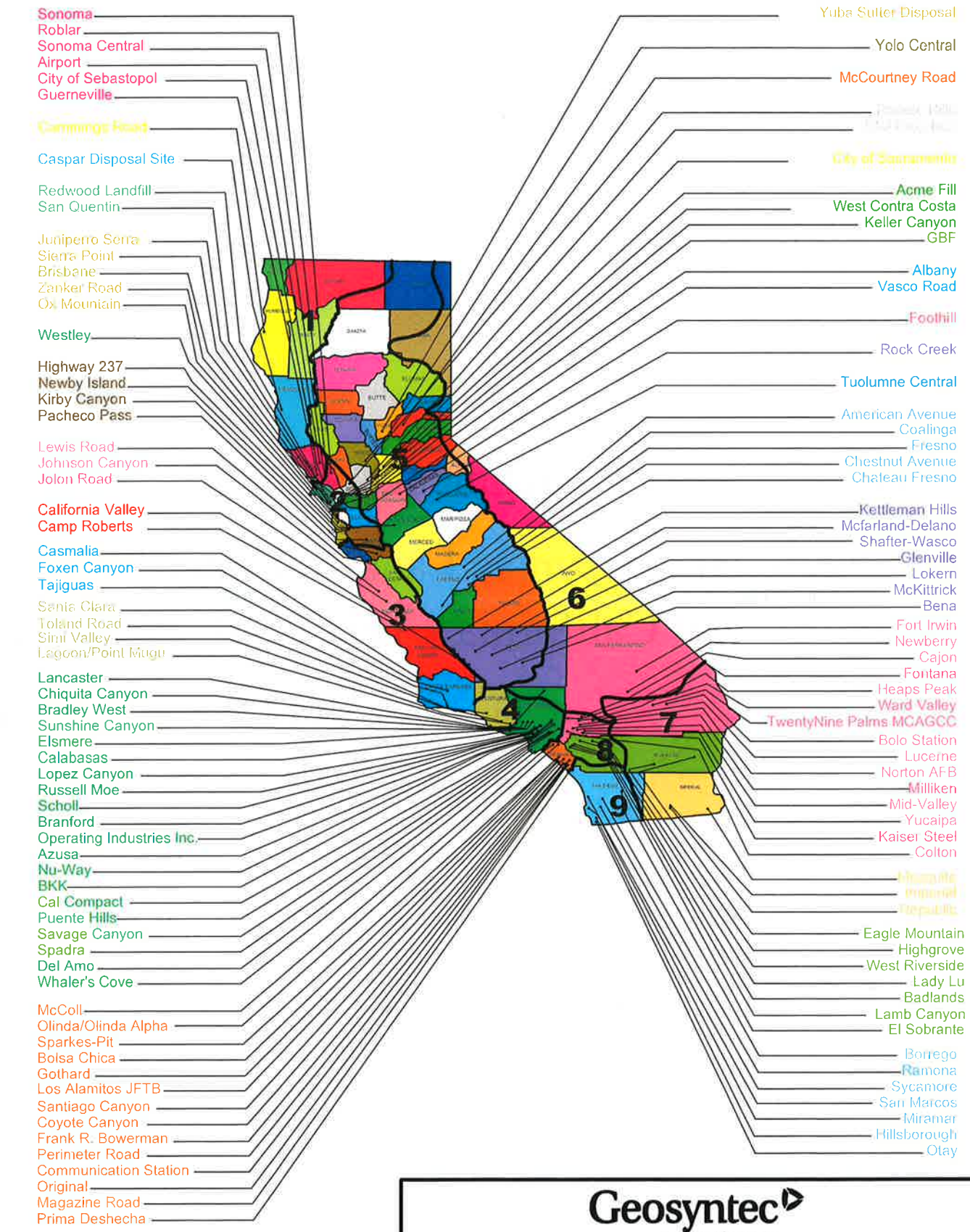
Attachment	Sub-Designation
A - Company Qualifications	A-1: Selected Geosyntec Landfill Experience in California - **Graphical**
	A-2: Selected Geosyntec Landfill Experience in California - **Tabulated**
	A-3: Geosyntec's Landfill-Specific Company Brochure
	A-4: Selected Project Descriptions
B – Personnel Qualifications	B-1: Geosyntec Team Organization Chart
	B-2: Resumes of Key Personnel
	B-3: Dr. Matasovic's Landfill Experience Table
	B-4: 2010 State-of-the-Art Paper / Presentation on Seismic Design of Landfills by Dr. Matasovic
C – Subconsultant Quals.	C-1: TRI Environmental Inc. (Geosynthetic and Interface Testing)
	C-2: Excel Geotechnical Testing Laboratory
D – Supplemental	D-1: 2009 Presentation to State Water Boards on new NGA Models by Dr. Matasovic
E – Insurance	E-1: Workers Compensation and General Liability Insurance
F – Cost Estimate	F-1: Cost Estimate
	F-2: Rate Schedule

Geosyntec
consultants

Attachment A-1

Selected Geosyntec Landfill Experience in California - Graphical

EXHIBIT B to Consultant Agreement



LEGEND

9 — CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD JURISDICTION APPROXIMATE LIMITS

Geosyntec consultants

SELECTED GEOSYNTEC LANDFILL EXPERIENCE IN CALIFORNIA
PROPOSAL FOR GEOLOGICAL AND GEOTECHNICAL SERVICES
LAMB CANYON AND BADLANDS SANITARY LANDFILLS, RIVERSIDE COUNTY, CALIFORNIA

DATE:	APRIL 2010	FILE NO.	4017F001
PROJECT NO.	NCP2010-4017	FIGURE NO.	1

N:\CACADD\P\PROPOSAL\2010CP\4017\FIGURES\4017F001.dwg 4/15/10 15:07 SBerdy

Geosyntec
consultants

Attachment A-2

Selected Geosyntec Landfill Experience in California - Tabulated

EXHIBIT B to Consultant Agreement

Geosyntec consultants

Selected Representative Landfill Experience in California

			Service A			Service B	Service C
Project	**Client**	**Reference**	**Stability Analysis**	**Geotechnical Lab. Testing and Data Evaluation**	**Design Review and Support**	**Geologic Mapping**	**Field QA/QC Testing**
Previous Work at Badlands Sanitary Landfill							
Geologic Assessment and Geotechnical Analyses for Canyon 4, Phase 2 Badlands Sanitary Landfill	**Riverside County Waste Management Department**	Imad M. Guirguis, P.E.	Yes	Yes	-	Yes	-
CQA Services, Uppermost Slope Liner Repair, C3P1 Expansion, Badlands Sanitary Landfill	**Riverside County Waste Management Department**	Imad M. Guirguis, P.E.	-	-	-	-	Yes
Static and Seismic Liner Stability Evaluation, Canyon 3, Phase 1, Badlands Sanitary Landfill	**Riverside County Waste Management Department**	Imad M. Guirguis, P.E.	Yes	Yes	-	-	-
Previous Work at Lamb Canyon Sanitary Landfill							
Slope Stability Assessment for P2S2, Lamb Canyon Sanitary Landfill	**Riverside County Waste Management Department**	Imad M. Guirguis, P.E.	Yes	Yes	-	Yes	-
Comprehensive Landfill Engineering Services							
Multi-Discipline Engineering Support Services, Riverside County Landfills	**Riverside County Waste Management Department**	Imad M. Guirguis, P.E.	Yes	Yes	Yes	Yes	Yes
Multi-Discipline Engineering Support Services, Kern County Landfills	Kern County Waste Management Department	Ramzi Mansour	Yes	Yes	Yes	Yes	Yes
Multi-Discipline Engineering Support Services, City of Los Angeles Landfills	City of Los Angeles, Department of Public Works, Bureau of Sanitation	Stephen A. Fortune, P.E.	Yes	Yes	Yes	Yes	Yes
Engineering, Design, and Construction Support Services, Sunshine Canyon Landfill County Extension	Browning-Ferris Industries, Inc., Western Region	Dan Tempelis, P.E.	Yes	Yes	Yes	Yes	Yes
Site Geologic And Geotechnical Characterization For Side Slope Liner And Final Cover Design, Azusa Landfill	Waste Management, Inc.and Browning-Ferris, Inc.	John Workman	Yes	Yes	Yes	Yes	Yes

			Service A			Service B	Service C
Project	**Client**	**Reference**	**Stability Analysis**	**Geotechnical Lab. Testing and Data Evaluation**	**Design Review and Support**	**Geologic Mapping**	**Field QA/QC Testing**
Cap and Buttress Design, Casmalia Hazardous Waste Management Facility	Casmalia Steering Committee	Corey Bertelsen	Yes	Yes	Yes	Yes	Yes
Landfill Design and Geotechnical / Geological Support							
Seismic Site Response and Deformation Analyses, 2003 and 2013 Configurations, Puente Hills Landfill	County Sanitation Districts of Los Angeles County	Chuck Dowdell, R.G., C.E.G.	Yes	-	Yes	-	-
Geologic and Hydrogeologic Investigation for Landfill Expansion, El Sobrante Landfill	Waste Management and Recycling Services of California, Inc.	Burrill McCoy	-	Yes	-	Yes	-
Design, Build, and Construction Support, Twenty Nine Palms Marine Corps Base	Naval Facilities Engineering Command	Mark Rogers, P.G., C.P.G.	Yes	Yes	Yes	-	Yes
North Ridge Cut, Calabasas Landfill	County Sanitation Districts of Los Angeles County	Russell Yoshida	Yes	Yes	-	Yes	-
Static and Seismic Slope Stability Evaluation, Heaps Peak Sanitary Landfill	County of San Bernardino Waste Systems Division	Art. Rivera, P.E.	Yes	-	-	-	-
Landfill Design and Permitting, Kettleman Hills Facility	Waste Management, Inc.	Rodney Walter	-	Yes	Yes	-	-
Design and Construction Support, Los Alamitos Joint Forces Training Base	US Army Environmental Center	Sandi Schafer	Yes	Yes	Yes	-	Yes
Hydrogeologic Investigation And Groundwater Modeling, Mesquite Regional Landfill	County Sanitation Districts of Los Angeles County	Alex Mena, P.E.	-	Yes	-	Yes	-
Evaluation of Stability of Cemented Gravel Slopes, Nuway Live Oak Site	Waste Management, Inc.	Bo McCoy	Yes	Yes	-	-	-
Operating Industries, Inc. Landfill Superfund Site	New Cure, Inc.	Ian Webster	Yes	Yes	Yes	-	Yes
Eagle Mountain Landfill and Recycling Center	Mine Reclamation Corporation	Gary Johnson, P.E.	Yes	-	Yes	-	-

			Service A			Service B	Service C
Project	**Client**	**Reference**	**Stability Analysis**	**Geotechnical Lab. Testing and Data Evaluation**	**Design Review and Support**	**Geologic Mapping**	**Field QA/QC Testing**
Landfill Design and Permitting, Altamonte Landfill and Resource Recovery Facility	Waste Management, Inc.	Guy Petraborg	-	-	Yes	-	-
Landfill QA/QC Services							
Construction Quality Assurance Monitoring, Cell IV, Steps 3 and 4, Antelope Valley Public Landfill	Waste Management and Recycling Services of California, Inc.	John Workman	-	-	-	-	Yes
Construction Quality Assurance Monitoring, Cell B3 A and Cell D 1, Simi Valley Landfill and Recycling Center	Waste Management and Recycling Services of California, Inc.	Jim Riley	-	-	-	-	Yes

Geosyntec
consultants

Attachment A-3

Geosyntec's Landfill-Specific Company Brochure

426-0100	Pasadena	(626) 449-0664
202-9500	Pensacola	(850) 477-6547
451-4003	Portland	(503) 222-9518
929-7333	Princeton	(609) 895-1400
995-0900	Richmond	(804) 332-6376
263-9588	Raleigh	(919) 870-0576
269-5880	San Diego	(858) 674-6559
658-0500	San Diego - Old Town	(619) 297-1530
433-9280	Santa Barbara	(805) 897-3800
527-4670	Seattle	(206) 381-8486
920-4601	Tacoma	(253) 237-0722
522-0470	Tampa	(813) 558-0990
969-0800	Toronto	(519) 822-2230
682-8576	Washington D.C.	(410) 381-4333
388-8821		
330-0037		
401-4858	**Overseas**	
839-6040	Bristol	+44(0) 117 915 4535
328-6181	Ipoh	+(605) 323 5301
377-9828	Kuala Lumpur	+(603) 7665 3081
836-3034	Manchester	+44(0) 1925 230 655

Geosyntec consultants

ngineers | scientists | innovators

- Conceptual & Full-Scale Design
- Permitting
- Capacity Optimization and Expansion
- Geotechnical Design
- Cover System Design
- Construction Management/ Construction Quality Assurance
- Foundation Stabilization
- Waste to Energy
- Landfill Gas Management
- Leachate Control
- Bioreactor Design
- Post-Closure Care

Having successfully completed more than 2,000 waste management facility projects for clients throughout the United States, Geosyntec Consultants knows the waste management business.

Whether the need is for designing landfill liners and covers, increasing landfill capacity, developing landfill facilities at difficult sites, or closing and redeveloping landfills, Geosyntec has the experience, the know-how, and the in-house talent to make it happen. We have provided professional services at landfill sites throughout the region including the El Sobrante Landfill, the Buttonwillow Facility, Puente Hills Landfill, Frank R. Bowerman Landfill, and the Sycamore Canyon Landfill.

Geosyntec's professionals and project support specialists are leaders in technology and innovation in all aspects of solid waste projects including:

- design and permitting;
- facility expansion;
- landfill gas and leachate management;
- bioreactors;
- alternative and temporary cover system design;
- closure and post-closure care and redevelopment;
- construction management/quality assurance; and
- groundwater monitoring and remediation.

Through privately- and publicly-funded research and development, we find innovative, cost-effective solutions to the most challenging problems faced by waste management facilities today. The result is outstanding service and long-term value for our clients. Regulators and other environmental professionals across the country rely on our guidance manuals and technical documents, including the U.S. EPA, which uses Geosyntec's technical analyses for evaluating the performance of liner and cover systems for municipal and hazardous waste landfills. Our research can be found in government-sponsored publications such as *Assessment and Recommendations for Improving the Performance of Waste Containment Systems* and *Technical Guidance for RCRA/CERCLA Final Covers* for the U.S. Environmental Protection Agency.

Clearly, Geosyntec understands the permitting, engineering design, construction, operation, and closure associated with modern solid waste management facilities. Let us help you with your next solid waste project.

Post-Closure Care at Municipal Solid Waste Landfills: RA Subtitle D

te proactive data collection) and four "PCC s" representing the elements described in D. The goal was to design a scientifically ble, site-specific process to evaluate when source media (leachate and landfill gas, longer pose a threat to HHE and, there- hen ow c onal itorir stabil , anc ce th t-term t to a non-regulatory custodial care program after the principal landfill components are demonstrated to not to pose a threat to HHE. It provides technical support to implement proactive operational practices (such as bioreactor or alternative final cover technology), accelerate waste decomposition and

Permitting & Construction Support Services

Buttonwillow Facility - Buttonwillow, California

Geosyntec developed an innovative approach to the in-place closure of four impoundme containing non-hazardous petroleum sludge. This allowed the facility's owner to gene revenue during the closure of the ponds by using incoming waste materials to stabilize existing sludge materials in the impoundments. Geosyntec developed a laboratory tes protocol to establish the maximum allowable placement water content in the stabili sludge materials such that liquids are not generated. In addition, Geosyntec has assis the client in the permitting of the active hazardous waste landfill at the site. Our un standing of the regulations and current landfill construction practices provided a revi permit that is less onerous to construct due to the update of existing materials, tes methods, and construction means and methods. Geosyntec has provided construc management and construction quality assurance during the construction of two new b liner systems and two final cover systems at the facility.

Design, General Contracting and CM/CQA

Thomas Ranch Site - Corona, California

Geosyntec prepared engineering design and permitting documents for the construc of the engineered cover and gas migration control system at the Thomas Ranch S Geosyntec's relationship with the California Department of Toxic Substances Con (DTSC), lead regulatory agency, allowed for an expedited approval. In addition, Geosyr provided General Contracting, Construction Management (CM), and Construction Qua Assurance (CQA) services for the construction of the engineered cover and gas migra control system. The cover and gas system encompassed approximately 1.5 acres in tc Our General Contracting, CM, and CQA services were commended by the clients for a safety incidents.

Horizontal Expansion Design

Sycamore Landfill - Santee, California

Geosyntec designed the first lined cell to be constructed at the Sycamore landfil accordance with Subtitle D. Our alternative liner used a geosynthetic clay liner (GCL lieu of the prescriptive compacted clay liner (CCL). This alternative liner system saved facility's owner more than $1.5 million in construction capital costs. Geosyntec desig a leachate collection and removal system, an alternative liner system including a GC side slope liner for steep slopes, and surface water control systems. The proj involved approximately 800,000 cubic yards of excavation and 22 acres of liner. In or to protect the liner system from damage due to the underlying geologic formation, Geosyr designed a protective layer consisting of a heavy non-woven geotextile.

Construction Services

Savage Canyon Landfill - Whittier, California

Geosyntec provided Construction Management (CM) and Construction Quality Assura (CQA ces f cons on of hase Comp Liner m at t

Geosyntec consultants

Attachment A-4

Selected Project Descriptions

GEOLOGIC ASSESSMENT AND GEOTECHNICAL ANALYSES FOR CANYON 4, PHASE 2 BADLANDS SANITARY LANDFILL, RIVERSIDE COUNTY, CALIFORNIA

Client:

Riverside County Waste Management Department

Client Address:
14310 Frederick Street
Moreno Valley, CA
92553

Contact Person:
Imad M. Guirguis, P.E.
Senior Civil Engineer
(909) 247-1594

Contract Amount:
$100,000

WORK TASKS:

- Geologic Mapping
- Geotechnical Sampling and Drilling
- Geologic Cross Sections
- Geotechnical Laboratory Testing
- Seismic Hazard Evaluation
- 2-D Static and Pseudostatic Slope Stability Analysis
- 1-D Non-Linear Seismic Site Response Analysis
- Seismic Deformation Analysis
- Engineering Support
- Preparation of Reports
- Landslide Back Analysis
- Selection of Design Ground Motions

Project Background

The Badlands Sanitary Landfill is an active solid waste disposal facility approximately 6 miles east of the City of Riverside, California. The landfill is being developed in phases. The current phase of development, Canyon 4, Phase 2, includes cut slopes with out-of-slope bedding and an active landslide adjacent to a proposed sedimentation basin. The Badlands site is in area of high seismicity, with an estimated bedrock Peak Horizontal Ground Acceleration (PHGA) of 0.81 g for the design earthquake.

Services Provided by GeoSyntec Consultants

GeoSyntec conducted an extensive field exploration and laboratory testing programs to characterize site geology, obtain relevant information about landslides in the vicinity of the site, characterize the landfill subgrade, and evaluate material properties of representative geologic materials. The field exploration program included a large-diameter bucket auger borehole which was advanced through the landslide adjacent to the sedimentation basin to a depth of 100 ft below ground surface. The borehole was logged by a GeoSyntec geologist and soil samples were collected from the slide plane area. Representative samples of the clay seam on which the landslide occurred were sent to a local laboratory for torsional ring shear testing. These laboratory test data, along with the back-calculated shear strength of the seam materials, were used in the subgrade stability evaluations.

Stability analyses included demonstrations of static and seismic stability of cut and fill slopes and of the interim waste slopes and final landfill buildout configurations. All of the analyses were conducted in accordance with stringent requirements on subgrade and liner stability established by the California Department of Water Resources (DWR) and adopted by the Santa Ana Region California Regional Water Quality Control Board (RWQCB). The seismic stability demonstration was based upon the results of one-dimensional (1-D) non-linear seismic site response analysis. Average acceleration time histories from the site response analysis were processed in a Newmark-type seismic deformation analysis to estimate seismic deformations. GeoSyntec was able to demonstrate that, despite the high seismicity of the site, native cut slopes can be cut as steep as 1H: 1V (Horizontal: Vertical), providing additional disposal volume with an anticipated additional revenue of $2,500,000.

Badlands Sanitary Landfill

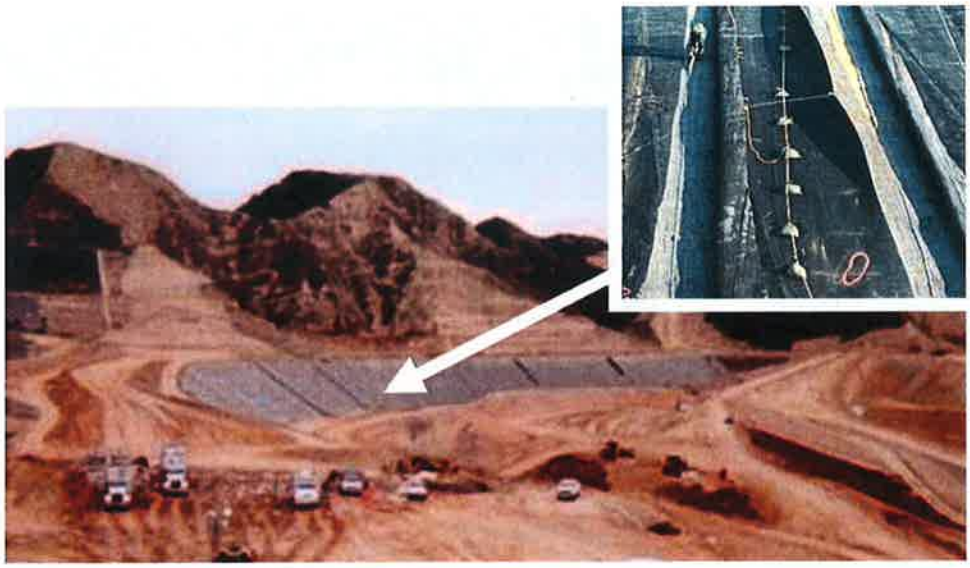
CQA Services, Uppermost Slope Liner Repair, C3P1 Expansion

Riverside County, California

Client:
Riverside County Waste Management Department

Owner Address:
14310 Frederick St.
Moreno Valley, CA 92553

Contact Person:
Imad M. Guirguis, P.E.
Senior Civil Engineer
(909) 955-8323



Project Background

The Badlands Sanitary Landfill is an active solid waste disposal facility approximately 6 miles east of Riverside, California. Canyon 3, Phase 1 (C3P1) is one of the recent phases of landfill expansion. The C3P1 Uppermost Slope was the last stage of C3P1 expansion and includes a 90-ft high cut slope inclined at 1.5H:1V (Horizontal:Vertical).

Services Provided by GeoSyntec

GeoSyntec provided Construction Quality Assurance (CQA) monitoring services for partial repair of the C3P1 Uppermost Slope liner, including:

- reviewing the Manufacturer's Quality Control (MQC) test results for compliance with the project specifications;
- monitoring trial weld geomembrane seaming and field destructive testing of seams;
- monitoring and documenting production joining of the overlapping GCL panels;
- selecting destructive geomembrane seam sample locations, documenting their location, and reviewing test results for compliance with Specifications;
- monitoring and documenting the non-destructive field testing of production geomembrane seams and repairs; and
- monitoring and documenting the reconstruction of geomembrane production seams that failed either non-destructive or destructive CQA testing criteria.

Project Success

GeoSyntec assisted the Owner in repairs to the uppermost slope liner that went previously undetected during installation. GeoSyntec's CQA services saved the client several million dollars by detecting early the liner deficiencies prior to waste placement.

Badlands Sanitary Landfill

Static and Seismic Liner Stability Evaluation, Canyon 3, Phase 1

Riverside County, California

Client:
Riverside County Waste Management Department

Owner Address:
14310 Frederick St.
Moreno Valley, CA 92553

Contact Person:
Imad M. Guirguis, P.E.
Senior Civil Engineer
(909) 955-8323

Project Features:

- Seismic Hazard Evaluation
- Selection of Design Ground Motions
- 3-D Static and Pseudo-Static Slope Stability Analysis
- 2-D Seismic Site Response Analysis
- Seismic Deformation Analysis
- Engineering Support
- Preparation of Reports

Project Background

The Badlands Sanitary Landfill is an active solid waste disposal facility approximately 6 miles east of Riverside, California. The landfill is being developed in phases. Canyon 3, Phase 1, is lined by a composite liner on both the base and the side slopes. The side slope liner includes a geosynthetic clay liner (GCL) in lieu of the compacted low permeability soil. The Badlands site is in area of high seismicity, with an estimated bedrock Peak Horizontal Ground Acceleration (PHGA) of 0.81 g for the design earthquake.

Services Provided by GeoSyntec

GeoSyntec demonstrated static and seismic stability of the Badlands Canyon 3, Phase 1 Expansion area and the final buildout configuration of the landfill in accordance with the stringent requirements on liner stability established by the California Department of Water Resources (DWR) and adopted by the Santa Ana Region California Regional Water Quality Control Board (RWQCB). The stability demonstration was based upon the results of two-dimensional (2-D) finite element seismic site response analysis using the computer program QUAD4M. Average acceleration time histories from the 2-D site response analysis were processed in a Newmark-type seismic deformation analysis to estimate seismic deformation of landfill mass. The stability assessment also included a three-dimensional (3-D) limit equilibrium analysis using the computer program CLARA to evaluate the yield acceleration of potential sliding masses. GeoSyntec also provided recommendations for the Specifications and Construction Quality Assurance Plan with respect to the base and side slope liner systems.

Project Success

GeoSyntec provided crucial input on critical design and installation components, and recommendations that were incorporated into the project strategy.

PROJECT TITLE: LAMB CANYON SANITARY LANDFILL, RIVERSIDE COUNTY, CALIFORNIA
SLOPE STABILITY ASSESSMENT FOR P2S2

JOB DESCRIPTION:

Client:

Riverside County Waste Management Department

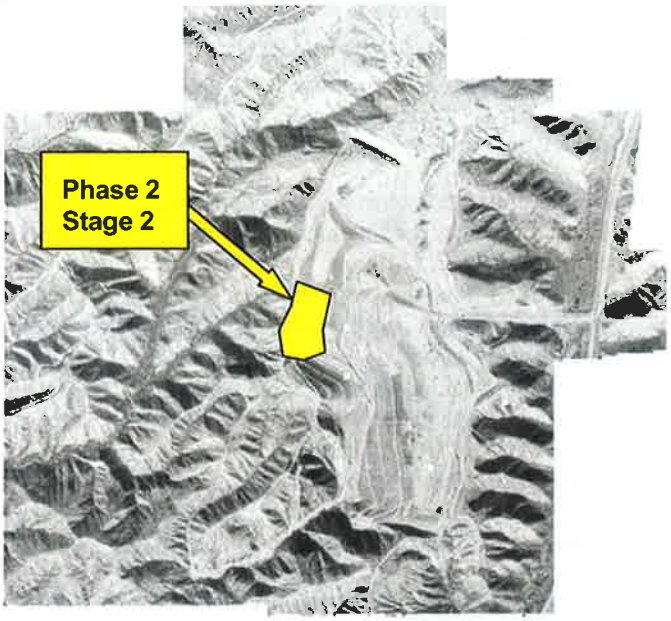
Client Address:
14310 Frederick Street
Moreno Valley, CA
92553

Contact Person:
Fouad A. Mina, P.E.
Senior Civil Engineer
(909) 247-1594

Contract Amount:
$45,000.

Start Date:
May 2005

Completion Date:
December 2005



Project Highlights

The Lamb Canyon Sanitary Landfill is an active solid waste disposal facility approximately 20 miles east of the City of Riverside, California. The landfill is being developed in phases. The current phase of development, the 30-acre Phase 2 Stage 2 expansion, is a canyon-type landfill lined by a composite liners on both landfill base and side slopes. The base liner contains encapsulated Geosynthetic Clay Liner (GCL). The entire site is in an area of high seismicity, with an estimated bedrock Peak Horizontal Ground Acceleration (PHGA) of 0.6 g.

SERVICES PROVIDED:

- **Geologic Mapping**
- **Landslide Back Analysis**
- **Seismic Hazard Evaluation**
- **Selection of Design Ground Motions**
- **2-D Static and Pseudostatic Slope Stability Analysis**
- **1-D Non-Linear Seismic Site Response Analysis**
- **Seismic Deformation Analysis**
- **Liner / Engineered Fill CQA Requirements**

Services Provided by GeoSyntec Consultants

GeoSyntec conducted a field exploration program, collected and tested representative soil samples, and conducted engineering evaluations. The field exploration program included geologic mapping of the landslide area. The laboratory testing program was conducted to further characterize the recent landslide and to further evaluate material properties of representative geologic materials (San Timoteo Formation clay seams).

The stability analyses included demonstrations of static and seismic stability of cut and fill slopes and of the interim waste slopes. All of the analyses were conducted in accordance with stringent requirements on subgrade and liner stability established by the California Department of Water Resources (DWR) and adopted by the Santa Ana Region California Regional Water Quality Control Board (RWQCB). The seismic stability demonstration was based upon the results of one-dimensional (1-D) non-linear seismic site response analysis. Average acceleration time histories from the site response analysis were processed in a Newmark-type seismic deformation analysis to estimate seismic deformations. GeoSyntec was able to demonstrate that, despite the high seismicity of the site, the P2S2 waste mass can be safely placed over the composite base liner.

Riverside County Landfills

Multi-Discipline Engineering Support Services

Riverside County, California

Client:
Riverside County Waste Management Department

Owner Address:
14310 Frederick St.
Moreno Valley, CA 92553

Contact Person:
Imad M. Guirguis, P.E.
Senior Civil Engineer
(909) 955-8323

GeoSyntec Success

- Demonstrated that several native slopes at the Badlands Landfill can be cut as steep as 1H:1V. The net revenue increas due to additional airspace generated by cutting slopes at 1H:1V was $2.5 Million.
- Established three-tier slope stability criteria for Badlands and Lamb Canyon landfills (temprary, interim and final slopes). This enabled more economical landfill design and landfilling practices.
- By closely working with the Santa Ana Region RWQCB, managed to closely delineate portion of the Badlands Landfill where side slope composite liner had to be replaced due to "necking" of GCL pannels.
- Identify local borrow sources that met stringent design requirements for design and evaluation of Mecca II and Edom Hill landfill final cover designs.
- Landslide assessment, back-analysis and development of remedial measures.

Project Background

Since 1999, GeoSyntec has been providing services through a series of contracts administrated by Riverside County Waste Management Department (RCWMD). Under these contracts GeoSyntec has been involved with the Badlands, Lamb Canyon, Mecca II, and Edom Hill Landfills. The scope of services provided by GeoSyntec to RCWMD included the following services called upon in the scope of work of the RFP:

- Solid Waste Services.
- Hydrology and Hydrogeology Services.
- Architect/Engineering Services.
- Geotechnical Engineering Services.
- Real-Estate Related Services.
- Miscellaneous Services.
- Biological Services.

Key Personnel

The following key personnel has provided services at the RCWMD landfills:

- Neven Matasovic
- Tarik Hadj-Hamou
- Ramon Chavez
- Steve Chickey
- Todd St. Peter
- Jerko Kocijan

The following describes the work performed at four of the landfills owned and operated by RCWMD.

Badlands Sanitary Landfill

Landfill Description

The Badlands Sanitary Landfill is an active solid waste disposal facility approximately 6 miles east of the City of Riverside, California. The landfill is being developed in phases. The current phase of development, Canyon 4, Phase 2, includes cut slopes with out-of-slope bedding and an active landslide adjacent to a proposed sedimentation basin. The Badlands site is in area of high seismicity, with an estimated bedrock Peak Horizontal Ground Acceleration (PHGA) of 0.81 g for the design earthquake.

Geologic Assessment and Geotechnical Analyses

GeoSyntec conducted extensive field exploration and laboratory testing programs to characterize site geology, obtain relevant information about landslides in the vicinity of the site, characterize the landfill subgrade, and evaluate material properties of representative geologic materials. The field exploration program included a large-diameter bucket auger borehole which was advanced through the landslide adjacent to the sedimentation basin to a depth of 100 ft below ground surface. The borehole was logged by a GeoSyntec geologist and soil samples were collected from the slide plane area. Representative samples of the clay seam on which the landslide occurred were sent to a local laboratory for torsional ring shear testing. These laboratory test data, along with the back-calculated shear strength of the seam materials, were used in the subgrade stability evaluations.

Stability analyses included demonstrations of static and seismic stability of cut and fill slopes and of the interim waste slopes and final landfill buildout configurations. All of the analyses were conducted in accordance with stringent requirements on subgrade and liner stability established by the California Department of Water Resources (DWR) and adopted by the Santa Ana Region California Regional Water Quality Control Board (RWQCB). The seismic stability demonstration was based upon the results of one-dimensional (1-D) non-linear seismic site response analysis. Average acceleration time histories from the site response

analysis were processed in a Newmark-type seismic deformation analysis to estimate seismic deformations. GeoSyntec demonstrated that, despite the high seismicity of the site, native cut slopes can be cut as steep as 1H: 1V (Horizontal: Vertical), providing additional disposal volume with an estimated additional revenue of $2,500,000.

Badlands Sanitary Landfill
Stability Evaluation of Native Cut Slopes, Waste Fill, and Landfill Cover

Static and Seismic Liner Stability Analysis

GeoSyntec demonstrated static and seismic stability of the Badlands Canyon 3, Phase 1 Expansion area and the final buildout configuration of the landfill in accordance with the stringent requirements on liner stability established by the California Department of Water Resources (DWR) and adopted by the Santa Ana Region California Regional Water Quality Control Board (RWQCB). The stability demonstration was based upon the results of two-dimensional (2-D) finite element seismic site response analysis using the computer program QUAD4M. Average acceleration time histories from the 2-D site response analysis were processed in a Newmark-type seismic deformation analysis to estimate seismic deformation of landfill mass. The stability assessment also included a three-dimensional (3-D) limit equilibrium analysis using the computer program CLARA to evaluate the yield acceleration of potential sliding masses. GeoSyntec also provided recommendations for the Specifications and Construction Quality Assurance Plan with respect to the base and side slope liner systems.

Badlands Sanitary Landfill
Construction Quality Assurance Services

Construction Quality Assurance Services

The Canyon 3 Phase 1 (C3P1) is one of the recent phases of landfill expansion. The C3P1 Uppermost Slope is the last stage of C3P1 expansion and includes a 90-ft high slope inclined at 1.5H:1V (Horizontal : Vertical). GeoSyntec provided Construction Quality Assurance (CQA) monitoring services for partial repair of the C3P1 Uppermost Slope liner, including:

- reviewing the Manufacturer's Quality Control (MQC) test results for compliance with the project specifications;
- conformance sampling of delivered geosynthetics and sample shipping to the appropriate testing laboratory;
- reviewing the conformance sampling test results for compliance with the specifications;
- monitoring trial weld geomembrane seaming and field destructive testing of seams;
- monitoring and documenting production joining of the overlapping GCL panels;
- selecting destructive geomembrane production seam sample locations and documenting their location;
- monitoring and documenting the non-destructive field testing of production geomembrane seams and repairs;
- reviewing the geosynthetic destructive test results for compliance with the specifications; and
- monitoring and documenting the reconstruction of geomembrane production seams that failed either non-destructive or destructive CQA testing criteria.

Lamb Canyon Sanitary Landfill

Landfill Description

Lamb Canyon is an active solid waste disposal facility owned and operated by the Riverside County Waste Management Department (RCWMD) in Beaumont, California, approximately 20 miles east of the City of Riverside, California. GeoSyntec was retained to characterize soils in excavations planned for landfill expansion, establish the suitability of such soils for

the final closure cover of filled parts of the landfill, and hence, prepare a final cover evaluation and design report and assist RCWMD in securing approval from the RWQCB.

Site Characterization

GeoSyntec performed a geotechnical investigation of the proposed expansion area at the Lamb Canyon Landfill to evaluate the suitability of soils in on-site borrow areas as alternative final cover material. To evaluate the properties of the soil in the three on-site borrow sources, GeoSyntec logged seven test pits excavated with a CAT backhoe. Bulk samples were collected and sent to the laboratory for testing.

Borrow Source Evaluation

GeoSyntec evaluated the borrow sources and established that the soils available for site closure included silty loam, sandy loam, and loam. GeoSyntec established that the three borrow sources soils are suitable for construction of a final soil cover provided that the many clay lenses are blended with the sandier soils to produce a low- plasticity material that has a limited desiccation-induced crack potential and the specified hydraulic conductivity.

Closure Cover Design

GeoSyntec developed an alternative final cover design for the Lamb Canyon Landfill by using the material excavated as part of the expansion. GeoSyntec performed an unsaturated flow analysis to demonstrate that the proposed alternative final cover would perform as well as the Title 27 prescriptive cover.

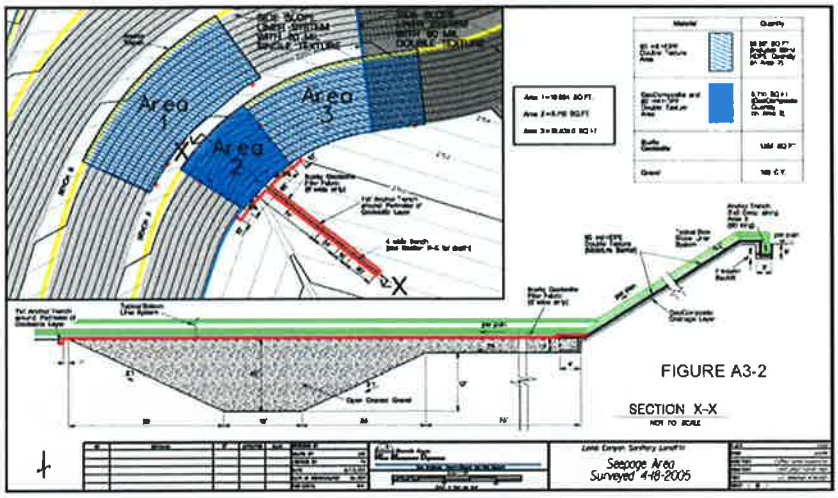
Slope Stability Assessment

The landfill is being developed in phases. The current phase of development, the 30-acre Phase 2, Stage 2 expansion, is a canyon-type landfill lined by composite liners on both landfill base and side slopes. The base liner contains encapsulated geosynthetic clay liner. The entire site is in an area of high seismicity, with an estimated bedrock Peak Horizontal Ground Acceleration of 0.6 g.

GeoSyntec conducted a filed exploration program, collected and tested representative soil samples, and conducted engineering evaluations. The field exploration program included geologic mapping of the landslide area. The laboratory testing program was conducted to further characterize the recent landslide and to further evaluate material properties of representative geologic materials (San Timoteo Formation clay seams).

The stability analyses included demonstrations of static and seismic stability of cut and fill slopes and of the interim waste slopes. All of the analyses were conducted in accordance with stringent requirements on subgrade and liner stability established by the California Department of Water Resources and adopted by the California Regional Water Quality Control Board, Santa Ana Region. The seismic stability demonstration was based upon the results of one-dimensional (1-D) non-linear seismic site response analysis. Average acceleration time histories from the site response analysis were processed in a Newmark-type seismic deformation analysis to estimate seismic deformations. GeoSyntec was able to demonstrate that, despite the high seismicity of the site, the P2S2 waste mass can be safely placed over the composite base liner.

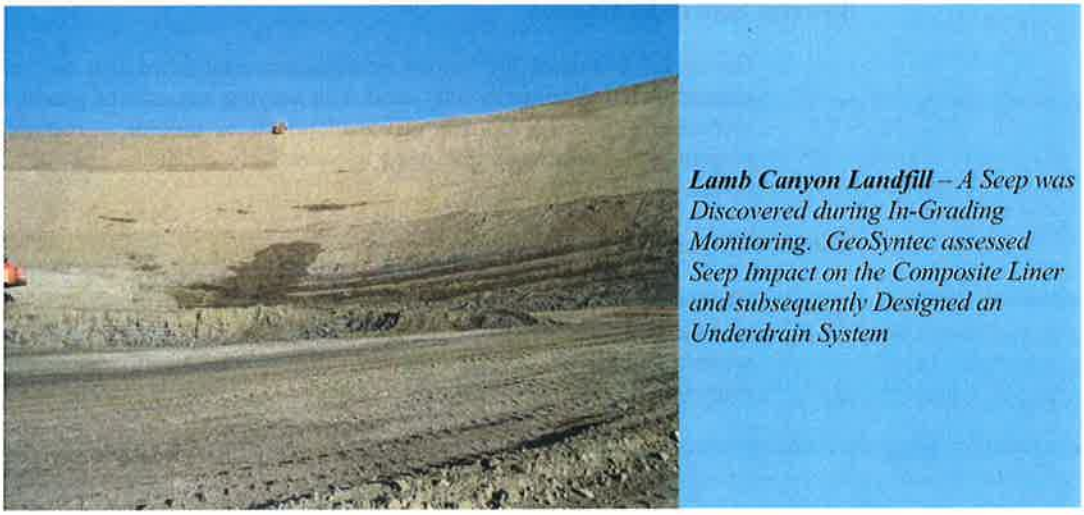
Landslide Remediation



GeoSyntec conducted a geologic investigation and geotechnical evaluation of the landslides that occurred on the west-facing slopes of the proposed P2S2 expansion area of Lamb Canyon. These landslides occurred near the access road and adjacent to the waste-filled slopes and potentially weakening the stability. The geologic investigation indicates the landslides were block-type translational slides along weak clay bedding seams within the San Timoteo Formation. Stability evaluations of the landslides were performed to evaluate the shear strength parameters of the clay seams. The resulting shear strength parameters were used to evaluate remedial grading options. Based upon results of those evaluations, GeoSyntec recommended that some of the material that slid be removed and recompacted in place as a buttress keyed into competent bedrock.

In-Grading Monitoring

GeoSyntec was retained by RCWMD to provide in-grading monitoring services for P2S2 phase of landfill development. Project challenges included in-project direction of grading based upon geologic conditions observed during grading, including bedding orientation and seeps. As anticipated during design stage of the project, several seeps were identified during grading. GeoSyntec assessed impact of these seeps on composite side-slope liner and subsequently designed an underdrain system



***Lamb Canyon Landfill** – A Seep was Discovered during In-Grading Monitoring. GeoSyntec assessed Seep Impact on the Composite Liner and subsequently Designed an Underdrain System*

Mecca II Sanitary Landfill

Landfill Description

Mecca II is a Class III landfill owned and operated by the Riverside County Waste Management Department near the community of Mecca, California. The landfill has been in operation since 1982. The on-going closure operations started in 2005. The site area is approximately 80 acres. The final closure plan, prepared by GeoSyntec, called for a soil-based evapotranspirative cover.

Site Characterization

In order to evaluate the properties of the soil in the potential borrow source to the east of the landfill, a test pit and laboratory testing program was conducted. GeoSyntec logged five test pits excavated with a CAT backhoe. Bulk samples were collected and sent to the geotechnical laboratory for testing.

Borrow Source Evaluation

GeoSyntec evaluated the borrow sources and established that the soils available for site closure included primarily silty sand with varying amounts of gravel. GeoSyntec prepared recommendations for borrow pit development to provide a material suitable for cover construction, specifically the need to selectively excavate and blend different soils and layers.

Closure Cover Design

GeoSyntec evaluated alternative closure covers and demonstrated that the a technically suitable and cost-effective cover involves a 3-ft thick layer of suitable soil with a maximum saturate hydraulic conductivity of 10^{-4} cm/sec. GeoSyntec demonstrated that this evapotranspirative cover performed as well as a prescriptive cover.

Edom Hill

Landfill Description

Edom Hill is a Class III landfill owned and operated by the Riverside County Waste Management Department. The landfill is on Edom Hill Road in Cathedral City, California. The landfill has been in operation since 1967. The closure operations were initiated in 2005. The site area is approximately 435 acres. The final closure plan, prepared by GeoSyntec, called for construction of soil-based evapotranspirative cover.

GeoSyntec provided geotechnical investigation services in support of closure plan development and the design of the final closure cover. The following is a brief descriptions of geotechnical investigation aspects of work performed by GeoSyntec Consultants.

Site Characterization

In order to evaluate the properties of the soil in the four potential on-site borrow sources, GeoSyntec logged nine test pits excavated with a CAT backhoe. Bulk samples were collected and sent to the laboratory for testing. The laboratory testing program included a series of test to characterize the material and assess their suitability for construction of the final cover. The following tests were performed on the bulk samples recovered in the test pits: grain size distribution analysi, Atterberg limits, Modified Proctor Compaction Test, saturated hydraulic conductivity, and plate load/hanging column tests required to develop moisture retention curves.

Borrow Source Evaluation

GeoSyntec evaluated the borrow sources and established that the soils suitable for the final cover construction could be produced by blending the silty and sandy soils in the potential borrow areas.

Closure Cover Design

GeoSyntec evaluated alternative closure covers and demonstrated that the a technically suitable and cost-effective cover involves a 3-ft thick layer of suitable soil with a maximum saturated hydraulic conductivity of 10^{-3} cm/sec. GeoSyntec demonstrated that this evapotranspirative cover performed as well as a prescriptive cover. GeoSyntec established soil cover placement requirements and specifications.

Kern County Landfills

Multi-Disciplined Engineering Support Services

Kern County, California

Client:
Kern County Waste Management Department

Owner Address:
2700 M Street, Suite 500
Bakersfield, CA 93301

Contact Person:
Ramzi Mansour
Eric Greenwood
(661) 862-8900

GeoSyntec Success

- Alternative liner performance demonstration saved $14 million for the Bena Landfill
- Asphaltic cover design allowed continued operation of Lebec Landfill transfer station
- Alternative liner performance demonstration for Shafter-Wasco saved over $1.5 million
- Landfill gas control remedial measures for Bena and Arvin Landfills
- Successful final cover repairs at the McFarland-Delano Landfill

Project Background

Since November 1994 GeoSyntec has been providing services to the Kern County Waste Management Department (KCWMD) at all four active landfills (Bena, Shafter-Wasco, Taft, and Ridgecrest) and at four of the fourteen inactive landfills (Kern Valley, Lebec, Arvin, and McFarland-Delano) currently owned and operated by Kern County.

GeoSyntec has been providing services through a series of contract administrated by both the Closed Landfill Division and the Active Landfill Division of the KCWMD.

The scope of services under these contracts includes the services described in the scope of work of the RFP:

- General Services
- Geotechnical / Geological / Hydrogeological Services
- Solid Waste Services
- Civil / Structural / Architectural / Electrical / Mechanical Services
- Engineering Support Services During Construction
- Project Management Services
- Miscellaneous Services

The following key personnel has provided services at the KCWMD landfills:

- Jeff Dobrowolski
- Neven Matasovic
- Matt Darr
- Yonas Zemuy
- Tarik Hadj-Hamou
- Haydar Azzouz
- Eric Smalstig
- Saverio Siciliano
- Jerko Kocijan

The following describes the work performed at each of the eight landfills where GeoSyntec has been involved.

Bena Landfill (Active Landfill)

Landfill Description

The Bena Sanitary Landfill is located approximately 17 miles east of the City of Bakersfield, California. The southern boundary of the site is approximately 0.25 miles north of State Highway 58. The site consists of a roughly rectangular-shaped parcel that encompasses approximately 2,285 acres, including 963 acres of buffer area. A total of approximately 1,322 acres of the site are available for waste disposal.

The southwest corner of the landfill site (54 acres) is occupied by an existing waste management unit referred to as Phase 1 of the Bena Sanitary Landfill. Future development of the Bena Sanitary Landfill will be entirely separate from Phase 1. Phase 2A is the first phase of the next waste management unit being developed at the Bena Sanitary Landfill.

Site Investigations

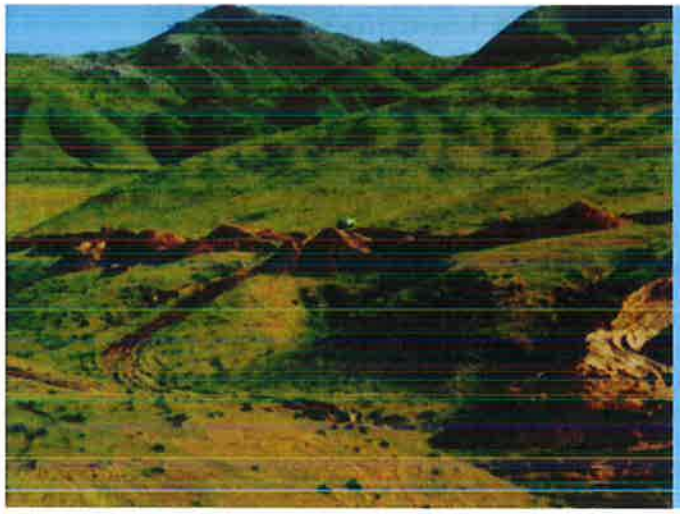
GeoSyntec undertook detailed geologic and geotechnical site investigations at the site. Our work focused on the recognition of active faults and landslides on site from past investigations, and possible areas of borrow sites for clay and aggregate construction materials. Specific activities included:

- Geologic mapping and subsurface investigations of faults and landslide locations.
- Compile a comprehensive geologic database.
- Bucket auger borings, trenches, and test pits logging.

Hydrogeologic Investigation and Modeling

GeoSyntec evaluated the conditions at an oil exploration well (Johnson Well 33-1) to obtain subsurface lithologic information and groundwater data (elevation and water quality) to include in the hydrogeologic model for the site. The investigation eliminated the need and cost to KCWMD for drilling an exploration boring in this area of the site. The investigation included the following:

- research of original drilling records (well driller's log and construction records);
- removal of pump and pump rods;
- down-hole video logging;
- geophysical logging (caliper and gamma logging);
- groundwater level measurements; and
- groundwater sampling and laboratory analysis.



Bena Landfill Master Plan
GeoSyntec performed a geologic field investigation that supported the Bena Landfill Master Plan.

Master Plan Development

GeoSyntec developed the Bena Landfill Master Plan – work included:

- Identify regulatory, permitting, operational, and design criteria.
- Establish and evaluate:
  - waste stream projections;
  - liner and final cover design options;
  - leachate management;
  - landfill gas management options;
  - environmental monitoring programs;
  - development constraints for Bena Master Plan;
  - operational constraints on landfill design;
  - geometric constraints on landfill design;
  - geometric design for phases 2 through 4;
  - evaluation of waste unit sub-division options;
  - field investigation and materials evaluation report; and
  - preliminary hydrologic evaluation for surface water management system conveyance structures.

Design

GeoSyntec prepared the following design packages, including drawings, specifications, and bid packages for the Bena Landfill:

- Preliminary base and final cover grading plans for Phases 2 through 4.
- Sequencing plans for the first 30 years of future landfill development.
- Alternatives to provide landfill gas control for the lined areas along the southern and western portions of Phase 1- Network 4.
- Phsae 2A Module 1 Earthworks Construction Project.
- Phase 2A Module 1 Liner Construction Project.
- South Access Improvement Construction Project.

Performance Demonstration

GeoSyntec prepared a performance demonstration for the Subtitle D "alternative" liner system for Phase 2A of the Bena Landfill. We demonstrated that the containment capabilities of the alternative liner system satisfied Federal and State groundwater protection standards for municipal solid waste landfills and provided a cost-benefit. As part of the performance demonstration, GeoSyntec undertook the following work and evaluated:

- site geology and hydrogeology;
- waste characteristics
- leachate chemistry; and
- unsaturated and saturated zone contaminant transport.

GeoSyntec established that the alternative liner system would result in a substantial cost saving of over $14 million.

GeoSyntec performed construction quality assurance services for Phase 2A Module 1 construction.

CQA During Construction

GeoSyntec provided CQA monitoring services for construction of the composite liner for Network 4 Phase 1B. CQA activities included monitoring:

- engineered fill and low-permeability soil liner construction;
- geosynthetics installation;
- leachate and lysimeter conveyance piping installation;
- collection piping systems construction;
- clearing and grubbing of surface vegetation and topsoil;
- grading of the subgrade including excavation and placement of the subgrade fill and the low-permeability soil liner; and
- density and moisture tests to monitor compaction during subgrade fill and soil liner placement.

GeoSyntec provided CQA for construction of the pan lysimeter and conveyance system.

GeoSyntec provided CQA services for construction of Phase 2A Module 1. We monitored earthwork, geosynthetics installation, surface water management system component installation, and leachate transmission system and holding tank facility construction. Upon completion of liner construction, GeoSyntec submitted a final CQA report documenting liner construction was conducted in compliance with the construction drawings, Technical Specifications, and CQA Plan. The RWQCB approved the Final CQA Report and KCWMD is currently operating in Phase 2A Module 1.

Detection Monitoring Program Report Preparation

GeoSyntec prepared a groundwater Detection Monitoring Program (DMP) Upgrade Report. Following approval by the regulatory agencies of the Report, GeoSyntec designed, logged, monitored the drilling and construction, and sampled four groundwater monitoring wells, each approximately 600 ft deep, down-gradient of the landfill.

Financial Assurance Plan

GeoSyntec prepared the Financial Assurance Plan for corrective action.

Gas Migration Investigation

GeoSyntec evaluated gas migration in the toe area of Phase 1 (lined facility) detected by perimeter landfill gas migration probes. On behalf of KCWMD, GeoSyntec evaluated the landfill design, operations procedures, and landfill gas concentrations and distributions to assess the nature and extent of the migration. GeoSyntec found that landfill gas migration may be occurring in the daily cover and operations layers of the landfill that in localized areas may be in connection with native soils, rather than through the liner system. GeoSyntec provided recommendations for passive landfill gas collection designs and improved operations procedures to mitigate the problem.

Future Landfill Development

In support of KCWMD evaluation of future landfill development, GeoSyntec:

- Developed preliminary base and final cover grading plans.
- Developed sequencing plans for the first 30 years of future landfill operations.
- Compiled a permitting roadmap for future landfill development.

Lebec Sanitary Landfill (Closed Landfill)

Landfill Description

The Lebec Sanitary Landfill (LSL) is an inactive, unlined landfill in a 14-acre site located in southern Kern County just north of the crest of the Tejon Pass and approximately one mile west of Interstate 5. The KCWMD manages a transfer station at the LSL which is located within the waste footprint. The transfer station is available to public and municipal users. The KCWMD intends to close around the existing transfer station and continue transfer station operations during the post-closure maintenance period.

Lebec Landfill
GeoSyntec designed, permitted, and provided CQA services for closure of the Lebec Landfill.

Report Preparation

GeoSyntec compiled the following documents for KCWMD for closure of the LSL:

- Final Closure and Post-Closure Maintenance Plans.
- CQA Plan for the Final Cover System Construction.
- CQA Report. This report documents the final closure of the LSL upon completion of closure construction.

Design Documents

GeoSyntec prepared the design drawings, construction specifications, and the bid documents for a series of projects at the LSL. These projects include:

- An alternative final cover for both an existing waste slope located immediately adjacent and a part of the primary drainage course for the site (a transfer station, designated for continued use throughout the post-closure maintenance period, was located at the top of the waste slope)
- Passive landfill gas collection system.
- Transfer station improvements, including concrete pads, grading improvements, access roads, surface water collection facilities, and electrical services.
- Gatehouse.
- Public drop-off and diversion area for recyclable goods station.

Surface Water Management

GeoSyntec designed surface water management system improvements including:

- surface water attenuation basin;
- corrugated steel pipe (CSP) down drains and culverts;
- lined natural drainage channels and Vee-ditches; and
- rip-rap protection.

Lebec Landfill
Surface water management system along the front face of the Lebec Landfill.

CQA Services

GeoSyntec provided CQA services during closure construction at the LSL, including the final cover, the transfer station final cover, a passive landfill gas collector network, and the surface water management system attenuation basin, down drains, culverts, and channels.

Miscellaneous Services

GeoSyntec undertook a geotechnical field investigation to delineate the edge of waste at the LSL. We excavated and logged 12 test pits around the perimeter of the landfill and compiled a map to document the extent of waste and limits of closure construction.

Shafter-Wasco Sanitary Landfill (Active Landfill)

Landfill Description

The Shafter-Wasco Sanitary Landfill (SWSL) is located at 17621 Scofield Avenue, approximately 7 miles south of Wasco in north-central Kern County, California. The site encompasses 248 acres of which 160 acres are permitted to accept Class III municipal solid waste (MSW). The remaining 92 acres are used for ancillary facilities that support waste disposal operations at the site and as a buffer between the landfill and surrounding properties.

The SWSL was comprised of two contiguous active waste modules, designated as Module 1 and Module 2. Module 1 is an unlined 48-acre cell constructed at the northwest portion of the site. Module 2 is a lined 21-acre cell located in the southwest portion of the site. Module 3 represented the next phase of landfill development at the site.

Performance Demonstration

GeoSyntec prepared a performance demonstration for the Subtitle D "alternative" liner system for Module 3 of the SWSL. We demonstrated that the containment capabilities of the alternative liner system satisfied Federal and State groundwater protection standards for municipal solid waste landfills and provided a substantial cost benefit. As part of the performance demonstration, GeoSyntec undertook the following work and evaluated:

- site geology and hydrogeology;
- waste characteristics
- leachate chemistry; and
- unsaturated and saturated zone contaminant transport.

GeoSyntec established that the alternative liner system resulting in a substantial cost savings of over $1.5 million.

Design

GeoSyntec prepared an alternative liner system design for construction of Module 3 at the SWSL. The alternative liner system design consisted of the following components, from top to bottom:

- 2 ft (0.6 m) thick operations layer (consisting of soils derived from on-site cut/excavation activities);
- non-woven geotextile filter;
- 1 ft (0.3-m) thick granular leachate collection layer;
- non-woven geotextile cushion (if necessary);
- 60 mil (1.5-mm) thick high-density polyethylene (HDPE) geomembrane;
- encapsulated geosynthetic clay liner (GCL) (with a minimum 10-mil (0.3-mm) thick HDPE vapor barrier on the bottom); and
- prepared subgrade.

GeoSyntec also developed alternatives design to provide landfill gas control at the SWSL. The design alternatives were developed such that construction could be accomplished in a manner protective of the liner system components. The design alternatives consisted of passive venting of soil pore gas with vertical vent probes and passive venting with a

perforated pipe and gravel collector. These design alternatives were accepted by the KCWMD for use as needed in the lined modules of the site.

CQA Services

GeoSyntec has performed two CQA programs at the SWSL, namely:

- *Module 2 Composite Liner System Construction*. The composite liner system included a low-permeability subgrade protection layer ($k < 1 \times 10^{-5}$ cm/s), over 900,000 ft^2 (83,605 m^2) of geosynthetic clay liner (GCL), over 1,125,800 ft^2 (104,580 m^2) of 60 mil (1.5 mm) thick HDPE textured geomembrane liner, geonet and granular drainage layers, LCRS collection piping, pan lysimeter construction, riser pipes, and operations soil layer; and

- *Module 3 Liner System Construction*. Facilities monitored include earthworks; over 800,000 ft^2 (74,322 m^2) of GCL and geomembrane; side slope geocomposite; the LCRS system; and leachate transmission system and holding tank facility. GeoSyntec compiled all CQA documentation into a final CQA report which was submitted and approved by the RWQCB.

A field soils laboratory and the GeoSmart™ data acquisition system were used to expedite the monitoring and testing activities and final CQA documentation, providing a cost savings to KCWMD.

Arvin Landfill (Inactive Landfill)

Landfill Description

The Arvin Sanitary Landfill is owned by the County of Kern and operated by the KCWMD. The landfill is located approximately 5 miles west of the City of Arvin, California. The landfill facility encompasses approximately 273 acres, with the existing waste management unit covering approximately 127 acres. The site was originally a "burn dump." It began operating as a municipal solid waste landfill in 1971 and was permitted as a Class III waste management unit in 1989. The landfill reached final capacity in 2004. The Arvin Sanitary Landfill is not equipped with an engineered liner system.

Evaluation Monitoring Program (EMP) Upgrade Report

GeoSyntec evaluated a release including lateral and vertical extents and performed an evaluation of monitoring natural attenuation (MNA) as a potential remedial option for the site. GeoSyntec wrote the report and in compliance with the report designed, logged, constructed, and sampled shallow and deep groundwater monitoring wells.

Detection Monitoring Work Plan

In compliance with a Central Valley Regional Water Quality Control Board (CVRWQCB) request that KCWMD address issues with the existing DMP, GeoSyntec performed a geochemical analysis, groundwater flow analysis, and intrawell statistical analysis of historic groundwater data to provide the technical rationale for the existing DMP network and to limit CVRWQCB-imposed facility additions. We developed a suitable list of monitoring parameters and a statistical analysis method that addressed the natural variability in groundwater composition and was not susceptible to false-positive detections.

VOC Migrations Evaluation

Following the detection of volatile organic compounds in down-gradient point of compliance wells, GeoSyntec prepared a work plan to investigate the vertical extent of VOC migration in the uppermost aquifer and to assess the continuity and competency of the underlying aquitard. The lateral extent of VOC migration has been delineated in a previous EMP investigation. GeoSyntec supervised the installation of an additional down gradient groundwater monitoring well as part of the work plan. Future sampling and laboratory testing of collected groundwater samples and review of analytical data will allow GeoSyntec to develop its findings relative to the vertical extent of VOC migration.

Miscellaneous Services

- Provide technical and regulatory support on an as-need basis as requested by KCWMD.
- Review and prepare response memoranda for draft and tentative regulatory documents prepared by the CVRWQCB.
- Review draft waste discharge requirements and tentative cleanup and abatement orders for various sites.
- Provide assistance to KCWMD in preparing response documents that addressed inaccuracies and errors in CVRWQCB documents and to provide technical and regulatory justification for KCWMD monitoring programs.

Kern Valley Sanitary Landfill (Closed Landfill)

Landfill Description

The Kern Valley Sanitary Landfill (KVSL) is a 36-acre inactive Class III MSW landfill located approximately 40 miles northwest of Bakersfield, California and east of the north end of Lake Isabella. The KCWMD proposed to improve the drainage channel adjacent to the KVSL by constructing a hydraulic drop structure and an embankment to protect the landfill and transfer station from being undercut by erosion.

Design

GeoSyntec conducted a geotechnical field investigation and prepared construction documents (construction drawings, Technical Specifications, and CQA Plan) for surface water drainage system improvements at the KVSL. The findings of the geotechnical field investigation were used to develop design recommendations for a St. Anthony's Fall surface water drop structure, including recommendations for grading, retaining walls, and foundations (settlement and bearing capacity of shallow footings), seismic design (in accordance with the 1997 Uniform Building Code), and resistance to lateral loads. GeoSyntec prepared the structural design of the drop structure, the earthworks grading including design of reticulated concrete block-lined slopes for embankment erosion protection, subsurface seepage control system, and a groundwater monitoring well decommissioning plan and well extension designs.

CQA Services

GeoSyntec provided CQA services for construction of the surface water drainage system improvements. These CQA services included observation and documentation of 132,000 ft^2 of sideslope grading and reticulated concrete blocks, 122,000 ft^2 of geotextile, 500 yd^3 of structural concrete, 1,400 tons of rip-rap, and 25,000 yd^3 of earthworks excavation and engineered fill.

Kern Valley Sanitary Landfill
GeoSyntec designed and provided CQA services for the concrete-reticulated block embankment protection system.

Taft Sanitary Landfill (Active Landfill)

Landfill Description

The Taft Sanitary Landfill (TSL) is an active Class III MSW landfill located four miles north of the City of Taft, in Kern County, California.

Slope Stability Analyses

GeoSyntec evaluated the impact of adjacent excavation on the stability of the existing waste disposal unit at the TSL. The evaluation included a seismic hazard evaluation and a static and a pseudo static stability evaluation of the waste mass as it relates to the excavation on adjacent property east of the landfill. To assess this effect, the inclination of the excavation and its depth were varied to evaluate the limiting conditions. The results of the stability evaluation provided the KCWMD with combinations of excavation inclinations and depth that demonstrated adequate factors of safety under both static and dynamic conditions.

McFarland-Delano Sanitary Landfill (Closed Landfill)

Landfill Description

The McFarland-Delano Sanitary Landfill is an inactive Class III MSW landfill located one mile south of the City of Delano, in Kern County, California.

Post-Closure Inspection and Maintenance Work Plan

GeoSyntec prepared a Post-Closure Inspection Maintenance Work Plan (PCIMWP) for the KCWMD to comply with Waste Discharge Requirements of the California Regional Water Quality Control Board (WDR No. 5-01-159). The PCIMWP provided (i) a method to detect defects in the landfill cover system; (ii) procedures for repairing each defective component of the landfill cover system; and (iii) procedures for maintaining the cover system to minimize the need for future repairs. As part of the PCIMWP, GeoSyntec prepared final cover inspection and settlement inspection forms for KCWMD staff to use during the post-closure maintenance period.

EXAMPLE

GeoSyntec Consultants

McFARLAND - DELANO LANDFILL
KERN COUNTY, CALIFORNIA
FINAL COVER SYSTEM INSPECTION FORM

Completed By: ______ Sheet ____ of ____
Title: ______ Date: ______
Verified By: ______ Date: ______
Title: ______
Weather Conditions: ______
Type of Inspection (check only one):
☐ Quarterly ☐ After Seismic Event[1] ☐ After Heavy Rain[2]
☐ Other (explain): ______

Item Description	Condition*/Remarks
1. Erosion	
2. Stressed Vegetation (Plant Die-Back)	
3. Sediment Build-Up	
4. Local Subsidence or Loss of Grade, Sags	
5. Water Ponding	
6. Burrowing Animals	
7. Weeds or Undesirable Vegetation	
8. Evidence of Fires or Vandalism	
9. Slope Instability or Sloughing	
10. Survey Monuments	
11. Cracking	
12. Intrusions	

Notes: [illegible]

[illegible] 1 [illegible]

EXAMPLE

GeoSyntec Consultants

McFARLAND - DELANO LANDFILL
KERN COUNTY, CALIFORNIA
SETTLEMENT INSPECTION FORM

Completed By: ______ Sheet ____ of ____
Title: ______ Date: ______
Verified By: ______ Date: ______
Title: ______
Weather Conditions: ______
Type of Inspection (check only one):
☐ Quarterly ☐ After Seismic Event[1] ☐ After Heavy Rain[2]
☐ Other (explain): ______

Sketch Showing Location of Area of Concern (If Any):

Description of Conditions* (Use additional sheets as necessary):

Notes: [illegible]

[illegible] 2 [illegible]

Final Cover System Repairs

GeoSyntec directed final cover system repairs when site inspections revealed extensive surface cracking in 2004. GeoSyntec employed a grout injection subcontractor to effectively seal cracks in the final cover system and overlying vegetative soil layers.

McFarland-Delano Landfill
GeoSyntec proscribed and provided construction quality assurance services for a grout injection process for repairing cracks in the final cover system.

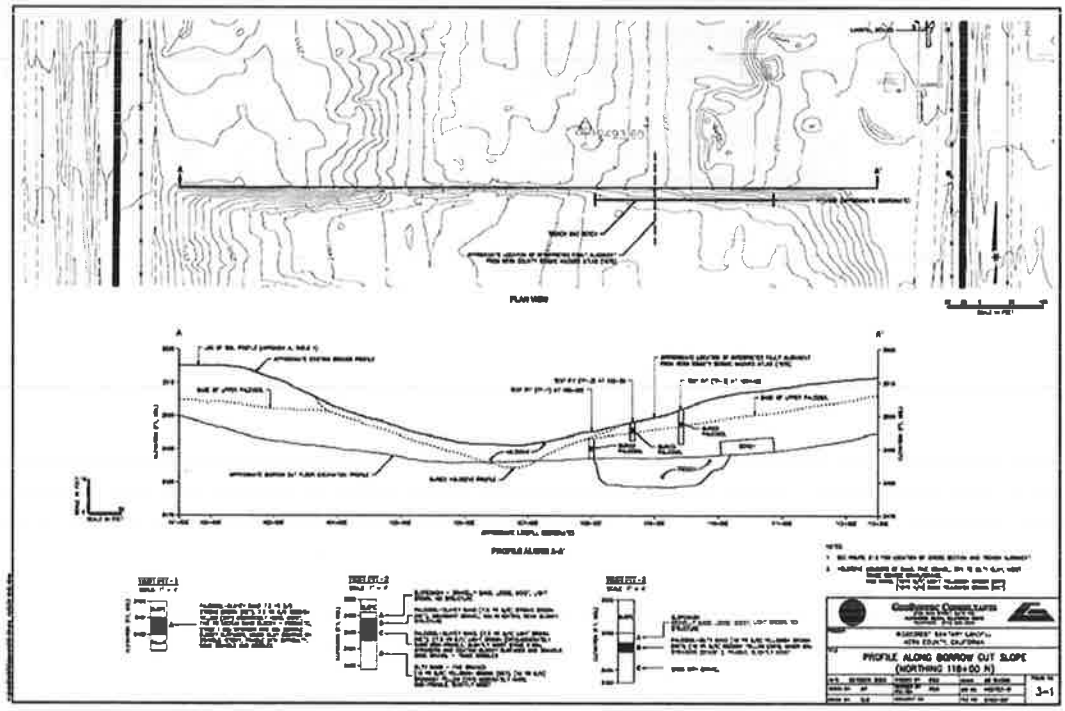
Ridgecrest Sanitary Landfill (Active Landfill)

Landfill Description

The Ridgecrest Sanitary Landfill (RSL) is an active Class III MSW landfill located five miles southwest of the City of Ridgecrest, in Kern County, California.

Evaluation of Faulting Potential

GeoSyntec evaluated the presence of an identified fault transecting the RSL and the age of most recent faulting, if present. GeoSyntec: (i) reviewed available geotechnical, geological, and seismological data; (ii) performed field reconnaissance and geologic mapping/logging of exposed slopes; and (iii) performed trench excavation and logging. GeoSyntec found no evidence of any faulting beneath the RSL for at least the past 40,000 years and perhaps as long as 350,000 years. GeoSyntec found no siting restrictions due to faulting at the RSL.



City of Los Angeles Landfills

Multi-Discipline Engineering Support Services

Los Angeles, California

Client:
City of Los Angeles, Department of Public Works, Bureau of Sanitation

Owner Address:
1149 S. Broadway, Suite 800
Los Angeles, CA 90015

Contact Person:
Stephen A. Fortune, P.E.
Division Manager
(213) 485-3023

GeoSyntec Success

- First Subtitle D liner installed in California at Lopez Canyon (1992)
- SWANA Award for Excellence (1994)
- First monolithic soil cover unconditionally approved by the RWQCB (2003)
- Closure Cost Savings in excess of $2 million due to value-added engineering
- Seamless management of over a dozen subconsultants and subcontractors
- Approval of Interlayered Asphalt as alternative cover (2003)
- Approval of construction of a green waste / composting facility on deck of Disposal Area B at Lopez Canyon

Project Background

Since 1992, GeoSyntec has provided multi-discipline engineering support services to the City of Los Angeles, Bureau of Sanitation at the six landfills owned and maintained by the City of Los Angeles, namely: Bishops Canyon Landfill; Branford Landfill; Gaffey Street Landfill; Lopez Canyon Landfill; Sheldon-Arleta Landfill; and Toyon Canyon Landfill.

Upon expiration of the first contract for $8.9 million in June 2002, GeoSyntec was competitively awarded a new contract for $2.4 million. The scope of services under these contracts covers the scope of work described in the RFP, namely:

- Solid Waste Services.
- Hydrology and Hydrogeology Services.
- Architect/Engineering Services.
- Geotechnical Engineering Services.
- Real-Estate Related Services.
- Miscellaneous Services.
- Biological Services.

Key Personnel

The following key personnel have provided services at the City of Los Angeles landfills:

- Tarik Hadj-Hamou
- Haydar Azzouz
- Bertrand Palmer
- Neven Matasovic
- Alan Bradford
- Mike Reardon
- Jeff Dobrowolski
- Steve Chickey
- Matt Darr
- Todd St. Peter
- Yonas Zemuy
- Jerko Kocijan

The following describes the work performed at each of the six landfills.

Lopez Canyon Landfill

Landfill Description

Lopez Canyon Sanitary Landfill is a cut and cover, canyon-fill landfill of 400 acres located in the foothills of the San Gabriel Mountains. The refuse disposal area of 166 acres is subdivided into Disposal Areas A, B, AB+, and C. Area C is lined in accordance with Subtitle D. The capacity of the landfill is 19.2 million tons of waste. The landfill has operated from October 1975 to July 1996. Closure construction is currently underway.

Liner System Design

In 1992, GeoSyntec was asked to redesign the Disposal Area C liner system on an emergency basis after construction had already started on the first phase of a design prepared by a previous consultant. The redesign was required because the Los Angeles Regional Water Quality Control Board (RWQCB) had informed the City that the liner system under construction did not meet Subtitle D standards. GeoSyntec prepared the following:

- A base liner design that included a bentonite-amended soil for the low-permeability soil component.
- A liner system for the canyon side-slopes using a geosynthetic clay liner (GCL) and a geonet for HDPE leachate collection system.
- Cost estimates and bid documents.

Construction Document Preparation

For closure construction of Areas AB+ and C, and the upper benches, slopes and decks of Disposal Areas A and B., GeoSyntec prepared:

- The construction drawings for a revised landfill gas extraction system, surface water drainage facilities, alternative final cover designs for 2H:1V slopes, irrigation systems, and landscaping.
- The Technical Specifications.
- A Quality Assurance/Quality Control (QA/QC) plan.
- Quantity and cost estimates.
- A detailed construction schedule.

Construction of Liner in Disposal Area C

Final Cover Design

GeoSyntec designed four final covers for the Lopez Canyon Landfill:

- A prescriptive Title 27 cover for the slopes of Disposal Area B, an unlined area;
- An evapotranspirative (monolithic soil) cover for Disposal Areas A and AB+, both unlined areas;
- An asphalt interlayer cover for the deck of Disposal Area B, an unlined area; and
- Mixed geosynthetic and low-permeability cover for Disposal Area C, a lined area.

GeoSyntec proposed to qualify the existing interim cover on the slopes of Disposal Area A and to design the cover for the Deck of Disposal Area A and all of Disposal Area AB+. To support the qualification of the existing interim cover and the design of the monolithic final soil cover, GeoSyntec:

- performed a geotechnical investigation that included evaluating the thickness and in-situ density of the existing in-place interim soil cover and collecting samples for laboratory testing;
- performed a laboratory testing program to evaluate the saturated and unsaturated hydraulic properties of the in-place existing soil cover;
- conducted water balance analyses using the computer model UNSAT-H using site-specific weather data and results of the laboratory testing program to demonstrate that the monolithic soil cover performed better than the Title 27 prescriptive final cover;
- installed three moisture monitoring stations (MMS);
- monitored the MMS for a two-year period at the request of the RWQCB;
- simulated a 100-year storm event;
- prepared three reports for submission to the RWQCB during the final cover performance evaluation, namely: (a) an installation report; (b) a model calibration report; and (c) a performance evaluation report; and

- prepared amendments to the closure and post-closure maintenance plans for submittal to the RWQCB.

The GeoSyntec design saved the City nearly $2 million in construction cost and will reduce post-closure maintenance costs.

Moisture Monitoring Station at Disposal Area A

CQA Services

General. GeoSyntec prepared the Construction Quality Assurance (CQA) plan for the prescriptive and alternative covers, the liner system for Disposal Area C, assisted the City in locating sources of low-permeability soil (clay) for the prescriptive cover and soil for the monolithic cover. GeoSyntec managed all laboratory testing necessary to qualify the soils for prescriptive and alternative cover and performed all the conformance tests required for the geosynthetics used in Disposal Area C. GeoSyntec performed the sealed double-ring infiltrometer test on the low-permeability borrow soil to demonstrate that it met the hydraulic conductivity requirements for the barrier layer in prescriptive final covers.

Disposal Area A. GeoSyntec provided QA/QC services for the closure of Disposal Area A, including CQA of the engineering fill placed to grade the lower slopes. No closure work was performed on the upper slopes as they have been qualified as closed with the existing interim cover, in excess of 8 ft thick, acting as a monolithic soil cover. GeoSyntec provided CQA services for installation of the reinforced concrete drainage elements and landscaping and irrigation.

Disposal Area B. GeoSyntec provided QA/QC services for closure of Disposal Area B, including CQA of the prescriptive cover with a clay barrier cover layer on the slopes and a monolithic final cover on the deck. GeoSyntec performed all the in-situ conformance tests (nuclear gauge testing and BAT® testing to verify the in-place hydraulic conductivity) and managed the laboratory testing program. In addition, GeoSyntec provided CQA services for installation of the reinforced concrete drainage elements, landfill gas system modifications, and landscaping and irrigation.

Disposal Area AB+. GeoSyntec provided CQA services for the closure of the deck of Disposal Area AB+. Closure of the slopes is scheduled to take place in 2004. GeoSyntec CQA services for the deck included conformance testing, in-situ, and laboratory testing; monitoring of construction activities; assistance in identifying soil sources; and other services such as monitoring the installation of the drainage elements and construction of the helipad.

Disposal Area C. During construction of the Phase I and II liner systems of Disposal Area C, GeoSyntec provided CQA services for construction of the liner system, including in particular, the placement of the GCL/geomembrane/geonet/ geotextile liner system on 90-meter high canyon side slopes with an inclination of 1.0 vertical to 1.0 horizontal. GeoSyntec prepared QA/QC plans and final reports documenting the construction for approval by the RWQCB. GeoSyntec will also provide CQA services during construction of the final cover scheduled to begin in 2005.

CEQA Document Preparation

GeoSyntec provided support for public hearings for CEQA document preparation for partial closure of Disposal Area A, B and closure of Disposal Area C.

For closure of the slopes of Disposal Areas A and B, GeoSyntec prepared a Negative Declaration under CEQA for closure activities. In response to public comments, GeoSyntec redesigned the grading plan for the Disposal Area A prepared by a previous consultant to minimize the amount of excavation required for closure.

Regulatory Support Services

GeoSyntec provided regulatory support services, including preparation of the 5-year update for the Report of Disposal Site Information (RDSI) and for use of green waste as alternative daily cover.

GeoSyntec Consultants provided support for preparation of the Solid Waste Facilities Permit (SWFP) for Disposal Area C and support for extension of the conditional use permit (CUP) from 1996 to 2001.

GeoSyntec prepared a petition on behalf of the City for submission to the RWQCB for approval of the alternative side slope liner system under Subtitle D.

GeoSyntec prepared the documents on behalf of the City to report and obtain approval of:

- the alternative covers for Disposal Areas A, B, and AB+; and
- the construction of a green waste recycling and composting facility on the deck of Disposal Area B.

Closure and Post-Closure Maintenance Plan Preparation

GeoSyntec prepared the final closure and post-closure maintenance plans (FCPCMP) for Disposal Area C for submission to the California Integrated Waste Management Board, the RWQCB, and the Local Enforcement Agency (LEA). Plans included an alternative cover design on the steep cover slopes and a gas collection system beneath the geomembrane cap.

GeoSyntec again revised the FCPCMP to accommodate the installation of the monolithic final soil cover in Disposal Areas A, AB+, and portions of Area B. This revised FCPCMP was approved by the RWQCB, the CIWMB, and LEA.

Community Relations Support Services

GeoSyntec, through its subconsultants, provided support for community relations activities during the active phase of the landfill and during the negotiation for extension of the closure date. GeoSyntec provided assistance with landfill gas monitoring and noise monitoring for Conditional Use Permit/Mitigation Monitoring Plan compliance. GeoSyntec assistance to the City on community relations activities included monthly community meetings, technical briefings, preparation of Negative Declarations, and the publication of a newsletter.

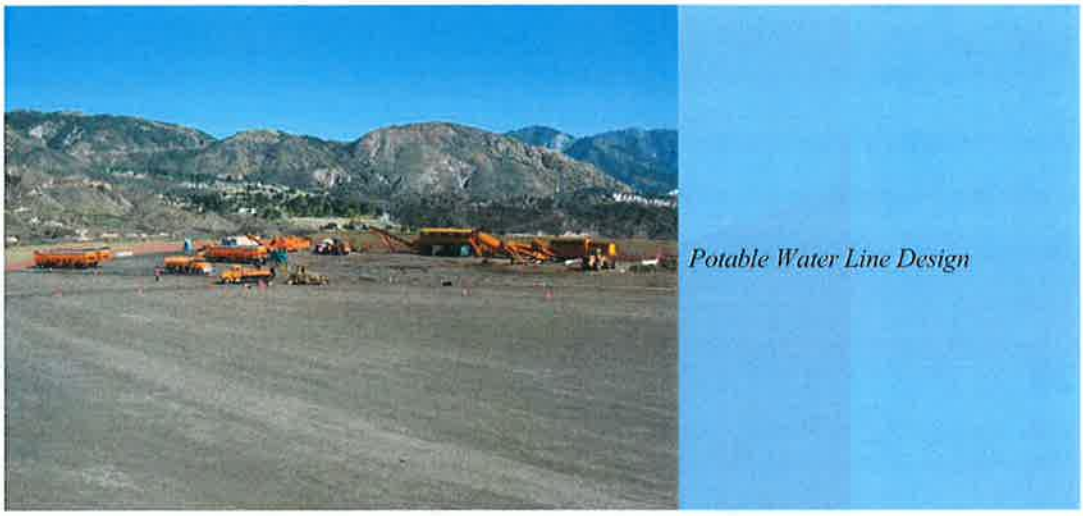
GeoSyntec, through its subconsultants, was very active in 2002 in providing support to the City in presenting and obtaining approval from the community for the proposed composting facility.

Community Relations:
Guided Tour of Lopez Canyon

Green Waste Facility Design

GeoSyntec provided engineering services for the design of the composting facility known as the Lake View Terrace Green Waste Recycling Facility (GWRF). The GWRF will be constructed on top of Disposal Areas A and B. The facility that will occupy approximately 20 acres is designed to produce 300 tons of compost per day when in full production. GeoSyntec's services included:

- design of an enhanced landfill cover for the area that will house the composting facility, including interlayer asphalt mix design and development of a grading plan to accommodate the composting facility;
- design of the surface water drainage system;
- assistance with the selection and procurement of the composting equipment;
- assistance with the design of the aeration system for the composting piles;
- evaluation of the impact of the GWRF and its equipment on the air quality; and
- submission of a revised post-closure plan to the RWQCB.



Potable Water Line Design

GeoSyntec designed a new potable water line for the ancillary facilities. The design included enhancement of the existing pump station, design of the 2,700-ft-long water line and new storage tank for the administrative office facilities, and provisions for future services to a proposed landfill gas-to-energy plant. The million-gallon water tank was retro-fit with a top-feed supply line rather than a bottom-feed line to mitigate the potential for reoccurrence of a tank discharge due to a broken feed line, as occurred in the Northridge earthquake.

Miscellaneous Design Services

GeoSyntec designed:

- the administrative office pad which was upgraded for installation of an additional building;
- paving of the parking lot;
- structural systems to stabilize the slopes adjacent to the administrative pad and those along a sedimentation basin in Disposal Area B; and
- a helipad on top of Disposal Area AB+.

Lopez Canyon
GeoSyntec designed the pavement system for the helipad built directly on top of Disposal Area AB+. To minimize cracking of the asphalt and preserve the integrity of the cover, GeoSyntec designed a geosynthetic-reinforced asphalt pavement system. The system included two layers of asphalt separated by a resin-impregnated geotextile. The asphalt pavement cover was approved by the RWQCB as an alternative cover.

Drainage Structures

GeoSyntec designed the main downchute and sedimentation basins at Lopez Canyon. GeoSyntec provided the hydrologic calculation to evaluate volumes of flow velocity down the drainpipes. These calculations resulted in the design of inlet structures that included energy dissipaters, spillways, and rip-rap aprons where necessary.

Lopez Canyon
Outlet Structure Drainage Line in Disposal Area B

Groundwater Monitoring

GeoSyntec prepared the revised groundwater monitoring report requested by the RWQCB under the provisions of Order No. 93-62 for implementation of Subtitle D/Article 5 groundwater monitoring provisions. GeoSyntec designed the groundwater monitoring network at the site.

GeoSyntec monitored the installation of ten new groundwater monitoring wells and the abandonment of four old groundwater monitoring wells.

GeoSyntec conducted slug tests at selected monitoring wells and developed a site-specific hydrogeologic groundwater flow model. GeoSyntec collected groundwater samples for laboratory testing each quarter over a period of two years. GeoSyntec evaluated the laboratory chemical data using statistical and non-statistical data analysis methods and submitted quarterly compliance reports to the RWQCB.

Develop and Implement Training Programs

GeoSyntec prepared a training manual and provided training to City personnel on groundwater sampling protocols.

GeoSyntec presented a half-day seminar to City personnel on the design, construction, and maintenance of alternative final covers, namely, evapotranspirative final covers such as those designed by GeoSyntec for Lopez Canyon and Gaffey Street Landfills.

Post-Earthquake Damage Assessment

GeoSyntec performed the post-earthquake inspection of the landfill following the 17 January 1994 Northridge earthquake.

GeoSyntec conducted downhole video well logging to assess potential damage caused by the Northridge earthquake to three groundwater monitoring wells.

Following the Northridge earthquake, GeoSyntec designed remedial slope stabilization measures, including drilled pier/soldier pile retaining walls for the landfill office and the Disposal Area B sedimentation basin.

Damage to Office Trailers Following 1994 Northridge Earthquake

Geologic and Geotechnical Services

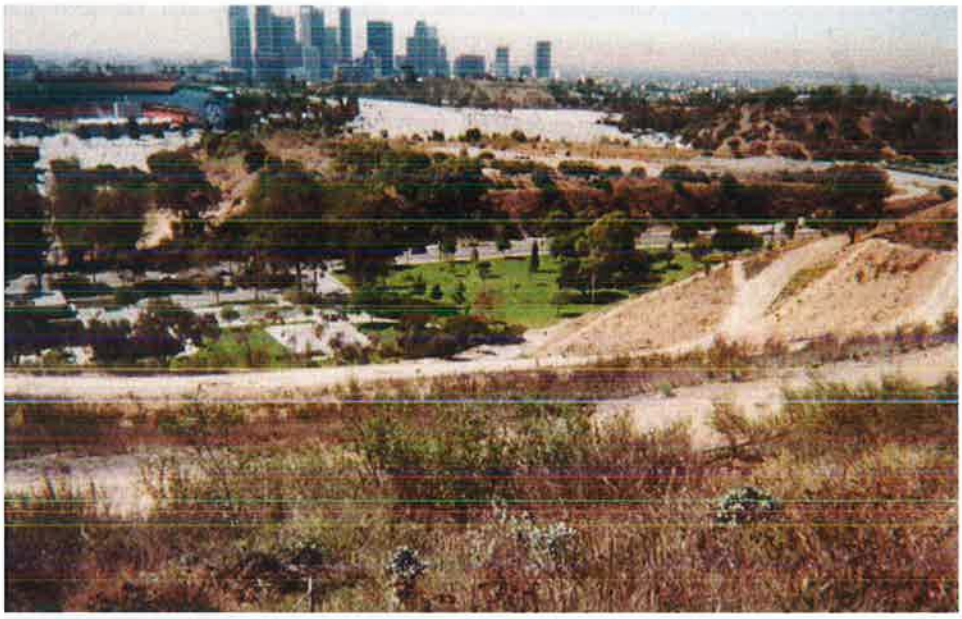
GeoSyntec conducted a series of geologic and geotechnical investigations to assess the stability of natural and manmade slopes along the main access road, the North Road, and on the western ridge. These investigations included geologic mapping, advancing borings, and collecting samples for laboratory testing. Technical memoranda were prepared to document these investigations and provide recommendations for design and grading.

GeoSyntec routinely undertook geologic mapping and provided geotechnical support during grading of the canyon side slopes for the liner system and construction activities.

GeoSyntec provided geological mapping support of hydrogeologic studies to evaluate the source of seeps encountered during closure construction.

GeoSyntec evaluated over a dozen potential borrow sources for material for construction of the monolithic soil cover. GeoSyntec reviewed geotechnical reports, collected samples, and managed laboratory testing. GeoSyntec successfully identified large volumes of suitable construction materials. GeoSyntec constructed and monitored the low-permeability soil (clay) test pad for qualification of this soil for construction of the liner in Disposal Area C. The results were presented in a report submitted to the RWQCB. The soil was approved and used in construction.

Bishops Canyon Landfill



Landfill Description

The Bishops Canyon Landfill is an inactive California Class III municipal solid waste landfill in Elysian Park in Los Angeles, California. The Bishops Canyon Landfill accepted waste between 6 June 1966 and 7 November 1969. The landfill received approximately 1.86 million tons of waste and covers approximately 45 acres. The maximum height of the waste prism is 120 ft (36.6 m). As much as 39 ft (11.9 m) of soil cover currently exists at the site.

Final Cover Design

GeoSyntec proposed to use an alternative engineering cover in accordance with Title 27 regulations. GeoSyntec's goal was to evaluate if the very thick existing soil cover could be qualified as a monolithic final soil cover, thereby, eliminating any need for additional construction at the site.

To achieve this goal, GeoSyntec performed unsaturated flow analyses to demonstrate that the existing soil cover would control percolation as well as or better than the Title 27 prescriptive cover. Major tasks performed by GeoSyntec included:

- collecting samples of the existing soil cover to evaluate its unsaturated hydraulic properties;
- coordinating with the irrigation consultant and landscape architect for the site to determine appropriate vegetation and irrigation schemes; and
- conducting unsaturated flow analyses to compare the performance of the existing soil cover when irrigated to a non-irrigated Title 27 prescriptive cover.

Upon completion of closure, the Bishops Canyon Landfill was reclaimed by the City of Los Angeles Department of Parks and Recreation and converted into irrigated recreational areas. Using the existing soil cover resulted in considerable cost savings for the City compared to closure using the prescriptive cover.

Gaffey Street Sanitary Landfill

Gaffey Street Landfill Before Final Cover Construction

Gaffey Street Landfill After Final Cover Construction

Landfill Description

The Gaffey Street Sanitary Landfill, a 15 acre inactive municipal solid waste landfill, is near the harbor area in the Wilmington section of Los Angeles. The Gaffey Street Sanitary Landfill was an incinerator ash and municipal refuse disposal facility operated by the City of Los Angeles, Bureau of Sanitation between 1957 and 1963 and a street maintenance refuse disposal facility operated by the Bureau of Street Maintenance between 1963 and 1978. The landfill was inactive after 1978.

In 1999, the City of Los Angeles, Bureau of Sanitation decided to formally close the landfill and redevelop it as irrigated recreational and athletic fields.

Final Cover Design

Irrigation of the recreational and athletic fields was a concern to GeoSyntec. Consequently, GeoSyntec developed an innovative final cover system as an alternative to the low-permeability soil barrier layer final cover prescribed by the regulations and recommended installation of a smart irrigation system. The final cover is an evapotranspirative cover, including a capillary break. In addition to significant cost savings compared to a prescriptive final cover with a compacted clay layer, the capillary break design provided excellent infiltration control without affecting landfill gas migration. The capillary break layer minimizes the potential for enhanced lateral gas migration inherent to low-permeability final covers, and it facilitated contingency plans for gas control should irrigation from the athletic fields enhance gas generation within the landfill.

GeoSyntec used UNSAT-H to demonstrate that, based on historical weather data, site-specific soil data, and vegetative parameters, the capillary barrier will allow less moisture movement into the waste mass than will the prescriptive cover and achieve a cost-effective design for the capillary break cover. In addition, GeoSyntec designed a cover that used the on-site materials, including street grindings and silty soils. The city had only to procure the gravel for the capillary break layer.

Based upon the water balance analyses, GeoSyntec and the City staff developed an innovative "smart" irrigation system to both conserve water and minimize the potential for over-irrigation and excessive infiltration due to "break through' of the capillary barrier.

Regulatory Compliance

To accommodate a request by regulatory agencies for development of a contingency plan, perforated pipes were embedded in the gravel layer to provide a means for gas collection should infiltration due to irrigation enhance gas generation. Following final cover construction, the Gaffey Street Sanitary Landfill was reclaimed by the City of Los Angeles Department of Parks and Recreation and converted into irrigated recreational areas used extensively by Los Angeles residents.

Branford Landfill

Landfill Description

The Branford Landfill (BL) is an inactive Class III landfill located at the intersection of San Fernando Road and Branford Street.

The BL occupies a portion of a former sand and gravel quarry pit. The portion of the pit occupied by BL was filled with municipal solid waste upon cessation of quarrying activities. From August 1957 through January 1961, approximately 435,000 tons of residential and non-residential waste were deposited at the BL. It is estimated that the thickness of waste may be as much as 70 feet.

Litigation Support

GeoSyntec was retained as technical consultant for a litigation case involving property at the inactive Branford Landfill in Sun Valley, California. The joint defendants for the case were defending a civil action brought by a private citizen who had previously operated a wood recycling center at the inactive site. The defendants consisted of the property owner (represented by McCutchen, Doyle, Brown & Enersen LLP) and the former landfill operator (City of Los Angeles). The suit involved allegations that proximity to the landfill had caused adverse health effects to the employees and damage to the wood recycling business.

GeoSyntec was retained to examine the site and the available data spanning approximately 40 years and evaluate the claims based on technical facts. GeoSyntec analyzed the historical data and explored correlations among water spreading, groundwater elevation, and emission rates. GeoSyntec recommended engineering controls to improve site safety and limit liability. GeoSyntec made recommendations regarding the installation, control, and operation of a gas extraction system.

Stability Evaluation

GeoSyntec evaluated the stability of the waste mass. As part of the evaluation, GeoSyntec:

- performed a seismic hazard analysis to estimate the Maximum Probable Earthquake;\
- recovered geologic and geotechnical information to define representative cross-sections and select material properties;
- performed static and pseudo-static slope stability analyses and seismic deformation; and
- submitted a report to the City.

The analysis indicated that the slopes at BL satisfied the requirements in Title 27.

Sheldon-Arleta Landfill

Landfill Description

The Sheldon-Arleta Landfill, in the Sun Valley area of Los Angeles, California, was the site of a quarry from the 1950's to 1962. The landfill accepted waste from 1962 to 1974. The landfill is at the intersection of Sheldon Street and Arleta Avenue, directly east of Highway 170. Immediately to the north and west of the Landfill are the Tujunga Spreading Grounds (TSG). The County of Los Angeles Department of Public Works (LACDPW) operates the TSG to replenish the regional water table with collected surface water spread in the TSG.

Effect of Recharge on Landfill Gas Migration

A Task Force composed of representatives of the City of Los Angeles, Department of Water and Power (DWP), BOS, LACDPW, City of Los Angeles Department of Environmental Affairs, and the Upper Los Angeles River Area Watermaster was established to study the potential for increase of the permitted flow of surface water into the TSG. Current practice limits the flow to 50 cfs. This limit was established to avoid inducing landfill gas (LFG) migration from the landfill.

The Task Force commissioned GeoSyntec to perform a study with the objective of maximizing the recharge of surface water at the TSG while controlling off-site LFG migration. Work done by GeoSyntec included:

- developing an understanding of the mechanisms relating groundwater recharge from water spreading at the TSG to LFG off-site migration;
- evaluating operational options which, when implemented, would maximize water spreading at the TSG and mitigate the risk of LFG off-site migration;

- collecting and analyzing data about the history of the landfill, regional, and local geology and hydrogeology; LFG production at the landfill; LFG migration monitoring; volume of water spread; and weather over a multi year period; and

- entering the data into a database and a GIS system.

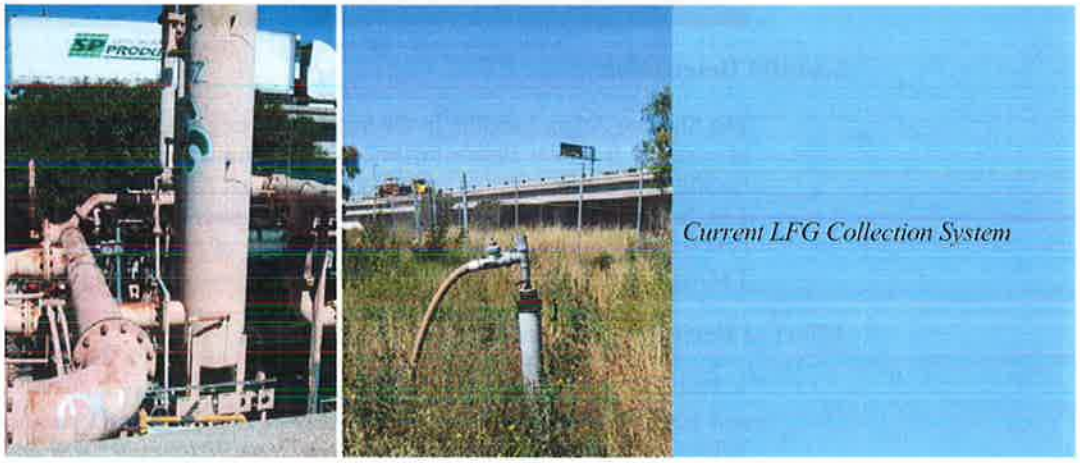
GeoSyntec used the database and the GIS to investigate the relationship between the amount of water spread at the Tujunga Spreading Grounds and the migration of LFG beyond the boundaries of the landfill. GeoSyntec established that there is a direct cause and effect relationships between water spreading, precipitation, and LFG migration; however, the mechanism could not be established conclusively.

To identify the dominant mechanism for LFG migration from the landfill due to recharge during water spreading and identify the optimum option for an enhanced groundwater recharge through water spreading at TSG, GeoSyntec developed and implemented a pilot study that:

- filled the data gaps identified in the characterization study;

- established the ability of the existing LFG collection system to control off-site migration during increasing controlled water spreading;

- resulted in recommendations for improve the performance of the LFG collection system and to implement additional engineering systems to control the off-site migration of LFG during spreading operations at the TSG.



Landfill Gas Collection

GeoSyntec performed a third party review of the design and construction cost estimate of the proposed new LFG collection system prepared by other consultants. GeoSyntec recommended modifications to the proposed system to accommodate settlements and the waste footprint. GeoSyntec identified items in the cost estimate that were ill-defined and potentially led to a change order against the City.

The current system diverted parts of the LFG to the on-site flare and parts to a gas-to-energy facility off-site. However, because the City wanted to redevelop the landfill as a community park, it wanted to gain full control over LFG collection. Consequently, the City requested that GeoSyntec design the new flare station.

GeoSyntec is currently designing a new flare station that will include the existing flare and a new flare designed to destroy all the LFG extracted from the landfill.

Toyon Canyon Landfill

Landfill Description

The Toyon Landfill, a 90-acre municipal solid waste facility, is currently undergoing closure. Over 16,000,000 tons of residential, street sweepings, construction and demolition materials were landfilled between 1957 and 1985. It is estimated that the waste can reach a thickness of 290 ft.

Miscellaneous Services

GeoSyntec has provided the following services:

- Performed a third-party review of the performance analyses conducted in support of construction of an alternative final cover.
- Developed recommendations for the installation of a geomembrane in a slurry cut-off wall installed at the toe of the landfill.

PROJECT TITLE:

GEOLOGICAL, GEOTECHNICAL, AND HYDROGEOLOGICAL SERVICES
PHASE I, II, AND III EXPANSIONS
SUNSHINE CANYON COUNTY EXTENSION LANDFILL
LOS ANGELES, CALIFORNIA

Client:

Browning-Ferris Industries

Owner Address:
14747 San Fernando Bl.
Sylmar, CA 91342

Contact Person:
Mr. Dan Tempelis
Formerly Area Engineer
(now with MWD)
(213) 217-7667

Contract Amount:
$650,000

WORK TASKS:

- **Review of Existing Data and Reports**
- **Geologic Mapping**
- **Geotechnical Sampling**
- **Piezometer Installation**
- **Geodetic Surveying**
- **Preparation of Geologic Cross Sections**
- **Geotechnical Laboratory Analyses of Soil**
- **Slope Stability Analyses**
- **Seismic Hazard Evaluation**
- **Seismic Site Response**
- **Seismic Deformation**
- **Groundwater Seepage Analyses**
- **Engineering Support**
- **Preparation of Reports**

Project Highlights

The Sunshine Canyon Landfill is a Solid Waste Landfill Facility located in the City and County of Los Angeles, California. The Sunshine Canyon Landfill encompasses the inactive City landfill, the active County Extension landfill, and the proposed City Extension Landfill linking the City landfill to the County Extension Landfill. The inactive City landfill is a 205-acre unlined Class III facility with approximately 18 million tons of refuse. The County Extension landfill is a permitted 17 million-ton capacity California Class III solid waste facility. The Proposed City Extension will have an approximate capacity of 55 million tons and will add 18 million tons of capacity to the County Extension.

Services Provided by GeoSyntec

GeoSyntec has been providing multi-discipline engineering services at the Sunshine Canyon Landfill since February 1993. GeoSyntec provided geologic, geotechnical, hydrogeologic, and hydrologic services for the County Extension Landfill for expansion Phases I, II-A, II-B, II-C, III-A, and III-B and for master planning of the proposed City Extension Landfill.

Services performed for the above-cited phases of landfill development include the following:

- geologic mapping of exposed bedrock for geologic structure and site stratigraphy;
- geomorphic mapping of landslides relative to the landfill expansions;
- subsurface investigations of **landslides** to define geometry for use in designing stable slope designs for landfill expansion, including downhole logging of bucket-auger borings, logging of oriented core, and acoustic televiewer logging of mud rotary borings;
- based upon mapping of landslides, back-calculation of the static stability of the landslides, and estimated shear strength parameters of clay seams within Towsley Formation bedrock;

- development of a bedrock structural model incorporating the site stratigraphic section, corehole data, and structural geologic data;
- logging of bucket-auger boreholes to document basal slip planes of landslides;
- installation of piezometers for the evaluation of confined groundwater and upward gradient conditions at the site;
- collection of samples of subsurface continuous cores from selected borings for geologic and geotechnical characterization and testing;
- geotechnical testing of soil and bedrock samples, including the performance of triaxial and direct shear tests for the development of peak and residual shear strength parameters;
- development of geologic cross sections to represent subsurface conditions in the expansion areas and in the landslide areas for use in slope stability analyses;
- analysis of field investigation and laboratory results, and evaluation of previous data, to develop engineering properties for the geologic materials at the site;
- slope stability analyses to develop grading, design, and construction recommendations, including landslide repair schemes;
- preparation of engineering reports summarizing the results of the studies performed for the various phases of landfill expansion;
- seismic hazard analyses;
- 1-D and 2-D seismic response analyses;
- seismic deformation analyses of the waste mass and fill and native cut slopes;
- hydrologic evaluation and design of the surface water management system; and
- ongoing groundwater monitoring.

PROJECT TITLE: **AZUSA LANDFILL**
SITE GEOLOGIC AND GEOTECHNICAL CHARACTERIZATION FOR SIDE SLOPE LINER AND FINAL COVER DESIGN

Clients:

WASTE MANAGEMENT, INC.

and

BFI

Clients:
Waste Management, Inc.
and
Browning Ferris Ind.

Addresses:
25772 Springbrook Road
Saugus, CA 91350
and
1209 West Gladstone St.
Azusa, CA 91702

Contact Person:
Mr. John Workman
(Waste Management, Inc.)
(661) 753-5276

WORK TASKS:

- Review of Existing Data and Reports
- Geologic Mapping
- Exploratory Drilling, Geologic Logging and Geotechnical Sampling
- Piezometer Installation
- Seismic Site Response Analysis
- Seismic Deformation Analyses
- Side Slope Liner and Final Cover Liner Design
- Preparation of Construction Documents and Third Party Review of Documents
- Engineering Support During Construction

Vibroseis Rig

Project Highlights

The Azusa Landfill is a 300-acre, approximately 250-foot deep excavation in gravels near the intersection of the 605 and the 210 freeways in Los Angeles County. The site is located in the San Gabriel Groundwater Basin. GeoSyntec has been providing technical services to the landfill for over a decade. Most recently, GeoSyntec has helped prepare liner design and landfill closure documents and responses to comments by the regulatory agencies. Over the years GeoSyntec provided the site with monitoring and regulatory compliance expertise, geologic and waste characterization, and geotechnical evaluations in support of continued expansion of the waste management unit.

Among other work, GeoSyntec evaluated:

- effects of vertical expansion on leachate and gas production and migration;
- side slope cuts as steep as 1.75H:1V in alluvial gravels;
- vertical, exposed liner placement over native alluvial outcrops;
- seismic site response analysis of a 250-ft high waste slope;
- in-situ density and shear wave velocity measurement by spectral analysis of surface waves; and
- deep drilling (>500 ft) in boulders.

Services Provided by GeoSyntec Consultants

GeoSyntec has served for many years as the primary site technical consultant on a wide variety of projects at the Azusa Landfill. GeoSyntec was initially involved as a third party reviewer of design documents prepared by another consultant. GeoSyntec's role as a

reviewer was ultimately expanded to include construction quality assurance (CQA) services during the design installation, and included prime technical consulting services for the landfill. For a 10-year period, GeoSyntec prepared all site technical documents, including 5-year permit reviews, Reports of Waste Discharge (ROWDs), Reports of Disposal Site Information (RDSIs), Waste Discharge Requirement (WDR) compliance and monitoring reports, design documents and closure documentation. Lately, consulting services in support of landfill development activities slowed as public opposition to the landfill increased.

GeoSyntec has evaluated the geology at the site, by literature review, mapping, and exploratory drilling. In an effort to optimize the data gathering process, schedule, and cost, GeoSyntec performed a side-by-side exploratory drilling comparison of air rotary methods and rotosonic drilling methods during the evaluation of subsurface lithology at the site. This innovative evaluation was continued during deep drilling within the waste mass, where combined bucket auger and rotosonic drilling techniques were used to evaluate geotechnical properties of waste. This evaluation was augmented by the used of Spectral Analysis of Surface Waves (SASW) testing of waste. This is a non-invasive geophysical technique used to evaluate stratigraphy and uniformity of the material being tested, in this case, waste. The process uses a mechanical source to impart energy to the surface of the waste (in this case, by a device known as a Vibroseis which induces low frequency, high energy waves into the waste mass). A detailed technical analysis of the reflection of those waves to receivers spread across the waste mass allows the evaluation of depth of the waste, thickness of various lenses within the waste, and overall uniformity of waste characteristics which may then be used for geotechnical evaluations (i.e., stability of cut waste slopes).

GeoSyntec has also installed a number of water wells, piezometers, landfill gas wells and landfill gas monitoring probes at the landfill in both waste and surrounding native alluvium. Certain of these wells were drilled to depths in excess of 500 feet, as well as within and through the waste mass into the underlying alluvium. Deep drilling in waste was performed with an innovative casing method to avoid cross-contamination of underlying strata. Data gathered from these wells and probes were used to characterize site geology and hydrogeology. GeoSyntec used innovative techniques to provide cost savings to the client for the abandonment of selected wells and probes. For the deep wells, GeoSyntec received agency approval for, and implemented an oil well abandonment technique that perforates the deep casing and uses pressure grouting to seal the bore and borehole annulus. The monetary savings realized relative to the costs of overdrilling were significant, both in labor effort and material disposal costs, while satisfying the regulatory agency desire to protect the underlying, protected water source.

GeoSyntec also designed and assisted with construction monitoring of innovative liner designs of both side slopes and final covers. Work included a demonstration that vertical expansion would not result in a short or long-term release of contaminants from the unlined portion of the landfill. Modeling demonstrated that the liquids contained within the waste mass would not migrate, and that active landfill gas operations would control gas migration. Side slope liner design involved evaluation and design of a shingle approach and single-liner tie-ins, and the evaluation of down-drag forces on existing site systems. GeoSyntec performed the slope stability analyses, including seismic response and seismic deformation analyses, using data gathered from the geologic and waste characterizations described above and in accordance with California Code of Regulations, Title 27 requirements.

PROJECT TITLE:

CAP AND BUTTRESS DESIGN FOR HAZARDOUS WASTE LANDFILLS CASMALIA HAZARDOUS WASTE MANAGEMENT FACILITY

JOB DESCRIPTION:

Client:
Casmalia Steering Committee

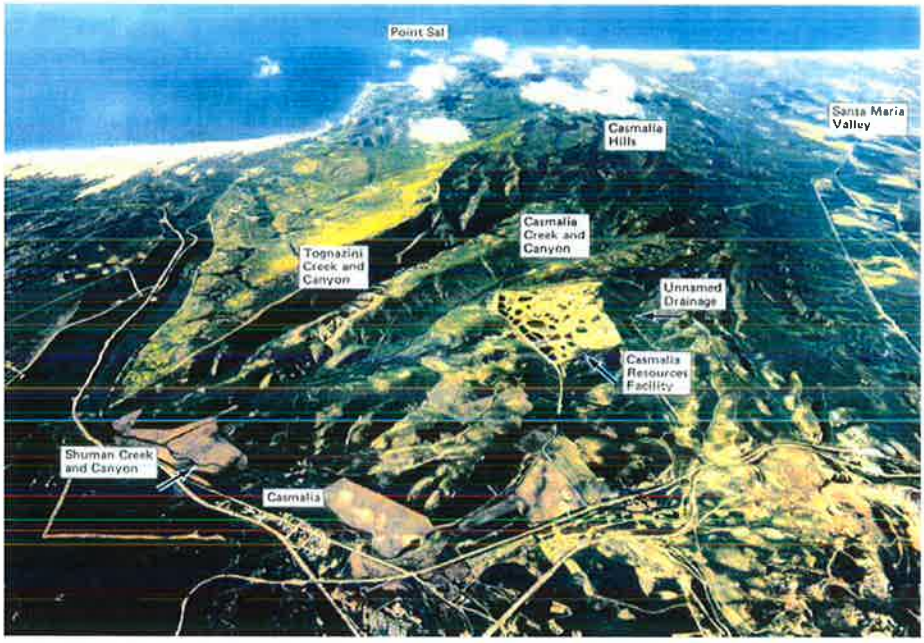
Client Address:
868 Greystone,
San Luis Obispo, CA
93401

Contact Person:
Mr. Corey Bertelsen
(805) 934-5941

Contract Value:
Approx. $2 million

Starting Date:
1997

Completion Date:
On-going



SERVICES PROVIDED:

- **Geotechnical, Seismic, and Engineering Geology Field Investigations**
- **Seismic Hazard Evaluation**
- **Slope Stability Analyses**
- **Seismic Response Analyses**
- **Seismic Deformation Analyses**
- **Closure Design**
- **Regulatory Approval (Federal: USEPA Region IX; State: DTSC, RWQCB)**
- **Construction Quality Assurance**

Project Highlights

The Casmalia Resources Hazardous Waste Management Facility (CRHWMF) is a former commercial hazardous waste disposal facility. The site has been recently placed on the National Priorities List (NPL) of Superfund Sites. During its 16 years of operation, CRHWMF accepted more than 4.5 billion pounds of industrial and commercial solid and containerized liquid wastes. The wastes were sorted, based upon chemical compatibility, into the following canyon-type landfills: PCB, Pesticides/Solvents (P/S), Heavy Metals, Caustics/Cyanides, and Acids landfills. The P/S landfill has recently been closed with a cap designed by Geosyntec. The Geosyntec-designed cap for the Heavy Metals Landfill is under construction. Geosyntec is currently completing the design of the cap and buttress systems for the Caustics/Cyanides and Acids Landfills. Construction of these caps and buttresses is scheduled for 2002.

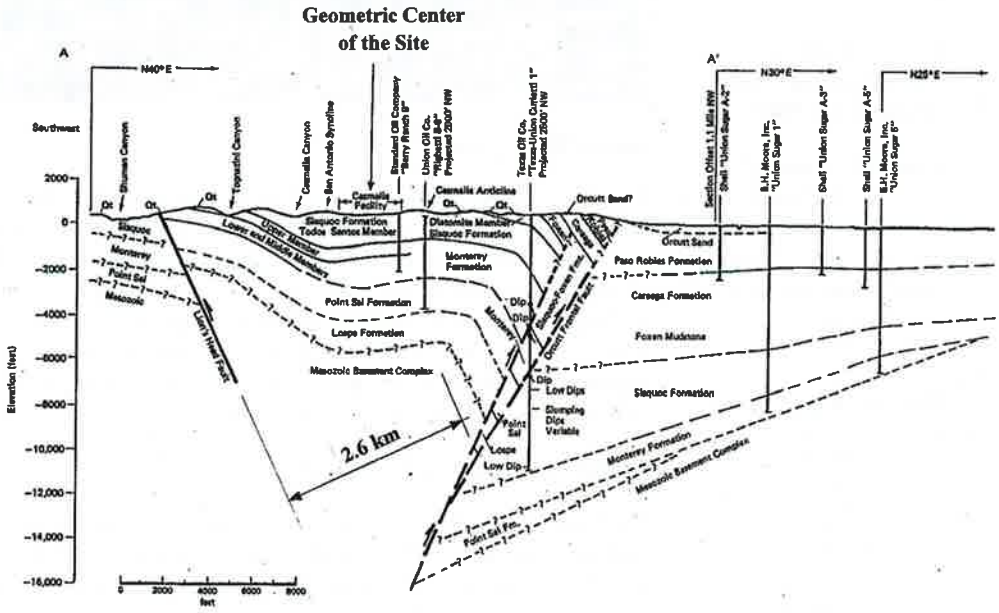
The closure of the 14-acre P/S Landfill was a major concern for both the Potentially Responsible Parties (PRPs) and regulators. A group of PRPs retained Geosyntec to characterize the landfill and develop remedial and closure solutions. As a part of closure design for the site, Geosyntec demonstrated static and seismic stability of the landfill mass, designed a buttress wall at the landfill toe to control percolating liquids, and designed composite landfill caps. Upon approval of the proposed design for the P/S Landfill, Geosyntec provided CQA services during the construction of the landfill cap and buttress.

Project Challenges

The Casmalia Site directly overlies two major thrust faults, the Orcutt Frontal and the Lion's Head Fault. The estimated bedrock Peak Horizontal Ground Acceleration (PHGA) from the Maximum Credible Earthquake (MCE) generated by these faults equals 0.86 g. The P/S landfill is the deepest and largest landfill at the site. The landfill consists of a soil – containerized liquid waste matrix with side slopes inclined at 3H:1V (Horizontal: Vertical).

Given the relatively high seismicity of the site, demonstration of existing waste mass stability and design of the P/S Landfill composite landfill cap were both significant challenges.

In order to characterize the soil – containerized liquid waste matrix and to provide input parameters for pseudostatic and seismic site response analyses of the P/S landfill, Geosyntec conducted a field investigation program. The program consisted of coordinated Cone Penetration Test (CPT) soundings and Spectral Analysis and Surface Waves (SASW) measurements combined with sampling and testing of materials from borrow sources used during waste placement (i.e., from which the soil matrix was derived). A local site-specific correlation with CPT tip resistance for landfill stability analysis was developed to estimate the undrained shear strength of waste mass materials. To evaluate seismic loading on the waste mass, non-linear seismic site response analyses were conducted in the time domain using the computer program D-MOD.



Considering a range of possible shear strength profiles and liquid levels within the landfill mass, Geosyntec demonstrated static and seismic stability of the waste mass to the satisfaction of the State and Federal regulatory agencies and developed a cost-effective composite landfill cap design. The design for the P/S Landfill was approved by both the State and Federal regulators and has now been constructed.

Geosyntec has performed conceptual design of the new Fill Area 2 landfill, including layout of a mile long access road. Based on land use conditions, Fill Area 2 was limited to a maximum of 250 acres and 40 million tons of municipal solid waste. Based on a total design airspace of 60 million cubic yards, Geosyntec optimized the design to a lined waste footprint of 208 acres, with an option for a future 29 acre tie-in between Fill Area 1 and Fill Area 2.

Puente Hills Landfill

Seismic Site Response and Deformation Analyses, 2003 and 2013 Configurations

Whittier, California

SANITATION DISTRICTS OF LOS ANGELES COUNTY

Client:
County Sanitation Districts of Los Angeles County

Owner Address:
1955 Workman Mill Rd.
Whittier, CA 90607

Contact Person:
Mr. Chuck Dowdell, R.G., C.E.G., *Division Engineering Geologist*, Solid Waste Management Department
(562) 699-7411

Project Features:

- Evaluation of Site Geologic and Geotechnical Conditions
- Seismic Hazard Evaluation
- Evaluation of Design Ground Motions
- Static and Pseudo-Static Slope Stability Evaluation
- 2-D Seismic Site Response Analysis
- Newmark-type Seismic Deformation Analysis

Project Background

The Puente Hills Sanitary Landfill is a California Class III landfill owned and operated by the County Sanitation Districts of Los Angeles County (Districts). The landfill site is located south of the Pomona Freeway (60) and east of the San Gabriel River Freeway (605), about 10 miles (16 km) east of downtown Los Angeles, California. As the landfill was approaching its 2003 permitted fill capacity, the Districts proposed a vertical expansion of the landfill and a 10-year extension of the 2003 operating permit to the year 2013. The expansion added approximately 90 feet of waste height to the Main Canyon area and approximately 180-feet of waste height to the Eastern Canyons area of the site.

Services Provided by GeoSyntec

GeoSyntec was contracted by the Districts to evaluate the seismic stability of the 2003 final configuration and the static and seismic stability of the proposed vertical expansion. The initial task on the project involved the review of available data, and development of representative cross sections for static analyses and seismic evaluations.

The seismic evaluations were performed for the Maximum Credible Earthquake (MCE) as defined in Title 27 of the California Code of Regulations. The evaluations included: (i) an evaluation of the seismic hazard for the site to establish the bedrock Peak Horizontal Ground Acceleration (PHGA), target acceleration response spectra, and significant duration of strong shaking (Ds) associated with the MCE for the site; (ii) selection of a suite of significant duration- and target spectrum compatible accelerograms to characterize the MCE; (iii) static and pseudo-static limit equilibrium stability evaluations for the waste mass / liner system for six representative cross sections developed through both the 2003 and 2013 Configurations; (iv) three one-dimensional (1-D) non-linear and three two-dimensional (2-D) equivalent linear seismic site response analyses of six representative cross sections developed by both GeoSyntec and the Districts; and (v) Newmark-type seismic deformation analysis for waste mass / liner system sliding blocks established by both the Districts and GeoSyntec for both the 2003 and 2013 Configurations.

Project Success

Calculations developed by GeoSyntec were used to design an effective expansion workplan that is functioning as designed. The expansion will add 10 years to the landfill acceptance period.