ATTACHMENT "A"

SCOPE OF SERVICES

SURVEYING SERVICES

Topographic Survey

This project is located in Lafayette Parish in Lafayette, LA, between the Lafayette Regional Airport and Broussard, LA. This project is a proposed widening of US 90/I-49 South and realignment of Verot School Road. A Topographic Survey will be required along the entire proposed route. A complete Topographic Survey including all utilities with depths and all drainage is required, along with finish floor elevations of all buildings that fall in the survey limits. This project shall be completed in accordance with the Location and Survey Manual and all current accepted Location and Survey Automation procedures.

The survey will begin approximately 600 feet south of the intersection of US 90 and South Park Road. From this point the survey will proceed in a northerly direction along the existing alignment of US 90 for approximately 2.6 miles to a point that is 600 feet north of the intersection of US 90 and Kaliste Saloom Road. The ending project limits will overlap an adjacent state project H.004273 - I-49 Connector (Lafayette). Coordination between surveyors on both projects will be required. The width of the survey and DTM will vary along this entire route.

The survey will also include a portion along the existing and proposed alignments of Verot School Road. This portion of the survey will begin at the intersection of Verot School Road and LA 182 (Pinhook Road). From this point, the survey will proceed in an easterly direction along the existing and proposed alignment of Verot School Road for approximately 0.9 miles and tie into the portion of the survey mentioned previously in this scope. It shall also include a portion of South College Road, South Hugh Wallis Road, an all other intersections and side streets, as well as a new proposed alignment between South College Road and South Hugh Wallis Road. The width of the survey and DTM will vary along this entire route.

An existing drainage map will be required. Please refer to the Location and Survey Manual for detailed instructions of what is required for the drainage map.

Permission of land owners shall be acquired by the consultant before entering any property associated with this description.

The project alignments shall be established using the existing centerline of roads.

Property Survey, Right-of-Way (R/W) Maps, Title Take-Off

A property survey is necessary for each required parcel. Title take-offs may be obtained by the surveyor if necessary to expedite commencement of field work.

Upon completion of the property survey, the consultant will notify the Location and Survey Administrator, in writing, and provide an electronic text file listing coordinates and descriptions of all found monuments, a "PDF" copy of all documents (plats, maps, etc.) used to determine property line locations and a "PDF" copy of title take-offs reports used to determine property line locations. Consultant shall also provide an electronic copy of the property survey in Microstation "DGN" and Adobe "PDF" formats showing all surveyed property lines, property monuments, existing right of way, and all major improvements within 50 feet of required taking lines with ties to project centerline. The Microstation "DGN" file shall be referenced to the survey control coordinate system.

Consultant shall prepare a right of way map that will consist of one title sheet, approximately 7 plan sheets at a scale of 1"=20', and approximately 1 residual sheets at an acceptable scale to utilize the limits of the sheet. Two sets of prints of the 60% right of way map will be submitted for a joint plan review and two sets of prints of the final right of way map shall be submitted for final review. LA DOTD Real Estate will provide Title Updates if the Title Research Reports are older than 6 months at the completion of final review maps.

Upon completion of the right of way map, the consultant will provide a film copy of the Right of Way Map, a Parcel Input file, one (1) paper copy of each title research report, and a scanned "PDF" file of each title research report. Each report shall have the corresponding parcel number shown on the cover sheet.

Note that all work is to be completed in English units of measurements.

PRELIMINARY PLANS (ROAD)

The Consultant shall be responsible for all engineering services required for the completion of preliminary roadway plans, and for the construction estimates of the project, all under a schedule for completion which shall be in conformity with the contract time negotiated between DOTD and the Consultant and approved by the Project Manager. Preliminary road plans shall be for the Selected Alternative presented in the EIS and approved in the ROD or as modified and approved by DOTD and FHWA.

During the progress of the preliminary road design phase of work, intermediate submissions will be made to the DOTD for review and comment at the 30%, 60% and 90% levels of completion. Comments received as a result of the submissions will be discussed with the DOTD and incorporated into the final submittal of that respective phase as warranted.

The preparation of preliminary road plans for the Project shall be in accordance with the requirements outlined in the latest and current editions of DOTD's Roadway Plan Design Procedures and Details Manual and Hydraulics Manual. Specifications for the Project shall be in

accordance with the latest edition of Louisiana Standard Specifications for Roads and Bridges, amended to comply with the current practices of the DOTD.

PRELIMINARY PLANS (BRIDGE)

The bridge design scope of work will include all engineering services as necessary to complete the following:

a) Design/Evaluation Criteria:
   - Provide safe and aesthetically pleasant structures for the traveling public
   - Provide functionality, durability, corrosion protection, ease of inspection and maintenance.
   - New structures shall be designed in accordance with the latest AASHTO Bridge Design Specifications, LADOTD Bridge Design and Evaluation Manual and Bridge Design Technical Memoranda (BDTMs).
   - All columns shall be protected in accordance with AASHTO LRFD Bridge Design Specifications.

b) Bridge Design Tasks:
   - Task 1: Prepare design criteria and submit it to LADOTD for approval prior to proceeding with design. The design criteria should be in accordance with the latest versions of the reference documents and any other relevant documents.
   - Task 2: Conduct a field visit to the bridge site and assess the existing conditions for possible permit issues, roadway alignment alternatives, etc.
   - Task 3: Provide a list of estimated type, sizes (lengths and widths), and locations of bridges. Develop feasible alternates for structure types if appropriate. Prepare construction cost estimates (itemizing construction, right-of-way, and utility relocation costs) for each bridge and each alternate.
   - Task 4: Submit the aforementioned items to DOTD for review and comment. The preferred option should be included and supported as applicable.
   - Task 5: After receiving approval from DOTD, prepare a set of preliminary plans for the preferred option. Required drawings for preliminary plans shall include, as applicable, General Bridge Notes and Index, Summary of Estimated Bridge Quantities, General Bridge Plans, Typical Bridge Sections, Superelevation Diagrams, Construction Phasing Details, Traffic Control Details, Foundation Layouts, Pile Loads/ Details, and any other sheets that may be necessary to begin final bridge design plans.
   - Task 6: Attend a Plan-In-Hand meeting for 100% Preliminary Plans.
   - Task 7: Prepare preliminary construction cost estimate.

   **A supplemental agreement will be developed for final plans.*

c) Consultant Submittals:
   - Design Criteria
   - Summary of all bridges and their associated costs for all reasonable alternatives; this shall include type, size, and location as well as corresponding explanations of the design obstacles and constructability.
   - 30%, 60%, 90%, and 100% Preliminary Plans
   - Preliminary Construction Cost Estimate

- QA/QC Documentation

TRAFFIC ENGINEERING ANALYSIS

The Consultant shall conduct a formal traffic study for the purpose of obtaining both existing and projected future traffic volumes for the locations listed below, including the data needed for evaluation of the roundabout concepts in accordance with LADOTD's EDSM VI.1.1.5 (Roundabout Study and Approval) and EDSM VI.1.1.6 (Roundabout Design), signalized concepts in accordance with LADOTD's EDSM VI.3.1.6 (Traffic Signals), and HCM analysis to evaluate projected weave, merge, and diverge segments for ramp placements. Analysis shall be performed on proposed intersection locations to evaluate alternatives.

A general guideline for deliverables is outlined below:

I. Submit machine tube counts and recommended peak hours for approval on the following intersections:
    a. Seven-Day 24-hour Approach Machine Counts: (See Map)
        1) E. Verot School Road at Industrial Parkway (EB, WB Approach (2))
        2) US 90, West of E. Verot School Road (Both Directions (2))
        3) US 90 Frontage, West of E. Verot School Road (Both Directions (2))
        4) Perimeter Road, West of E. Verot School Road (Both Directions (2))
        5) US 90 at Knight Oil Tool Driveway (US 90 Approaches Only) (2))
        6) US 90 Frontage at Beau Pre Road (US 90 Frontage Approaches Only (2))
    b. 24-Hour Approach Machine Counts: (See Map)
        1) Industrial Parkway at E. Verot School Road (SB Only (1))
        2) E. Verot School Road at S. College Road (All Approaches (3))
        3) Queens Row at E. Verot School Road (NB Only(1))
        4) E. Verot School Road at Hugh Wallis Road South (All Approaches (3))
        5) E. Verot School Road at US 90 Frontage (All Approaches (3))
        6) E. Verot School Road at US 90 (All Approaches (2))
        7) E. Verot School Road at Perimeter Rd. (All Approaches (2))
        8) E. Verot School Road at LA 182 (Pinhook) (All Approaches (4))
        9) US 90 at Perimeter Road (All Approaches (4))
        10) US 90 at Perimeter Road, West of Alligator Road (All Approaches (2))
        11) Alligator Road at Perimeter Road (All Approaches (3))
        12) US 90 Frontage at Beau Pre Road (Beau Pre Road approach only (1))
        13) US 90 Frontage at Garber Road (All Approaches (2))
        14) US 90 at Garber Road (All Approaches (3))

II. Submit list of driveway locations on E. Verot School Road and median openings on US 90, within the project limits, and obtain approval before starting counts.

III. Submit counts during approved peak hours for approval on the following intersections:

a. Peak Hour Turning Movement Counts with demand volumes:
    1) E. Verot School Road at Industrial Parkway
    2) E. Verot School Road at S. College Road
    3) E. Verot School Road at Queens Row
    4) E. Verot School Road at Hugh Wallis Road South
    5) E. Verot School Road at US 90 Frontage
    6) E. Verot School Road at US 90
    7) E. Verot School Road at Perimeter Rd.
    8) E. Verot School Road at LA 182
    9) US 90 at Perimeter Road
    10) US 90 U Turn at Cypress Tree Inn
    11) US 90 at Perimeter Road, West of Alligator Road
    12) Alligator Road at Perimeter Road
    13) US 90 Frontage at Beau Pre Road
    14) US 90 at Knight Oil Tool
    15) US 90 Median Opening East of Beau Pre Road
    16) US 90 Frontage at Garber Road
    17) US 90 at Garber Road

IV. Submit the following for approval prior to Section V
    a. Turning Movement Count data
    b. Proposed growth rate with assumptions and methods for design year 2035
    c. Existing AM and PM Synchro 8

V. Redistribute traffic for the proposed interchange at E. Verot School Road and US 90. The consultant shall provide a conceptual layout detailing volume distribution with each intersection alternative. Alternatives may include, but not limited to, roundabouts, signalized, stop controlled, and/or restricted movement intersections.

VI. Perform analysis on all intersections detailed in the proposed interchange design
    a. Roundabouts shall be designed in accordance with LADOTD EDSM VI.1.1.6.
    b. All intersection analyses shall be performed using Sidra 6 and Synchro 8, or their latest LADOTD approved version.
    c. The roundabout analysis shall be performed according to LADOTD EDSM VI.1.1.5 and LADOTD "Roundabout Analysis: Required Settings and Standards for Sidra 6".
    d. For comparing roundabouts to signalized intersections, signalized alternatives shall be analyzed in Synchro 8, then the phasing results and layout shall be inserted in Sidra 6 for analysis as described in LADOTD's "Roundabout Analysis: Required Settings and Standards for Sidra 6".
    e. Analyze weave, merges, and diverges at ramp termini using HCM.

VII. Submit draft Traffic Study Report for review and approval based on approved concepts
    a. Design Year - No Build
    b. Design Year – 2035 Intersection Alternatives

c. Synchro and Sidra files - proposed major intersections shall include Sidra comparisons for AM and PM peaks comparing optimized signal phasing (performed in Synchro and analyzed in Sidra).

Meetings

Throughout the Traffic Study process, the Consultant shall meet with DOTD Traffic Engineering Management and District 03 Traffic Engineering Section to evaluate methods, layouts and analyses. All components shall be submitted for approval to DOTD Traffic Engineering Management (Section 77) and DOTD District Traffic Operations Engineer (DTOE) before advancing to the next stage of the study.

Final Traffic Analysis Deliverables

Upon review and approval by DOTD, the Consultant will provide two (2) copies of a stand-alone traffic report signed and sealed by a licensed Professional Engineer who is also a certified PTOE as outlined in the minimum personnel requirements of the contract. A .pdf version of the final report, including appendices and maps, shall be provided on a compact disc.

Other deliverables shall include

- Synchro Files - electronic
- Sidra Files - electronic
- All turning movement and 24 hour counts - electronic spreadsheet

SUE SERVICES

Provide CI/ASCE Standard 38-02 Quality Level D Subsurface Utility Engineering services. All QLD utility findings should be marked/painted on the ground to meet LADOTD Location & Survey standards. The limits of work are along US 90 from R/W to R/W between South Park Road to Kaliste Saloom Road. Also from the Bolton Street and Verot school road intersection along the existing and proposed alignment of Verot School Road in an easterly direction to tie in to the US 90 and Verot School Road intersection. Also to include a portion of South College Road, South Hugh Wallis Road, and a new proposed alignment between South College Road and South Hugh Wallis Road. Once potential conflicts have been identified, any Quality Level A and B services deemed necessary will be supplemented into the contract based on the results of the records research.

GEOTECHNICAL ENGINEERING SERVICES

Project Description

The selected Consutlant will perform geotechnical exploration services for the above captioned project, consisting of fifty-two (52) deep soil borings, twenty-four (24) shallow roadway borings, sampling, and laboratory testing along the project alignment in Lafayette Parish. The project alignment includes bridge crossings at E. Verot School Road over US 90 and BNSF Rail Road. This project also includes five MSEW structures. The exact number of soil borings may change

as survey data and preliminary engineering are finalized. The following table indicates the number of borings estimated for each structure.

Structure	Type of Crossing	Number of Borings
E. Verot School Rd Bridge	Overpass	3
North Bound MSEW South of E. Verot School Rd.	Land	10
North Bound MSEW North of E. Verot School Rd.	Land	10
South Bound MSEW North of E. Verot School Rd.	Land	10
South Bound MSEW South of E. Verot School Rd.	Land	10
MSEW along E. Verot School Rd. toward College Rd.	Land	9

The shallow borings will be made in the median spaced at approximately 1000-ft intervals. The MSEW borings are anticipated to be 75 feet deep spaced in accordance to the latest edition of AASHTO LRFD. The soils investigations, sampling and testing services to be provided shall include, but are not limited to:

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

- Field Reconnaissance (including rights of entry, utility locations, access, etc.);
- Mobilization/demobilization;
- Deep and Shallow Soil borings;
- CPT soundings (ASTM D5778);
- 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; and
- Traffic Control.

Drilling and Sampling

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.

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.

Transport of samples from the field to the laboratory shall conform to ASTM D4220, Group C. 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.

Laboratory Testing

Soil mechanics laboratory testing shall be performed on at least 75 percent of all samples obtained from the borings. 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. All other sampling and

testing shall be performed in accordance with current AASHTO test procedures, unless otherwise noted.

Cone Penetrometer Testing
The CPT rigs shall be capable of providing up to 20 tons reaction. Pore pressure measurements, when requested by the Project Manager, shall be obtained using U2 location, unless otherwise specified. Dissipation tests shall be performed until at least 50 percent of the excess pore water pressure has been dissipated. All CPT probes and equipment utilized shall have been calibrated within the previous year or within a period specified by the project manager. The cost of performing the calibration shall be the consultant's responsibility. The final CPT sounding results shall conform to the input format of LTRC's CPT-Pile software.

Other Considerations
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.

Unless otherwise stated, it will be the responsibility of the Consultant to obtain consent from the respective landowners in order to enter onto private property. The process for contacting landowners and documentation for Consultant Entry will be discussed at the Consultant Kickoff meeting with DOTD personnel. 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

Unless otherwise specified by the Project Manager, 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). In addition to the paper submittal, electronic logs that can be imported into the gINT software for the electronic storage of the soil boring and CPT logs shall be submitted. 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;
- Bridge foundation static and dynamic load test program;
- Earth retaining structures; and
- Geotechnical analysis & design recommendations report.

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. The resistance factors from the AASHTO LRFD Bridge Design Specifications, latest edition, shall be used to analyze slope stability.

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 un-drained shear strength design parameters, (3) performing the stability analysis utilizing the Bishop, Spencer, and/or sliding block method deemed appropriate by the engineer, (4) determining the maximum resistance 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. Maximum resistance factor 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 erodible materials and analyzing erosion control measures, and (7) preparing a report with all the above information and engineering 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 resistance factors, or critical excavation cross-sections with resistance factors;
- Certification that the modeled embankments meet the required long and short-term resistance factors required;

- Summary of alternatives for mitigating possible stability problems with resistance factors and estimated costs;
- Specifications for slope stability mitigation measures;
- Geotechnical Instrumentation Plan (if recommended);
- Recommended erosion control measures; and
- Construction Slope Stability notes for the Bridge General Notes Sheet.

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, and (8) preparing a report with all the above information and engineering recommendations.

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;
- Specifications for recommended settlement mitigation measures (surcharge, wick drains, etc.); and
- 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 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 or 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);
- If the FHWA software Driven 1.2 is used, include an electronic copy of the data file generated along with a hard copy of the input and output;
- Lateral load analyses;
- Recommended plan pile tip elevations for all bents. (Shown in the pile data sheet.);
- Feasibility study for utilizing a test pile (static resistance factors vs. dynamic resistance factors);
- Drivability recommendations;
- Pile installation criteria with discussion of installation issues;
- Pile Driving Analyzer (PDA) recommendations;
- Hammer approval method recommendations;
- Necessary pay items and corresponding quantities for test piles, indicator piles, and monitor piles;

- 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;
- Considerations for pile "set-up;"
- Uplift Capacity of Group Piles if required by project conditions; and
- 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 resistance factor, (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;
- Drilled Shaft notes for the Bridge General Notes Sheet;
- Special Provision for Integrity Testing if required for project; and
- 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.

BRIDGE FOUNDATION LOAD TEST PROGRAM

If the project subsurface conditions are difficult, 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);
- Dynamic Test Procedures and Schedules;
- 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; and
- Foundation Load Test Report.

EARTH RETAINING STRUCTURES

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.

General Considerations
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; and
- Special Provisions.

MECHANICALLY STABILIZED EARTH (MSE) WALLS

The AASHTO LRFD Bridge Specifications, latest edition as well as all supplements shall be followed for analysis and design of all MSE Walls. FHWA NHI-10-024 Vol. I and NHI-10-025 Vol. II, "Design of MSE Walls and Reinforced Slopes" (Berg et al., 2009) may be used as a reference.

Additional Deliverables for MSE Walls shall be 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; and
- 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 resistance factors from the AASHTO LRFD Bridge Design Specifications, latest edition, shall be used to design 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; and
- 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.

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, geological irregularity, if exists, engineering features and requirements, etc., and shall include all the items listed under Deliverables above that are a part of the project.

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:

- AASHTO LRFD Bridge Design Specifications, latest edition and supplements;
- Standard Specification, latest edition;
- Bridge Manual;
- Road Design Manual;
- Hydraulics Manual;
- Materials Sampling Manual;
- Materials Testing Procedures Manual;
- Drilled Shaft Foundation Construction Inspection Manual (1/08/02);
- LTRC “PILECPT” Software;
- FHWA “DRIVEN” Software;
- Pile and Driving Equipment Data Form (06/19/06);
- Deep Soil Boring Request and Field & Laboratory Request Form (1/03/02) (in one sheet);
- Wick Drain Design Sheets; and
- DOTD Testing Procedures Guidelines For Standard Format.