Review of Geotechnical Services
California Department of Transportation

Conducted August through November, 2006

By
Federal Highway Administration
In Conjunction with the
California Department of Transportation (Caltrans)

May16, 2007

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LIST OF ABBREVIATIONS

AASHTO - American Association of State Highway and Transportation Officials
ADSC – Association of Drilled Shaft Contractors
CALTRANS – California Department of Transportation
DOT – Department of Transportation
DES – Division of Engineering Services
FHWA - Federal Highway Administration
FR – Foundation Report
GDR – Geotechnical Design Report
GS – Geotechnical Services
LRFD – Load Resistance Factor Design
MR – Materials Report
PS&E – Plans, Specifications and Estimate

1.0 SUMMARY

A review of the California Department of Transportation's (Caltrans), Division of Engineering Services, Geotechnical Services (GS) program was conducted during the months of August through November 2006 by a review team comprised of FHWA, Caltrans, and other outside professionals. The review objectives were to evaluate the current geotechnical engineering practices and procedures used by Caltrans in project development, construction, and maintenance and to provide specific recommendations to strengthen current practices and procedures identified during the review.

The recommendations that follow are offered as constructive opinions, which, if implemented, could result in improvements in the quality, efficiency, and cost-effectiveness of Caltrans' geotechnical engineering functions and the State's annual program. A detailed explanation of each recommendation and respective observation is contained in Section 5 of this report.

Quality Management

Recommendation 1: Develop and implement a quality management program.

Recommendation 2: Develop a set of policies and procedures documenting the geotechnical standards of practice at Caltrans. Train internal staff and consultants on these policies and procedures. GS should consider adopting the FHWA and AASHTO publications that contain or cite the state-of-practice in geotechnical engineering for State Departments of Transportation (a list of these publications is included in the Appendix).

Recommendation 3: Ensure appropriate GS involvement during the project construction phase. Geotechnical observations and testing during construction are considered a continuation of project design and are essential to verify that the site conditions encountered are as anticipated.

Recommendation 4: Work with your clients (Design, Structure Design, Construction, Contractor, etc.) to ensure that your reports provide the information in an easily understandable format.

Recommendation 5: Develop your geotechnical design procedures and process to be compatible with Load Resistance Factor Design (LRFD) implementation.

Recommendation 6: Establish policy to ensure that District Design and Structures Design include GS in constructability reviews throughout the life of projects that include geotechnical related recommendations. GS should consider input from contractor associations.

Recommendation 7: Establish a procedure to ensure observations, findings and recommendations in the Geotechnical Design Report (GDR) and Foundation Report (FR) are consistent.

Recommendation 8: Route Geotechnical reports (GDR and FR) to appropriate groups (Design, District Materials Engineer, Construction, Environmental, Hydraulics, etc.) for review or information.

Risk Reduction through Improved Site Characterization Processes

Recommendation 9:
Provide time and resources for appropriate geotechnical site and subsurface characterization during the planning (K) phase of project development. This could include review of information from nearby projects, a site visit, and/or a geophysical survey.

Recommendation 10:
Explore ways to work more efficiently with Department Environmental Planning so that permits are obtained in a timely manner. Consider additional programmatic agreements for drilling services with resource agencies.

Recommendation 11:
Establish an educational exchange between GS and other units within the Department. These units include Design, Environmental, and Construction. The educational exchange should include technical issues related to geotechnical engineering and engineering geology practice as well as marketing and outreach to other Department functions.

Geotechnical Staffing and Professional Development

Recommendation 12: Review Geotechnical staffing in the Districts to ensure an appropriate level of Geotechnical presence.

Recommendation 13: Define the roles and responsibilities of Civil Engineers and Engineering Geologists within GS and utilize their professional expertise appropriately as part of a multidisciplinary team.

Recommendation 14: Develop a program whereby experienced geotechnical and geologic staff provide training and educational exchange to other GS staff. Also, establish a technical expert development program.

Slope Management Program

Recommendation 15: Develop and implement a proactive Slope Management Program that includes identification, prioritization and mitigation. It may begin as a district, regional or corridor-specific program.

Task Management Implementation

Recommendation 16: Continue implementation of task management to ensure the timely and cost effective delivery of geotechnical products and services.

2.0 INTRODUCTION AND BACKGROUND

At the request of State transportation agencies, the Federal Highway Administration (FHWA) reviews State geotechnical engineering programs to assure use of good engineering practices, and to assure compatibility with AASHTO approved standards and FHWA guidelines and technical recommendations. Results of these reviews permit a determination of the national state of practice, establish recommended areas of improvement for specific agencies, provide an effective vehicle for technology transfer, and produce input for the development of a national geotechnical engineering improvement program. Reports and findings of this activity have produced significant advances to technology, improved quality of geotechnically related features and reduced highway construction costs of participating agencies. Geotechnical features include the design and construction monitoring aspects of earthworks, structural foundations and earth retaining structures.

The review concept began in the early 1970s, when the FHWA conducted "Soil Management Reviews" of all State Transportation Departments. These reviews were updated with additional survey information between 1977 and 1981, and were more specifically oriented at structural foundations and earth retaining structures. The survey results were distributed nationally (August 1983) and became the basis for the FHWA "Foundation Engineering Improvement Program, FY 1983-87." The review program continued in the 1980's with the release of the 1986 "National Geotechnical Improvement Program" report, which outlined a 10-year business plan for the FHWA Geotechnical Engineering program. The current national review program began in the late 1990s.

The first documented FHWA review of the California Department of Transportation (Caltrans) geotechnical program was conducted in 1974 and then again in 1989. In an effort to evaluate their current practice and procedures, Caltrans requested a review of their geotechnical program via a formal request to the FHWA California Division Office. The team conducting this review was comprised of FHWA, State, and outside professionals with a variety of administrative and technical perspectives and responsibilities, with emphasis on structural, geotechnical and managerial skills. Members of the review team are identified in Table 1 below.

Table 1. Members of review team

Name	Affiliation	Title
Barry Siel, P.E.	FHWA Resource Center	Senior Geotechnical Engineer
Daniel Alzamora, P.E.	FHWA Resource Center	Geotechnical Engineer
Sarah Skeen, P.E.	FHWA California Division	Assistant Bridge Engineer
James E. Davis, P.E.	Caltrans	Deputy Div. Chief Geotech. Services
Mark Willian, P.G.; C.E.G.	Caltrans	Supervising Engineering Geologist
Craig Hannenian, P.E.	Caltrans	Sr. Materials & Research Engineer
Tony Allen, P.E.	Washington DOT	State Geotechnical Engineer
Mark Tufenkjian, Ph.D., P.E	CSU, Los Angeles	Professor of Civil Engineering

The review team followed the procedures and criteria in the FHWA publication PD-97-050, "The National Geotechnical Engineering Improvement Program." This document summarizes the national state of practice in geotechnical engineering and provides a nationally focused action plan of needs and improvements. Further, the review team evaluated the priority topics described in the project charter for the FHWA Review of Caltrans' Geotechnical Services. This project charter is shown in the Appendix. The objectives of the Caltrans review were to:

1. Assess the overall adequacy of the Caltran's geotechnical investigations, engineering design, and construction, including compatibility with AASHTO and FHWA guidelines and technical recommendations.

2. Assess if the Caltran's geotechnical organization, practices and procedures currently provide for the most efficient and cost-effective end product to the traveling public.

3. Develop a constructive quality improvement plan with measurable, targeted goals that will help improve existing practices, procedures, efficiency and cost-effectiveness, and upgrade Caltran's geotechnical capabilities.

4. Identify Geotechnical Services best practices and the best practices of other DOTs, FHWA, and AASHTO that could be used by Geotechnical Services to improve its program.

3.0 REVIEW FORMAT AND PROCEDURES

The review of Caltran's Geotechnical Services (GS) program was conducted between August and November 2006. Four separate visits were conducted in 3 of the State's 12 districts and in Headquarters. A peer exchange and final closeout meeting was also held at Headquarters. The districts were selected to provide a representative cross-section of the products and services GS provides to its clients. Table 2 below shows the review team's visitation schedule.

Table 2. Locations and dates of review visitations

Meeting Place	Date
Sacramento Office (Headquarters)	August 28-September 1
Eureka Office (District 1)	September 19-21
San Bernardino Office (District 8)	October 16-19
Los Angeles Office (District 7)	November 6-9
Sacramento Office (Headquarters)	November 28-30

The visitations generally lasted one week and included in-depth discussions with the Department units that interface with GS. These units typically included staff from Geotechnical Services, District Design and Construction, Structure Design and Construction, Environmental, Maintenance, and Project Management. Time permitting, a site visit was arranged at each meeting place that allowed team members a glimpse of a current GS project in the district. Descriptions of the sites visited are summarized in the Appendix. At the conclusion of the week, District Management was debriefed on the findings.

The review was performed by examining Caltrans standards and references that directly and indirectly address the scope and timing of geotechnical issues, reviewing technical references that are used to assure uniformity of practice, and reviewing project documents for selected projects. A complete list of the reviewed documents is shown in the Appendix. Key to the review process was information gleaned from on-site interviews with Caltrans and other personnel. Interviews and discussions with nearly 150 professionals occurred during the review process. One of the main objectives during the interview process was to obtain information on the

communication frequency and content between the units performing geotechnical functions and their clients. To gain an understanding of the role of each unit performing geotechnical functions, the following questions were asked during the interviews:

- What are your responsibilities?
- Who are your clients?
- What services do you provide?
- Describe how the interaction between your unit and your clients occurs.

A questionnaire addressing a broad range of procedural and technical issues related to the geotechnical program was provided to the supervisors of the following offices: Geotechnical Design; Geotechnical Support; Structure Design; Structure Construction; and Research & Innovation in advance of the interviews. The questionnaires enabled the review team to become more familiar with Caltrans geotechnical practices and procedures, and identified issues that were further discussed during the interviews. A sample questionnaire, with a summary of the responses, provided to Geotechnical Design is shown in the Appendix.

The purpose of the peer exchange and final closeout meeting was twofold. First, the peer exchange allowed a roundtable discussion of the proposed recommendations among senior DOT personnel from across the country with the aim of gathering their insight on strategies and potential complications when implementing the recommendations. The results of these discussions have been incorporated into the Observation descriptions as appropriate. Second, the closeout meeting allowed the review team an opportunity to present and discuss the major findings and recommendations to senior Caltrans management. The meeting agendas, list of meeting participants, and review notes from the peer exchange are shown in the Appendix.

The review team wishes to express its appreciation to all of the State personnel for their time and cooperation with this effort. The team was very impressed with the professional manner and cooperation of all of the Department personnel who participated in this review.

4.0 CALTRANS GEOTECHNICAL SERVICES PROGRAM

This section provides an overview of Caltrans' Geotechnical Services Program from a current and historical perspective. The information provided is based on discussions with members of the review team, review of reference materials, and interviews with Caltrans personnel who participated in the meetings.

4.1 Current Organization

Caltrans has been carrying out its mission of improving mobility across California for more than 100 years. It manages more than 45,000 miles of California's highway and freeway lanes, provides inter-city rail services, permits more than 400 public-use airports and special-use hospital heliports, and works with local agencies. Caltrans is organized into 12 geographic districts (see Figures 1 and 2) that are supported by the headquarters office in Sacramento. The Geotechnical Services (GS) subdivision is part of Caltrans' Division of Engineering Services (DES) and provides the districts, Structures, and headquarters with expertise in geotechnical engineering, geology, and specialized testing. Their primary clients within the Department are

the District's design, maintenance and construction programs, Structures Design, and Structures Construction. GS is made up of approximately 265 employees including 10% consultant staff, and is comprised of the Offices of Geotechnical Design, the Office of Geotechnical Support, and the Office of Drilling Services. An organizational chart for the DES as well as GS is shown on Figures 3 and 4. Organizational charts of each GS office are shown on Figures 5 through 10.

The Offices of Geotechnical Design provide their clients with expert soils and foundations recommendations during all phases of a project including project planning, project design, construction, maintenance, and emergency response. The offices are regionalized within the districts as shown on Figure 11, and include Design North, Design West, Design South 1, and Design South 2. The coverage area of the design offices are a function of the local populace and built environment. For example, Design West and South 1 have smaller coverage areas because they encompass the densely populated regions in and around San Francisco and Los Angeles, respectively. Two of the design offices (North and South 2) are headed by a manager who is physically located at headquarters in Sacramento. The manager of South 1 divides his time between his office in Sacramento and his office in District 7 (Los Angeles). The manager of West's office is located in District 4 (Oakland). The supervisor's staff is either located at headquarters and/or in the districts within each design office region. Geotechnical staffing is present in each design office region but not necessarily in each district. For example, in Design North, there are no geotechnical staff present in Districts 6, 9, and 10. In Design South 2, there is no geotechnical staff in District 8.

The Office of Geotechnical Support serves the Geotechnical Design Offices, and District and Structure Construction through specialized engineering geologic services, field instrumentation, pile testing, geotechnical training, and laboratory testing of soil and rock samples. The office consists of four branches: Foundation Testing, Geotechnical Instrumentation, Geotechnical Laboratory, and Geophysics. The office also contains two specializations: Scour Critical Program, and Training & Records. The Office of Drilling Services is headquartered in Sacramento and provides the drilling, sampling and in-situ testing to the Offices of Geotechnical Design.

The majority of the research and development program is carried out by the Division of Research & Innovation, which is a parallel group outside of DES. GS staff is involved in development of the program and in some instances they are responsible for specific project delivery. A smaller amount of research and development in the geotechnical area is done by personnel in GS.

4.2 Historical Perspective

In the 1970's the geotechnical personnel within Caltrans were divided among the Foundation Section at headquarters in Sacramento, the Division of Structures at headquarters in Sacramento, and the 11 district offices around the State (a 12^{th} district was later added). The function of the Foundation Section (which later became known as the Office of Geotechnical Engineering) was essentially as a consultant to the district offices by assisting with subsurface investigation and analysis of difficult or unusual foundation problems. They were also responsible for ensuring that the districts were conducting quality foundation investigations using efficient and up-to-date

methods, and conducted research to solve statewide geotechnical issues. At the time, their assistance was provided only if initiated by district personnel.

The function of the geotechnical personnel within the Division of Structures was to provide foundation exploration, analysis, and design for all structure foundations (e.g. bridges) in the State. Geotechnical personnel were grouped under the Bridge Geology Section, which later became know as the Office of Engineering Geology. Later, a smaller Office of Geotechnical Earthquake Engineering was developed and responsible for preparation of geotechnical earthquake design recommendations for Structures Design.

In 1993, Caltrans centralized all District and headquarters geotechnical functions under the Engineering Service Center as a state-wide consolidated function to deliver all geotechnical services to Districts and Structures Design. In 2001, Structural Foundations was reorganized to create three geographically based, single focal point geotechnical design offices (Design North, Design West, and Design South) and was renamed Geotechnical Services (GS).

In 2002, the Office of Geotechnical Design South was split into Design South 1 and Design South 2, where each was now responsible for its particular region in southern California. The Office of Geotechnical Earthquake Engineering was dissolved and personnel were redistributed to each of the four Geotechnical Design Offices. The four GS design offices (Design North, West, South 1, and South 2) were now responsible for all geotechnical products within their geographic areas.

5.0 OVERALL FINDINGS

This section details the Recognized Achievements of GS as well as the final Observations and Recommendations. The Observations and Recommendations have been grouped into the following five categories: *Quality Management*; *Risk Reduction through Improved Site Characterization Processes*; *Geotechnical Staffing and Professional Development*; *Slope Management Program*; and *Task Management Implementation*. The observations associated with each recommendation provide the background information and rational as to why the recommendation is being made. Information gleaned from the peer exchange related to best practices among FHWA, AASHTO, and other State DOTs has also been incorporated as appropriate.

5.1 Recognized Achievements

1. GS is commended for providing their customers with timely and quality geotechnical information. It was frequently noted during the interviews that GS's customers were very supportive of and pleased with their timely recommendations and innovative solutions to construction related problems. They were especially pleased with GS's responsiveness during emergency repair work.

2. It was widely acknowledged that drill crews were always available and responsive when requested. They often provided creative solutions when site access was difficult or made use of innovative drilling practices in environmentally sensitive areas.

3. GS is commended for developing an advanced soils laboratory data management system. The system replaces lab processes where test data had been logged by hand on paper forms. The system uses a network of touch-screen workstations where lab technicians use onscreen keypads to enter data during tests. The system automatically validates the data, compiles test results and generates appropriate reports. This initiative is a good example of the collaboration between GS and the Division of Research & Innovation.

4. GS is commended for developing two highly effective communications and marketing brochures. The first outlines its products and services and provides contact information based on design office coverage areas. The second brochure outlines GS's drilling services and is used to demonstrate the type of procedures used in environmentally sensitive areas to outside agencies.

5. GS is widely recognized as a DOT leader in the design, construction, and load testing of large diameter shafts and has provided significant contributions to the national pile load test database. They have made important contributions to the non-destructive testing of drilled shafts and have been the industry leader in developing quality control/quality assurance procedures for shaft defects using gamma-gamma logging.

6. GS is commended for developing a comprehensive Soil & Rock Logging, Classification, Description, and Presentation Manual (currently in final draft form). This manual is an important step in defining the Department's practice for presenting soil and rock descriptions and classifications, which will help standardize its logging practices.

7. GS has at its disposal several designated Senior Technical Specialists who can provide expertise in many aspects of geotechnical engineering and engineering geology. Having technical experts (who are nationally and internationally recognized) readily available is an advantageous and important resource.

8. GS is commended for putting on demonstration drilling exercises for its customers and resource agencies, which showcases their capabilities and environmental stewardship. The demonstrations are also an important communication tool with other units.

9. GS has historically been a leader in seismic design and research. Their employees have excellent depth and breadth of knowledge in the earthquake engineering field. They have helped develop and update important practice tools such as the Caltrans California Seismic Hazard Map. The Department has devoted $4 million annually for earthquake engineering research and frequently collaborates with the Pacific Earthquake Engineering Research Center.

10. GS is recognized for their development of software tools that allow better geotechnical project scoping and estimating. The software incorporates project geotechnical features to better scope field exploration needs and personnel resourcing for preparation of GDRs and FRs.

11. GS is commended for their capabilities in geophysical testing (e.g. seismic reflection/refraction surveys, ground penetrating radar, gamma-gamma and cross-hole sonic logging). They have applied advanced geophysical testing methods and data acquisition capabilities to a host of difficult field situations such as the use of slope stability radar at the Ferguson landslide near Yosemite Valley.

12. GS is recognized for their efficiency and problem-solving abilities during emergency response situations. GS is faced annually with several unstable slope situations that require the use of multidisciplinary quick response teams to mobilize, assess, analyze, and develop prompt solutions. GS has also successfully responded to tremendous regionally declared storm damage events by evaluating dozens of sites within one season. GS provided rapid response to many highways closed or threatened with closure due to landslides and floods

5.2 Observations and Recommendations

Quality Management

Recommendation 1:
Develop and implement a quality management program.

Observation:
GS relies on its supervisors for reviews of products and services. There is neither a documented nor systematic process in place to ensure consistent and competent products and services.

Recommendation 2:
Develop a set of policies and procedures documenting the geotechnical standards of practice at Caltrans. Train internal staff and consultants on these policies and procedures.

Observation:
A common theme among the geotechnical staff and with consultants was the lack of documented or familiarity with geotechnical standards of practice at Caltrans. The practice of geotechnical engineering at the Department varies widely given the diverse backgrounds and experiences of geotechnical staff, which affects consistency of the product quality and PS&E. Policies and standards need to include guidelines for site exploration, laboratory testing, analysis procedures (including seismic design and the use of standardized software packages), project file development and closeout procedures, and standards for the preparation of geotechnical reports. This is also key to the implementation of LRFD. To their credit, GS has begun developing standards and procedures by revising its soil and rock logging manual and developing guidelines for preparing GDRs and FRs. GS should consider adopting the FHWA and AASHTO publications that contain or cite the state-of-practice in geotechnical engineering for State Departments of Transportation. A list of these publications is included in the Appendix. GS may also wish to leverage information from existing geotechnical design manuals developed by DOTs in Washington, Nevada, and Kansas; as well as FHWA Federal Lands.

Recommendation 3:
Ensure appropriate GS involvement during the project construction phase. Geotechnical observations and testing during construction are considered a continuation of project design and are essential to verify that the site conditions encountered are as anticipated.

Observation:
The role of the geotechnical engineer and engineering geologist in a project does not end after subsurface investigation and design recommendations. Differing site condition issues frequently arise during construction and GS is not always called to assist in their evaluation and/or defense. Temporary works such as shoring are not typically reviewed by GS. GS should work to develop a closer relationship with Construction and be more involved in pre-construction meetings, review of temporary works such as shoring, review of differing site conditions claims, and inspector training so that Construction can be advised of unexpected conditions or other constructability issues that would require modifications to the original recommendations. In addition, the presence of GS at the site provides Construction with needed geotechnical expertise related to construction procedures.

Recommendation 4:
Work with your clients (Design, Structure Design, Construction, Contractor, etc.) to ensure that your reports provide the information in an easily understandable format.

Observation:
Many users both within and outside of the Department make use of the information contained in GS reports. However, not all of these end-users understand technical jargon and an attempt should be made to provide the end-user with pertinent information in an easily understandable format. Geotechnical recommendations are not always interpreted properly in the PS&E or by Contractors.

Recommendation 5:
Develop your geotechnical design procedures and process to be compatible with LRFD implementation.

Observation:
AASHTO and FHWA set a transition date of October 1, 2007 for all new bridges to be designed by the LRFD specification. GS needs to review its design practice for all foundations as part of the deadline. In terms of deep foundations, such as piles and shafts, the general Caltrans design practice limits vertical deformations to ½ inch or less, which results in not using end bearing in deep foundation capacity analysis. This in turn requires a larger and stiffer foundation with more steel in the foundation. This results in constructability issues and increases the cost of the foundation.

Maintaining the current deformation criteria, and considering it applicable to the strength limit state, in implementing LRFD in effect mixes the service and strength limit states. The strength limit state resistance factors provided in the current AASHTO specifications are not intended to be combined with deformation criteria. Force fitting this deformation based practice into LRFD as proposed by Caltrans is inconsistent with the intent of LRFD and has the potential to make the designs even more conservative relative to the current Caltrans practice.

It was observed that insufficient dialogue is occurring between GS and Structures Design, which is limiting the foundation options and exacerbating the deformation criteria problem. More teamwork and mutual understanding between GS and Structures Design needs to occur so that cost effective foundation options can be discussed. More interactive communication between the two offices is also necessary to fully implement LRFD, considering that each office contributes a portion of the design, and considering that those portions affect one another.

The AASHTO state-of-practice publication for LRFD bridge design is "LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition;" or "LRFD Bridge Design Specifications, SI. Units, 4th Edition."

Recommendation 6:
Establish policy to ensure that District Design and Structures Design include GS in constructability reviews throughout the life of projects that include geotechnical related recommendations. GS should consider constructability input from contractor associations.

Observation:
GS needs to be more involved in constructability reviews of the draft (50% and/or 75%) and final PS&E. Geotechnical recommendations are not always included or interpreted properly. This can lead to issues with constructability. These constructability issues lead to increased project costs due to change orders and differing site condition claims by contractors during construction. Contractor associations are not currently included in constructability reviews. The Washington DOT utilizes the Association of Drilled Shaft Contractors to review shaft recommendations for constructability.

Recommendation 7:
Establish a procedure to ensure observations, findings and recommendations in the Geotechnical Design Report (GDR) and Foundation Report (FR) are consistent.

Observation:
Geotechnical engineering and some engineering geology have historically existed within the Roadways side of Department (earthwork, soundwalls, standard retaining walls etc.) while both geotechnical engineering and engineering geology existed on the Structures side (bridges, non-standard retaining walls, etc.). The timing of the project development process often necessitates creation of separate geotechnical reports (GDR versus FR). Consequently, geotechnical information may be communicated to clients in multiple forms by more than one author, which increases the chance for contradictory geotechnical information and recommendations. Additionally, all sources of geotechnical information should be readily available to the contractor.

Recommendation 8:
Route Geotechnical reports (GDR and FR) to appropriate groups (Design, District Materials Engineer, Construction, Environmental, Hydraulics, etc.) for review or information.

Observation:
It was observed in some districts that geotechnical reports were not reaching some functional units that could use or influence these recommendations.

Risk Reduction through Improved Site Characterization Processes

Recommendation 9:
Provide time and resources for appropriate geotechnical site and subsurface characterization during the planning (K) phase of project development. This could include a site visit, review of information from nearby projects, a site visit, and/or a geophysical survey.

Observation:
Adequate geotechnical information, investigation and analysis are often insufficient during the planning (K) phase of a project. Geotechnical input is usually sought right before or during design, or in some cases after design and prior to construction. This leads to increased risk and project costs resulting from inadequate or inappropriate preliminary geotechnical design recommendations. GS is often requested to provide project input on multiple projects in a short amount of time during a programming cycle. More proactive planning by the department as a whole to get the geotechnical site investigation completed earlier in the project schedule is needed.

Recommendation 10:
Explore ways to work more efficiently with Environmental Planning in the districts so that permits are obtained in a timely manner. Consider additional programmatic agreements for drilling services with resource agencies.

Observation:
The time required to obtain environmental compliance for site investigation has significantly increased. The need for geotechnical investigations and appropriate environmental compliance is not being identified in the planning stage of project delivery. This has on some occasions led to inadequate site and subsurface characterization prior to foundation selection by choosing not to perform drilling at particularly difficult environmental sites, which has the effect of transferring risk to the construction phase of the project. This in turn has led to change orders and differing site condition claims by contractors during construction, which has significantly increased the total project costs. Two key environmental agreements that currently exist are the programmatic Categorical Exemption agreement with FHWA and the agreement that relates to the Department's Cultural Resources. Establishing additional pre-arranged agreements with other key resource agencies may help streamline the permitting process.

Recommendation 11:
Establish an educational exchange between GS and other units within the Department. These units include Design, Environmental, and Construction. The educational exchange should include technical issues related to geotechnical engineering and engineering geology practice as well as marketing and outreach to other Department functions.

Observation:
In many instances Department units outside of GS were unaware of or misinformed about GS duties, responsibilities, and capabilities. This was especially apparent with District Design, Environmental, and Construction. There has been high turnover and new hiring in these groups that has made this more challenging. GS has also experienced high attrition leading to less

presence in the Districts. GS also must improve its awareness and knowledge about the duties, responsibilities and capabilities of other functional units within the Department.

Geotechnical Staffing and Professional Development

Recommendation 12:
Review Geotechnical staffing in the Districts to ensure an appropriate level of Geotechnical presence.

Observation:
Project workload (emergency response and more traditional geotechnical-type products) necessitates that geotechnical staff be physically located in some districts. Currently, Districts 1 through 5, 7, 11, and 12 have geotechnical engineering staff present in the district; Districts 6, 8, 9, and 10 do not. There has been high attrition in GS over the last year. Staffing levels should be reviewed and modified to include more geotechnical presence in the appropriate districts.

Recommendation 13:
Define the roles and responsibilities of Civil Engineers and Engineering Geologists within GS and utilize their professional expertise appropriately as part of a multidisciplinary team.

Observation:
Successful geotechnical engineering and engineering geologic practice relies on the expertise and integration of both Civil Engineers and Engineering Geologists. GS must recognize and appreciate the contributions of both professions and utilize their expertise as part of a multidisciplinary team.

Recommendation 14:
Develop a program whereby experienced geotechnical and geologic staff provide training and educational exchange to other GS staff. Also, establish a technical expert development program.

Observation:
It generally takes 5 to 7 years of experience to become a journey-level geotechnical professional. GS has had a high attrition over the last few years leading to a loss of technical expertise. GS should consider providing staff with professional development training to ensure that they are engaged, motivated, well-rounded, possess good decision-making skills, and prepared to handle various challenging assignments. Training should include geotechnical experiences in field investigation, design, inspection, construction support, emergency response, and maintenance. GS should also provide a process by which dissemination of research and technical practice occurs. This will help maintain employee competency and stem the loss of institutional knowledge through attrition. There is no technical expert succession plan.

Slope Management Program

Recommendation 15:
Develop and implement a proactive Slope Management Program that includes identification, prioritization and mitigation. It may begin as a district, regional or corridor-specific program.

Observation:
Due to the amount of unstable slopes (landslides, rockfall, debris flows, etc.) impacting Department right of way annually, some form of comprehensive slope management system is needed. A more proactive approach to handle unstable slopes would help reduce liability. The program may be developed at the district, regional, or statewide level. The Washington Department of Transportation model is one to consider, as well as programs established at other DOTs such as Tennessee, New York, New Mexico, Montana, Oregon, Colorado, and Wyoming. Efforts in this direction exist in some districts. For example, District 8 has identified the need for a proactive slope management program. District 7 has had a number of studies performed on slope assessment, but has not been successful in securing funding. District 5 has worked closely with various stakeholders to develop the Coast Highway Management Plan along the Big Sur Coast. This is not a pure proactive slope management plan, but a hybrid that streamlines the process of reacting to unstable slope damage. Permanent funding for such a program may have to come from the state legislature. Program funding is key to the successful implementation of a slope management program.

Task Management Implementation

Recommendation 16:
Continue implementation of task management to ensure the timely and cost effective delivery of geotechnical products and services.

Observation:
GS plays an important role in the Department's overall project delivery and must be accountable to both its internal and external customers. Task management is the assignment of individuals to manage the scope, cost and schedule of particular deliverables on a project and is a tool for effective communication of responsibilities at all levels of a project. Task managers "plan the work" by participating in the development of the Project Management Plan, committing to the scope, schedule and resource estimates for their work packages, and delivery of their work product. The Department needs to support task management efforts by providing adequate project management tools and processes so that GS can be successful in task management implementation.

APPENDIX

1. Meeting Agendas
2. List of Participants
3. Reference Material Reviewed
4. AASHTO and FWHA State-of-Practice Publications in Geotechnical Engineering
5. Project Charter
6. Sample Questionnaire
7. Sites Visited
8. Review Notes from Peer Exchange

1. Meeting Agendas

FHWA REVIEW OF GEOTECHNICAL SERVICES
August 28, 2006 – September 1, 2006
Caltrans - Transportation Laboratory
5900 Folsom Blvd, Sacramento, CA

Monday, August 28: Introducing GS to FHWA (10:30 – 4:00)

Topics: Plan for the Week
- Questionnaire
- Organization Chart
- Policy and Procedures
- Business Process Review and Improvement Proposal
- Business Plan
- Standards (Reports, LOTB)
- Data Management and Records
- Quality Management

Tuesday, August 29: Geotechnical Services (8:00 – 11:30)

Topics: FHWA Review Charter (Major Topic Areas)
- Business Plan
- Business Process Review and Improvement Proposal
- Quality Management
- Vision
- Questionnaire Responses

Tuesday, August 29: LRFD (12:30 – 4:00)

Topics: LRFD

Wednesday, August 30: Structure Design, Externally Financed Projects (8:00 – 10:30)

Topics: Structure Design Support
- Questionnaire Responses

Wednesday, August 30: Structure Construction, HQ Construction (12:30 – 3:00)

Topics: Construction Support
- Differing Site Conditions/Claims
- GS/Structure Construction Partnering
- Questionnaire Responses

Thursday, August 31: Division of Research and Innovation (8:00 – 9:30)

Topics: Research Topics
- Interaction with GS
- Questionnaire Responses

Thursday, August 31: HQ Design (9:30 – 10:30)

Topics: Highway Design Manual
- Project Development Procedures Manual
- Overhead Signs
- Tire Shred Usage
- Communication of Policy and Procedures to Districts

Thursday, August 31: Structure Specifications, Office Engineer (12:30 – 3:00)

Topics: Differing Site Conditions/Claims
- Contract Documents (what is and what is not)
- Non-Standard Specifications
- Information Handout

Friday, September 1: Kleinfelder (8:00 – 10:00)

Topics: Quality Management
- Borehole Logging and Presentation Standards
- Data Management (Storage/Retrieval of Logs/Reports/Data)

FHWA REVIEW OF GEOTECHNICAL SERVICES
September 18, 2006 – September 21, 2006
Farm Bureau Building
5601 South Broadway
Spruce Point Conference Room, Suite A
Eureka, CA

Tuesday, September 19: Geotechnical Services Eureka Staff (8:00 – 4:00)

Wednesday, September 20: North Region Environmental (8:00 – 9:30)

Topics: Marketing Brochure
- Exploration Drilling Permits
- Site Access
- Storm Damage Response

Wednesday, September 20: District 1 Maintenance (10:00 – 11:30)

Topics: Site Access
- Traffic Control
- Storm Damage Response
- Storm Damage Funding
- On-site Services
- Scaling

Wednesday, September 20: North Region Design (1:00 – 3:00)

Topics: Exploration Drilling Permits
- Site Access
- Geotechnical Design Reports
- Quality and Consistency of GS Products
- Storm Damage Response
- Overhead Sign Foundations
- Wall Design
- Shrink-Swell Issues
- Communication
- Marketing Brochure
- On-site Services

Wednesday, September 20: District 1 Project Management (3:30 – 5:00)

Topics: Marketing Brochure
- Planning Process
- Project Scoping and Estimating
- Task Management
- Risk Management
- Exploration Drilling Permits
- Site Access
- Storm Damage Response

Thursday, September 21: District 1 Construction & Structure Construction (8:00 – 9:30)

Topics: Geotechnical Design Report
- Foundation Reports
- Project Information SSP
- Claims
- Construction Support
- Review of Shoring Plans
- Non-Standard SSP
- Non-Destructive Testing
- Drilled Shafts
- Shrink-Swell Issues

Thursday, August 31: District 1 Management (11:00 – 12:00)

Topics: Review the Week and present "Recommendations and Successes"

FHWA REVIEW OF GEOTECHNICAL SERVICES
October 16, 2006 – October 19, 2006
San Bernardino, CA

Monday, October 16: Geotechnical Services Staff (11:00 – 1:00, Room 1120)

Monday, October 16: District 8 Environmental (1:00 – 3:00, Room 1120)

Topics: Marketing Brochure
Exploration Drilling Permits
Site Access
Storm Damage Response

Monday, October 16: District 8 Design (3:00 – 5:00, Room 1120)

Topics: Exploration Drilling Permits
Site Access
Geotechnical Design Reports
Quality and Consistency of GS Products
Storm Damage Response
Overhead Sign Foundations
Wall Design
Shrink-Swell Issues
Communication
Marketing Brochure
On-site Services

Tuesday, October 17: Geotechnical Services Staff (8:00 – 9:30, Room 718)

Tuesday, October 17: District 8 Maintenance (10:00 – 11:30, Room 718)

Topics: Site Access
Traffic Control
Storm Damage Response
Storm Damage Funding
On-site Services
Scaling

Tuesday, October 17: District 8 Project Management (1:00 – 3:00, Room 718)

Topics: Marketing Brochure
Planning Process
Project Scoping and Estimating
Task Management
Risk Management
Exploration Drilling Permits
Site Access
Storm Damage Response

Wednesday, October 18: District 8 Construction & Structure Const (8:00 – 9:30, Room 1225)

Topics: Geotechnical Design Report
Foundation Reports
Project Information SSP
Claims
Construction Support
Review of Shoring Plans
Non-Standard SSP
Non-Destructive Testing
Drilled Shafts
Shrink-Swell Issues

Wednesday, October 18: Field Trip (10:00 – 5:00)

Thursday, October 19: District 8 Management (8:00 – 10:00, Room 1227)

Topics: Review the Week and present "Recommendations and Successes"
Unstable Slope Management Program

FHWA REVIEW OF GEOTECHNICAL SERVICES
November 6, 2006 – November 9, 2006
Los Angeles, CA

Monday, November 6: Geotechnical Services Staff (10:00 – 5:00, Room 03.026)

Tuesday, November 7: District 7 Environmental (8:00 – 9:30, Room 03.026)

Topics:
- Marketing Brochure
- Exploration Drilling Permits
- Hazardous Waste Clearance
- Site Access
- Storm Damage Response

Tuesday, November 7: Structure Design (10:00 – 11:30, Room 03.026)

Topics:
- Structure Design Support

Tuesday, November 7: District 7 Maintenance (1:00 – 2:30, Room 03.026)

Topics:
- Site Access
- Traffic Control
- Storm Damage Response (Roles of GS, Maintenance, Construction)
- Storm Damage Funding
- On-site Services
- Scaling

Tuesday, November 7: District 7 Design (3:00 – 4:30, Room 03.026)

Topics:
- Exploration Drilling Permits
- Site Access
- Geotechnical Design Reports
- Quality and Consistency of GS Products
- Storm Damage Response
- Overhead Sign Foundations
- Wall Design
- Shrink-Swell Issues
- Communication
- Marketing Brochure
- On-site Geotechnical Services Staff
- District Consultant Contracts

Wednesday, November 8: District 7 Project Management (8:00 – 9:30, Room 03.026)

Topics:
- Marketing Brochure
- Planning Process
- Project Scoping and Estimating
- Task Management
- Risk Management
- Exploration Drilling Permits
- Site Access

Storm Damage Response
District Consultant Contracts

Wednesday, November 8: District 7 Construction & Structure Const (10:00 – 11:30, Room 03.026)

Topics: Geotechnical Design Report
Foundation Reports
Project Information SSP
Claims/DSC
Construction Support
Review of Shoring Plans
Non-Standard SSP
Non-Destructive Testing (GGL and CSL)
Drilled Shafts
Shrink-Swell Issues

Thursday, November 9: District 7 Management (9:00 – 10:00, Room 03.026)

Topics: Review the Week and present "Recommendations and Successes"

FHWA REVIEW OF GEOTECHNICAL SERVICES
November 28, 2006 – November 30, 2006
Sacramento, CA

Tuesday, November 28: Team Meeting (8:00 – 11:30, Translab Auditorium)

Topics: Review Report and Prepare for Peer Exchange

Tuesday, November 28: Peer Exchange (1:00 – 4:30, Translab Auditorium)

Topics: Discussion of FHWA Recommendations

Wednesday, November 29: Peer Exchange (8:00 – 11:30, Translab Auditorium)

Topics: Open Forum

Wednesday, November 29: Team Meeting (1:00 – 4:30, Translab Conference Room)

Topics: Discussion of FHWA and Peer Recommendations

Wednesday, November 29: LRFD (1:00 – 4:30, Translab Auditorium)

Topics: Discussion of Example Designs

Thursday, November 30: Caltrans Management Briefing (1:00 – 3:00, Translab Auditorium)

Topics: Review the process and present “Recommendations and Successes”

2. List of Participants

FHWA REVIEW OF GEOTECHNICAL SERVICES
August 28, 2006 – September 1, 2006
Caltrans - Transportation Laboratory
5900 Folsom Blvd, Sacramento, CA

Angel Perez-Cobo	Senior Transp. Engr., Caltrans Geotechnical Services
Deh-Jeng Jang	Senior Transp. Engr., Caltrans Geotechnical Services
Tim Pokrywka	Office Chief, Caltrans Geotechnical Design –West
Roy Bibbens	Office Chief, Caltrans Geotechnical Design – North
Tom Shantz	Senior Engineer, Caltrans Division of Research & Innovation
Sue Hida	Senior Bridge Engr., Caltrans Structures Design
Kevin Thompson	Deputy Division Chief, Caltrans Structures Design
Ron Richman	Branch Chief, Caltrans Geotechnical Design – North
Elias Kurani	Office Chief, Caltrans Structures Design
Mohammed Islam	Senior Engr., Caltrans Geotechnical Design –South 1
Dan Adams	Senior Bridge Engr., Caltrans Structures Design
Shannon Post	Office Chief, Caltrans Structures Design
Mike Keever	Supervising Bridge Engr., Caltrans Earthquake Engineering
Earl Seaberg	Supervising Bridge Engr., Caltrans Office of Special Funded Projects
Kathryn Griswell	Retaining Wall Specialist, Caltrans DTS
Tom Ostrom	Chief Bridge Engineer, Design North, Caltrans Structure Design
John Babcock	Supervising Bridge Engr., Caltrans Structure Construction
Chuck Suszko	Office of Construction Engineering, Caltrans Structure Construction
David Keim	Bridge Construction Engineer, Caltrans Structure Construction
John Walters	Bridge Construction Engineer, Caltrans Structure Construction
Tom Shantz	Senior Engineer, Caltrans Division of Research & Innovation
Paul Davies	Senior Transp. Engr., Caltrans Headquarters Roadway Drainage Design
Kevin Herritt	Chief, Caltrans Office of Geometric Design Stds., Division of Design
John Ehsan	Chief, Caltrans Geotechnical Design – South 1
Mary Beth Herritt	Chief, Caltrans Office of Project Development Procedures; Division of Design
John Stayton	Office Chief, Caltrans SDSEE/SOE
Ruth Fernandes	Branch Chief, Caltrans SDSEE/SOE
Guadalupe Magana	Caltrans Office Engineer - OCCS
Bruce Hilton	Principal Geologist, Kleinfelder
Stephen Boll	Principal, Kleinfelder
Zia Islam	Group Manager, Kleinfelder
Charles Smiroldo	Director Quality Assurance, Kleinfelder
Darrell Beddard	Contract Manager, Caltrans OSCM
Sam Jee	Transportation Engineer, Caltrans OSCM
Deh-Jeng Jang	Senior Transp. Engr., Caltrans Geotechnical Services

FHWA REVIEW OF GEOTECHNICAL SERVICES
September 18, 2006 – September 21, 2006
Farm Bureau Building
5601 South Broadway, Eureka, CA
Spruce Point Conference Room, Suite A

Charlie Narwold	Office of Geotechnical Design North
Kathy Gallagher	Office of Geotechnical Design North
Reid Buell	Office of Geotechnical Design North
John Ehsan	Office of Geotechnical Design South 1

Lena Ashley	Environmental
Rod Parsons	Environmental
Nick Motto	Rock Scaling
Stan Woodman	Maintenance
Sebastian Cohen	Storm Management Coordinator
Kelly Timmons	Design
Dennis McBride	Design
Cindy Graham	Design
Valency Langtry	Design
Talitha Stronsom	Design
Juan Salas	Design
Michael Stapleton	Materials
Richard Mullen	Project Management

Friday Ululani	Construction
Larry Bowermaster	Construction
Terry Davis	Construction Manager
Dan Thomas	Structure Construction
Matthew Brady	Program Project Management
Mark Suchanek	Materials and Operations
Charlie Fielder	Division 1 Director

FHWA REVIEW OF GEOTECHNICAL SERVICES
October 16, 2006 – October 19, 2006
San Bernardino, CA

Mark DeSalvatore	Senior M&R Engr; Office of Geotechnical Design South 2
Brian Hinman	Office of Geotechnical Design South 2
Tim Lam	Office of Geotechnical Design South 2
Marie Petry	Senior Environmental Planner
Ernie Figueroa	Deputy Division Director Environmental Planning
Russell Williams	Biology, Sr. Environmental Planner
David Bricker	Cultural Studies; Sr. Environmental Planner
Boniface Udotor	Senior Environmental Planner
Don Copeland	Sr. Biological Construction Monitor
John Bumps	Design Senior
Jesus Paez	Design
Jesus Galvan	Design Services
Savat Khamphou	Design Oversight
Christy Connors	Design Manager
Renee Sasse	Design Senior
George Morhig	Design Senior
Larry Heasley	Maintenance Manager District 8
Catalino Pining	Maintenance Project Manager
Armand Silva	Maintenance Area Superintendent
Eric Hedberg	Maintenance Area Superintendent
John Hubbs	Maintenance Area Superintendent
Nader Naguib	Project Manager
Mohammad Mollazadeh	Project Manager
Nassim Elias	Project Manager
Rafih Achy	Project Manager
Paul Engstrom	Project Management District Deputy Director
Alfonso Gonzalez	Resident Engineer
Fred Khosrowabadi	Construction Engineer
Bruce Kean	District Materials Engineer
Alex Angha	Senior Bridge Engineer
Hector Davila	Construction Deputy Director

FHWA REVIEW OF GEOTECHNICAL SERVICES
November 6, 2006 – November 9, 2006
Los Angeles, CA

Fariborz Gahvari	Senior Trans. Engr. (Geotechnical Liaison) OGDS-1
Deh-Jeng Jang	Senior Trans. Engr. OGDS-1
John Ehsan	Chief, OGDS-1
Mohammed Islam	Senior Trans. Engr./Seismic Specialist OGDS-1
Sharid Amiri	Senior Trans. Engr. OGDS-1
Ted Liu	Senior Trans. Engr. OGDS-1
Gustavo Ortega	Geologist OGDS-1
Gary Iverson	HRC, Environmental Planning
Karl Price	Senior Environmental Planner
Jennifer Leung	Associate Environmental Planner
Frank Cheng	TE, Hazardous Waste
Ros Dimenstein	TE, D, Hazardous Waste
Mina Pezeshpour	Senior Bridge Engr., Structure Design
Wallie Jordan	MM II, Maintenance North
Dan Sanchez	MM II, Maintenance Special Crews
Don Sizemore	MM I, Maintenance East Region
Asadour Terterian	Senior Trans. Engr., Design
Charles Ton	Senior Trans. Engr., Design C
Nancy Pe	Senior Trans. Engr., Design A
Khan Hossain	Senior Trans. Engr., Design D
Oji Kalu	Senior Trans. Engr., Design B
Osama Megalla	Project Manager, District 7
Sam Tzou	Sr. Trans. Engr, Construction
Roy Fisher	Area Construction Manager, Office of Structure Construction
Henry Kirshner	Bridge Construction Engineer, Office of Structure Construction
Roger Miramontes	Bridge Construction Engineer, Office of Structure Construction
Joseph Tehrani	Sr. Trans. Engr, Construction
Ken Burkle	Bridge Construction Engineer, Office of Structure Construction
Godson Anyanwu	Sr. Trans. Engr., Materials Lab
David Njoya	Sr. Trans. Engr, Construction
Mohammad Pasebani	Sr. Trans. Engr, Construction
Bob Buckley	Chief, Division of Engineering Services
Tony Tavares	Division of Engineering Services
Doug Failing	District 7 Director

FHWA REVIEW OF GEOTECHNICAL SERVICES
Peer Exchange
November 28, 2006 – November 30, 2006
Sacramento, CA

Rick Land	Project Delivery Deputy Director, Chief Engineer
Bob Buckley	Chief, Division of Engineering Services
Bob Pieplow	Construction Division Chief
Rob Stott	Structures Design & Earthquake Engineering
Kevin Thompson	Deputy Division Chief, Structure Design
Dennis Scovill	Chief Operating Officer, FHWA- CA Division
Rich Weaver	Environmental Management Office, Caltrans
Glenn DeCon	Hydraulic Engineer, Caltrans
Dolores Valls	Deputy Division Chief, Structure Construction
Bob Burnett	Civil Engineer, New York DOT
John Pilipchuk	Western Regional Geotech. Engr., North Carolina DOT
Jim Brennan	Assistant Geotech. Engr., Kansas DOT
Bob Myers	Geotech. Section Manager, New Mexico DOT
Parviz Noori	Assistant Matls. Engr. Geotech., Nevada DOT
Tony Allen	State Geotech. Engr., Washington DOT
Scott Anderson	Geotechnical Leader, FHWA Federal Lands
Curtis Monk	Division Bridge Engr., FHWA – Iowa
Bill Forester	Director Engr. Services, FHWA –CA Division
Peter Osborn	Geotech. & Hydraulics Team Leader, FHWA
John Ehsan	Office of Geotechnical Design South 1
Abbas Abghari	Office of Geotechnical Design South 2

3. Reference Material Reviewed

Geotechnical Services Overview:

1. Project Charter, FHWA Review of Caltrans Geotechnical Program (Fall 2006).
2. Previous FHWA Review Documents.
    a. Management Review of the California Division of Highway's Soil Engineering Program (1974).
    b. Management Review of the California Division of Highway's Soil Engineering Program (1976).
    c. Federal Highway Administration Review of Geotechnical Practice (1989).
    d. Review of Geotechnical Practices by Caltrans' District Offices (1990).
3. Caltrans District Map
4. Organization Charts
5. Delegation of Authority Memo
6. Geotechnical Services Marketing Brochure
7. Drilling Services Brochure
8. Sub-Surface Exploration (Drilling Services) Fact Sheet (2006)
9. Business Plan
10. Task Management
11. Business Process Review and Improvement Team
    a. Proposal Document
    b. GS Product List and Module Description
12. Quality Management
    a. QC/QA for Geotechnical Services for Preparation of Geotechnical Design Reports and Foundation Reports
    b. Deputy Directive – 90, Funding of Quality Management Work on State Highway Projects
13. GDR & FR Activity Network Diagram
14. Data Management and Records
    a. Geotechnical Data Management Initiatives at Caltrans
    b. Geotechnical Data Lifecycle (Existing)
    c. Geotechnical Data Lifecycle (Proposed Future Process)
    d. CTeFile Demonstration
15. Geotechnical Laboratory Certification
16. List of Committees
17. List of Experts
18. Decision Documents
    a. Consolidating Responsibilities (April 5, 1993)
    b. Consolidation of Geotechnical Activities (August 10, 1993)
    c. Consolidation of Geotechnical Operations (October 22, 1993)
    d. Geotechnical Consolidation of District 4 Personnel (May 11, 1995)
    e. Reorganization of the Offices of Geotechnical Earthquake Engineering and Geotechnical Design South (September 27, 2002)
    f. Transfer of Geotechnical Staff from District 4 (June 30, 2003)
    g. Log of Test Boring (LOTB) Sheets (February 2006) – DRAFT

Standards Maintained by Geotechnical Services

19. Guidelines for Preparing Geotechnical Design Reports
20. Guidelines for Structure Foundation Reports Version 2.0
21. Soil & Rock Logging Classification Manual (Field Guide), 1996
22. Soil & Rock Logging, Classification, Description and Presentation Manual, 2006

   a. List of Outstanding Issues – GSMT
   b. List of Outstanding Issues – Field Logging Committee
23. Assessing and Responding to Major Damage Caused by Unstable Slopes
24. Code of Safe Drilling Practices
25. GS Procedures
   a. Overhead Sign Foundations
   b. Report Titles and Guidelines
   c. Project Information
   d. Core Room
26. Non-Standard Special Provisions
27. Tire Shred Usage in Lightweight Fill

Standards Maintained by Others

28. Highway Design Manual
   a. Geotechnical Design Report or Materials Report (Sec. 111.2)
   b. Reinforced Earth Slopes and Earth Retaining Systems (Sec. 210)
   c. Geotechnical (Sec. 805.6)
29. Project Development Procedures Manual
   a. Table of Contents
   b. Materials (Sec. 6)
30. Standard Specifications
   a. Examination of Plans, Specifications, Contract, and Site of Work (Sec. 2-1.03)
   b. Coordination and Interpretation of Plans, Standard Specifications, and Special Provisions (Sec. 5-1.04)
   c. Differing Site Conditions (5-1.116)
31. Standard Special Provisions
32. Standard Plans
33. Bridge Standard Details Sheets
34. Bridge Memos to Designers
   a. Foundation Data (1-35)
   b. Pile Foundation Design (3-0)
   c. Deep Foundations (3-1)
   d. Piles Adjacent to Existing Roadway or Private Property (3-4)
   e. Large Diameter Hollow Prestressed Driven Piles (3-6)
   f. Spread Footings (4-1)
   g. Superimpose Footing Locations on Log of Test Borings Sheet (4-2)
   h. Mechanically Stabilized Embankment (5-8)
   i. Earth Retaining Structures Using Tiebacks (5-12)
   j. Review of Working Drawings for Tieback Anchors (5-14)
   k. Review of Working Drawings for Proprietary Earth Retaining Systems (5-16)
   l. Earth Retaining Structures (Costs) (5-17)
   m. Soil Nail Walls (5-18)
   n. Foundation Report/Geotechnical Design Report Checklist for Earth Retaining Systems (5-20)
35. Bridge Design Aids
   a. Earth Retaining Systems (3-1.1)
   b. Mechanically Stabilized Embankment (3-8)
   c. FORCES: Cantilever Sign Truss on Retaining Wall (3-9)
   d. Foundation Investigation and Reports (15-2)
36. Bridge Design Details
   a. Foundation Plan Checklist
37. Bridge Design Practice

    a. Substructures (Sec. 5)
38. Bridge Design Specifications
    a. Foundations (Sec. 4)
    b. Retaining Walls (Sec. 5)
39. Surface Fault Rupture Guidelines
40. Seismic Design Criteria v1.3
41. Construction Manual
42. Falsework Manual
43. Trenching and Shoring Manual
44. California Foundation Manual

LRFD

45. Geotechnical Services LRFD Team Issue Paper
46. California Amendments to AASHTO LRFD Bridge Design Specifications

Discussion Topic Documents

47. Geotechnical Baseline Report
48. Geotechnical Services Coordination on Culvert Rehabilitation
49. OSC-GS Partnering Meeting Minutes (June 22, 2006)

Questionnaire Responses

50. Geotechnical Design Offices
51. Geotechnical Support
52. Structure Design
53. Structure Construction
54. Research and Innovation

4. AASHTO and FHWA State-of-Practice Publications in Geotechnical Engineering:

a) AASHTO LRFD Bridge Design Specifications, Customary U.S. Units, 4th Edition; or LRFD Bridge Design Specifications, SI Units, 4th Edition;"

b) Subsurface Investigations - Geotechnical Site Characterization Reference Manual, FHWA-NHI-01-031.

c) Geotechnical Engineering Circular No. 5 - Evaluation of Soil and Rock Properties, FHWA-IF-02-034.

d) Micropile Design and Construction, FHWA NHI-05-039.

e) Geotechnical Engineering Circular No. 8 – Augercast Piles (not yet published).

f) Geotechnical Engineering Circular No. 7 – Soil Nail Walls, FHWA-IF-03-017.

g) Mechanically Stabilized Earth Walls and Reinforced Soil Slopes, FHWA NHI-00-043.

h) Soil Slope and Embankment Design, FHWA NHI-01-026.

i) Rock Slopes, FHWA HI-99-007.

j) Geosynthetic Design and Construction Guidelines, FHWA HI-95-038, Revised April 1988.

k) Ground Improvement Techniques, FHWA-SA-98-086R (printed August 2001).

l) Geotechnical Aspects of Pavements, (NHI course manual, new 2006).

m) Manual for Design and Construction of Road Tunnels, (not yet published).

5. Project Charter

Purpose

Provide an independent multi-functional (including geotechnical engineers, structural engineers and engineering geologists from FHWA, Caltrans, other DOT's and Consultants) review of Caltrans' geotechnical program to ensure it is in compliance with AASHTO and FHWA guidelines and technical recommendations and is providing cost effective quality products to its clients. The review objectives are to:

- Assess the adequacy of current Caltrans geotechnical program, through a review and evaluation of organizational structure, policies, procedures, guidelines and practices used during project development, construction and maintenance activities.
- Provide specific recommendations to improve the quality and cost effectiveness of the current Caltrans geotechnical program via enhancements and changes in organizational structure, policies, procedures, guidelines and practices identified in the review.
- Identify FHWA, AASHTO, State DOT or other documents that can be leveraged and implemented as best practices.

Topics to be Evaluated – First Priority

- Management and communication of policy, procedure, guidelines and practices (Corporate)
- Organizational Structure and responsibilities - Corporate and Line, geographical organization (by Districts) vs. specialized functional units (foundations, roadway, seismic, etc.), and use of senior specialists
- Quality Management Program
- Specifications and Special Provisions
- Review of Design Offices Processes
    - Foundation Report Guidelines and development process
    - Geotechnical Design Report Guidelines and development process
    - Seismic recommendations, hazard identification and mitigation processes (Seismic Design Guidelines)
    - Interaction with Structure Design
    - Bore Hole Logging (Logging Manual)
    - Construction Claims and Differing Site Condition Response
    - LRFD Implementation
- Review of Geotechnical Support Processes
    - CIDH Quality Assurance

Topics to be Evaluated – Second Priority

- Business Process Review Implementation (BPRI) Team Recommendations
- Correct use of professional staff (Engineering Geologists and Geotechnical Engineers)
- Use of committees, and structure and effectiveness of those committees
- Draft Decision Document (LOTB)

- Participation in nationally non-profit organizations such as the Association of Drilled Shaft Contractors
- Training Program
- Contracting out practices and efficiencies
- Geotechnical Data Management System
- Use of tools (SUV's, conferences, training, etc)
- Research Program
- Review of Design Offices Processes
    - Estimating process and tracking systems
    - Implementation of New Technologies
    - Construction and Structures Construction Support
    - Drilling Requests
    - Laboratory Requests
- Review of Geotechnical Support Processes
    - Geotechnical Laboratory
    - Pile Load Testing
    - Geophysics
    - Scour Program
    - Project Filing and Archiving
- Review of Drilling Services Processes
    - Drilling Operations and efficiencies
    - Code of Safe Drilling Practices

Success Criteria

- Help us to know ourselves better and provide direction and recommendations that can be used to improve our products and services.
- Provide direction, recommendations, and best practices that have been implemented successfully by other States.

Due Date

- A draft report and presentation should be presented to the Caltrans Geotechnical Management team by _____.
- A final report and presentation should be presented to the Geotechnical Management team by _____.

Resources

- Caltrans will provide staff to participate in interviews and policy, procedure, guidelines and practice documents. Interviews will include staff from:
    - Geotechnical Services
    - Structures Design
    - Structures Construction
    - Office Engineer
    - District Maintenance
    - Division and District Design
    - Division and District Construction
    - Division of Research and Innovation

    - Division of Design
- FHWA will provide resources to interview Caltrans employees, review Caltrans policies, procedures, guidelines and practices, research and identify best practices and make recommendations.

Sponsor

- James E. Davis, Deputy Division Chief-Geotechnical Services, Caltrans
- Barry Siel, Resource Center, FHWA

Documents to Review

- Highway Design Manual
- Construction Manual
- List of Guidance Material
- Draft Decision Documents
- Standard Specifications
- Standard Special Provisions
- Non-standard special provisions
- Marketing Brochure
- SUV Legislation
- 2006/2007 Research Roadmap
- Code of Safe Drilling Practices
- Draft Soil and Rock Logging, Description, Classification and Presentation Manual
- Differing Site Condition Study
- Business Plan
- Committee Charters
-

Approved Decision Documents

6. Sample Questionnaire

FHWA Review of Geotechnical Services
Summary Results of Design Office Questionnaire

ORGANIZATION

1. In which organizational unit(s) are geotechnical specialists located (excluding technicians and drilling personnel)?

Central Office Technical services unit
District/Region Offices
Research unit

2. What are the key units and positions for coordination and review (approval) of consultant geotechnical work?

Unit: Geotechnical Design Offices
Position(s): Engineers and geologists

3. What is the total number of geotechnical specialists (geotechnical engineers, engineering geologists and geologists - excluding technicians and drillers) in the State DOT organization?
Approximately 240 positions -

Geotech Engineers 65 %
Engr. Geologists 35 %
Geologists

4. How many geotechnical specialists (geotechnical engineers, engineering geologists and geologists) are located in:

Central office 75 %
District/Reg. Office 25 %

5. What State manuals, standards, or directives are used to maintain uniformity of geotechnical operations?

Agency Construction manual (Geotechnical Sections)
Agency Design or Bridge manual (Geotechnical Sections)
Agency Special Geotechnical publications, (provide specific references and titles, provide copies of items circled above at interview)
FHWA design guide publications
Soil & Rock Logging Manual 1996

6. Who initiates geotechnical design work in the following project phases?

	Bridge Projects	Roadway Projects
a. Planning	OSD	District
b. Preliminary design	OGD	GPE
c. Final design	OGD	GPE
d. Construction (monitoring and problem solving)	OGD	GPE

SUBSURFACE INVESTIGATION

7. Who [(1)central office, (2) district office, or (3) not applicable] requests subsurface explorations in the following project phase(s)? Fill in 1, 2, or 3 in blank spaces

	Bridge Projects	Roadway Projects
a. Planning	OGD	OGD
b. Preliminary design	OGD	OGD
c. Final design	OGD	OGD
d. Construction	OGD	OGD

8. Are existing testhole logs, water well logs, soil maps, aerial photos, ground water resource bulletins, geology maps/publications routinely consulted before requesting subsurface explorations? (Unusual/Major Projects only) Yes

Does your Agency maintain a database of existing testhole information? Yes for CPT, no for boreholes

9. Who provides the details of sampling, field testing, boring depths, etc. for each of the following project types: Geotechnical Engineers and Engineering Geologists

10. What types of in situ tests are used by the State to determine the engineering properties of soil and rock? Check one

	Routinely	Occasionally	Special project only
a. Standard penetration test	X		
b. Static cone penetrometer		X	
c. Vane shear			X
d. Dynamic penetrometer		X	
e. Pressuremeter			X
f. Dilatometer			X

11. Are field moisture content tests done before packaging soil samples for shipment to lab?

No

12. How many drill crews statewide?
We run 8 to 9 in-house crews and 0 to 4 consultant crews.

What is the typical crew size? We generally run a three-man drill crew.

Total number of drillers and driller‘s helper positions?
SEE ORGANIZATION CHART ATTACHED.

13. How many drill rigs, what types? (include only operational equipment)
13 MUD ROTARY RIGS – includes 3 all terrain -- 1 horizontal – 1 light weight barge rig
What equipment is needed? We are acquiring the necessary equipment for Air Rotary capabilities.

14. Are preliminary layouts for bridges and retaining walls available prior to planning and conducting subsurface investigations?

Yes

15. Who is responsible for preparing the field exploration logs? (geologist, engineer, drill inspector, driller?)

In-House Drilling Geologist/Engineer

Contract Drilling Contractor

Is the person on the contract-drilling rig a state employee?

Sometimes

16. How often do State drilling personnel receive training in subsurface exploration techniques and procedures? Annually

17. Check the frequency of use of the following geotechnical instrumentation? Check one

	Routinely	Occasionally	Special project only
a. Settlement plates	X		
b. Survey deflection		X	
c. Inclinometers	X		
d. Strain gages			X
e. Load cells			X
f. Piezometers	X		

g. Time domain reflect. X

18. Are visual descriptions of soil and rock samples routinely done by:

Technicians or Geotechnical Specialists in the field

19. Which of the following is the routine procedure for determining groundwater elevations?

Determined during drilling
Determined 24 - 48 hours after drilling
Establish observation well or piezometer

20. Are special tests such as vane shear, cone penetrometer, and pressuremeter performed in the field by:

District geotechnical unit
Central office geotechnical unit

21. What type of hammers are used when conducting standard penetration tests

Number state owns
a. Donut Hammer (cathead & rope) 0
b. Automatic Hammer 7
c. Safety Hammer 6

22. Have energy measurements been made in an effort to calibrate the agency's SPT hammer systems on each of the drill rigs?
WE HAVE ATTEMPTED THIS BUT RESULTS ARE IN DISPUTE.
Yes No

(Provide a copy of calibration report during review)

23. What type(s) of core barrel(s) does the state utilize when coring rock:
Circle one or more (if more than one type, indicate the reason for the variation)

a. Single tube
b. Double tube
c. Triple tube
d. Wire line

24. What is the frequency of use of the following geophysical test methods:

	Routinely	Occasionally	Special project only
a. Electrical Resistivity			X
b. Seismic Techniques		X	

(refraction, reflection, etc.)
c. Ground Penetrating Radar X

25. Briefly describe the applications where each geophysical and non-destructive tool is applied.

Seismic refraction for rippability, gamma-gamma and CSL for CIDH

LAB TESTING

26. Who selects test samples and decides which laboratory tests will be performed on soil and rock samples for foundation design of walls and structures?

Geotechnical specialist

27. List the laboratory (soil/rock) testing equipment, which the state owns and indicate the approximate age, whether or not the equipment is automated for loading, data acquisition and data reduction.

Automated Loading/ Equipment (Type)	Age (Years)	Data Acquisition/ Data Reduction (Yes/No)
Triaxial (3)	4	yes
Consolidation (4)	4	yes
Direct Shear (2)	2	yes
Unconfined Compression	1	yes
Permeability (2)	?	no
Point Load (1)	?	no
Expansion Index (2)	1	no

28. Who selects test samples and decides which laboratory tests will be performed on soil and rock samples for foundation design of roadway embankments?

Geotechnical specialist

29. Which one of the following tests are performed routinely on DISTURBED samples (split spoon, liner, Dennison, etc.) for: Insert the appropriate test number(s) in the blanks below

Tests

(1) Visual description
(2) Moisture content
(3) Atterberg limits
(4) Gradation
(5) Hydrometer

(6) Percent organic
(7) Penetrometer, torvane or lab vane
(8) Electrochemical

Bridge & Wall Borings		Roadway Borings	
a. Cohesionless soils	1,4,5	a. Cohesionless soils	1,4,5
b. Cohesive Soils	1,2,3,5,7,8	b. Cohesive Soils	1,2,3,5,7
c. Organic soils	1,2,3,4,6,7,8	c. Organic soils	1,2,3,5,6

30. Which of the following laboratory tests are performed routinely on UNDISTURBED samples BEFORE specifying strength or consolidation tests?

Bridge Wall Borings	Roadway Borings
Visual description	Visual description
Penetrometer, torvane or lab vane	Penetrometer, torvane or lab vane

31. Which rock properties indices/tests are routinely performed?

Core Recovery
Rock Quality Designation
Unconfined compression test
Point load

32. Which of the following geosynthetic tests are performed by the State laboratory?

a. No geosynthetic testing is performed
b. Tensile strength (which test)
c. Puncture
e. Abrasion
f. Durability
g. Hydraulic (which test)
h. Other (list and briefly describe)

33. Is the laboratory test data provided to the geotechnical designer for interpretation or only the interpreted results? We forward only the results of index tests. Triaxial, unconfined compression, direct shear and consolidation test data and results are provided to the designers so they can perform their own review and interpretation, if desired.

34. Do lab technicians receive training on test procedures? Yes

If Yes, briefly describe frequency and extent of training:

Annual internal reviews and bi-annual AASHTO (AMRL) certifications, training is conducted in accordance with our AASHTO certification

35. Does the geotechnical section supervise geotechnical lab technicians? Yes

36. Are physical properties of common soil and rock deposits correlated Statewide for future use (i.e.: data base of soil boring logs)? Not currently, but we are working towards that goal

DESIGN GENERAL

37. Is the Geotechnical/Foundations Section involved in the following (for Bridge projects indicate appropriate choice with a "B", for Roadway projects indicate appropriate choice with an "R"): Indicate appropriate “C” for central office and “D” district offices. (Example “BC-bridge-central office)

In-House Design	Routinely	Occasionally	Never
a. Provide input during project location/planning stage	BRC		
b. Review draft EIS	BRC		
c. Field Reconnaissance	BRC		
d. Provide input to prelim. design	BRC		
e. Review final PS&E	BRC		
f. Participate in Plan-in-Hand Field Reviews			X
g. Participate in Pre-Construction Meeting		BRC	
h. Meet with Project Engineer prior at start of construction to discuss important geo-aspects		BRC	
i. Troubleshoot construction problems	BRC		

Consultant Design	Routinely	Occasionally	Never
a. Provide input during project location/planning stage		BRC	
b. Review draft EIS		BRC	
c. Field Reconnaissance		BRC	
d. Provide input to prelim. design		BRC	
e. Review final PS&E	BRC		
f. Participate in Plan-in-Hand Field Reviews		BRC	
g. Participate in Pre-Construction Meeting		BRC	
h. Meet with Project Engineer prior		BRC	

to start of construction to discuss important geo-aspects

i. Troubleshoot construction problems — BRC

38. Are geotechnical analyses, bearing capacity, settlement, stability, etc. routinely performed on:

a. Earthwork projects? Yes
b. Structural foundation projects? Yes

39. Which type/size projects, if any, do not require geotechnical analyses? Landscaping, pavement rehab, guardrail.

40. List methods of analysis used for:

a. Slope stability: Janbu, Bishop, Spencer, Bilinear, Ordinary

b. Embankment settlement: One-dimensional consolidation theory, Modified Terzaghi and Peck, Schmertmann.

c. Footing bearing capacity/settlement: Terzaghi, Hansen, CPT, SPT

d. Pile foundation design/construction control: Design: Sand-Norland, Clay-Alfa. Construction: Gates, PDA, static pile load test.

e. Drilled shaft design/construction control: Design: FHWA Design manual. Construction: gamma-gamma, CSL, static pile load test.

41. How often are technical feasibility, constructability and cost comparisons performed during preliminary design of structural foundation alternates? Routinely

42. Has the State utilized spread footings on:

a. Approach embankments? No

b. Natural soil deposits? Yes
If yes, typical range of allowable bearing capacity used? 2-5 tsf

43. Are FHWA geotechnical publications, Geotechnical Engineering Notebook issuances or Geotechnical Engineering Circulars used routinely by designers? Yes

List publications most often used. Drilled Shafts, Driven Piles, Shallow Foundations, Rock Slopes, MSE, Soil Embankments.

44. Are design computations typically retained in the project files until completion of construction? Yes

45. Are project specific laboratory strength and consolidation results routinely used as basis for geotechnical analyses, particularly stability and settlement? Yes

46. Does the geotechnical specialist who performs geotechnical design computations routinely make a visual review of soil and rock samples? Yes

47. With what frequency does the geotechnical designer prepare subsurface profiles for:

a. Bridge:	Routinely	X	Occasionally	Rarely
b. Roadway:	Routinely	X	Occasionally	Rarely

48. Are field logs and lab data routinely available at the time of design?

	Yes	No
a. Roadway	X	
b. Bridges	X	
c. Retaining Walls	X	
d. Pavements	X	

49. Do geotechnical designers interact routinely with structural designers to determine realistic foundation requirements? Yes

Briefly describe the interaction and communication process (include formal and informal interaction): We receive a formal memo request. Geotechnical Designer and Structural Designer discuss alternative pile types. We verbally discuss constructability issues and provide preliminary pile tips for alternate pile types. A Foundation Report is prepared by Geotechnical Designer to formally transmit recommendations to Structural Designer. If Structural Designer requests changes in foundation system then an amended report is produced.

50. How often does the geotechnical designer review the final plans prior to project advertisement to insure all appropriate geotechnical recommendations have been included?

a. Bridge:	Routinely	X	Occasionally	Rarely
b. Roadway:	Routinely	X	Occasionally	Rarely

51. Describe the State's design approach or method for handling lateral loads on driven piles and drilled shafts (indicate specific technical references as appropriate):

a. Routine projects: For standard retaining walls, sign foundations and noise barriers the lateral loads are converted to a toe pressure or soil pressure and geotechnical designer verifies that ground meets those requirements. For non-standard walls, geotechnical provides peak ground acceleration. For soil nail walls, geotechnical designer uses SNAIL program to analyze seismic case.

b. Projects where lateral load are significant: For bridges, a Senior Seismic Specialist provides input parameters (p/y, t/z, q/z curves, ARS curves) to structural designer who does lateral pile analysis.

52. How are the effects of negative skin friction (downdrag) accounted for on driven pile and drilled shaft projects?

Increased allowable stress of pile/shaft material
Bitumen coating
Preloading
Extend length of piles

53. For each of the following pile types estimate the percentage of use (base percentage on estimate of all types of highway features which require deep foundations):

a.	Timber	1
b.	Precast concrete	30
c.	Closed end steel pipe	10
d.	Open end steel pipe, steel H	15
e.	Shell Piles (Mandrel Driven)	0
f.	Monotube	1
g.	Composite	1
e.	Drilled shafts	40
f.	Others (micropile, augercast)	2

54. Indicate the frequency of use of the wave equation on Driven Pile projects

Routinely Occasionally X Rarely

Done in-house or by Contractor? Both

55. How are wave equation results used? Hammer approval, construction driving control

56. Are geotechnical designers responsible for preparing and reviewing updates to foundation and earthwork specifications? Yes

Briefly describe the role of the geotechnical unit in preparation of specifications, special provisions, and plan details: Review and approve special provisions, check standard specs and plans to make sure geotechnical recommendations are covered.

57. Approximately when was the most recent "major rewrite" of State specifications for the following items? (Provide approximate dates for each item.)

a.	Excavation and embankment	2006
b.	Driven piles	2006
c.	Drilled shafts	2006

d. Geosynthetics 2006
e. Earth retaining systems 2006

58. Do geotechnical designers receive routine training in new design techniques? Yes

Briefly describe the training opportunities which are routinely used to train technical staff: FHWA course, cross training, seminars, Capital Projects Staff Development (CPSD) courses.

59. How often does the geotechnical unit responsible for design prepare a geotechnical report that contains interpretation and analysis of subsurface data, along with design and construction monitoring recommendations?

	Routinely	Occasionally	Never
a. Embankment foundations	X		
b. Soil and rock slopes	X		
c. Structural foundations	X		
d. Retaining walls	X		

60. Is a subsurface profile drawing included in the final geotechnical report?

a. Bridge No
b. Roadway No

61. Is the soil profile drawing included in the plans for:

a. Bridge No
b. Roadway No

62. Are the boring logs included in the contract plans or special provisions for:

a. Bridge Yes
b. Roadway Yes

63. Are computer assisted drafting techniques used for subsurface profiles? Yes

HP Workstation, Microstation, gINT

64. List the distribution of the geotechnical report(s).
Foundation Reports to Structure Design
Geotechnical Design Reports to Districts

65. Which of the following are made available to bidders? Laboratory data, Soil/rock samples, Boring logs, Geotechnical/Foundation reports, Subsurface profile.

66. Who routinely responds to field geotechnical construction problems?

District geotechnical specialists
Central office geotechnical specialists

67. Do central office or district geotechnical specialists inspect spread footing excavations before the footing pour? No

68. How often do the central office or district geotechnical specialists provide technical training for construction and design personnel? Rarely

69. Do geotechnical specialists monitor or supervise either dynamic or static pile load tests? Yes

70. How frequently are static pile and drilled shaft load tests conducted?

	Often	Occasionally	Never
a. Compression		X	
b Tension		X	
c. Lateral		X	

Briefly describe recent or near future intent to use either statnamic and/or Osterberg load testing: Osterberg used on Beneicia-Martinez Bridge in 2005, may use on Antler Bridge in 2008.

71. For what purpose are static/dynamic load tests performed?

Verify design load
Modify tip elevation or design load
Establish pile type or length and driving criteria
Quality Assurance for driving system and pile damage

72. Who is responsible for the interaction of test pile and load test results, and subsequent decisions regarding order lengths and driving criteria? Central office geotechnical specialist

73. How frequently does the State perform dynamic pile testing?

Routinely Occasionally X Rarely

State owns dynamic pile testing equipment.

74. Who is responsible for contractor hammer approval? Main office geotechnical specialist

75. How are earthwork material sources for construction handled? Approved by the State

76. Which of the following apply in standard bridge approach embankment sections?

Special materials (topsize, gradation, etc.)
Special compaction requirements (e.g. < 8" lifts, 100 percent AASHTO T - 99)

77. Approximately what percentage of change orders and construction claims are related to geotechnical items? 10%

78. Is the geotechnical unit (central office, district) typically requested to provide assistance in the evaluation and resolution of significant change orders and construction claims? Yes

79. What percentage of the combined project engineering and construction budget is spent annually on geotechnical investigation and engineering? 2%

80. Is the agency using the bridge scour guidance contained in the FHWA Hydraulic Engineering Circular 18, FHWA NHI-01-001? Yes

81. Who performs the scour depth estimates or measurements? Hydraulics unit

82. Are soil type/gradation and rock type taken into consideration when estimating scour depth? Yes

83. Briefly describe the timing and process for the incorporation of scour analysis results into the foundation design for bridge substructures: Hydraulics group estimates the scour depth. This length of pile is added to the length needed for axial and/or lateral loads.

84. Geographically, what percentage of the State requires major seismic design considerations? 100%

Has the state developed it's own seismic zonation map? Yes
If yes, what is reoccurrence interval (years) for design earthquake? MCE

What is the current highest seismic acceleration (%g) used in design? 0.7 g

Is the geotechnical unit involved in seismic design issues? Yes

Which geotech designs include seismic: All designs.

85. Is the geotechnical unit involved in vessel impact design issues? No

86. What design tools are used where seismic effects are incorporated into the design?
Caltrans Seismic Hazard Map, SHAKE, LPILE, GROUP

87. What design tools are used where vessel impact effects are incorporated into the design?
LPILE, GROUP

88. What are the State's technical needs in the area of Seismic Design and Retrofit?

We need help with developing and applying Seismic Design Criteria to retaining walls. For bridges we can always streamline and improve our process. Some suggestions are updates to our tools such as the CA Seismic Hazard Map, reviewing our Fault Rupture Guidelines, exploring opportunities to incorporate the probabilistic methods to our work and making sure that our ground motions database is current and accurate.

EARTH RETAINING SYSTEMS

89. Does the State have a formal written policy on the selection, design, and review/acceptance of new or proprietary earth retaining systems? Yes

90. What is the State policy/procedure for the evaluation/acceptance of new earth retaining systems prior to approving the system for routine use? By Earth Retaining Structure Committee and HDM Topic 210. We request that the vendor use HITEC.

91. What restrictions does the State have, if any, on certain types of earth retaining systems? Guidelines are provided by Earth Retaining Structure Committee and HDM Topic 210.

92. What technical guidelines and design procedures are available for the analysis of noise wall, sign and light standard foundations? Caltrans standard specifications.

93. Which operating units of the State routinely review and comment on earth retaining designs submitted by consultants and wall suppliers? Caltrans DES/Structure Design Support/ Earth Retaining System Specialist.

94. What contracting approaches for earth retaining structures are currently used or have been used previously by the State? Generally, we fully develop plans and specifications for walls. For MSE walls alternative proprietary walls are permitted in addition to the fully designed wall system.

95. What design, construction, and contracting problems has the State experienced with specific types of earth retaining systems. Soil nail wall: differing site conditions, specifications were not followed.

96. Since 1990, approximately how many of the following earth retaining systems has the State constructed? **We do not track these quantities**

CIP Concrete Cantilever/Counterfort Wall
Timber Crib Wall
Concrete Crib Wall
Metal Bin Wall
Gabion
Reinforced Soil Slope
Cantilever Sheetpile Wall
Soldier Pile and Lagging Wall

Slurry (Diaphragm) Wall
Tangent Pile/Secant Pile Wall
Soil Mix Wall
Ground Anchored Wall (all types)
Soil-Nailed Wall
Micropile Wall

Prefabricated Modular Block Facing (MSE) Wall
List types

Segmental, Precast Facing Mechanically Stabilized Earth (MSE) Wall

Reinforced Earth
VSL/Foster
Hilfiker
Tensar
Other (types)

Geotextile/Geogrid/Welded Wire Facing (MSE) Wall

Hilfiker
Tensar
Other (types)

GROUND IMPROVEMENT TECHNIQUES

97. Since 1990, what is the approximate number of projects where the following Ground Improvement Techniques have been used? **We do not track these quantities**

Grout
Vertical Drains (wick drains)
Stone Columns
Vibro Compaction
Dynamic Compaction
Soil Mixing
Ground Freezing
Other (types)
Lightweight Fill
Expanded Polystyrene)
Wood Chips
Shredded Tires
Foamed Concrete (Elastizell)
Other (types)

USE OF CONSULTANTS

98. What percent of the entire statewide geotechnical needs are provided by geotechnical consultants or specialty testing firms?

	Current	1990
Subsurface Investigations	10	10
Design	10	10
Construction Monitoring	5	5
Special Testing or Services	1	1

99. Do written guidelines exist which state minimum technical qualifications for geotechnical consultants and testing firms? Yes, located in our A&E contracts

100. Are contract laboratories performing geotechnical work inspected or certified for conformance with minimum State technical requirements and quality of procedures? No

101. Indicate the role of State geotechnical unit(s) for consultant work (Central Office and Districts).

Involvement in ranking and selection process either annually or on an individual project basis
Involvement in developing scope of work and specifications
Reviews, comments or approves work
Reviews and comments only upon request from other State unit(s)

102. Briefly describe any available cost comparisons studies that compare contract geotechnical work with in-house costs (for both contract drilling and engineering services): Currently not available

103. Are geotechnical consultants given specific written guidance on what constitutes the minimum acceptable amount of drilling, lab testing, analysis, and report content for State projects? No

104. Are contract drillers used by the State? Only on unusually large projects to supplement agencies drillers

If utilized, what approximate percentage of the total annual drilling program is performed by contractors? < 10%

105. How are contract drillers technically prequalified?

106. Are consultants used to inspect contract-drilling work? No

107. What previous experience with drilling and sampling is required for drilling contractor inspectors? We don't use them

108. If consultant-drilling inspectors are used, what minimum technical qualifications does the agency require of the inspectors? N/A

109. How many contract drill rigs does one drilling inspector cover? (Applies to both State and consultant inspectors) N/A

110. Do specifications for contract drilling work contain specific instructions and step-by-step procedures for drilling and sampling; not just references to ASTM or AASHTO standards?

Yes No

111. What approximate percentage of the agency's geotechnical lab testing is done by contract laboratories? < 10%

112. For contract geotechnical lab testing, does the agency have a formal quality assurance policy or does the agency perform random check testing in the State laboratory?

No

113. On drilling contracts is the contract laboratory required to open the samples, particularly initial tube samples, and notify the inspector of the quality of the samples?

No

114. For contract geotechnical laboratory testing who usually determines the total number of each test to be performed? State geotechnical specialist

115. Does the contract laboratory interpret the test data i.e. list cohesion, friction angle, preconsolidation pressure, etc? No

116. Is a final report summarizing laboratory test information required from the contract laboratory? Yes

117. Are private firms technically prequalified prior to performing geotechnical testing for the agency? Yes

118. Are design consultants required to outline in a design guidelines report the proposed geotechnical analysis procedures to be used prior to beginning a project? No

119. Are design consultants required to include laboratory test data/results and computations for geotechnical analyses in the Geotechnical Design Report? Yes

120. Is the publication, "FHWA Check List and Guidelines for the Review of Geotechnical Reports, Plans, and Specifications," routinely used by the agency to review or set minimum requirements for consultant work? No

121. Do design consultant reports contain a discussion of foundation, wall, or slope stabilization alternates- including relative costs and constructability? Yes

122. Is more than one layer of geotechnical consultants (management consultants) used on specific projects by the agency?

Routinely Occasionally X Special Projects

123. Who is responsible for the final geotechnical design of projects where management consultants are used? Individual geotechnical subconsultant

RESEARCH AND TECHNOLOGY DEVELOPMENT AND EXPERIMENTAL STUDIES

124. What research, development and experimental studies have been conducted or sponsored by the agency on geotechnical subjects? Pile load test database/capacity estimation methods, improved load test instrumentation, geotechnical data management, improved slope inclinometer--shape rope, pen map, landslide corridors, earthquake ground motion prediction (NGA and related projects), liquefaction triggering (probabilistic using SPT, CPT, or Vs), liquefaction screening using geology, improved ground deformation estimation, foundation loading due to liquefaction, fault rupture hazard, LRFD, nonlinear site response analysis.

125. What specific geotech research and technology development topic areas would you like to see the FHWA address?
Geotechnical information systems, alternative foundation load testing methods.
More help taking on pooled fund management and administration. (NCHRP is a good model.)

126. What is the approximate percentage of the annual research budget devoted to geotechnical related research and technology development (indicate average over the last five years)?
Approximately 4% (about $1M/yr)

127. For projects with experimental geotechnical features, is the geotechnical unit involved in the development of the work plan, monitoring, evaluation, and writing reports?

Yes

TRAINING

128. What geotechnical training and technical design or construction guidance from the FHWA would be most helpful to your agency? (Please be specific)

Training
Advanced level, in depth training courses on:
(1) Field/Laboratory Testing and Differing Site Conditions
(2) Foundation Construction Inspection and Testing
(3) Groundwater, seepage and drainage design for highway facilities
(4) Foundation Design for Special Cases and Extreme Events
(5) Landslide Stabilization Design
(6) Geotechnical Risk Management
(7) Soil-Foundation-Structure Interaction (SSI)
(8) Advanced Modeling and Numerical Analysis in Geotechnical Engineering
(9) Geotechnical Earthquake Engineering

Technical Guidance
1. Seismic Design of Foundations
2. Groundwater, seepage and drainage design for highway facilities
3. Foundation Construction Inspection and Testing
4. Risk Management in Geotechnical Engineering

129. Are FHWA Geotechnical resources currently adequate to address the states needs? (please elaborate)
The current FHWA resources are very useful at the basic, and in some cases, at the intermediate level. More advanced and detailed treatment of many important topics will be of useful.

Some of our needed training is currently not offered by FHWA. In the past, we had to turn to other vendors for courses such as Geotechnical Earthquake Engineering, LRFD for Bridge Substructure, Rock Blasting, Rockfall Hazards Mitigation, Evaluation and Mitigation Seismic Hazards, Tunneling, Geophysical Testing.

130. Please indicate when each of these training courses was last held in your state or if you have requested the course or if you plan to request the course:

NHI Course/Demo #	Date Last Held	Date Requested	Will Request
132012 Soils & Foundations Workshop	05/09/2005		__X
132013 Geosynthetics Eng. Workshop	04/23/2003		__X
132014 Drilled Shafts	02/06/2007		__X
132021 Driven Pile Design and Construction	06/03/2002		__X

132022 Driven Pile Construction Monitoring	12/03/2003	__X
132031 Subsurface Investigations	02/03/2003	__X
132033 Soils Slopes and Embankment Design	12/09/2003	__X
132034 Ground Improvement Techniques	08/24/2004	__X
132035 Rock Slopes	04/17/2002	__X
132036 Earth Retaining Structures	02/24/2004	__X
132037 Shallow Foundations	08/27/2002	__X
132040 Geotechnical Aspects of Pavements		X
132041 Geotechnical Instrumentation	04/21/2003	__X
132042 Design of MSEW & RSS	10/19/2004	__X
132043 Construction of MSEW & RSS		X
132069 Driven Pile Foundation Inspection		X
132070 Drilled Shaft Foundation Inspection		X
132078 Micropile Design and Construction	11/28/2006	__X
132079 Subsurface Investigation Qualification		X
132080 Inspection of MSEW & RSS		X

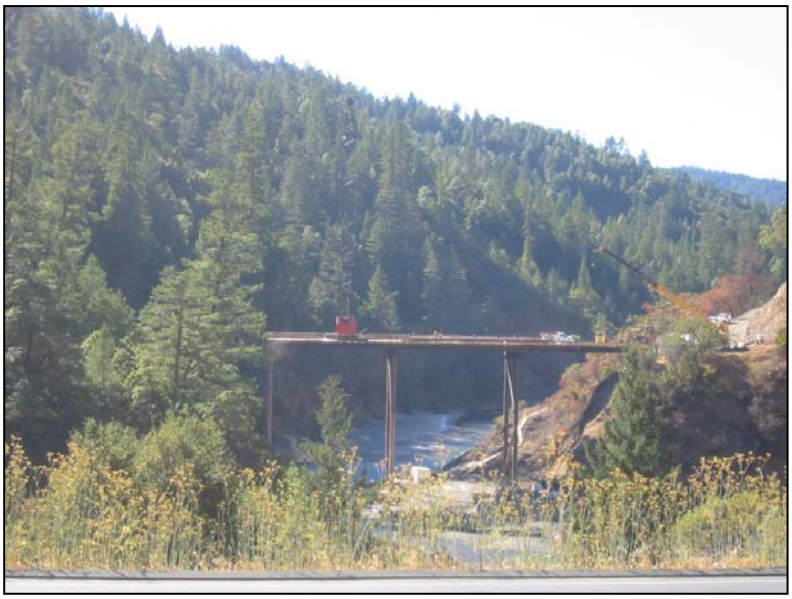
Note (X) :When the course will be requested depending on the needs assessment and subject to funding availability.

7. Sites Visited

Site visits to several construction/repair projects were conducted during the review, which provided the team an opportunity to meet with construction personnel and to observe Caltrans construction/repair means and methods. The following paragraphs provide a short description of the sites visited.

District 1 – Eureka (Humboldt County)

The group visited two construction sites along SR 101 in Humboldt County. The photo below shows a temporary trestle used to facilitate construction of a bridge for the Confusion Hill Bypass project. The existing highway in this particular area has been subject to landside and rockfall damage for many decades requiring annual closures sometimes lasting many weeks.



Trestle used for construction of new bridge at the Confusion Hill Bypass project (District 1)

District 8 – San Bernardino (San Bernardino County)

Various Slope Repairs and Rockfall Mitigation Measures

The group visited several sites along SR 18 (Rim of the World Highway) in the San Bernardino Mountains. Many locations along this highway are plagued with rockfall and landslide events that require continual maintenance and repair as shown in the photos below.

Loose rock mass along SR 18 in the San Bernardino Mountains.

Example of netting used to arrest rock fall onto SR 18.

Gabion wall used to repair landslide along SR 18.

District 7 – Los Angeles (Los Angeles County)

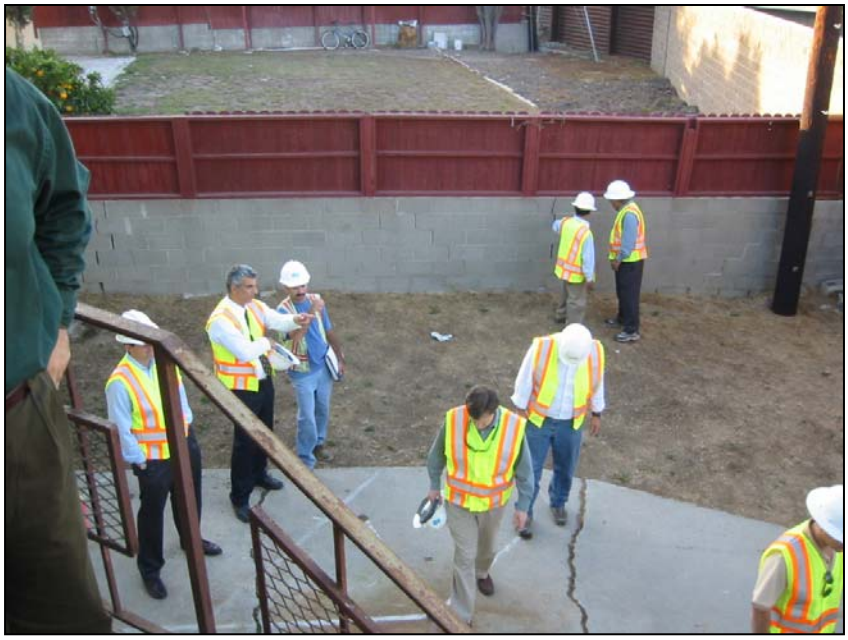
Landslide Repair Along SR 10

Heavy rains in 2005 caused a landslide along the eastbound side of Interstate 10 east of downtown Los Angeles at Post Mile 0.40. The cut slope was approximately 90 feet high with an original overall slope gradient of 1:l and a 20-foot bench at mid-height. The slide occurred on the upper part of the cut (above the bench) and was approximately 45 feet high and 250 feet wide. The main scarp of the slide was located about 35 feet away from an existing 3-story apartment building complex. The slope was repaired and stabilized using a combination soil nail and tieback wall system as shown in the photo below.

Slope repair using tieback anchors along SR 10 in Los Angeles.

Soil Nailed Wall Repair Along SR 405.

Significant lateral movement occurred to a soil nailed wall along the southbound 405 Freeway near La Tijera Boulevard in Culver City. The wall movement caused severe cracking to a residential property located at the top of the wall as shown on the photo below. The wall failure was attributed to heavy rain and inadequate construction technique during construction of the wall. During our site visit the wall was being repaired by constructing a drilled pier wall with tiebacks in front of the existing soil nailed wall.



Distress to residential property above soil nailed wall along SR 405 in Culver City.

8. Review Notes from Peer Exchange

A Peer Exchange meeting was held at Headquarters November 28 through 30, 2006. The purpose of the meeting was to allow a roundtable discussion of the proposed recommendations among senior DOT personnel from across the country with the aim of gathering their insight on strategies and potential complications when implementing the recommendations. The notes from that meeting, as compiled by the review team, are shown below. They represent the feedback from the various State DOTs to each of the comments/observations listed below.

Comment:
Establish a means by which geotechnical and geologic training and educational exchange among Geotechnical Services (GS) staff occurs.

Observation:
A common theme among Department staff in the districts was the lack of quality and experienced geotechnical engineers and engineering geologists prepared to handle complex foundation problems in construction or during response to emergencies. GS should consider providing staff with professional development training to ensure that they are engaged, motivated, well-rounded, possess good decision-making skills, and prepared to handle various challenging assignments. Training should include geotechnical experiences in field investigation, design, inspection, construction support, emergency response, and maintenance. GS should also provide a process by which dissemination of research and technical practice occurs. This will help maintain employee competency and stem the loss of institutional knowledge through attrition.

NY– Rotation program to develop generalists/training/groom those with interest/combination of geographic and functional organization. Mentoring is informal/match abilities to needs. Brown bag exchanges and invite other groups

NC– In-house technical conf. once/year for training of geotech/geologists; outside presenters.

KS – Several times/yr; housed in one office/staff meetings for exchange. Small state/face-to-face meetings occur.

NV – Engrs. do field work thru construction; experience in all facets; Informal in-house exchange; generalists; MS and PhDs. Two NHI classes/yr.

NM – Engrs more generalists; Rely on consultants; Geotech forum group once/month with consultants. Cross training on PDA

Comment:
Establish an educational exchange between GS and other units within the Department. These units include Design, Environmental, and Construction. The educational exchange should include technical issues related to geotechnical engineering and engineering geology practice as well as marketing and outreach to other Department functions.

Observation:
In many instances Department units outside of GS were unaware or misinformed about GS duties, responsibilities, and capabilities. This was especially apparent with Department District Design, Environmental, and Construction. There has been high turnover and new hiring in these groups that has made this more challenging. GS has also experienced high attrition leading to less presence in the districts

Department. GS also must improve its awareness and knowledge about the duties, responsibilities and capabilities of other functional units within the Department.

NY – Emphasis on putting a human face on the geotech program; know who to call; responsive to customer needs; work on developing relationships

NV – Checklist to Roadway on who to call

KS – 3 to 4 times/yr educational presentation to construction/design office on geotech projects

NM - Technician training certification program; specialty certifications for geotech work; Specialty training on big projects (MSE wall design & construction inspection). Rock excavation training.

NC – Introduce staff; get their name out there.

IA – Geotech participate in PMTs

FHWA – Meet with lead engrs in each discipline and discuss current issues.

Quantify geotechnical costs/savings to management

Comment:
Include a plain language summary in geotechnical reports. Information tailored to the specific end-user (Contractor, Specifications, Structures Design, etc.) should be included.

Observation:
Many Department units make use of the information contained in GS reports. However, not all of these end-users understand technical geotechnical jargon and an attempt should be made to provide the end-user with pertinent information in plain language and in summary form.

WS – 1-2 page summary of conditions tailored to constr and contractor (e.g caving conditions; boulders present); part of specs; to minimize change order conditions; Avoid geotech jargon;
NV – Construction notes in report; photos of cores as part of package

NY – With limited information provide baseline information; provide notes on plans; attend pre-bid meeting; explain in-person.

KS – Exec. Summary up front; place reports on web as part of bid package.

Pitfall
Don't overly simplify language; misinterpretation of conditions.

Comment:
Establish a comprehensive Slope Management Program.

Observation:
Due to the amount of unstable slopes (landslides, rockfall, debris flows, etc.) impacting Department right of way annually, some form of comprehensive slope management system is needed. A more proactive approach to handle unstable slopes would help reduce liability. The program may be developed at the district, regional, or statewide level. The Washington Department of Transportation model is one to consider. Efforts in this direction exist in some districts. For example, District 7 has had a number of

studies performed on slope assessment, but has not been successful in securing funding. District 5 has worked closely with various stakeholders to develop the Coast Highway Management Plan along the Big Sur Coast. This is not a pure proactive slope management plan, but a hybrid that streamlines the process of reacting to unstable slope damage. Permanent funding for such a program may have to come from the state legislature.

WS – Legislature funding; slope management program in- place.

NY – Rock slope inventory/condition assessment/slopes rated and prioritized/have on occasion provided funding for mitigation; earth slope inventory/mostly fixed.

NM – Rockfall program but no funding

Number of States with programs -Montana, Oregon, Colorado, Wyoming

Pitfall
Not having dollars to mitigate once recommendation made.

Comment:
Create a procedure to ensure more GS presence during project construction.

Observation:
The role of the geotechnical engineer and engineering geologist in a project does not end after subsurface investigation and design recommendations. Geotechnical observations and testing during construction are considered a continuation of the project and are essential to verify that the actual soil conditions are as anticipated. Differing site condition issues frequently arise due to the lack of geotechnical presence during construction. GS should work to develop a closer relationship with Construction and be more involved in pre-construction meetings so that Construction can be advised of unexpected or changed conditions that would require modifications in the original recommendations. In addition, the presence of GS at the site provides Construction with needed geotechnical expertise related construction procedures.

Ties in with certification training program

NC - Operations engineer talks to construction; resident engr needs to know when to call.

NV – Construction trains their own staff and also provides geotech staff training one day/yr. Pre construction training for staff.

NM – Geotech on-site first couple days of project;

IA – Wintger training done by construction office includes geotech; just-in-time training on-site; mandatory pre-drill meeting with inspectors and contractors.

Pitfall
Manpower issue

Comment:
Establish a procedure to facilitate better cooperation and communication with roadway and structure designs in order to ensure the findings and recommendations in the Geotechnical Design Report (GDR) and Foundation Report (FR) are consistent.

Observation:
Geotechnical engineering has historically existed within the Roadways side of Department (earthwork, soundwalls, retaining walls etc.) while both geotechnical engineering and engineering geology existed on the Structures side (bridges, retaining walls, etc.). The timing of the project development process often necessitates creation of separate geotechnical reports (GDR versus FR). Consequently, geotechnical information may be communicated to clients in multiple forms, which may contain contradictory geotechnical recommendations. Additionally, all sources of geotechnical information should be readily available to the contractor.

NC – Same group does both reports

WS – One report; but produce parts at different times; superceded;

NV – Multiple reports for different bridges; one report for roadway; Geotech PM ensures consistency.

Comment:
Conduct more site and subsurface characterization earlier during the planning stage of project development.

Observation:
Geotechnical investigation is often absent during the planning stages of a project. Geotechnical input is usually sought right before or during design, or in some cases after design and prior to construction. This leads to increased risk and project costs resulting from conservative or inappropriate geotechnical design recommendations.

See question 1 later

Comment:
Explore ways to work more efficiently with Department Environmental so that delays in obtaining permits are minimized.

Observation:
Delays are occurring in obtaining Department permits for site investigations. The need for geotechnical investigations and appropriate environmental clearances is not being identified in the planning stage of project delivery. This has on some occasions led to inadequate site and subsurface characterization prior to foundation selection. This in turn has led to change orders and differing site condition claims by contractors during construction, which may significantly increase the total cost of a project.

NY – Blanket agreement with enviro; exploration not an issue.

FHWA - Federal Lands does not have requirements

NV - Get Enviro people involved early on

Comment:
Put in place environmental programmatic agreements for drilling services with resource agencies.

Observation:
Obtaining timely environmental permits or clearance from outside resource agencies can be problematic, which can delay the initiation of site investigation. Establishing pre-arranged agreements with resource agencies may help streamline the permitting process.

NY – In place with many agencies; Help resource agencies solve their problems

Comment:
Establish policy to ensure that Design and Structures Design includes GS in constructability reviews throughout the life of projects that include geotechnical related recommendations.

Observation:
GS is not always involved in constructability reviews of draft and final PS&E plans during design submittals. Geotechnical recommendations are not always included or interpreted properly. This can lead to issues with constructability. These constructability issues lead to increased project costs due to change orders and differing site condition claims by contractors during construction.

WS – ADSC reviews shaft recs for constructability; project level;

Solicit design feedback; Construction submit form to Design.

NV and Federal Lands - involved in review at 30/60/90 design submittals

NV – Construction reviews plans for constructability issues

NY - Rely on geotechs to do QA;

Comment:
Route Geotechnical reports (GDR and FR) to appropriate groups (Design, District Materials Engineer, Construction, Environmental, Hydraulics, etc.) for review or information.

Observation:
It was observed in some districts that geotechnical reports were not reaching some functional units that could use or influence these recommendations.

NC – Sends final version to multiple units for their information.

NY – Reports co-signed; iterative process;

NV - Follow checklist; send to structures; roadway; hydraulics; FHWA; for information

WS – Courtesy copy between geotech and roadway for information

Comment:
Develop a set of policies and procedures documenting the geotechnical standards of practice at Caltrans.

Observation:
A common theme among the geotechnical staff and with consultants was the lack of documented or familiarity with geotechnical standards of practice at Caltrans. The practice of geotechnical engineering at the Department varies widely given the diverse backgrounds and experiences of geotechnical staff. Policies and standards need to include guidelines for site exploration, laboratory testing, analysis procedures (including seismic design and the use of standardized software packages), project file development and closeout procedures (including checking of calculations, review process, etc.), file room archival, chain-of-command and organizational structure, and standards for the preparation of

geotechnical reports. To their credit, GS has begun developing standards and procedures by revising its soil and rock logging manual and developing guidelines for preparing GDRs and FRs.

WS – Developed geotech manual

NV – Developed geotech manual; hired consultant;

KS – Developed geotech manual

FHWA Resource Center– Pooled fund study synthesizing DOT geotech manuals; dozen states; categorized and searchable;

FHWA Federal Lands – Project development and design manual (with geotech chapter). Standards, policies, and guidance defined. Web based portal to other information; direct people to information.

Leverage off existing manuals and deviate only with exceptions.

Comment:
Ensure that GS is following a quality management program internally and by consultants.

Observation:
GS relies on its supervisors for reviews of products and services. There is no systematic process or quality management program in place in GS to ensure consistent and competent products and recommendations.

NV – Supervisor initializes; multiple reviews; general review.

FHWA Federal Lands – Reviewed by Peer and then supervisor more cursory review.

NC - Quality group (cross functional team) reviews consultant and in-house reports.

NM – Design/Build Peer reviewed but no authority to enforce review comments

WS – Geotech manual into RFP for Design/Build projects; hierarchial

Comment:
Geotechnical staffing levels in the district should be reviewed and modified as appropriate.

Observation:
Project workload (emergency response and more traditional geotechnical-type products) necessitates that geotechnical staff be physically located in some districts. Currently, Districts 1 through 5, 7, 11, and 12 have geotechnical engineering staff present in the district; Districts 6, 8, 9, and 10 do not. There has been high attrition in GS over the last year. Staffing levels should be reviewed and modified to include more geotechnical presence in the appropriate districts.

On-site presence

NY – Presence in the regions (districts); each one has geotech and matls side of geotech construction. In Bureau, area engrs. cover two regions and travel to the regions and work closely with regional geotech. Try to maintain continuity. Area engrs cover QA role;

Issues
Renegade regional geotech; loss of drilling staff
Unwanted regions might become dumping grounds

Comment:
Define the role of the geotechnical liaison in District 8, and establish procedures for the execution of that position.

Observation:
Each of the four Offices of Geotechnical Design has a geotechnical liaison that reports to the Supervising Transportation Engineer in that design office. For various reasons, each of the geotechnical liaisons plays a slightly different role depending upon location. It was noted from our discussions with staff in District 8 that the assigned geotechnical liaison was difficult to reach and not physically present in the district enough to respond to their needs. There is a clear need to have more on-site geotechnical presence in District 8.

Comment:
Define the roles of a Civil Engineer and Engineering Geologist within the Department and identify the types of work they can perform. GS should utilize their functions appropriately as part of a multidisciplinary team.

Observation:
A successful geotechnical engineering practice relies on the expertise and integration of both Civil Engineers and Engineering Geologists. GS must recognize and appreciate the contributions of both professions and utilize their functions as part of a multidisciplinary team.

NY – Rock slopes/stone fill/rock sockets/rockfall – Geologists

WS,IA,NY- Tech/driller prepares field log/sampling

WS – 2 geotech to 1 EG; Do some simple RW design; mostly field work; landslide; overlap with responsibilities; work together

NV - Geotechs

IA – 1 or 2 geol

NC - Engr. geolgists in field; 1:1 ratio; EG no found. design/ geol. Do rock slope design; reports signed/stamped by both.

KS – 12 geol:6 geotech; roadway work geol. Field work; bridge work combination of crews; geology and soil crews sweep thru. Licensed geologists

FHWA FL- EG rock slope; geotech or EG with field crew; 1 EG to 2-3 geotech
Resource Center – No EG; only geotechs in field

NM - EG logging holes and collecting samples; geotechs in office; 1:1; EG rock slopes/rockfall analysis

Comment:
Review current geotechnical practice related to deep foundations as part of Load Resistance Factored Design (LRFD) implementation in order to address construction control methods.

Observation:
GS must implement LRFD by April 2007 and a large portion of determining the design parameters is the management of risks in construction through control methods (e.g. pile load tests, PDA, etc.). The current GS team implementing LRFD should address design and construction control methods versus reduction factors.

WS – Following AASHTO but tailored to their practice; lateral loading control in design and designs not different from earlier methods

NC – Moving in that direction; structures group not implemented yet; comparative designs.

NM – Completed two pile designs; concerns with conservative designs; older design LRFD methodology; all bridge designs are now LRFD; WEAP for hammer/pile type; PDA for cost savings.

NV – Bridge division doing LRFD; conservative results with designs; attending NHI course in March. Wave equ/test 1st pile with PDA with CAPWAP.

FHWA FL – Bridge foundations LRFD; western div not there yet; ASD and LRFD designs similar based on their practice. PDA and CAPWAP on all projects; PDA on 1/substructure unit

KS – bridge design LRFD until foundations; waiting to do comparative design; WAVE equ analysis; PDA with CAPWAP.

NY – Bridges in LRFD; some foundations LRFD; bridge designs want to see both designs; time consuming; LRFD refinement to match their practice; moving vigoursly. WEAP to analyze driving; PDA on occasion.

IA - Structural elements with LRFD; 1st bridge LRFD; calibration; how incorporate load test database; highway research board established to examine. WAVE; PDA on major projects or problem projects.

Comment:
Continue implementation of task management to ensure the timely and cost effective delivery of geotechnical products and services.

Observation:
GS relies very heavily on information provided by other units such as Design, Structures Design, Right of r, Maintenance, Surveys, and Environmental before performing geotechnical subsurface exploration. GS has not always planned for the need or proactively managed the support activities these units perform.

NY – No pms; proj. designers end up pms; no pm system; struggle

FHWA FL - Pms manage Cross functional teams; geotech task manager on project coordinates with other units.

NM – Primavera system; burden on pms; on-call contracts

NC – Pms above geotech; enviro side; monthly meetings; proj. scheduling software;

NV -Hired consultant for pm system; attend monthly mtgs; action items;

KS – program management system; flawed system; devolved into reactive; high profile

Additional Questions for the Peer Review:

1. When is the most economical time to perform a geotechnical investigation?

The most economical time to perform a geotechnical investigation is one that allows for risks to be quantified, scope to be defined, and project schedule and costs to be estimated prior to commitment at the end of planning phase. A phased approach is needed to target the geotechnical investigation to target the various stages of project development.

A successful geotechnical investigation depends on availability of adequate project definition and resources. The goal is to quantify risks, define scope, and to facilitate appropriate alternative selection and estimate project schedule and cost.

Phased – Project Specific
Adequate info to make alternative decision
Quantify Risks
Accurately scoped
Earlier the better with consideration to availability of adequate project definition

NM – Went to a geotech scoping report included as part of enviro document; broad rpt; catch the unexpected; risks identified. Get geotech rpt before alternative decision; Geotech worked into work plans and schedules.g

KS – Discovery phase report (review prev. reports; site reconnaissance); followed by use of geophysics along corridor.

NC – Scoping report to identify geotech issues; Based on FHWA review eotech involved based on

NY – Invited to on-site scoping meeting

2. What kind of risk management activities can GS do to insure good cost estimates and schedules?

WS – ADSC to review PSEs;

NY – Adequate investigation necessary; strong communication with constituents;

FHWA FL – Investigation phasing necessary

NV –Linking EIS to planning stage; need more geotech in planning phase

NY- Use existing info for scoping phase; try to coordinate for roadway projects with bridges

Estimates; Talk to people who know how to build the job;

FHWA RC- Inspector qualification course for subsurface investigation; more detailed 4-day course; 6 modules for inspectors available; Proper interpretation of lab data; manual for evaluation of lab and rock properties.

Baseline Rpts:
NY - 25% deviation; predicted slip; change order; definition of soil/rock; boring and GW info given;
NV – time on core/switching back and forth

Different types of risks.

During planning phase the risks are change in scope; increased costs and time, and not meeting schedule.

Risk management activities
strong communication with constituents
Adequate investigation
more geotech in planning phase
Talk to people who know how to build the job
Outreach, marketing, education
Participation in the PDTs and task management
Policies and procedures manual
Understandable report information
Constructability reviews
Developing and maintaining technical expertise
Slope management program

During design phase the risks are not constructable; economical; changed conditions; environmental; unforeseen soil/rock conditions; impacts to right-of-way, utilities, adjacent structures.

Risk management activities
ADSC to review PSEs
Adequate investigation
Proper interpretation of lab data; manual for evaluation of lab and rock properties
Baseline Rpts:
Enviro. permits
Outreach, marketing, education
Participation in the PDTs and task management
Policies and procedures manual
Understandable report information
Constructability reviews
Developing and maintaining technical expertise
Slope management program

During construction phase the risks are …..

Risk management activities
Inspector qualification course for subsurface investigation; more detailed 4-day course; 6 modules for inspectors available
Baseline Rpts:
Outreach, marketing, education
Participation in the PDTs and task managment
Policies and procedures manual
Appropriate geotechnical construction support
Understandable report information
Copied from Discussion:

NM - Technician training certification program; specialty certifications for geotech work; Specialty training on big projects (MSE wall design & construction inspection). Rock excavation training.

IA – Geotech participate in PMTs

WS – 1-2 page summary of conditions tailored to constr and contractor (e.g caving conditions; boulders present); part of specs; to minimize change order conditions; Avoid geotech jargon;

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IA – Winter training done by construction office includes geotech; just-in-time training on-site; mandatory pre-drill meeting with inspectors and contractors.
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WS – Geotech manual into RFP for Design/Build projects; hierarchial

Open Discussion:

1. Inspector Qualification
2. LRFD

Inspector Qualification

KS – drilled shaft and pile driving NHI courses; certif. required for inspectors; tied in to salary; requirements for consultants as well. Database of inspectors to keep track. Geol. On site with inspector initially.

WS – geotech/geol with inspector initially; tracking; NHI courses not yet; Just in time training on-site.

NV – No NHI courses for drilled shafts; ADSC courses have taken; Geotechs go to districts for teaching inspectors once/yr. Engr goes out initially.

NM - NHI driven pile course; moving toward certification; will be using NHI courses; in-house and consultants will be required; TTCP; not having problems with drilled shafts;

FHWA FL – Not had NHI courses yet; upcoming; distribution of projects geographically difficult;

Making sure you have qualified inspector on site difficult to monitor

6 NHI courses: Drilled shafts, driven piles, MSE walls, subsurface investigation. Earth embankments (upcoming), earth retaining structures (upcoming)

IA – No certification program; training provided thru just in time model has been helpful

NC – No certif. program; some training provided; On their list to attend NHI courses

NY – staff received training for earthwork; no certif. program;