ENGINEERING AND RELATED SERVICES
February 9, 2007

STATE PROJECT NO. 700-99-0398
F.A.P. NO. STP-9906(511)
RETAINER CONTRACT FOR
GEOTECHNICAL ENGINEERING SERVICES
STATEWIDE

Under Authority granted by Title 48 of Louisiana Revised Statutes, the Louisiana Department of Transportation and Development (DOTD) hereby issues a Request for Qualification Statements (RFQ) on Standard Form 24-102 (SF 24-102), "Professional Engineering and Related Services", revised January 2003, from Consulting Firms (Consultant) to provide engineering and related services. **All requirements of Louisiana Professional Engineering and Land Surveying (LAPELS) Board must be met prior to the execution of the contract. As required by law, any firm drilling soil borings shall be licensed as a Water Well Contractor in accordance with the Water Well Rules, Regulations and Standards of the State of Louisiana**. Evidence of a current license will be provided with the Qualification Statements. One Consultant will be selected for this Contract. In the event that a Sub-Consultant or Sub-Contractor needs to be utilized for drilling services, formal written notice shall be given to the DOTD of their qualifications two weeks prior to the execution of any Task Order. The Sub-Consultant or Sub-Contractor shall possess a Louisiana Water Well Contractor license and are subject to DOTD approval.

Project Manager - Mr. Benjamin A. Fernandez, P.E., may be reached at (225) 248 – 4125. The phone number for the main Geotechnical Office at DOTD Headquarters is (225) 379-1312.

PROJECT DESCRIPTION

The selected Consultant/Team will perform geotechnical exploration and engineering related services for statewide projects covered by a Retainer Contract under separate Task Orders. The Consultant/Team shall be required to execute a Task Order (TO) for each designated project which will specify the scope of services, contract time, and compensation. Each TO will become part of the Retainer Contract.

SCOPE OF SERVICES

Geotechnical Exploration and Investigations

The Consultant shall send a progress report either by email or fax to the Project Manager every Monday when a Task Order is active detailing the progress to-date and their planned weekly activities related to the Task Order. Units of measure (English or Metric (SI)) for reporting results for each Task Order will be designated and will be consistent throughout each Task Order. These Task Orders may consist of deep and/or shallow soil

borings, sampling, testing, ECPT probings, and engineering services at proposed bridge, MSE Wall, or culvert sites throughout the State.

The geotechnical investigations, sampling and testing services to be provided shall include, but are not limited to:

- Field Reconnaissance (including right of entry, utility locations, access, etc.)
- Mobilization/demobilization
- Deep and Shallow Soil borings
- Electronic Cone Penetrometer (ECPT) probings (ASTM D 3441)
- Water table elevations with duration of reading
- GPS Latitude and Longitude of borings to within 10 ft (3 m) accuracy
- Sealing boreholes in accordance to LA Water Well and DEQ Regulations
- Standard Penetration Tests and Split-Barrel Sampling of Soils (AASHTO T 206)
- Unconfined Compressive Strength of Cohesive Soils (AASHTO T 208)
- Specific Gravity of Soils (AASHTO T 100)
- Laboratory Determination of Moisture Content of Soils (AASHTO T 265)
- Triaxial Compression Tests, Unconsolidated, Undrained (AASHTO T 296)
- Triaxial Compression Tests, Consolidated Drained 3-point (AASHTO T 297)
- Atterberg Limits (DOTD TR 428)
- Consolidation Tests with Rebound (AASHTO T 216)
- Organic Content (DOTD TR 413)
- Classification of Soils
    - Deep borings (ASTM D 2487 (USCS method))
    - Shallow borings (ASTM D 3282(AASHTO method))
- Drafting of boring logs
- Drafting of subgrade soil surveys
- Traffic Control

The deep soil borings shall be made by the wet rotary drilling method. In each deep boring, undisturbed samples of cohesive or semi-cohesive material shall be obtained from each distinct soil stratum that is penetrated or 5 ft (1.5 m) interval, whichever is less, using a 3 in. (76 mm) diameter Shelby tube sampling barrel as per AASHTO D 207. When cohesionless soils are encountered at any depth, a split spoon sampler shall be used in conjunction with Standard Penetration Tests (SPT) at 3 foot (1 m) intervals. In the case of massive dense sands being encountered, the Project Manager may be contacted in order to relax the sampling interval, on a case-by-case basis. If requested by DOTD, continuous sampling of a boring will be obtained at 3 foot (1 m) intervals to a pre-determined depth. Boring samples shall be retained for a minimum period of 90 days.

Boring logs which show evidence of SPT's in cohesive soils or tube samples in cohesionless soils will not be accepted.

Shelby tube samples shall be sealed in the field using wax or other approved method. Samples may not be extruded at the worksite. Sample tubes shall be transported vertically in the same orientation as they were sampled, with care taken to avoid

excessive temperature variation, vibration, or any other sample disturbance. They shall be extruded in the laboratory in accordance by means of a continuous pressure hydraulic ram. Extrusion by any other method, such as water pressure, is prohibited. Samples shall be extruded directly onto a sample trough, and shall not be caught with the hands.

Soil mechanics laboratory testing shall be performed on at least 75 percent of the samples obtained from the borings. Strength testing (Unconfined compression and/or UU Triaxial compression) and Atterberg limit testing shall be performed on at least 75 percent of the extruded cohesive samples.

If designated as required for the boring, consolidation tests shall be performed according to AASHTO T 216, and results shall be reported as graphs of "Void Ratio vs. Log of Pressure" and "Coefficient of Consolidation vs. Log of Pressure". Both plots may be shown on the same graph, if adequately labeled. Any sample from a clay layer that shows signs of being overconsolidated must be subjected to a load/rebound/re-load cycle during the consolidation testing, as per AASHTO T 216. Any sample selected for consolidation testing shall also have the specific gravity determined according to AASHTO T 100, and the Atterberg Limits determined according to DOTD TR 428, and with supporting results reported. Laboratory classification of soils from deep borings shall be in accordance with ASTM D 2487. Additionally, sufficient unconsolidated undrained triaxial compression shear tests, unit weight tests, and natural water content tests shall be performed to augment the unconfined compression tests and provide engineering data necessary to design pavement, bridge, and embankment structures, all in accordance with present design requirements and standard engineering practice. All other sampling and testing shall be performed in accordance with current AASHTO test procedures, unless otherwise noted.

Shallow soil borings for subgrade soil surveys can be made utilizing either hollow-stem or continuous-flight augers. Any other method shall be approved by the DOTD Pavement & Geotechnical Services Administrator prior to it being implemented. Due to the unique nature of each subgrade project, sampling and testing requirements for each project requiring shallow borings will be specified in the Task Order before the notice to proceed.

All or part of the services listed above may be required for each boring. The natural ground in elevation at the location of each borehole shall be determined to within 6 in. (0.15 m). These elevations maybe determined utilizing elevations of existing structures for landmarks that may be shown on the plans supplied. If DOTD has established a temporary benchmark (TBM) at the site, it shall be used in lieu of elevations shown on the plans. If no such TBM exists, or the plans supplied do not show any elevations, then each borehole shall be assigned an assumed elevation relative to the elevation of a fixed location that shall serve as a TBM. All borings surveyed in this manner shall be referenced to the same TBM, and this information noted on the final boring log or subgrade sheet.

Unless otherwise stated in a Task Order, it will be the responsibility of the Consultant to obtain consent from the respective landowners in order to enter onto private property. In the case that consent is not granted, the Consultant shall contact the project manager to execute a Forced Entry, as per Louisiana Revised Statute 48:217. Forced entry access will be granted via written notice from the project manager.

Deliverables

It will be the responsibility of the Consultant to obtain 3 or 4 mil polyester double matte film for use in reporting the geotechnical exploration results. The DOTD Pavement & Geotechnical Services Section will provide one sheet to the Consultant for use as an example of each format. The lettering used on the profiles shall be of such size and clarity that the legibility of data can be maintained when reduced to fifty (50) percent of its original size. Soil profiles shall be grouped on the plan sheets according to the Construction Project Number(s). All project deliverables shall become the property of DOTD upon successful completion of the above captioned project.

All reported test results, including each profile sheet, shall be sealed and manually signed and dated by the Professional Engineer in responsible charge of testing. The DOTD Pavement and Geotechnical Services Section will review the completed boring logs for completeness and accuracy prior to their final submittal.

Geotechnical Engineering Analysis and Design

All geotechnical engineering will be performed in accordance with present design requirements and standard engineering practice. These services are to include but are not limited to:

- slope stability (embankment & excavation)
- embankment settlement
- bridge foundations
    - piles
    - drilled shafts
- other foundations
- pile supported approach slab design data
- bridge foundation load test program
- earth retaining structures
- culverts
- geotechnical analysis & design recommendations report
- geotechnical instrumentation

Please refer to Attachment “A” for specific requirements for the above engineering services. Payment for these services will be at the rates established by the CCS.

ELECTRONIC DELIVERABLES

The Consultant hereby agrees to produce electronic deliverables in conformance with "DOTD Software and Deliverable Standards for Electronic Plans" as outlined at http://www.dotd.louisiana.gov/highways/project_devel/design/electronic_standards_disclaimer.asp. The Consultant shall download and apply the latest CAD standards. The Consultant hereby agrees to install incremental updates to software and CAD standards as instructed by the Project Manager. Such updates will not have a significant impact on the development time or delivery date for project plans, or require the Consultant to purchase additional software. Prior to proceeding with plan development, the Consultant shall contact the Project Manager for any special instructions regarding updates to standards or project-specific requirements if this information has not already been provided.

In the event that any electronic standard conflicts with written documentation, including DOTD plan-development manuals, the electronic standard typically governs. The Consultant is responsible for contacting the Project Manager should questions arise.

Plan deliveries shall be made on CD or DVD media and labeled with media-compatible indelible ink on separate lines as follows:

State Project Number
"Final Plans Submittal", "60% ACP Submittal" (or other milestone)
"Electronic Deliverables"
Consultant Firm Name

The CD/DVD shall be delivered with a signed cover letter that includes, among the formalities, a deliverable "hash" code that is documented in a report generated by the ControlCAD Indexer Submittal tool. The hash code is used to verify that the CD is authentic. At any stage of the plan development process, the Project Manager may require plan delivery by other methods including, but not limited to, upload to the DOTD ProjectWise repository.

The prime Consultant is responsible for ensuring that Sub-Consultants are prepared to produce electronic deliverables in conformance with DOTD electronic standards for plans.

QUALITY CONTROL/QUALITY ASSURANCE

The DOTD requires the Consultant to develop a Quality Control/Quality Assurance program or adopt DOTD's program; in order to provide a mechanism by which all construction plans can be subject to a systematic and consistent review. Consultant's must ensure quality and adhere to established design policies, procedures, standards and guidelines in the preparation and review of all design products. The DOTD shall provide limited input and technical assistance to the Consultant. The Consultant's plans shall meet or exceed DOTD's Construction Plans Quality Control / Quality Assurance Manual and EDSM No. Volume I. 1.1.24 on Plan Quality. The Consultant shall transmit plans with a DOTD Quality Control/Quality Assurance Checklist, Documentation Manual for Project Delivery, and a certification that the plans meet the DOTD's quality standards.

ITEMS TO BE PROVIDED BY DOTD

DOTD will provide, if available:

1. As-Built Plans
2. Design Plans
3. Shop Drawings
4. Structural Maintenance Records
5. Soil Boring logs
6. Traffic Studies
7. Traffic Data
8. Capacity Analysis

CONTRACT TIME

This Retainer Contract shall be in effect for the duration of three years. The services to be performed for each TO, will be determined upon activation of the TO. The Consultant will proceed with the services required in the TO upon issuance of the Notice to Proceed from the DOTD. The contract time for each TO, will be specified in the executed TO. Any TO in effect, prior to the expiration date of the Retainer Contract shall be completed.

COMPENSATION

Compensation to the Consultant for services rendered in connection with each TO shall be made based on unit/billable rates for the services rendered as listed in the "Statewide Geotechnical Rates" in Table 1 below from the Consultant Contract Services Unit of DOTD. Any item not covered by this list will be negotiated.

The total amount payable under this Retainer Contract for services to be performed under the various TO's shall not exceed a maximum of **$750,000**. Each TO shall be payable under the respective TO project number which shall be obtained by the Project Manager.

Table 1: Statewide Geotechnical Rates

GEOTECHNICAL SERVICES		
Line Item	Unit	**Recommended**
Mobilization/Demobilization		
Land ECPT Equipment/vehicle	**To be negotiated on a per Task Order basis due to dynamic factors relating to these items.**	
Swamp ECPT Equipment/vehicle		
Water ECPT Equipment/vehicle		
Mobilization/Demobilization, land drilling equipment/vehicle		
Mobilization/Demobilization, swamp drilling equipment/vehicle		
Mobilization/Demobilization, water drilling equipment/vehicle		
Geoprobe Equipment Mob/Demob		
Drilling and Sampling		

0 ft. to 100 ft. (land)	/ft	**$**	**14.50**
101 ft. to 150 ft. (land)	/ft	**$**	**18.00**
151 ft. to 200 ft. (land)	/ft	**$**	**23.00**
0 ft. to 100 ft. (swamp)	/ft	**$**	**17.50**
101 ft. to 150 ft. (swamp)	/ft	**$**	**22.00**
151 ft. to 200 ft. (swamp)	/ft	**$**	**27.50**
0 ft. to 100 feet (water)	/ft	**$**	**22.50**
101 ft to 150 ft (water)	/ft	**$**	**27.50**
151 ft. to 200 ft. (water)	/ft	**$**	**33.50**
Auger Drilling and Sampling	/ft	**$**	**11.00**
ECPT Probing-Land [1st 100 ft.] (includes sealing holes)	/ft	**$**	**8.00**
Geoprobe Sampling (0 to 20 ft.)	/ft	**$**	**10.00**
Geoprobe Sampling (20 to 50 ft.)	/ft	**$**	**14.00**
Related Services			
Difficult Boring Access	/hr	**$**	**165.00**
Difficult ECPT Access	/hr	**$**	**165.00**
Continuous Sampling, 0 ft. to 40 ft.	/ft	**$**	**19.00**
Setting Casing	/ft	**$**	**8.00**
Setting ECPT Casing	/ft	**$**	**5.00**
Sealing Boreholes, 4 in.	/ft	**$**	**4.50**
Sealing Boreholes, 6 in.	/ft	**$**	**6.25**
Coring of Portland Cement for Borings,4 in.	/in	**$**	**10.50**
Coring of Portland Cement for Borings,6 in.	/in	**$**	**15.50**
Coring of Portland Cement for ECPT, 3 in.	/in	**$**	**8.75**
GPS Coordinates	/ea	**$**	**25.00**
Laboratory Services			
Unconfined Compressive Strength and Unit Weight	/ea	**$**	**34.00**
Unit Weight of Undisturbed Samples	/ea	**$**	**17.00**
Atterberg Limits	/ea	**$**	**42.00**
Triaxial Compression, Unconsolidated Drained or Undrained	/ea	**$**	**55.00**
Triaxial Compression, Consolidated-Drained (3 pt. for sand)	/ea	**$**	**386.00**
Consolidation Tests with Rebound	/ea	**$**	**325.00**
Sieve Analysis	/ea	**$**	**50.00**
Particle Size Analysis (Mechanical)	/ea	**$**	**77.00**
Moisture Content & Classification of Samples	/ea	**$**	**7.50**
Organic Content	/ea	**$**	**39.00**
pH Determination	/ea	**$**	**20.00**
Passing 200 Sieve (wet)	/ea	**$**	**30.00**
Dry Preparation of Subgrade Soil Samples	/ea	**$**	**30.00**
Shelby Tube Extraction - Laboratory	/ea	**$**	**13.00**
Other			
Louisiana State Travel Regulations shall be used to determine reimbursement for meals, lodging rates, and mileage.			
DOTD Traffic Control Manual shall be used to define procedures to be used for traffic control. Police Officers used for public safety shall be in accordance with DOTD's *Policy for Use of Police Officers in*			

Construction/Maintenance Work Zones.		
Supplies (consumables such as gloves, cement, etc.) shall be no more than 10% of the drilling costs, with receipts required.		
In the event of lost or damaged equipment, including but not limited to: cone penetrometers, drilling bits and rods, tools, etc. DOTD shall not be liable to absorb the cost of replacement.		
All requests for additional administrative or other (not listed) compensation must be pre-approved by DOTD's Pavement & Geotechnical Services Section prior to submittal to the Consultant Contract Services Section.		
Any Metric projects assigned to the Consultant will be required to be reported in Metric units except for invoices, which will use English unit equivalents.		
Additional test procedures not listed above will be negotiated on a per Task Order basis as required.		
GEOTECHNICAL SERVICES		
BILLABLE RATES		
Salary Classes, per hour	**Field**	**Office**
Principal	**$134**	**$170**
Supervisor Engineer	**$109**	**$138**
Supervisor Other	**$ 95**	**$120**
Engineer	**$ 83**	**$106**
Preprofessional	**$ 54**	**$ 69**
Senior Technician	**$ 58**	**$ 74**
Cadd Technician	**$ 50**	**$ 63**
Technician	**$ 44**	**$ 56**
Cadd Drafter	**$ 37**	**$ 47**
Clerical	**$ 33**	**$ 42**

Difficult Boring access charges apply for off-road borehole locations that require transporting equipment and supplies between location by the use of matting or bulldozer in excess of one hour. Hourly rates include billing rates for drill rig, service vehicles, and drill crew. Drill rig set up and dismantling is included in the drilling costs per linear foot (meter) and is not to be included in boring access charges.

Unless specifically requested in the Task Order, payment for sieve analysis will be included in the cost for classification.

Payment for natural water content as determined by DOTD TR 403 will be restricted to samples having a reported plasticity index (PI) greater than 5, as determined by DOTD TR 428.

Payment for unit weight of undisturbed samples will be included in the cost for unconfined compressive strength unless compressive strength is unable to be determined due to sample condition.

Invoicing for Task Orders of durations less than or equal to 45 days should be on one invoice. Task Orders of durations greater than 45 days should be separated into field exploration and lab testing invoices. The lab testing invoice will be reviewed after receipt of the boring log/subgrade soil survey. DOTD requests that the items on the invoice should be in the same order as Table 1 to expedite payment. Direct costs, such as equipment rental or surveying charges, should be included on the invoice as separate items with receipts and not subject to the 5% retainage.

MINIMUM PERSONNEL REQUIREMENTS

The following requirements must be met at the time of submittal:

1. At least one Principal of the Consultant must be a Registered Professional Engineer in the State of Louisiana.
2. At least one Principal, or a responsible member of the Consultant, must be a Registered Professional Civil Engineer.
3. The Consultant must also employ, on a full time basis, a minimum of one Registered Professional Civil Engineer with at least five years experience in responsible charge of geotechnical services.
4. The Consultant must also have a complete corresponding geotechnical support staff, both office and field personnel, and equipment needed to perform the required services.

REFERENCES

All services and documents will meet the standard requirements as to format and content of the DOTD; and will be prepared in accordance with the latest applicable editions, supplements and revisions of the following:

1. AASHTO Standards, ASTM Standards or DOTD Test Procedures
2. DOTD Location and Survey Manual
3. DOTD Roadway Design Procedures and Details
4. DOTD Hydraulics Manual
5. DOTD Standard Specifications for Roads and Bridges
6. Manual of Uniform Traffic Control Devices (Millennium Edition)
7. DOTD Traffic Signal Design Manual
8. National Environmental Policy Act (NEPA)
9. National Electric Safety Code
10. National Electric Code (NFPA 70)
11. DOTD Environmental Impact Procedures (Vols. I-III)
12. Policy on Geometric Design of Highways and Streets
13. Construction Contract Administration Manual
14. Materials Sampling Manual

15. DOTD Bridge Design Manual
16. Consultant Contract Services Manual
17. Geotechnical Engineering Services Document
18. Bridge Inspectors Reference Manual, October 2002
19. AASHTO Guide Specification and Commentary for Vessel Collision Design of Highway Bridges
20. AASHTO Standard Specifications for Highway Bridges, latest edition
21. AASHTO LRFD Bridge Design Specifications, latest edition

EVALUATION CRITERIA

The general criteria to be used by DOTD (when applicable) in evaluating responses for the selection of a Consultant to perform these services are:

1. Consultant's firm experience on similar projects, weighting factor of 3;
2. Consultant's personnel experience on similar projects, weighting factor of 4;
3. Consultant's firm size as related to the estimated project cost, weighting factor of 3;
4. Consultant's past performance on similar DOTD projects, weighting factor of 6;
5. Consultant's current work load with DOTD, weighting factor of 5;
6. Location where the work will be performed, weighting factor of 4.*****

*All respondents will receive a 4 for this category.

Consultants will be evaluated as indicated in Items 1- 6. The evaluation will be by means of a point-based rating system. Each of the above criteria will receive a rating on a scale of 0-4. The rating will then be multiplied by the corresponding weighting factor. The firm's rating in each category will then be added to arrive at the Consultant's final rating.

DOTD's Consultant Evaluation Committee will be responsible for performing the above described evaluation, and will present a short list of the three (if three are qualified) highest rated Consultants to the Secretary of the DOTD. The Secretary will make the final selection.

CONTRACT REQUIREMENTS

The selected Consultant will be required to execute the contract within 10 days after receipt of the contract.

INSURANCE - During the term of this contract, the Consultant will carry professional liability insurance in the amount of $1,000,000. The Prime-Consultant may require the Sub-Consultant(s) to carry professional liability insurance. This insurance will be written on a "claims-made" basis. Prior to executing the contract, the Consultant will provide a Certificate of Insurance to DOTD showing evidence of such professional liability insurance.

AUDIT - The selected Consultant will allow the DOTD Audit Section to perform an annual overhead audit of their books, or provide an *independent* Certified Public

Accountant (CPA) audited overhead rate. This rate must be developed using Federal Acquisition Regulations (FAR) and guidelines provided by the DOTD Audit Section. In addition, the Consultant will submit semi-annual labor rate information, when requested by DOTD.

The selected Consultant will maintain an approved Project Cost System, and segregate direct from indirect cost in their General Ledger. Pre-award and post audits, as well as interim audits, may be required. For audit purposes, the selected Consultant will maintain accounting records for a minimum of five years after final contract payment.
Any Consultant currently under contract with the DOTD and who has not met all the audit requirements documented in the manual and/or notices posted on the DOTD Consultant Contract Services Website (www.dotd.louisiana.gov), will not be considered for this project.

SUBMITTAL REQUIREMENTS

One original (**stamped original**) and four copies of the SF 24-102 must be submitted to DOTD. **Evidence of a current license as a Water Well Contractor must be included in Section 14 of the SF-102**. All submittals must be in accordance with the requirements of this advertisement and the Consultant Contract Services Manual. Any Consultant failing to submit any of the information required on the SF 24-102, or providing inaccurate information on the SF 24-102, will be considered non-responsive.

Name(s) of the Consultant listed on the SF 24-102, must precisely match the name(s) filed with the Louisiana Secretary of State, Corporation Division, and the Louisiana State Board of Registration for Professional Engineers and Land Surveyors.

The SF 24-102 will be identified with **State Project No. 700-99-0398**, and will be submitted **prior to 3:00 p.m. CST** on **Monday, March 5, 2007**, by hand delivery or mail, addressed to:

Department of Transportation and Development
Attn.: Mr. Edward Wedge, III, P. E.
Consultant Contract Services Administrator
1201 Capitol Access Road, **Room 405-T**
Baton Rouge, LA 70802-4438 or
Post Office Box 94245
Baton Rouge, Louisiana 70804-9245
Telephone: (225) 379-1989

REVISIONS TO THE RFQ

DOTD reserves the right to revise any part of the RFQ by issuing an addendum to the RFQ at any time. Issuance of this RFQ in no way constitutes a commitment by DOTD to award a contract. DOTD reserves the right to accept or reject, in whole or part, all Qualification Statements submitted, and/or cancel this announcement if it is determined to be in DOTD's best interest. All materials submitted in response to this announcement

become the property of DOTD, and selection or rejection of a submittal does not affect this right. DOTD also reserves the right, at its sole discretion, to waive administrative informalities contained in the RFQ.

ATTACHMENT "A"

This attachment details the minimum requirements and expectations for performing geotechnical engineering services for DOTD. This attachment is intended to be an overview of expectations and may not be 'all-inclusive'. Any questions or comments should be directed to Kim Garlington, P.E., DOTD Pavement and Geotechnical Services Engineer Administrator, at (225) 379-1312.

SLOPE STABILITY (Embankment & Excavation):

The Objective of a Slope Stability Analysis is to determine the factor of safety of the proposed embankment or excavation on the project subsurface soils and make appropriate Engineering Design Recommendations. A minimum factor of safety of 1.3 is considered adequate for embankment side and end slopes. For cut sections, a safety factor of 1.5 is desirable. For short term draw-down conditions, a safety factor of 1.1 is considered adequate.

Standard Procedure: The embankment/excavation slope stability analysis shall consist of (1) modeling the appropriate boring logs to define the critical embankment/excavation geometry (cross-section) with subsurface soils, (2) interpreting the shear strength test data to determine drained and/or undrained shear strength design parameters, (3) performing the stability analysis utilizing the Bishop, Janbu, and/or sliding block method deemed appropriate by the engineer. PCSTABL4 or newer version is recommended, (4) determining the minimum safety factors for both long and short-term conditions at the critical fill heights at each bridge end, along the approach embankment (intermediate fill height) and in critical cut sections. Minimum safety factors should also be taken into consideration for rapid drawdown conditions when applicable, (5) analyzing different methods for mitigating possible stability problems and if necessary, make recommendations for geotechnical instrumentation to monitor stability performance, (6) defining areas of highly erodable materials and analyzing erosion control measures, (7) preparing a report with all the above information and engineering recommendations, and (8) during construction, the consultant will interpret slope stability data from all geotechnical instrumentation monitoring devices and make appropriate recommendations.

Deliverables of Slope Stability Analysis shall include the following:

- Printout of critical stability circle and/or block for each design case.
- Geotechnical models (cross-sections) and design input parameters.
- Summary table with critical fill heights and safety factors, or critical excavation cross-sections with safety factors.
- Certification that the modeled embankments meet the required long and short-term safety factors required.
- Summary of alternatives for mitigating possible stability problems with safety factors and estimated costs.
- Specifications for slope stability mitigation measures.
- Geotechnical Instrumentation Plan (if recommended).
- Recommended erosion control measures.
- Construction Slope Stability notes for the Bridge General Notes Sheet.

- Graphical presentation of lateral movements obtained from Geotechnical Instrumentation data during construction monitoring.

EMBANKMENT SETTLEMENT:

The Objective of a Consolidation/Settlement Analysis is to determine the amount of settlement in inches/feet, and the time required for this settlement to take place in days/months/years when the proposed embankment is constructed on the project subsurface soils, and make appropriate Engineering Design Recommendations.

Standard Procedure: The embankment settlement analysis shall consist of (1) modeling the appropriate boring logs to define the critical embankment geometry (cross-section) with subsurface soils, (2) interpreting the consolidation test data to determine design consolidation soil parameters, (3) performing a settlement analysis for the critical bridge end fill heights and for intermediate fill heights as needed, (4) determining the predicted total consolidation settlement, the predicted 90% consolidation settlement and the time periods for the predicted settlement to occur, (5) if the predicted time for 90% of the settlement to occur is excessive (greater than 5 months) recommendations shall be made to reduce the amount of consolidation settlement and/or to accelerate the settlement through the use of lightweight fills, surcharge placement, wick drains or other methods determined by the Engineer, (6) if mitigation is required, the consultant shall include all analyses and information including special provisions relating to surcharge quantities and limits, wick drain information and layouts and settlement monitoring instrumentation details, (7) assess the impact of predicted settlement and recommended mitigation on pavement, culverts, retaining walls and bridge abutments, (8) preparing a report with all the above information and engineering recommendations, and (9) during construction, the consultant will interpret settlement data from all monitoring geotechnical instrumentation devices and make recommendations for surcharge removal or other geotechnical related construction activity.

Deliverables of Consolidation/Settlement Analysis shall include the following:

- Geotechnical models (cross-sections) with design input parameters.
- Printout of settlement analysis for each design case.
- Presentation of settlement analysis in graphical form (Settlement vs. Time of consolidation Curves) with clear indications of total predicted settlement, 90% predicted settlement, and the effect of surcharging and/or placing wick drains. Hand calculations should be included.
- Assessment of the potential impact of predicted settlement and any recommended mitigation on pavement, culverts, retaining walls and bridge abutments.
- Wick Drain Design Sheets (see example).
- Specifications for recommended settlement mitigation measures (surcharge, wick drains, etc.)
- Geotechnical Instrumentation Plan with Drawings and Specifications (if recommended)
- Graphical output of actual field settlement data obtained from Geotechnical Instrumentation during construction monitoring.

- Construction Settlement notes for the Bridge General Notes Sheet.

BRIDGE FOUNDATIONS:

PILES:

The Objective of a Pile Design Analysis is to determine the pile type, pile capacity, lateral load requirements, and pile length for the project subsurface soils considering pile set-up, down-drag (negative skin friction), potential scour, and other project related factors.

Standard Procedure: The Pile Foundation Design Scope of work shall consist of (1) modeling the appropriate deep boring logs and/or Cone Penetration (CPT) sounding data to define the project subsurface soil profile, (2) obtaining Standard Penetration Test (SPT) N-values and interpreting the laboratory test data to determine pile design soil parameters, (3) performing pile static analyses to determine pile type, pile capacity and plan pile tip elevation or length, (4) estimating foundation settlement and "down-drag" loads, (5) performing lateral load analyses,(6) estimating scour depths, (7) performing wave equation analyses to determine pile drivability and hammer approval, (8) assessing constructability issues such as installation sequencing, heave and/or lateral pile movement, installation aids (jetting or augering), etc., (9) performing analyses to develop test pile recommendations (feasibility, location, test pile tip elevation, etc.), and pile driving analyzer (PDA) recommendations.
((The consultant shall utilize the DOTD "Pile Capacity Guide" found on the DOTD Internet site or other approved pile capacity prediction methods or software. The "PILECPT" software provided by the LTRC Web site shall be utilized with the CPT sounding data.))

Deliverables for Pile Foundation Design Analysis shall include the following:

- Design spreadsheets of calculations indicating the geotechnical design parameters utilized for each boring log, including scour elevations if applicable, for the pile type selected.
- Graphical or tabulated representation of the pile capacity vs. tip elevation (not depth of penetration).
- Lateral load analyses.
- Recommended plan pile tip elevations for all bents. (Shown in the pile data sheet.)
- Feasibility study for utilizing a test pile (safety factor 2.0 vs. safety factor 3.0).
- Drivability recommendations.
- Pile installation criteria with discussion of installation issues.
- Pile Driving Analyzer (PDA) recommendations.
- Hammer approval method recommendations.
- Special Provisions for Dynamic Monitoring and Dynamic Analysis, if recommended for project.
- Special Provision for Static Load Test, if recommended for project.
- Considerations for "down-drag" effects on piles driven through new fill materials.
- Considerations for pile "set-up".

- Uplift Capacity of Group Piles if required by project conditions.
- Pile notes for the Bridge General Notes Sheet.

DRILLED SHAFTS:

The Objective of a Drilled Shaft Analysis Design is to determine the diameter, tip elevation and installation procedure for the project subsurface soil conditions.

Standard Procedure: The Drilled Shaft Foundation Design Scope of work shall consist of (1) modeling the appropriate deep boring logs and/or Cone Penetration (CPT) sounding data to define the project subsurface soil profile, (2) obtaining Standard Penetration Test (SPT) N-values and interpreting the laboratory test data to determine drilled shaft design soil parameters, (3) selecting appropriate design equations for the project soil types to determine ultimate base and side resistance and selecting appropriate factor of safety, (4) performing axial and lateral load analyses to determine drilled shaft diameter and tip elevation, and (5) performing analyses to determine appropriate Construction Method for project soil conditions.

Deliverables for Drilled Shaft Foundation Analysis and Design shall include the following:

- Design spreadsheets or calculations indicating the geotechnical design parameters utilized for each boring log including scour elevations if applicable.
- Graphical or tabulated representation of the drilled shaft capacity vs. tip elevation for each diameter.
- Lateral load analyses.
- Considerations for “down-drag”.
- Recommended plan drilled shaft diameters and tip elevations for all bents. (Shown in the Drilled Shaft data sheet.)
- Recommended Construction Method with discussion of installation issues.
- Recommendations for Construction Quality Control.
- Drilled Shaft notes for the Bridge General Notes Sheet.
- Special Provision for Integrity Testing if required for project.
- Special Provision for drilled shaft Load Test if required for project.

OTHER FOUNDATIONS:

If other types of foundation are recommended for the specific project conditions, the Standard Procedure format and the Deliverables format outlined for piles and drilled shafts shall be followed with specific design details for the type of Foundation recommended.

PILE SUPPORTED APPROACH SLAB DESIGN DATA:

The DOTD normally uses a timber pile supported approach slab to minimize differential settlement in the transition zone between the approach embankment and the bridge abutment.

Deliverables for Pile Supported Approach Slabs shall include the following:

- Layout showing pile locations.
- Pile diameter and length.
- Drivability Recommendations

BRIDGE FOUNDATION LOAD TEST PROGRAM:

If the project subsurface conditions are difficult and if significant uncertainties exist in the Foundation Design and if cost savings can be predicted, a Foundation Load Test Program may be appropriate. Depending on project conditions, a Foundation Load Test Program may be included either in the Design or in the Construction phase.

Deliverables for the Foundation Load Test Program shall include the following:

- Location and Type of Load Test Proposed.
- Design of Test Foundation (pile, drilled shaft, or other).
- Load Increment Requirements.
- Maximum Test Load.
- Instrumentation Requirements.
- Load Test Layout and Design Sheets for Plans.
- Special Provision for Construction of Test Foundation and Conduct of Load Test.
- Interpretation of Load Test Results and Recommendations.
- Foundation Load Test Report.

EARTH RETAINING STRUCTURES:

General Considerations:

A Retaining Wall is normally required if adequate space (r-o-w) is not available for a Slope. The DOTD has used Mechanically Stabilized Earth (MSE) Walls, Gravity Concrete Walls, Sheet Pile Walls, plus other types for transportation projects. The selection of the most appropriate Retaining Wall type for the specific project requirements and site and subsurface conditions can have profound effects on the project cost and constructability.

Every Retaining Wall type has a unique design procedure and generally requires the services and coordination of a Geotechnical Engineer and a Structural Engineer. The following criteria are generally required for analysis and design of all Retaining Wall types:

Deliverables for all Retaining Wall Analyses and Designs shall as a minimum include the following:

- Earth Pressure Distributions.
- Bearing Capacity of the foundation soil or rock.
- Analyses for Sliding and Overturning and Mitigation Recommendations.
- Settlement and Tilt (Rotation) Analyses and Mitigation Recommendations.

- Drainage Recommendations
- Global Stability Analyses and Mitigation Recommendations.
- Backfill Properties.
- Wall Components/Materials.
- Wall Construction Procedures.
- Wall Layout with plan view, elevation view, typical sections and details.
- Quantities Table with applicable General Notes.
- Design Life.
- Special Provisions.

MECHANICALLY STABILIZED EARTH (MSE) WALLS:

The DOTD has developed a Geotechnical Engineering Design Guide titled "MSEW Design Guide, G.E.D.G. No.8" dated Oct.1, 1999. Consultants should refer to this Guide for analysis and design of all MSE Walls.

Additional **Deliverables for MSE Walls** shall be as outlined in the DOTD MSEW Design Guide and as required to identify the MSE specific design and construction requirements:

- Type and Size of Facing Element.
- Type, Size and Design Length of Reinforcement Elements.
- Type of Connections.
- Minimum embedment requirements.
- Backfill Material Requirements.
- If TEMPORARY WALL, identify specific requirements.

CONCRETE WALLS:

Cast-In-Place Concrete Gravity or Cantilever Walls are now generally limited to small applications or specialized situations because of the development of more economical wall types. Standard design and construction procedures are well documented in many geotechnical books and other publications.

Deliverables for Concrete Walls are as outlined under General Considerations above.

SHEET PILE WALLS:

The DOTD developed a "Preliminary" Design Guide titled "DOTD CANTILEVER SHEET PILE DESIGN GUIDELINES" dated 10/26/00. Consultants should refer to this Guide for analysis and design of Sheet Pile Walls.

Additional **Deliverables for Sheet Pile Walls** shall be as outlined in the DOTD Guidelines:

- Sheet Pile Section and Type.
- Minimum Section Modulus.
- Minimum Depth of Penetration.

- Moment of Inertia Requirements.
- Estimated long and short term Deflections.
- Anchor Loads.
- Long and Short term Stability including Drawdown and Liquefaction.
- Complete Design Details of sheet piling, Backfill, Drainage, and Connections.
- Corrosion Protection Measures.
- Construction Constraints

OTHER RETAINING WALL TYPES:

Other types of Retaining Walls that may be appropriate for DOTD transportation projects are Drilled Shaft Walls, Soldier Pile & Lagging Walls, Slurry Walls, Anchored (Tied-back) Walls, Soil Nailed Walls, Reticulated Micro-Pile Walls, Jet-Grouted Walls, and Deep Soil Mixing Walls. These walls shall be designed using generally recognized design procedures applicable to the specific type of wall used.

Note that **Reinforced Soil Slopes** may in some cases be an economical alternative to a Retaining Wall.

CULVERTS:

The geotechnical design review of the culvert locations shown in the plans shall consist of earth pressure calculations, bearing capacity analyses, settlement analyses and a constructability review of the culvert. Recommendations for bedding material, foundation supported options, insitu bearing improvements and construction procedures should be addressed.

Deliverables for Culverts shall include the following:

- Earth Pressure calculations and Recommendations.
- Bearing Capacity calculations and Recommendations.
- Settlement and Differential Settlement Estimates with design parameters.
- Recommendations for bedding material and/or other foundation support options.
- Any Specialized Construction Procedures and Recommendations.

GEOTECHNICAL ANALYSIS & DESIGN RECOMMENDATIONS REPORT:

No standard report format is required and the Consulting Firm may use its own format. However, the GEOTECHNICAL ANALYSIS & DESIGN RECOMMENDATIONS REPORT shall contain a Background Description of THE PROJECT such as location, engineering features and requirements, etc. and shall include all the items listed under Deliverables above that are a part of THE PROJECT.

CONSTRUCTION MONITORING:

BRIDGE FOUNDATIONS:

PILES:

The Pile foundation construction scope of work shall consist of providing the following Geotechnical services during the construction phase of the project:

- Hammer approval utilizing the Wave Equation Analyses (if alternate hammer approval method is not specified).
- Field monitoring the installation of test piles, monitor piles, indicator piles and/or production piles with the Pile Driving Analyzer (PDA).
- Analysis of PDA data utilizing CAPWAP AND GRLWEAP.
- Generating bearing capacity graphs (Inspector's Charts).
- Recommending pile driving criteria.
- Recommending final pile tip elevations based on the results of Load Tests or Dynamic Analyses.

The **Deliverables for Construction Monitoring of Piles** shall include the following:

- Hammer approval documentation.
- PDA Testing and Analysis Report with (1) PDA plots of pile capacity, driving stresses and energy transfer, (2) CAPWAP Pile Capacity Summary Table, and (3) Inspector's Charts.
- Final Pile Tip Elevations and Order Length Recommendations to the Project Engineer.

DRILLED SHAFTS:

The Drilled Shaft foundation construction scope of work shall include the construction monitoring items outlined in the DOTD Guide titled "Drilled Shaft Foundation Construction Inspectors Manual" dated 1/08/02 plus any special considerations specified in the Plan Notes.

The **Deliverables for Construction Monitoring of Drilled Shafts** shall include those required in the Guide Manual and the following:

- Comments/Recommendations on Contractor's "Drilled Shaft Installation Plan".
- Drilled Shaft Soil/Rock Excavation Logs.
- Drilled Shaft Concrete Placement Log.
- Theoretical Concrete Volume vs. Actual Concrete Volume Graph.
- Inspection Report with (1) description of drilling method, clean-out methods, bottom inspection methods and findings and concrete placement and effectiveness, (2) If slurry–displacement method is used, Record of slurry properties, (3) description of difficulties encountered.

- Integrity Testing (Cross-hole Sonic Logging or other) Interpretation and Recommendations.

Other Foundations:

The scope of work for Other Foundations and the Deliverables shall be as recommended in the Geotechnical Analysis & Design Recommendations Report.

GEOTECHNICAL INSTRUMENTATION:

The Objective of Geotechnical Instrumentation in construction monitoring is to record and interpret the Instrumentation data and compare actual soil behavior to that predicted by Design. Each type of Instrumentation has an intended purpose and allows major decisions to be made by Construction Managers that affect construction safety (prevent major failures), scheduling, and construction costs. The usual Instrumentation specified to monitor foundation performance on projects where stability and settlement are critical are (1) Slope Inclinometers, Piezometers, and Settlement Devices. The "Geotechnical Analysis & Design Recommendations Report" should have an Instrumentation Layout plus recommended Frequency of Readings.

The Deliverables for Geotechnical Instrumentation shall include the following:

- Plan and elevation Location, Details, and applicable Notes for all Instrumentation.
- Specifications for Furnishing, Installation, Monitoring, and Reporting for all Instrumentation.
- Graphical presentation of lateral movement data and Action Recommendations.
- Graphical presentation of actual field settlement data and Action Recommendations.
- Interpretation of other Instrumentation data as recommended in the "Geotechnical Analysis & Design Recommendations Report" and Action Recommendations.

OTHER GEOTECHNICAL FEATURES:

Construction Monitoring and Construction Inspection of other geotechnical features such as Embankments and Excavation Earthwork, Drilled Shafts, Earth Retaining Structures, Soil Stabilization, etc. in THE PROJECT shall be as required by the DOTD Standard Specifications. If special Construction Inspection and/or Monitoring is required for special Geotechnical features, they will be as recommended in the "Geotechnical Analysis & Design Recommendations Report", Construction "Plan Notes" and "Special Provisions".

APPENDIX "A"

LIST OF PUBLISHED GEOTECHNICAL DOTD REPORTS AND FORMS PLUS OTHER TECHNICAL REFERENCES

Most of the following can be obtained at the DOTD web site (www.dotd.state.la.us) or at the FHWA Bridge/Geotechnical web site (www.fhwa.dot.gov/bridge).

DOTD Reports and Forms:

- Standard Specification, latest edition
- Bridge Manual
- Road Design Manual
- Hydraulics Manual
- Materials Sampling Manual
- Materials Testing Procedures Manual
- 2001 Pile Capacity Guide
- Drilled Shaft Foundation Construction Inspection Manual (1/08/02)
- "Preliminary" DOTD Sheet Pile Design Guidelines (10/26/00)
- MSEW Design Guide, Geotechnical Engineering Design Guide (G.E.D.G.) No. 8 (10/01/1999)
- LTRC "PILECPT" Software
- Pile and Driving Equipment Data Form (1/08/93)
- Deep Soil Boring Request and Field & Laboratory Request Form (1/03/02) (in one sheet)
- Wick Drain Design Sheets
- DOTD Testing Procedures Guidelines For Standard Format

Other Technical References:
The DOTD has used the following as technical references and guidelines in the design and construction monitoring of Geotechnical features for DOTD projects in the past and are recommended for use by the Geotechnical Engineering Consultant community. This list is not all encompassing and other publications may be used and referenced. Additions will be made as this Document is updated.

- Subsurface Investigations Manual, Publication No. FHWA HI-97-021, Nov. 1997
- Manual On Subsurface Investigations, Published by AASHTO, 1988
- AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, PART I – SPECIFICATIONS and PART II – TESTS, current edition
- ASTM Procedures and Regulations, current edition
- Earth Retaining Structures, Reference Manual (Draft), FHWA-NHI, May 1998
- Earth Retaining Systems, Geotechnical Engineering Circular No. 2, Publication No.FHWA-SA-96-038, February 1997
- MSE Walls and Reinforced Soil Slopes (update of DP 82 Manual), Publications No. FHWA NHI-00-043, and FHWA-NHI-00-044, March 2001
- Geotechnical Instrumentation Manual, Publication No. FHWA HI-98-034, October 1998
- Drilled Shafts: Construction Procedures and Design Methods Manual, Publication No. FHWA-IF-99-025, August 1999
- Soils and Foundations Workshop Manual, Publication No. FHWA NHI-00-045, August 2000

- Geosynthetic Design and Construction Guidelines Manual, Publication No. FHWA HI-95-038, April 1998
- Ground Improvement Technical Summaries, DP 116, Publication No. FHWA-SA-98-086
- Design and Construction of Driven Pile Foundations, Volumes 1 & 2, Publications No. FHWA-HI-97-013 and FHWA-HI-97-014, December 1996
- Soil Slope and Embankment Design, Reference Manual, FHWA-NHI, 2003
- Manual for Design & Construction Monitoring of Soil Nail Walls, Publication No. FHWA-SA-96-069, November 1996
- Soil Nailing Field Inspectors Manual, (DP 103), Publication No. FHWA-SA-93-068, April 1994
- NAVFAC Design Manuals, DM 7.1, DM 7.2 and DM7.3, May 1982

"Frequently Asked Questions" on DOTD Geotechnical procedures may be found on the DOTD Pavement & Geotechnical Design web page.