ATTACHMENT C

SERVICES TO BE PROVIDED BY THE ENGINEER

The Engineer shall provide preliminary engineering services for development of a design schematic, environmental documents and services, and studies in support of the schematic work, identification and development of conceptual mobility solutions, public involvement, permit procurement, data collection and analysis, mitigation and remediation, monitoring, drainage, conceptual traffic control, traffic projections, traffic engineering and operations including capacity analysis, traffic simulations, safety analysis, and 3-D modeling, surveying and mapping, utility engineering investigation, and utility coordination for various highway projects located along SH29 from CR 258 (in Bertram) to IH 35 (in Georgetown) within the State of Texas.

The Engineer shall also provide engineering services required for the preparation of plans, specifications, and estimates (PS&E) and related documents, for various projects in both rural and urban settings. These services may include preparing roadway design, bridge design, hydrologic and hydraulic design, traffic signal design, utility adjustment coordination, subsurface utility engineering, utility engineering, survey, geotechnical data collection, environmental documentation, and if requested, provide design support, testify at right of way hearings, and construction phase services necessary to support the design process.

1. GENERAL REQUIREMENTS

1.1. Coordination.

The Engineer shall coordinate issues and communications with State's internal resource areas through the State's Project Manager. The State will communicate the resolution of issues and provide the Engineer direction through the State's Project Manager.

The Engineer shall notify the State and coordinate with adjacent engineers on all controls at project interfaces. The Engineer shall document the coordination effort, and each engineer must provide written concurrence regarding the agreed project controls and interfaces. In the event the Engineer and the other adjacent engineers are unable to agree, the Engineer shall meet jointly with the State and each adjacent engineer to resolve disagreements. If the engineers are unable to resolve an issue with the State as mediator, the State may decide the issue and the decision will be final.

The Engineer shall prepare each exhibit necessary for approval by each railroad, utility, and other governmental or regulatory agency in compliance with the applicable format and guidelines required by each entity and as approved by the State. The Engineer shall notify the State in writing prior to beginning any work on any outside agency's exhibit.

1.2. Progress Reporting and Invoicing.

The Engineer shall invoice according to function code breakdowns shown in Attachment C – Services to be Provided by Engineer, of the Contract for Engineering Services and Exhibit D – Fee Schedule, of each work authorization. The Engineer shall submit each invoice in a format acceptable to the State.

With each invoice, the Engineer shall include a completed projected vs. actual invoice form. The Engineer shall submit a monthly written progress report to the State's Project Manager regardless of whether the Engineer is invoicing for that month. The Engineer's written progress report must describe activities during the reporting period; activities planned for the following period, problems encountered, and actions taken to remedy them; list of meetings attended; and overall status, including a percent complete by task.

On a monthly basis, the Engineer shall enter the Historically Underutilized Business (HUB) or Disadvantaged Business Enterprise (DBE) reporting information and Projected vs. Actual information directly into the Professional Services-Contract Administration Management System (PS-CAMS) Consultant Portal.

The Engineer shall complete the services according to the milestone work schedule established in the work authorization. The Engineer shall submit a monthly written progress report to the State indicating the actual work accomplished during the month, scheduled work to be accomplished for the month, the estimated work to be accomplished for the coming month, problems encountered and actions taken to remedy them, list of meetings attended, and overall status. The progress report must use a bar chart diagram to indicate the percentage complete of each task shown on the previous report and the percentage complete of each task. The Engineer is required to meet with the designated State project manager or environmental coordinator on a monthly basis for progress tracking purposes unless prior written agreement is made with State not to hold a meeting in any given month. The Engineer shall submit minutes of the meeting summarizing the events of the meeting within seven calendar days after each meeting.

The Engineer shall prepare a project work schedule and design time schedule, using the latest version of Primavera software or another scheduling program approved by the State in writing. The schedules shall indicate tasks, subtasks, critical dates, milestones, deliverables, and review requirements in a format that depicts the interdependence of the various items. The work schedule must incorporate an allocation of time for stage reviews of the design schematic and the environmental documents by State personnel. The Engineer shall present the work schedule to the State for review and acceptance and provide assistance in interpreting the proposed work schedule. The Engineer shall provide advance written notice to the State if the Engineer is not able to meet the scheduled milestone review date. The Engineer shall provide schedule updates and changes throughout the project as requested by the State. The Engineer shall schedule milestone submittals at 30%, 60%, 90% and final project completion phases. The Engineer shall advise the State in writing if the Engineer is not able to meet the scheduled milestone review date.

Once the project has been completed and accepted by the State, or has gone to letting, the Engineer shall deliver all electronic files to the State within 30 calendar days of State's written request. Delivery of electronic files must comply with the requirements of Attachment G – Computer Graphics Files for Document and Information Exchange.

Final payment is contingent upon the State's receipt and confirmation by the State's Project Manager that the electronic files can be opened and are usable utilizing the current version of the software in use by the State, all files are formatted in

accordance with Attachment G – Computer Graphics Files for Document and Information Exchange, and all the review comments have been addressed.

The Engineer shall prepare a letter of transmittal to accompany each document submittal to the State. At a minimum, the letter of transmittal must include the TxDOT control-section-job (CSJ) number, the highway number, county, project limits, TxDOT contract number, and TxDOT work authorization number.

1.3. Traffic Control.

The Engineer shall provide all planning, labor, and equipment to develop and to execute each traffic control plan (TCP) needed by the Engineer to perform services under each work authorization. The Engineer shall comply with the requirements of the most recent edition of the Texas Manual on Uniform Traffic Control Devices (TMUTCD). The Engineer shall submit a copy of each TCP to the State for approval prior commencing any work on any State roadway. The Engineer shall provide all signs, flags, and safety equipment needed to execute the approved TCP. The Engineer shall notify the State in writing 24 hours in advance of executing each TCP requiring a lane closure and shall not begin lane closure without having obtained State's written approval. The Engineer shall ensure that its field crew possesses a copy of the approved TCP on the job site at all times. Upon request by the State, the field crew must make the TCP available to the State for inspection. The Engineer shall assign charges for any required traffic control to the applicable function code.

1.4. Right of Entry.

Prior to performing any work outside of the State's right of way, the Engineer shall request right of entry from public and private land owners to allow services (e.g. environmental services, surveying services, geotechnical services) to be performed and shall request concurrence from the State. The Engineer shall prepare right of entry permissions, which must be signed by the landowner. Letters or other materials seeking right of entry must contain explicit reference to the kinds of activities for which right of entry is requested and an indication of the impacts (if any) that will result from performance of these services. The Engineer shall not commit acts which will result in damages to private property and shall make every effort to comply with the wishes and address the concerns of private property owners.

1.5. Level of Effort.

For each work authorization, the Engineer shall base the level of effort at each phase on the prior work developed in earlier phases without unnecessary repetition or re-study. As directed by the State, the Engineer shall provide written justification regarding whether or not additional or repeated level of effort of earlier completed work is warranted, or if additional detail will be better addressed at a later stage in the project development.

1.6. Quality Assurance (QA) and Quality Control (QC).

The Engineer shall provide peer review at all levels. For each deliverable, the Engineer shall retain evidence of their internal review and mark-up of that deliverable as preparation for submittal. A milestone submittal is not considered complete unless the required milestone documents and associated internal mark-ups are submitted. If requested by the State's Project Manager, the Engineer shall

submit the Engineer's internal mark-up (e.g., red-lines, comments) developed as part the Engineer's quality control step. When internal mark-ups are requested by the State in advance, the State may reject the actual deliverable if the Engineer fails to provide sufficient evidence of quality control. The Engineer shall clearly label each document submitted for quality assurance as an internal mark-up document.

The Engineer shall perform QA and QC on all survey procedures, field surveys, data, and products prior to delivery to the State. If, at any time, during the course of reviewing a survey submittal it becomes apparent to the State that the submittal contains errors, omissions, or inconsistencies, the State may cease its review and immediately return the submittal to the Engineer for appropriate action by the Engineer. A submittal returned to the Engineer for this reason is not a submittal for purposes of the submission schedule.

1.7. Underground excavation

If necessary, the Engineer shall contact the Texas Excavation Safety System, Inc. (DIGTESS) or call telephone number 811 to have underground utilities marked prior to digging holes for right-of-way monuments, utility engineering investigation, geotechnical investigation, or other purposes. The Engineer shall separately contact utilities not a part of the DIGTESS organization. The Engineer shall maintain documentation of all notification calls. The Engineer shall comply with Texas's excavation laws.

1.8. Preventative Measures to Prevent the Spread of Oak Wilt Disease Contamination

The Engineer shall take the following preventive measures while cutting, pruning, or removing oak trees in counties which have confirmed cases of oak wilt disease or when directed by the State:

A. When possible, employ alternative methods instead of pruning or cutting oak trees.

B. When possible, perform necessary pruning and cutting of healthy trees during January or February when sap beetles are least active.

C. Treat wounds with pruning paint in oak wilt disease infected counties to discourage insects, especially during warm weather.

D. Sterilize all pruning tools between each use on each tree with either Lysol spray or a 70 percent rubbing alcohol solution.

E. Dispose of the tree cuttings by burning, burying, or another approved method.

1.9. Personal Protective Equipment (PPE).

A. The Engineer shall, and shall require its subcontractors to:

1. Provide personal protective equipment (PPE) to their personnel,
2. Provide business vehicles for their personnel, and
3. Require their personnel to use PPE and drive only business vehicles while performing work on or near roadways.

B. The PPE must meet all:

1. Current standards set by Occupation Safety and Health Administration (OSHA)

2. TxDOT requirements (e.g., safety glasses, Type 3 (TY 3) pants for night work).

C. Each business vehicle must be clearly marked with the Engineer's business name, or the name of the appropriate subcontractor, such that the name can be identified from a distance.

1.10. Training Requirements.

A. Each key staff member of the Engineer's project team that is performing or overseeing design or plan review tasks must complete the Environmental Management System (EMS) e-Learning courses prescribed by the State prior to working on the project. The required training for key staff members on the design project team is listed on the EMS training matrix, which may be accessed at: https://ftp.txdot.gov/pub/txdot-info/env/ems/070-04-fig.pdf.

The courses listed on the EMS training matrix are e-learning (online), unless otherwise noted as classroom learning. Information about these online courses may be accessed at: https://www.txdot.gov/inside-txdot/division/environmental/ems-courses.html.

The Engineer shall ensure that each key staff member of the Engineer's project team that will be performing or overseeing design or plan review tasks has completed the required training listed on the EMS training matrix prior to working on the project. In addition, the Engineer shall ensure that the required training is repeated by each key staff member of the project team based on the repeat requirements stated in the EMS training matrix.

B. Deliverables for Training Requirements:

The Engineer shall provide a list, signed by the Engineer's Project Manager that includes the following:

1. The names and titles of all key staff personnel performing or overseeing design or plan review tasks
2. The names of the training courses completed by each person on the list
3. The completion dates for the training courses completed by each person on the list

The Engineer shall update this list and resubmit it to the State any time new key staff personnel are assigned to the project team and any time training is repeated by key staff personnel on the project.

1.11. Information Resources and Security Requirements.

Engineer (as "Contractor" in Attachment I) shall perform its work in accordance with Attachment I, Information Resources and Security Requirements. A Contractor-Related Entity might create, access, transmit, store, or use Public TxDOT data in a Contractor-Related Entity Environment. The Engineer shall ensure that Contractor-Related Entity Environments comply with the TxDOT Low Security Baseline.

1.12. Use of the State's Standards.

The Engineer shall identify and use current applicable, State standard details, district standard details, and approved miscellaneous details whenever feasible instead of creating new details. The Engineer shall get approval to use District

developed standards. The Engineer shall sign, seal, and date each standard and miscellaneous detail if the standard selected has not been adopted for use in a district. The Engineer shall obtain approval for use of these details during the early stages of design from the project manager or area engineer designated by the State. These details must be accompanied by the appropriate general notes, special specifications, special provisions, and method of payment. The Engineer is responsible for the appropriate selection of each Standard identified for use within its design.

1.13. Organization of Plan Sheets.

The Engineer shall complete and organize the PS&E package in accordance with the latest edition of the TxDOT *PS&E Preparation Manual*. The Engineer shall ensure that the PS&E package is suitable for the bidding and awarding of a construction contract and that the PS&E package is in accordance with the latest TxDOT policies and procedures, and the district's PS&E checklist.

1.14. Organization of Design Project Folder and Files (Electronic Project Files).

The Engineer shall organize the electronic project files in accordance with the State's file management system (FMS) format. With the approval of the State, the Engineer may maintain the project files in the State's ProjectWise work areas.

1.15. Limited Access to State's Transportation Project Lifecycle Management Systems.

The State may grant to specific individuals designated by the Engineer limited access to TxDOT's Transportation Project Lifecycle Management Systems (TxDOTCONNECT) to update responsible engineer information, develop project construction cost estimates, build specification lists, and seal construction cost estimates. The State may limit the number of individuals granted access to TxDOTCONNECT.

The following are the TxDOTCONNECT security roles currently available for use by the Engineer:

Work Performed in Solution	Required License	Security Role
Update Responsible Engineer Information Develop Construction Cost Estimate Build Specifications Lists Seal Project Estimate	Professional Engineer (PE)	Professional Engineer - Consultant
Update Responsible Engineer Information Develop Construction Cost Estimate Build Specifications Lists	None	Engineer's Estimate Coordinator - Consultant

When requested by the State, the Engineer shall obtain completed forms and signatures required by TxDOT to issue a TxDOT network User ID from the individuals it has designated to receive TxDOTCONNECT access. After the TxDOT User ID is issued, those individuals must request access to TxDOTCONNECT.

1.16. State-Controlled Waters.

The placement of a new structure or modification of an existing structure within state-controlled waters will require confirmation that the structure lies within the General Land Office (GLO) property and whether the crossing is tidally influenced

or not. Consequently, the Engineer shall request, as early in the design process as possible, that the State determine whether the proposed improvements are within a tidal GLO property, a submerged GLO property, or a non-tidal GLO property. The State may request assistance from the Engineer to prepare an exhibit demonstrating the location of the proposed improvements on the GLO State Owned Map for the project location of an assigned TxDOT district.

1.17. Design Criteria.

The Engineer shall prepare all work in accordance with the latest version (at time of work authorization execution) of applicable TxDOT procedures, specifications, manuals, guidelines, standard drawings, and standard specifications or previously approved special provisions and special specifications, which include:

A. *PS&E Preparation Manual*, published by TxDOT;

B. *Roadway Design Manual*, published by TxDOT;

C. *Hydraulic Design Manual*, published by TxDOT;

D. *Bridge Design Manual-LRFD*, published by TxDOT;

E. *Bridge Project Development Manual*, published by TxDOT;

F. *Geotechnical Manual*, published by TxDOT;

G. *Texas Manual on Uniform Traffic Control Devices (TMUTCD)*, published by TxDOT;

H. *Highway Illumination Manual*, published by TxDOT;

I. *Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges* (latest Edition), published by TxDOT;

J. *Traffic and Safety Analysis Procedural Manual (TASP)*, published by TxDOT;

K. *TxDOT Survey Manual*, published by TxDOT;

L. other TxDOT-approved manuals and guides.

When design criteria are not identified in TxDOT manuals, the Engineer shall notify the State and refer to the American Association of State Highway and Transportation Officials (AASHTO), *A Policy on Geometric Design of Highways and Streets*, (latest Edition).

The Engineer shall follow the TxDOT district guidelines in preparing the plans, specifications, and estimates (PS&E) package and prepare each PS&E package in a form suitable for letting through TxDOT's construction contract bidding and awarding process.

The Engineer shall design the project according to the latest TxDOT's design criteria. The Engineer shall supply project-specific design criteria (e.g., typical sections, estimate, design exceptions) to be inserted into the design elements form for discussion at the design concept conference (DCC).

GENERAL REQUIREMENTS BY FUNCTION CODE

The Engineer shall perform the services under this contract in accordance with the following general requirements related to each function code.

2. GENERAL REQUIREMENTS FOR FUNCTION CODE 120(120) – SOCIAL/ ECON/ENV STUDIES – SOCIAL, ECONOMIC, AND ENVIRONMENTAL STUDIES AND PUBLIC INVOLVEMENT.

2.1. Environmental Services Requirements.

Each environmental service provided by the Engineer must have a deliverable. Deliverables must summarize the methods used for the environmental services and the results achieved. The summary of results must be sufficiently detailed to provide satisfactory basis for thorough review by the State, and where applicable, the Federal Highway Administration and other agencies with regulatory oversight. All deliverables must meet regulatory requirements for legal sufficiency and adhere to the requirements for reports enumerated in TxDOT's National Environmental Policy Act of 1969 (NEPA) Memorandum of Understanding (MOU) for federal projects and the Texas Administrative Code, Title 43, Part 1, chapter 2 for State projects.

A. Quality Assurance/Quality Control Review

For each deliverable, all documents must be in accordance with:

1. Current Environmental Compliance Toolkit guidance, documentation requirements, and templates published by the TxDOT Environmental Affairs Division (ENV) and in effect as of the date of receipt of the documents or documentation to be reviewed;
2. Current state and federal laws, regulations, policies, guidance, agreements, and memoranda of understanding between TxDOT and other state or federal agencies; and
3. Guidelines contained in Improving the Quality of Environmental Documents, A Report of the Joint AASHTO/ACEC Committee in Cooperation with the Federal Highway Administration (May 2006) for:
    a. Readability, and
    b. Use of evidence and data in documents to support conclusions. Upon request by the State, the Engineer shall provide documentation that the QA and QC reviews were performed by qualified staff.

B. Deliverables must contain all data acquired during the environmental service and be written to be understood by the public The format must meet all requirements as specified by the State and in accordance with the TxDOT *Writers Style Guide* published by TxDOT's Communications Division.

C. Electronic versions of each deliverable must be written in software that is fully compatible with the software currently used by the State and provided in the native format of the document for future use by the State. The Engineer shall supplement all hard copy deliverables with electronic copies in searchable Adobe Acrobat (.pdf) format, unless another format is specified by the State. Each deliverable must be a single, searchable .pdf file that mirrors the layout and appearance of the physical deliverable. The Engineer shall deliver the electronic files in a format acceptable to the State in both the document's native format and the PDF format.

D. Submission of Deliverables

1. Deliverables must consist of documentation to support reevaluation, or a categorical exclusion (CE) determination, or documentation in support of an environmental assessment (EA) or an environmental impact statement (EIS), as applicable. Technical reports and documentation must be prepared to support the applicable environmental classification (e.g. CE, EA, or EIS).

2. All deliverables must comply with all applicable state and federal environmental laws, regulations, procedures, and TxDOT's Environmental Compliance Toolkits, documentation requirements, and templates.

3. On the cover page of any environmental documentation, the Engineer shall insert the following language in a way that is conspicuous to the reader:

   "The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried-out by TxDOT pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated December 9, 2019, and executed by FHWA and TxDOT."

4. The State will provide the State's and other agency comments on draft deliverables to the Engineer. When required, the Engineer shall revise the deliverable:

   a. To include any State commitments, findings, agreements, or determinations (e.g., wetlands, endangered species consultation, Section 106, or Section 4(f)), required for the transportation activity as specified by the State;

   b. To incorporate the results of public involvement and agency coordination;

   c. To reflect mitigation measures resulting from comments received or changes in the transportation activity; and

   d. To include with the revised document a comment response form (matrix) in the format provided by the State.

E. The Engineer shall provide photographs and graphics that clearly depict details relevant to an evaluation of the project area. Comparable quality electronic photograph presentations must be at least 1200 x 1600 pixel resolution. The State may request images/graphics be provided in another format or quality.

2.2. Environmental Assessment (EA) Content and Format Requirements.

The Engineer shall provide an EA and ensure that:

A. The EA meets the requirements of 23 C.F.R. § 771.119 and 43 Tex. Admin. Code Ch. 2 and the EA content is sufficiently detailed to meet regulatory requirements for legal sufficiency.

B. When print copies are requested , the exhibits included in reports or EAs do not exceed 11 inches x 17 inches and are in color. Text pages must be 8.5

inch x 11 inch. Exhibits and text included in reports or EAs must be neat and reproducible via photocopying without loss of legibility. The EA documents must be reproduced on plain white paper unless otherwise approved in advance in writing by the State.

2.3. Environmental Reevaluation Content and Format Requirements.

The Engineer shall conduct reevaluations, as directed by the State, in accordance with TxDOT's Environmental Toolkit and the applicable Federal and State's guidance. A Reevaluation Consultation Checklist (RCC) and supporting documentation must include the project history, addressing the specific changes that have occurred, potential environmental impacts and associated necessary technical studies, with a supported conclusion of the need for further action, or lack thereof

2.4. Environmental Impact Statement (EIS) Content and Format Requirements.

The Engineer shall provide an EIS and ensure that:

A. The EIS meets the requirements of 23 C.F.R. § 771.and 43 Tex. Admin. Code § 2.84 and the EIS content is sufficiently detailed as directed by the State, and in accordance with TxDOT's Environmental Toolkit and the applicable Federal and State's guidance.

B. When print copies are requested, the exhibits included in reports or EISs do not exceed 11 inches x 17 inches and are in color. Text pages must be 8.5 inch x 11 inch. Exhibits and text included in reports or EISs must be neat and reproducible via photocopying without loss of legibility. Except as noted in specifications in this attachment, EISs must be reproduced on plain white paper unless otherwise approved in advance by the State in the work authorization.

2.5. Environmental Technical Analyses and Documentation Requirements.

A. Definition of technical analyses and documentation for environmental services

In general, technical analyses and documentation for environmental services might include a report, checklist, form, or analysis detailing resource-specific studies identified during the process of gathering data to make an environmental decision.

The State may determine what technical reports and documentation are necessary for any given project. The Engineer shall prepare all technical reports and documentation for the State with sufficient detail and clarity to support environmental determinations. All technical reports must be in accordance with TxDOT's Environmental Compliance Toolkits, documentation requirements, and templates. The environmental document must reference the technical reports.

Environmental technical reports and documentation must include appropriate NEPA or federal regulatory language in addition to the purpose and methodology used in delivering the service. Technical reports and forms must use templates and documentation standards as applicable and include sufficient information to determine the significance of impacts.

B. The Engineer shall provide the requested environmental technical analyses and documentation at the work authorization level, that may include:

1. Section 4(f) Evaluations

   The Engineer shall provide a Section 4(f) evaluation conforming to the appropriate TxDOT Section 4(f) checklist for exceptions, de minimus, and programmatic evaluations. For individual Section 4(f) evaluations, the format and outline will be approved by the State beforehand. All Section 4(f) evaluations must meet the requirements set forth in TxDOT's Environmental Compliance Toolkits. The 4(f) Section of the environmental document states the reason a Section 4(f) evaluation is being completed. The 4(f) Section of the environmental document discusses the presence of all Section 4(f) properties located in the project area.

2. Environmental Public Involvement (23 C.F.R. § 771.111) 43 TAC § 2

   The Engineer shall:

   a. Develop a public involvement plan specifying all activities to be performed and alternatives to be discussed during public involvement activities. Public involvement activities must be carried out in compliance Attachment A, Article 38, sections J and K of this contract. The plan must discuss outreach strategies for both the general public and targeted strategies for environmental justice and limited English proficiency populations

   b. Submit legal notices to the State's project manager for review no less than six weeks prior to publication

   c. Obtain approval in writing by the State's project manager for all legal notices, exhibits, and other materials

   d. Provide staffing levels of personnel identified at the work authorization level.

   e. Not distribute acknowledgement or response letters without prior approval by the State's project manager

   f. Not distribute the newsletter without prior approval by the State

   g. Provide materials and information regarding the transportation activity to the State's project manager to be posted on the State-developed website.

   h. Ensure the website conforms to state law, Texas Department of Information Resources requirements, TxDOT policies and procedures, and TxDOT Brand Guidelines.

3. Community Impacts Analysis

   Community impacts include environmental justice, limited English proficiency, and other issues as addressed in TxDOT environmental guidance. The Engineer shall provide community impact assessments including environmental justice analysis in accordance with Attachment A, Article 38, Sections J and K of this contract. The report must follow guidance provided in TxDOT's Community Impacts Assessment Toolkit.

4. Induced Growth Impact Analysis and Cumulative Impacts Analysis

The Engineer shall meet the requirements of NEPA and the most current version of TxDOT's *Guidance on Preparing Impact Analyses and Cumulative Impacts Analysis Guidelines* in TxDOT's Environmental Compliance Toolkits. The extent of the analyses will be provided in the work authorization.

5. Air Quality Studies

   The Engineer shall complete all required technical reports and the air quality section of all environmental documents in accordance with the current version of the TxDOT's Environmental Handbook for Air Quality and Air Quality Toolkit. The State's project manager may determine what technical reports and documentation are required for any given project.

6. Noise Analysis Technical Reporting

   The Engineer shall use TxDOT's .DGN file coordinate system for all traffic noise modeling, so that all design files and traffic noise modeling software coordinate systems are the same.

   The Engineer shall provide TxDOT with all .DXF files used for the traffic noise model.

   The Engineer shall not begin identification of noise sensitive land uses unless TxDOT's Environmental Affairs Division's Historical Studies Branch (ENV-Historical Studies) has approved a Project Coordination Request (PCR).

7. Water Resources Analysis and Documentation

   The Engineer shall provide environmental documentation, conduct field surveys, and provide analysis of biological natural resources for compliance with state and federal regulations as described in the *Environmental Guide: Volume 2 Activity Instructions*, http://ftp.dot.state.tx.us/pub/txdot-info/env/toolkit/060-06-gui.pdf, and the associated forms, templates, and guidance found in the Water Resources section of the Natural Resources Toolkit, https://www.txdot.gov/inside-txdot/division/environmental/compliance-toolkits/natural-resources.html. The applicable water resource studies must be determined at the work authorization level. In the case that field surveys are required, then the Engineer shall contact TxDOT's Project Manager for clearance prior to starting fieldwork. TxDOT will verify that approved methods and appropriately permitted and experienced staff will be used.

8. Biological/Natural Resources Management Analysis and Documentation

   a. The Engineer shall provide environmental documentation, conduct field surveys, and provide analysis of biological natural resources for compliance with state and federal regulations as described in the *Environmental Guide: Volume 2 Activity Instructions*, http://ftp.dot.state.tx.us/pub/txdot-info/env/toolkit/060-06-gui.pdf, and the associated forms, templates, and guidance found in the Natural Resources Toolkit, https://www.txdot.gov/inside-txdot/division/environmental/compliance-toolkits/natural-resources.html. The applicable natural resource studies must be

determined at the work authorization level. In the case that field surveys are required, then the Engineer shall contact TxDOT's Project Manager for clearance prior to starting work.TxDOT will verify that approved methods and appropriately permitted and experienced staff will be used. At the request of the State, the Engineer shall provide the following biological/natural resource analysis:

(1) .

9. Initial Site Assessment (ISA) with Hazardous Materials Project Impact Evaluation Report

   The Engineer shall provide ISA with Hazardous Materials Project Impact Evaluation Report in accordance with Statement of Work for Hazardous Materials Processes related to NEPA in the TxDOT Hazardous Materials Management Toolkit (http://www.txdot.gov/inside-txdot/division/environmental/compliance-toolkits/haz-mat.html).

10. Archeological Documentation Services

    The Engineer shall complete all archeological studies to satisfy the current TxDOT Archeological Sites and Cemeteries Toolkit. An archeological background study must be performed prior to field work. If the Engineer was provided with a background study by the State, a new background study is not required.

    An archeological survey (reconnaissance or intensive) must satisfy state and federal regulations. The applicable archeological survey will be determined at the work authorization level. The Engineer shall contact TxDOT's Environmental Affairs Division's Archeological Studies Branch (ENV-ARCH) for approval prior to starting field and survey work. ENV-ARCH will verify that approved methods and appropriately permitted and experienced staff will be used.

11. Historic Resource Identification, Evaluation, and Documentation Services

    The Engineer shall complete all historic resource identification, evaluation, and documentation services in compliance with TxDOT's Environmental Compliance Toolkits. All services, except the historic resource PCR, must have prior approval by TxDOT's Environmental Affairs Division's Historical Studies Branch (ENV-HIST) to be performed. The historic resource PCR must be accepted by ENV-HIST prior to survey field work.

12. Floodplain Impacts

    The Engineer shall document any Regulatory Zone requirements, and International Boundary Water Commission (IBWC) requirements (transportation activity within the floodplain of the Rio Grande) if the project is within the area covered by these regulations. Studies for floodplain impacts must fulfill the requirements of Executive Order 11988 and 23 C.F.R. subpt. 650.A. Documentation must:

a. Briefly describe the watershed characteristics of the study area in terms of land uses and changes in land use that affect stream discharge.

b. Briefly describe the streams in the study area, including evidence of stream migration, down cutting, or aggradations.

c. Identify the presence and nature (e.g., zone A, zone AE, zone AE with floodway) of any FEMA mapped floodplains; including the panel number.

d. Indicate the existence of any significant development associated with the mapped area and identify the jurisdiction responsible for the floodplain.

e. Identify the locations where an alternative might encroach on the base (100-year) floodplain (encroachments), where an alternative might support incompatible floodplain development, and the potential impacts of encroachments and floodplain development. This identification must be included in the text and on a map.

f. Include a list of all jurisdictions having control over floodplains for each alternative.

g. Where an encroachment or support of incompatible floodplain development results in impacts, the Engineer shall provide more detailed information on the location, impacts, and appropriate mitigation measures. In addition, if any alternative (1) results in a floodplain encroachment or supports incompatible floodplain development having significant impacts, or (2) requires a commitment to a particular structure size or type, the report must include an evaluation and discussion of practicable alternatives to the structure or to the significant encroachment. The report must include exhibits which display the alternatives, the base floodplains and, where applicable, the regulatory floodplains.

h. For each alternative encroaching on a designated or regulatory floodplain, provide a preliminary indication of whether the encroachment is consistent with or requires a revision to the regulatory floodplain. If the preferred alternative encroaches on a regulatory floodplain, the report must discuss the consistency of the action with the regulatory floodplain. In addition, the report must document coordination with FEMA and local flood plain administrator or state agencies with jurisdiction indicating that a revision is acceptable or that a revision is not required.

i. If the preferred alternative includes a floodplain encroachment having significant impacts, the report must include a finding that it is the only practicable alternative as required by 23 C.F.R. subpt. 650.A. The finding must refer to Executive Order 11988 and 23 C.F.R. subpt. 650.A. In such cases, the report must document compliance with the Executive Order 11988 requirements and must be supported by the following information:

(1) The reasons why the proposed action must be located in the floodplain;

(2) The alternatives considered and why they were not practicable; and

(3) A statement indicating whether the action conforms to applicable state or local floodplain protection standards

13. Stormwater Permits (Section 402 of the Clean Water Act)

The Engineer shall describe the need for Municipal Separate Storm Sewer System (MS4) notification. List MS4 participating municipalities.

3. GENERAL REQUIREMENTS FOR FUNCTION CODE 130(130) – RIGHT-OF-WAY – SURVEY ACTIVITIES.

3.1. Right of Way Mapping Requirements.

Traditional ROW mapping includes ground surveying and preparation of parcel maps, legal descriptions also known as metes and bounds descriptions, an ROW maps, and GIS shape files.

A. In this attachment, the term “Surveyor” means the firm (prime provider or subprovider) that is providing the surveying services shown in the scope. The Engineer remains ultimately responsible and shall ensure that the work is performed as required.

Standards and deliverables are detailed in the *TxDOT Survey Manual* and the TxDOT Surveyor’s Toolkit. The latest versions of the *TxDOT Survey Manual* and the TxDOT Surveyor’s Toolkit at the time the work authorization or supplemental work authorization is executed are applicable to that work authorization and the Surveyor shall comply with those versions unless a written exception is provided by the TxDOT ROW Division Survey Section Director. The Surveyor shall provide the services of a licensed state land surveyor (LSLS) to locate the boundary of any lands controlled by the Texas General Land Office. The Engineer remains ultimately responsible and shall ensure that the work is performed as required.

The Surveyor shall use all standards, procedures, and equipment such that, at a minimum, the results of the survey is in compliance with the precision and accuracy requirements set forth by the Texas Board of Professional Engineers and Land Surveyors (TBPELS) rules.

By mutual agreement between the TBPELS and the State, ROW maps need not be signed and sealed by a RPLS.

For purposes of clarity, consistency, and ease of understanding, the State, as an acquiring agency of private property for public use, has adopted standards and formats for a ROW map to facilitate the processes of negotiation, appraisal, relocation assistance, and condemnation. The Surveyor shall adhere to these standards and formats to every extent possible.

4. GENERAL REQUIREMENTS FOR FUNCTION CODE 135(135) – RIGHT-OF-WAY – UTILITY ACTIVITIES.

4.1. Definitions.

In this attachment, the following definitions apply.

A. "Utility Coordinator" means the individual or entity performing utility-related services that are not required to be performed by a licensed professional engineer under Texas law. The Engineer remains ultimately responsible and shall ensure that the work is performed as required.

B. "Utility Engineer" means the individual or entity performing utility-related services that are required to be performed by a licensed professional engineer under Texas law. The Engineer remains ultimately responsible and shall ensure that the work is performed as required.

C. "Ensure" means to make certain that something has happened or will happen, and includes an obligation to deploy the appropriate level of engineering or other technical expertise, consistent with the complexity, cost, and level of risk associated with a task. The term ensure does not require the completion of any task assigned to another entity by the State under a separate agreement.

4.2. Utility Engineering Investigation Requirements.

Utility engineering investigation includes utility investigations subsurface and above ground prepared in accordance with ASCE/CI Standard 38-02and Utility Quality Levels.

A. Utility Quality Levels (QL)

Utility Quality Levels are defined in cumulative order (least to greatest) as follows:

1. Quality Level D - Quality level value assigned to a utility segment or utility feature after a review and compilation of data sources such as existing records, oral recollections, One-Call markings, and data repositories.

2. Quality Level C - Quality level value assigned to a utility segment or utility feature after surveying aboveground (i.e., visible) utility features and using professional judgement to correlate the surveyed locations of these features with those from existing utility records.

3. Quality Level B - Quality level value assigned to a utility segment or subsurface utility feature whose existence and position is based upon appropriate surface geophysical methods combined with professional judgment and whose location is tied to the project survey datum. Horizontal accuracy of utilities is 18" (including survey tolerances) unless otherwise indicated for a specific segment of the deliverable. Quality Level B incorporates quality levels C and D information. A composite plot is created.

4. Quality Level A – Quality level value assigned to a portion (x, y, and z geometry) of a point of a subsurface utility feature that is directly exposed, measured, and whose location and dimensions are tied to the project survey datum. Other measurable, observable, and judged utility attributes are also recorded (per District Best Practices). The utility location must be tied to the project survey datum with an accuracy of 0.1 feet (30-mm) vertical and to 0.2 feet (60-mm) horizontal. As test holes

may be requested up front or during the project, test holes done prior to completion of QL D, C, or B deliverables must be symbolized on the QL B deliverable with a call out indicating test hole's number. This is in addition to and not in lieu of the test hole.

B. Utility Engineering Investigation Methodology Requirements

The Engineer shall:

1. Provide utility designating services. Designate means to indicate the horizontal location of underground utilities by the application and interpretation of appropriate non-destructive surface geophysical techniques and reference to established survey control. Designating (Quality Level B) services are inclusive of Quality Levels C and D.

   The Engineer and State acknowledge that the line sizes of designated utility facilities detailed on the deliverable will be from the best available records and that an actual line size is normally determined from a test hole vacuum excavation. A note must be placed on the designate deliverable only that states "lines sizes are from best available records". All above-ground utility feature locations must be included in the deliverable to the State. This information must be provided in the latest version of OpenRoads civil design system used by the State. The electronic file will be delivered on USB flash drive or as required by the State. A hard copy is required and must be signed, sealed, and dated by the engineer overseeing the utility engineering (Utility Engineer). When requested by the State, the designated utility information must be overlaid on TxDOT's design plans.

2. Provide utility locate (test hole) services. Locate means the process used to obtain precise horizontal and vertical position, material type, condition, size, and other data that might be obtainable about the utility facility and its surrounding environment through exposure by non-destructive excavation techniques that ensures the integrity of the utility facility. Subsurface utility locate (test hole) services (Quality Level A) are inclusive of Quality Levels B, C, and D. Quality Level A test holes that do not encounter an expected utility will not be considered complete until discussed with the TxDOT Project Manager.

   Include the following data on an appropriately formatted test hole data sheet that has been sealed and dated by the Engineer:

   a. Elevation of top of utility tied to the datum of the furnished plan
   b. Minimum of two benchmarks utilized. Elevations must be within an accuracy of 15mm (.591 inches) of utilized benchmarks
   c. Elevation of existing grade over utility at test hole location
   d. Horizontal location referenced to project coordinate datum
   e. Outside diameter of pipe or width of duct banks and configuration of non-encased multi-conduit systems
   f. Utility facility material
   g. Utility facility condition

h. Pavement thickness and type

i. Coating/wrapping information and condition

j. Unusual circumstances or field conditions

Excavate test holes in such a manner as to prevent any damage to wrappings, coatings, cathodic protection, other protective coverings, and features. Water excavation can only be utilized with written approval from the appropriate TxDOT district office.

Be responsible for any damage to the utility during the locating process. In the event of damage, the Utility Engineer must stop work, notify the appropriate utility facility owner, the State, and appropriate regulatory agencies. The regulatory agencies include: the Railroad Commission of Texas and the Texas Commission on Environmental Quality. The Utility Engineer must not resume work until the utility facility owner has determined the corrective action to be taken. The Engineer shall be liable for all costs involved in the repair or replacement of the utility facility.

Back fill all excavations with appropriate material and methods approved in writing by the State's project manager. The Engineer is responsible for the integrity of the backfill and surface restoration.

Provide complete restoration of work site and landscape to equal or better condition than before excavation. If a work site and landscape is not appropriately restored, the Engineer shall return to correct the condition at no extra charge to the State.

Plot utility location position information to scale and provide a comprehensive utility plan signed and sealed by the responsible engineer. This information must be provided in the latest version of MicroStation and be fully compatible with the OpenRoads civil design system used by the State. The electronic file must be delivered on USB flash drive or as required by the State. When requested by the State, the locate information must be over laid on TxDOT's design plans.

3. Maintain a utility layout in the current approved version of OpenRoads Civil Design system used by TxDOT. This layout must include all existing utilities that are to remain in place or be abandoned, and all adjusted utilities. This layout must be utilized to monitor the necessity of relocation and evaluate alternatives.

4. Provide utility engineering investigation information in the latest version of MicroStation OpenRoads Designer and MicroStation Connect Edition that are implemented at TxDOT at the time the work authorization is executed.

5. Ensure that there is no conflict between the utility management plan, utility certifications, and special provisions.

6. The Utility Engineer's activities must conform with those specified under Texas Administrative Code, Title 43, Part 1, Chapter 21, Subchapter C, Section 21.37, relating to the specified utility types, eligibility requirements, agreements, and approvals.

C. Utility Adjustment Coordination Requirements

The Engineer is responsible for communicating, coordinating, and conducting meetings with any one, combination, or all of the following: individual utility companies, local public agencies (LPAs), State's project manager, TxDOT utility staff, TxDOT right of way project delivery, design engineer, maintenance staff, and area office staff. The Engineer's utility coordination duties include, but are not limited to, preparation or assisting others in preparing utility agreement assemblies including utility agreements, utility reimbursable billings, joint use agreements, assisting utility companies with utility permit submittals, and assisting with documentation for advance funding agreements (AFAs).

1. The Engineer shall perform utility coordination activities with involved utility owners, their consultants, and the State to achieve timely project notifications. In conjunction with formal coordination meetings, the Engineer must create meeting minutes, create and update the utility conflict matrix, create action item log, perform document control, and assist with conflict analysis and resolution. The Utility Coordinator must act as the "Responsible Party" as indicated in the State's – Utility Cooperative Management Process and Right of Way Utility Adjustment Subprocess (See the TxDOT *ROW Utilities Manual*, Chapter 2).
2. Utility Agreement Assemblies: A packaged agreement consisting of a Utility Joint Use Acknowledgement, Standard Utility Agreements, plans on 11x17 sheets, statement of contract work form, Affidavit form and copy of recorded easement, schedule of work, Buy America compliance Mill Test Reports (MTR's) or certifications, and various attachments as detailed in the Utility Accommodation Rules (UAR) (43 Tex. Admin. Code §§ 21.31-21.57) and the TxDOT *ROW Utilities Manual*.
3. Utility Agreements: If a utility is located within an easement, the utility company might have a compensable interest. The Utility Coordinator must obtain a copy of applicable easements from the utility.
4. Utility Acknowledgement: For this project, all non-reimbursable utility adjustments must be submitted with the Form 1082 Utility Installation Request (UIR) or must be submitted using the current program used by TxDOT such as Right-of-Way Utility and Leasing Information System (RULIS). The term "permit" refers to "Form 1082". The Utility Coordinator must furnish the appropriate form to the utility company. The Utility Coordinator must obtain Form 1082 and adjustment plans from the utility for the Utility Coordinator and Utility Engineer to review.
5. Escrow Agreements: If it is determined that the utility will be adjusted as part of the highway contract, the State's project manager must be notified immediately.
6. The Engineer shall coordinate the development of the required advance funding agreement (AFA) with the utility and the State in accordance with TxDOT Contracts Services Division procedures.
7. State Utility Procedure (SUP): When applicable, the Engineer shall follow the procedures found in Chapter 8, Section 6 in the TxDOT *ROW Utilities Manual*.

8. Local Utility Procedure (LUP): When applicable, the Engineer shall follow the procedures found in Chapter 8, Section 8 in the TxDOT *ROW Utilities Manual*.
9. All documentation to be included in utility agreements must conform to the requirements of 23 C.F.R. subpt. 645.A.
10. For each utility, the records for all utility owners' costs must be in accordance with the requirements of 23 C.F.R. subpt. 645.A., in a format that is compatible with the estimate attached to the utility agreement, and with sufficient detail for analysis. The totals for labor, overhead, construction costs, travel, transportation, equipment, materials, supplies, and other services must be shown in such a manner as to permit comparison with the approved estimate.
11. The Engineer shall not perform engineering of relocation plans relative to a particular utility agreement under this contract as this is a cost of right of way that is subsidiary to the specific utility agreement.
12. The Engineer is responsible for ensuring utility agreements comply with UAR (43 Tex. Admin. Code §§ 21.31-21.57) and Buy America (23 U.S.C. § 313; 23 C.F.R. § 635.410; and Tex. Transp. Code § 223.045).

D. Utility Adjustment Monitoring and Verification Requirements

1. Utility adjustment monitoring and verification includes the utility location installation verification, compliance with UAR, monitoring, reporting, and as-built surveying as required by the State for joint bid, non-joint bid, and any utility permits submitted from schematic development through construction.
2. Notification.

   The Utility Engineer must notify the State a minimum of 48 hours before mobilization and demobilization will occur.
3. The Engineer is not responsible for inspections related to compliance with utility codes, industry standards, and design of the utility facility.
4. Utility adjustment monitoring and verification valuable final product:

   The Engineer shall provide full documentation of utility accommodations that adhere to the standards for safety, Buy America, the UAR and the specific approved engineering plan to the State.

5. GENERAL REQUIREMENTS FOR FUNCTION CODE 145(145) – MANAGING CONTRACT/DONATED PE – PROJECT MANAGEMENT AND ADMINISTRATION.

5.1. Contract Management and Administration Requirements.

The Engineer shall:

A. Perform all work in accordance with TxDOT's latest practices, criteria, specifications, policies, procedures and Standards of Uniformity (SOU). All documents must be sufficient to satisfy the current SOUs available from the State.

B. Act as an agent for the State when specified in a work authorization.

C. Produce a complete and acceptable deliverable for each service performed.

D. Notify the State's project manager of its schedule, in advance, for all field activities.

E. Notify the State's project manager in writing if at any time during this contract period the Engineer encounters unforeseen circumstances that may materially affect the scope, complexity or character of the work authorized by the State. The notification must include a complete description of the circumstances encountered.

6. GENERAL REQUIREMENTS FOR FUNCTION CODE 160(150) – ROADWAY DESIGN – DESIGN SURVEYS AND CONSTRUCTION SURVEYS.

6.1. General Survey Requirements.

A. In this attachment, the term "Surveyor" means the firm (prime provider or subprovider) that is providing the surveying services shown in the scope. The Engineer remains ultimately responsible and shall ensure that the work is performed as required.

B. Survey Standards and requirements for deliverables are detailed in the *TxDOT Survey Manual* and the TxDOT Surveyor's Toolkit. The versions in existence at the time the work authorization or supplemental work authorization is executed are applicable to that work authorization and the Surveyor shall comply with those versions unless a written exception is provided by the TxDOT District Survey Coordinator or the TxDOT ROW Division Survey Section Director. The Engineer shall provide the services of a certified Photogrammetrist or Mapping Scientist to perform or oversee the tasks done by aerial instrument platforms. The Engineer remains ultimately responsible and shall ensure that the work is performed as required.

6.2. Design Survey, Construction Survey, and As-Built Survey Requirements.

A. Definitions

1. Design Survey

   A design survey gathers data in support of transportation systems design. A design survey includes the research, field work, analysis, computation, and documentation necessary to provide detailed topographic (3-dimensional) mapping of a project site (e.g., locating existing ROW, surveying cross-sections or developing data to create cross-sections and digital terrain models, horizontal and vertical location of utilities and improvements, collecting details of bridges and other structures, review of ROW maps, and establishing control points).

2. As-Built Survey

   An as-built survey provides field data documenting utility installation and combines performance of field work coordination, verification, computation, analysis, and documentation of standard utility installation. As-built ITS drawings for all installations, shall be signed and sealed by a Professional Engineer or Professional Surveyor registered in the State of

Texas. Sub-foot horizontal accuracy is required. Vertical data is not required. Deliverables will be in GIS format with the correct scale factor applied.

B. Requirements

Design surveys, construction surveys, and as-built surveys must be performed under the supervision of a Registered Professional Land Surveyor (RPLS) currently registered with the Texas Board of Professional Engineers and Land Surveyors (TBPELS).

7. GENERAL REQUIREMENTS FOR FUNCTION CODE 160(160) – ROADWAY DESIGN – ROADWAY DESIGN CONTROLS.

7.1. Roadway Design Controls Requirements.

The Engineer shall inform the State of changes made from previous initial meetings regarding each exception, waiver, design deviation, and variance that might affect the design. The Engineer shall cease all work under the roadway design task until the exceptions, waivers, and variances have been resolved between the Engineer and the State unless otherwise directed by the State to proceed. The Engineer shall identify, prepare exhibits, and complete all necessary forms for design exceptions and waivers within project limits prior to the 30% Submittal. These exceptions shall be provided to the State for coordination and processing of approvals.

The Engineer shall perform the design work in accordance with the TxDOT *Roadway Design Manual*, the TxDOT *PS&E Preparation Manual*, and the guidance provided by the TxDOT district.

7.2. Geometric Design Requirements.

A. The Engineer shall review the schematic provided by the State to confirm its understanding of the project and to verify completeness and accuracy of the information. The Engineer shall refine the horizontal and vertical alignment of the design schematic in U.S. customary units of measure for main lanes, ramps, direct connectors, frontage roads, side streets, including grade separation structures. The Engineer shall determine vertical clearances at grade separations and overpasses, taking into account the appropriate percent grade and super-elevation rate. Modifications in the alignment must be considered to provide optimal design. Modifications must be coordinated with the State's project manager and adjacent Engineers. The State must approve the refined schematic prior to the Engineer proceeding to the 30% milestone submittal and prior to starting on the bridge layouts.

B. Preliminary Geometric Layout.

1. The Engineer shall develop the preliminary geometric layout consisting of a planimetric file of existing features and the proposed improvements within the existing and any proposed ROW. The layout must include features listed in the TxDOT *Roadway Design Manual* Chapter 1, Section 3.:

2. The Engineer shall develop the proposed alignment to avoid the relocation of existing utilities as much as possible. The Engineer shall consider Americans with Disabilities Act (ADA) requirements and *Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way (PROWAG)* when developing the preliminary geometric layout. The preliminary geometric layout must be prepared in accordance with the current TxDOT *Roadway Design Manual*. The Engineer shall provide horizontal and vertical alignment of the preliminary geometric project layout in U.S. customary units for main lanes and side streets. Minor alignment alternatives must be considered to provide for an optimal design. The project layout must be coordinated with the State's project manager and adjacent Engineers, if any. The Engineer shall also provide proposed and existing typical sections depicting the following:
    a. profile grade line (PGL)
    b. lane widths
    c. cross slopes
    d. ROW lines
    e. ditch shapes
    f. pavement structures
    g. clear zones.
3. The 3D corridor model must be created using Bentley's OpenRoads tools. The 3D corridor model must have enough details to verify the feasibility of the proposed design.
4. Prior to proceeding with the final preliminary geometric layout, the Engineer shall present to the State's project manager for review and approval, alternatives for the design (e.g., flush or raised curb median) with recommendations and cost estimates for each alternative. The Engineer shall attend all necessary meetings to discuss the outcome of the evaluations of the alternatives analysis.
5. Perform a safety analysis utilizing State approved tools to ensure safety-driven decisions are taken into account during the project development and design process.

7.3. Roadway Design Requirements.

A. The Engineer shall use Bentley's current design technology in the design and preparation of the roadway plan sheets, using the version of MicroStation OpenRoads Designer and MicroStation Connect Edition that are implemented at TxDOT at the time the work authorization is executed. However, TxDOT may approve the use of other versions.

B. The Engineer shall provide roadway plan and profile drawings using CADD standards as required in Attachment G or as approved by the State's project manager. The drawings must consist of a planimetric file of existing features and files of the proposed improvements. The roadway base map must contain line work that depicts existing surface features obtained from the schematic drawing. Existing major subsurface and surface utilities must be shown if

requested by the State. Existing and proposed right-of-way lines must be shown. Plan and profile must be shown on separate or same sheets (this depends upon width of pavement) for main lanes, frontage roads, and direct connectors.

7.4. Plan and Profile Drawing Requirements.

The Engineer shall prepare plan and profile drawings that include the following:

A. Plan view

1. Calculated roadway centerlines for mainlanes, ramps, side streets, and frontage roads, as applicable. Horizontal control points must be shown. The alignments must be calculated using OpenRoads horizontal geometry tools.
2. Pavement edges for all improvements (mainlanes, direct connectors, ramps, side streets, driveways, and frontage roads, if applicable).
3. Lane and pavement width dimensions.
4. The geometrics of ramps, auxiliary lanes, and managed lanes.
5. Proposed structure locations, lengths, and widths.
6. Sidewalks and shared use paths.
7. Direction of traffic flow on all roadways. Lane lines and arrows indicating the number of lanes must also be shown.
8. Drawing horizontal scale must be 1” =100’
9. Control of access line, ROW lines, and easements.
10. Begin and end superelevation transitions and cross slope changes.
11. Limits of riprap, block sod, and seeding.
12. Existing utilities and structures.
13. Benchmark information.
14. Radii call outs, curb location, Concrete Traffic Barrier (CTB), guard fence, crash safety items and *American with Disabilities Act Accessibility Guidelines (ADAAG)* compliance items.

B. Profile view

1. Calculated profile grade line (PGL) for proposed mainlanes (cite direction), direct connectors, ramps, side streets, and frontage roads, if applicable. Vertical curve data, including “K” values must be shown. The profiles must be calculated using OpenRoads vertical geometry tools.
2. Existing and proposed profiles along the proposed centerline of the mainlanes, the outside shoulder line of ramps, and the outside gutter line of the designated (north, south, east or west) bound frontage roads.
3. Water surface elevations at major stream crossing for 2, 5, 10, 25, 50, and 100-year storms.

4. Calculated vertical clearances at grade separations and overpasses, taking into account the appropriate superelevation rate, superstructure depth and required clearance.
5. The location of interchanges, mainlanes, grade separations and ramps, and cross sections of any proposed or existing roadway, structure, or utility crossing.
6. Drawing vertical scale must be 1" =10'

7.5. Typical Section Requirements.

The Engineer shall prepare typical sections. The typical sections must include the following:

A. width of travel lanes
B. shoulders
C. outer separations
D. border widths
E. curb offsets
F. managed lanes
G. ROW
H. proposed profile gradeline (PGL)
I. centerline
J. pavement design
K. longitudinal joints
L. side slopes
M. sodding or seeding limits
N. concrete traffic barriers
O. Sidewalks and shared use paths (if required)
P. station limits
Q. common proposed and existing structures including retaining walls
R. existing pavement removal
S. riprap
T. limits of embankment and excavation.

7.6. Mainlane and Frontage Road Design Requirements.

The design must be consistent with the approved schematic or refined schematic and the current TxDOT *Roadway Design Manual*.

7.7. Interchange Requirements.

The interchange design must be consistent with the schematic design and must include a plan and profile of the crossroads, intersection layout, drainage

structures, sidewalks and shared use paths, geometrics, signalization, turnaround details, and transitions to existing roadway.

7.8. Plan Preparation Requirements.

Prior to the 30% submittal, the Engineer shall schedule a workshop to review profiles, OpenRoads 3D corridor models, and cross-sections with the State. The profile and cross sections must depict the 2-, 5-, 10-, 25-, 50-, 100-, and 500-year (if available) water surface elevations. The drawings must provide an overall view of the roadway and existing ground elevations with respect to the various storm design frequencies for the length of the project. The Engineer shall not proceed with developing subsequent submittals until the State has approved the proposed profiles, 3D corridor models, and cross sections. The roadway plans must consist of the applicable types of sheets necessary for the project and be organized in the sequence as described in the TxDOT *PS&E Preparation Manual*.

7.9. Pavement Design Requirements.

A. The Engineer shall prepare pavement designs for the project in accordance with the latest edition of TxDOT's *Pavement Manual*. Proposed pavement designs include permanent pavement, interim condition transition pavement, and temporary detour pavement.

B. The pavement design report must be reviewed and approved by the State prior to its implementation. The pavement design report must document assumptions and design considerations. The pavement design report must include the following:

1. Cover sheet with highway designation, district, county, project control-section-job (CSJ) number, geographical limits, and signatures of persons involved in the preparation and approval
2. Existing and proposed typical sections
3. Soils map of the project area with a brief description of each type of soil located within the project area
4. Design input values and output
5. Conclusion consisting of recommended pavement design or designs based on the data, analyses, and procedures included in the report
6. Pavement design details specified for each location that includes structural layer materials, general specifications, and layer thicknesses
7. Relevant pavement evaluation data (structural and functional) and condition information on adjacent roads
8. Site conditions that might influence the design and performance of pavements
9. Relevant geotechnical data and drainage requirements including boring logs, laboratory soil test results, active or passive drainage system design, ground penetrating radar (GPR) data, falling weight deflectometer (FWD) data, dynamic cone penetrometer (DCP) data, pavement coring and report log (up to 5-foot depth), and soil classifications with Atterberg limits

10. Results of the field explorations and testing of pavement sections
11. Recommended pavement rehabilitation methods and designs for new pavements
12. Design criteria used in determining pavement designs, including traffic loads, pavement material characterization, environmental conditions, and pavement design life
13. Design summary from the program used to design the pavement structure (e.g., FPS 21, DARWin, TxCRCP-ME, MODULUS 6.1)
14. Life-cycle cost analysis, as required by TxDOT's *Pavement Manual*, including the periods for resurfacing, reconstruction, and other rehabilitation measures and what these activities are likely to entail
15. Traffic control plans required for subsurface geotechnical and pavement investigations
16. Other considerations used in developing the pavement designs, including subgrade preparations and stabilization procedures

7.10. Bicycle Facilities Requirements.

The Engineer shall coordinate with the State to incorporate context appropriate bikeways as required or shown on the project's schematic. All bikeways must be designed in accordance with the latest *AASHTO Guide for Development of Bicycle Facilities and Chapter 6, Section 4 of the Roadway Design Manual*. All bikeways that will also accommodate pedestrian such as shared used paths, must also be designed in accordance with the latest *PROWAG*, Americans with Disabilities Act Accessibility Standards (2010) or the Texas Accessibility Standards (TAS). Bikeways include but are not limited to, separated bicycle lane, shared use paths, buffered bicycle lanes and on-street bicycle lanes. Shared lane markings and shoulders may be considered where appropriate.

7.11. Pedestrian Facilities Requirements.

The Engineer shall coordinate with the State to incorporate pedestrian facilities as required or shown on the project's schematic. Consult the State pedestrian access inventory (TxDOT Comprehensive Accessibility Program - TCAP) and include any known deficiencies in the project design. All pedestrian facilities must be designed in accordance with the Chapter 7, Section 3 of the *Roadway Design Manual*, and the latest *PROWAG*, Americans with Disabilities Act Accessibility Standards (2010) or the Texas Accessibility Standards (TAS).

Pedestrian facilities include, but are not limited to, sidewalks, curb ramps, sidewalk ramps, pedestrian bridges, driveway crossings, street crossings, access to pedestrian push buttons and signal heads, pedestrian hybrid beacons, transit stops, and street furniture.

8. GENERAL REQUIREMENTS FOR FUNCTION CODE 160(161) – ROADWAY DESIGN – DRAINAGE DESIGN.

8.1. Hydrologic Studies Requirements.

The Engineer shall:

A. Incorporate in the hydrologic study a thorough evaluation of the methodology available, comparison of the results of two or more methods, and calibration of results against measured data, if available.

B. Consider the pre-construction and post-construction conditions in the hydrologic study, as required in the individual work authorization. Obtain the drainage area boundaries and hydrologic parameters (e.g., impervious covered areas, overland flow paths and slopes) from appropriate sources including: topographic maps, GIS modeling, construction plans, and existing hydrologic studies. The Engineer shall not use existing hydrologic studies without assessing their validity. If necessary, obtain additional information such as local rainfall from official sites such as airports.

C. Include the “design” frequency to be specified in the work authorization and the 1% annual exceedance probability (AEP) storm frequency. The report must include the full range of frequencies (50%, 20% 10%, 4%, 2%, 1%, and 0.2% AEP).

D. Compare calculated discharges to the effective Federal Emergency Management Agency (FEMA) flows or best available models where a detailed study exists. If calculated discharges are to be used in the model instead of the effective FEMA flows, full justification must be documented.

8.2. Hydraulic Studies Requirements.

The Engineer shall:

A. Develop designs that minimize the interference with the passage of traffic or cause damage to the highway and local property in accordance with the TxDOT *Hydraulic Design Manual*, TxDOT district criteria and any specific guidance provided by the State. Cross drainage design must be performed using HY-8, or HEC RAS computer models unless otherwise approved.

B. Design and analyze storm drains using software as approved by the State.

1. Size inlets, laterals, trunk line, and outfall. Develop designs that minimize the interference with the passage of traffic and damage to the highway and local property in accordance with the TxDOT *Hydraulic Design Manual*, TxDOT district criteria, and any specific guidance provided by the State. The Engineer shall select storm drain design software as directed in the work authorization.

2. Determine hydraulic grade line starting at the outfall channel for each storm drain design. Use the design water surface elevation of the outfall as the starting basis (i.e., tailwater) for the design of the proposed storm sewer system.

3. Calculate manhole headlosses in accordance with FHWA’s *Urban Drainage Design Manual (HEC-22*).

8.3. Complex Hydraulic Design and Documentation Requirements.

The Engineer shall:

A. Perform hydraulic design and analysis using appropriate hydraulic methods, which may include computer models such as HEC-RAS, unsteady HEC-RAS,

2D models or Storm Water Management Model (SWMM). The Engineer shall not develop 2D models without the express permission of the State.

B. Use the current effective FEMA models, where appropriate, as a base model for the analysis or best available model where a detailed study exists. If a model is provided by the local floodplain administrator, it must be utilized accordingly for this analysis unless otherwise approved by the State. Review the provided base model for correctness and update as needed. If the provided effective model is not in a HEC-RAS format, converting to HEC-RAS for this analysis will be required unless otherwise approved by the State.

C. Consider existing and post-construction conditions, as well as future development, as required the current TxDOT *Hydraulic Design Manual*.

8.4. Scour Analysis Requirements.

The Engineer shall:

A. Prepare each scour analysis using a State-approved methodology listed in the work authorization. The Engineer shall select the methodology based on the site conditions such as the presence of cohesive or cohesionless soil, rock or depth of rock, proposed foundation type, and existing site performance. The Engineer shall follow the methodology outlined in the latest *TxDOT Scour Analysis Guide* and *TxDOT Scour Evaluation Guide*. The Engineer shall coordinate with the State prior to commencing any work on any stream migration study. This coordination must include consultation with the appropriate State's technical expert.

B. Complete the scour form in accordance with the latest *TxDOT Scour Evaluation Guide* and submit to the State. Scour forms are available at https://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/bridge.html.

8.5. Drainage Reports Requirements.

The Engineer shall prepare letter reports and hydraulic reports as required in the work authorization and in accordance with the requirements listed below.

A. Letter Report Requirements

1. A letter report must include the preliminary findings. The report must also include conceptual and generic discussions of the alternatives considered, along with a comparative cost associated with each alternative and a recommended solution.

2. Recommendations at this point must be generic and conceptual in nature, mainly for discussions with the State and the local government entities. The recommended solution must be analyzed in detail to reflect the mitigation requirements for the roadway development.

3. Storm drain discussion must include the preliminary sizing of the storm drain, requirement for line rerouting, preliminary detention storage volumes (if required) based on hydrograph, and initial recommendations on mitigation of impacts on the receiving streams.

4. Bridge-Class and Cross-drainage Structure reports must include existing hydraulic conditions, FEMA floodplain status, proposed structure design,

proposed hydraulic conditions, and preliminary detention storage volumes (if required) based on hydrograph and initial recommendations on how to mitigate the storm impact on the receiving streams.

B. Hydraulic Report Requirements

The hydraulic report must document and justify all data, boundary conditions, assumptions, methodologies, and results. The text, tables, exhibits, and appendices must document clearly and concisely the work performed and results found. The report must provide recommendations for critical review by the State. Such recommendations may include the need for further detailed analysis such as an unsteady model analysis or the development of mitigation measures. The Engineer shall save text, tables, exhibits, and appendices (including computer models) on a compact disc and included the disk with each report. The report must be signed and sealed by a professional engineer.

8.6. Requirements for Electronic Copies of Hydrologic and Hydraulic Models.

The Engineer shall provide fully functioning hydrologic and hydraulic models in a format that allows the State to open, maneuver, and perform QA and QC of the models.

9. GENERAL REQUIREMENTS FOR FUNCTION CODE 160(162) – ROADWAY DESIGN – SIGNING, PAVEMENT MARKINGS, AND SIGNALIZATION (PERMANENT).

9.1. Signing and Pavement Markings.

A. The Engineer shall detail permanent pavement markings and channelization devices on plan sheets. The Engineer shall coordinate with the State (and other Engineers as required) for overall interim, and final pavement marking strategies.

B. The Engineer shall provide the following information on sign and pavement marking layouts:

1. Roadway layout
2. Center line with station numbering
3. Designation of arrow used on exit direction signs
4. Culverts and other structures that present a hazard to traffic
5. Location of utilities
6. Existing signs to remain and to be removed, relocated, or replaced
7. Proposed signs (illustrated, numbered, and showing sign size)
8. Proposed overhead sign bridges to remain, to be revised, removed, relocated, or replaced
9. Proposed overhead sign bridges, indicating location by plan
10. Proposed markings (illustrated and quantified) which include pavement markings, object markings and delineation
11. Quantities of existing pavement markings to be removed

12. Proposed delineators, object markers, and mailboxes
13. The location of interchanges, mainlanes, grade separations, frontage roads, and ramps
14. The number of lanes in each section of proposed highway and the location of changes in numbers of lanes
15. Right of way limits
16. Direction of traffic flow on all roadways
17. Existing and proposed crosswalk markings
18. Pedestrian related signage

9.2. Traffic Warrant Studies.

The Engineer shall refer to latest version of the *TMUTCD*, TxDOT *Traffic Signal Manual*, and TxDOT's roadway (ramp) and traffic standards for work performed for either temporary or permanent traffic signals.

9.3. Traffic Signals.

Traffic signal plans must be signed and sealed by a Texas Registered Professional Engineer.

9.4. Safety Scoring Tool.

A. The Engineer shall use the appropriate TxDOT Safety Scoring Tool.The internal quality assurance and quality control (QA and QC) checks of the analysis for each of the intersections in the project must include a review of the intersection scoring tool spreadsheet for each intersection to verify that the analysis includes an evaluation of traffic volumes, crashes, geometric design elements, traffic control elements, pedestrian elements, bicycle elements, and alternative intersections as needed.

10. GENERAL REQUIREMENTS FOR FUNCTION CODE 160(163) – ROADWAY DESIGN – MISCELLANEOUS ROADWAY.

10.1. Utility Engineering Requirements.

A. The Engineer must maintain a utility layout in the current approved version of OpenRoads Civil Design system used by the State. This layout must include all existing utilities which are to remain in place or be abandoned, and all adjusted utilities. This layout must be utilized to monitor the necessity of relocation and evaluate alternatives.

B. The Engineer shall not provide services under this contract that are for the sole benefit of a party or parties other than the State. The Engineer shall not invoice the State for any such services.

C. The Engineer is responsible for ensuring that there is no conflict between the utility management plan, utility certifications, and special provisions.

10.2. Utility Design Requirements.

The Engineer's utility design activities must conform with 43 Tex. Admin. Code § 21.37.

10.3. Geotechnical Borings and Investigation Requirements.

A. The Engineer shall conduct laboratory tests, other than field tests, at the Engineer's State certified facilities or State certified commercial laboratories.

B. The Engineer shall furnish equipment necessary to drill borings and recover continuous cores for soil classification and testing at the locations and depths specified in the Work Authorization. The Engineer shall perform Texas cone penetrometer testing in accordance with Test Method Tex-132-E. The Engineer shall:

1. Provide calibrated drilling equipment with an automatic hammer.
2. Provide to the State, cone measurement and certified hammer weight records signed and sealed by a professional engineer at the beginning of this contract and every 12-months thereafter.

C. All geotechnical work must be performed in accordance with the latest version of the TxDOT *Geotechnical Manual*. All testing must be performed in accordance with TxDOT's Test Procedures, which are available at https://www.txdot.gov/business/resources/testing.html. American Society for Testing Materials (ASTM) test procedures may be used only in the absence of TxDOT procedures. All soil classification must be done in accordance with the Unified Soil Classification System.

D. The Engineer shall perform all foundation exploration, drilling, testing, and logging in accordance with the latest version of the TxDOT *Geotechnical Manual* and TxDOT's Test Procedures, which are available at https://www.txdot.gov/business/resources/testing.html, and perform lane closures in accordance with the latest version of the *TMUTCD*.

E. All drilling logs and test data must be reviewed and evaluated by a registered professional engineer. Reports must be signed, sealed, and dated by a registered professional engineer.

F. The Engineer shall provide a qualified logger for sampling, identifying the drilled materials and logging the soil profile. The minimum requirements for the logger are:

1. Must be a geologist or Engineer in Training (E.I.T.) with at least two years of related experience in local soils and bedrock identification, testing, and data collection techniques or
2. Must be an engineering technician with at least five years of verifiable experience in local soils and bedrock description, testing, and data collection techniques.

G. The Engineer shall coordinate all drilling and testing with the State prior to initial sampling and drilling operation to avoid re-drilling. Any additional drilling activities resulting from poor coordination, driller error, or equipment issues will be the responsibility of the Engineer.

H. The Engineer shall submit draft logs to the State as necessary to assist in selection and assignment of tests. The Engineer shall give at least 72 hours of notice to the State prior to commencing work.

I. The Engineer shall clear each drilling location for all utilities prior to beginning drilling operations and shall avoid damaging properties and utilities.

J. When directed by the State, the Engineer shall provide equipment to clear brush to provide access to designated drilling sites.

K. Draft logs for all barge drilling must be submitted to the State within 48 hours. The Engineer shall notify the State of conditions that warrant standby charges on the same day.

L. The Engineer's drill crew shall clean up litter and surplus drilling materials and fill and plug completed holes (on and off pavement) before leaving each location. The Engineer shall also remove all piezometers and plug and fill the hole.

M. The soil boring log sheets must be created using the TxDOT WINCORE software, which can be found on the TxDOT website or other software as specified by the State. The preparation of soil boring log sheets must be in accordance with TxDOT standards. Spacing and depth of soil borings must be in accordance with the TxDOT *Geotechnical Manual*.

N. Geotechnical Report Requirements

Geotechnical reports must include:

1. Complete foundation exploration drilling logs using the latest version of WINCORE, or other software as specified by the State. Each log must include the following:
    a. Elevation, coordinate information acquired with a GPS unit, a sketch noting the relative location of each boring to the structure or other pertinent features on the site, and, when available, bore hole station, offset and elevation using survey readings.
    b. Soil and rock descriptions of all layers
    c. Groundwater conditions and depth to groundwater
    d. Texas cone penetration test blow counts
    e. Pocket penetrometer values for cohesive soils and standard penetration test (SPT) blow counts for granular soils. Indicate the hammer used for the SPT in the logs.
    f. Rock quality designation (RQD) and percent recovery for all rock layers
2. Analyses and recommendations for foundation design and construction, potential settlement, design soil parameters, and slope stability
3. Grain size distribution curves with D50 value, when scour analysis is performed;
4. Skin friction tables and design capacity curves
5. Pertinent lab test results (e.g. triaxial test, index tests)
6. Photographs of rock cores
7. Driller, logger, and the company or organization performing the drilling.

8. A conclusions and recommendations section that summarizes the Engineer's evaluation of the data and recommendations to the State.
9. A report transmittal letter summarizing the work performed under the given work authorization, along with a summary of the conclusions and recommendations.

O. Geotechnical Quality Assurance Requirements

1. As a minimum, the Engineer shall adhere to the following quality assurance program:
    a. Use a minimum of a three-man crew, consisting of a driller, a driller's helper, and a logger.
    b. Use the same crew on each project to ensure consistency.
    c. Each crew shall maintain a copy of the TxDOT *Geotechnical Manual* and Test Methods Tex-132-E and Tex-141-E for reference on the job site. Crews may utilize other references such as ASTM test procedures (only in the absence of the State's procedures) that are accepted methods of field classification of soil.
2. The Engineer's drilling crew must make the necessary field adjustments to minimize the disturbance to the cores and to insure maximum possible recovery percentage. Rock core samples with a recovery less than anticipated due to driller error, improper equipment selection, or equipment malfunction shall be considered unacceptable.
3. Incorrect laboratory test results or laboratory tests performed on incorrect samples are unacceptable and will not be paid for by the State. Lab tests performed on the samples that provide no additional engineering value for the design or classification are also not acceptable and will not be paid by the State. If required, the Engineer shall collect additional soil samples in a newly drilled hole adjacent to the original hole. The additional samples must be tested using the correct procedures. This work shall not be compensated by the State.
4. Engineering technicians performing laboratory testing services must be qualified (certified) in accordance with TxDOT Quality Assurance Programs or other TxDOT-approved programs. The Engineer shall provide the State with a list of certified personnel and copies of their current certificates before beginning work, when personnel changes are made, and when requested by the State.
5. Approval of engineering technicians by the State does not relieve the Engineer from the responsibility of ensuring that engineering technicians are fully qualified to correctly perform the laboratory testing services being provided.
6. All laboratory equipment must have a current calibration in accordance with the National Institute of Standards and Technology (NIST), AASHTO, and ASTM requirements and the Engineer shall ensure the equipment meets these requirements. The Engineer shall provide an inventory of pertinent laboratory equipment and current calibration certifications to the State upon request.

7. The Engineer shall be responsible for maintaining all equipment to ensure safe and efficient operation.

10.4. Retaining Wall Requirements.

A. The Engineer shall develop each retaining wall design and determine the location of each soil boring needed for the foundation design of each retaining wall in accordance with the TxDOT *Geotechnical Manual*.

B. Retaining wall analysis and design must meet the requirements of the TxDOT *Geotechnical Manual*.

C. For projects that have retaining walls, the Engineer shall develop the retaining wall layouts in the 3D corridor model.

D. For retaining wall submittals, the Engineer shall follow the current requirements shown on the TxDOT Bridge Division website and the TxDOT *Geotechnical Manual*.

E. The Engineer shall submit the retaining wall layouts to obtain approval from the State as a requirement of the 30% milestone submittal . The Engineer shall incorporate all necessary information from above referenced manuals and respective checklists into the retaining wall layouts. For phase construction, the Engineer shall indicate limits of existing retaining walls for removal and reconstruction and determine limits of temporary retaining walls or temporary special shoring to be shown on the traffic control plan (TCP) and retaining wall layouts.

F. The approximate limits of each retaining wall must be based on station or length. The Engineer shall notify the State of the type of retaining walls that will be used for each cut and fill location.

G. Retaining wall types considered by the Engineer must include:

1. Spread Footing Walls. The Engineer shall select a spread footing wall for a fill situation when considerable room behind the walls is available for forming, constructing, and backfilling the footings and stem. The Engineer shall notify the State when the quantity is less than 1000 square feet to have as an option in the plans to cast in place a spread footing wall design. This selection must be approved by State.
2. Mechanically Stabilized Earth (MSE) Walls. The Engineer shall prepare the retaining wall layouts showing plan and profile or retaining walls for design by a TxDOT-approved vendor. The Engineer is responsible for design of geometry and wall stability. The Engineer shall incorporate a slope of 4:1 or flatter from the existing and finished ground line elevation to the face of the retaining wall.
3. Concrete Block Walls (Structural and Landscape)
4. Tied Back Walls
5. Soil Nailed Walls
6. Rock Nailed Walls
7. Drilled Shaft Walls
8. Temporary MSE Walls

H. If applicable, the State will provide architectural standard drawings for the retaining walls. The Engineer shall incorporate architectural standard drawings into the design details.

I. The retaining wall plans must include the following information:

1. Layout Plan
    a. Designation of reference line
    b. Beginning and ending retaining wall stations
    c. Offset from reference line
    d. Horizontal curve data
    e. Total length of wall
    f. Indication of face of wall
    g. All wall dimensions and alignment relations (alignment data as necessary)
    h. Soil boring locations
    i. Drainage, signing, lightning, or other appurtenances that are mounted on or passing through the wall
    j. Subsurface drainage structures or utilities that could be impacted by wall construction
2. Elevation
    a. Top of wall elevations
    b. Existing and finished ground line elevations
    c. Vertical limits of measurement for payment
    d. Type, limits, and anchorage details of railing (only required if traffic railing foundation standard is not being used on the project)
    e. Top and bottom of wall profiles plotted at correct station & elevation
    f. Underdrains
    g. Any soil improvement, if applicable
    h. Drainage, signing, lighting, or other appurtenances as noted above
    i. Drainage structures and utilities as noted above
3. Sectional View
    a. Reinforced volume
    b. Underdrain location
    c. Soil improvements, if applicable

10.5. Traffic Control Plan, Detours, and Sequence of Construction Requirements.

A. A detailed traffic control plan (TCP) must be developed in accordance with the latest edition of the *TMUTCD*. The Engineer shall implement the current barricade and construction (BC) standards and TCP standards as applicable.

The Engineer shall interface and coordinate phases of work, including the TCP, with adjacent Engineers.

B. The Engineer shall:

1. Show proposed traffic control devices for at-grade intersections during each construction phase (e.g., stop signs, flag personnel, signals). Show temporary roadways, ramps, structures (including railroad shoo-fly), and detours required to maintain lane continuity throughout the construction phasing. If temporary shoring is required, prepare layouts and show the limits on the applicable TCP.
2. Coordinate with the State in scheduling a traffic control workshop and submittal of the TCP for approval by the traffic control approval team (TCAT). Assist the State in coordinating mitigation of impacts to adjacent schools, emergency vehicles, pedestrians, bicyclists, and neighborhoods.
3. Develop each TCP to provide continuous, safe access to each adjacent property during all phases of construction and to preserve existing access. Notify the State in the event existing access must be eliminated and receive approval from the State prior to elimination of any existing access.
4. Show horizontal and vertical location of culverts and required cross sectional area of culverts.
5. Include interim signing for every phase of construction. Interim signing must include regulatory, warning, construction, route, and guide signs.
6. Maintain continuous access to abutting properties during all phases of the TCP.
7. Make every effort to prevent detours and utility relocations from extending beyond the proposed right-of-way lines. If it is necessary to obtain additional permanent or temporary easements and right-of-entry, notify the State in writing of the need and justification for such action.

10.6. Temporary Traffic Signals and Illumination Requirements.

The Engineer shall immediately notify the State if the Engineer determines that an existing traffic signal or roadway illumination will be affected by the project.

10.7. Illumination Requirements.

A. The Engineer shall comply with the TxDOT *Highway Illumination Manual* and other applicable TxDOT-approved manuals for design of continuous lighting and safety lighting for all conventional, high-mast, and underpass lighting.

B. The Engineer shall include safety lighting as part of each design on each flashing beacon and traffic signal.

C. The Engineer shall include underpass lighting when required on structures within each project.

10.8. Contract Time Determination Requirements.

The contract time schedule must include tasks, subtasks, critical dates, milestones, deliverables, and review requirements in a format that depicts the interdependence

of the various items and adjacent construction packages. The Engineer shall provide the Primavera file or the file from the latest scheduling program used by the State for the construction time estimate.

10.9. Constructability Review Requirements.

The constructability review must be performed for all roadway and structural elements such as sequence of work and traffic control, drainage (temporary and permanent), storm water pollution prevention plan (SWP3), environmental permits, issues and commitments (EPIC) addressed, identification of utility conflicts; ensuring accuracy and appropriate use of items, quantities, general notes, standard and special specifications, special provisions, contract time/schedule, standards; and providing detailed comments in an approved format. Reviews must be captured in a constructability log identifying areas of concern and potential conflict. The Engineer shall provide the results of all constructability reviews and recommendations to the State at major project design milestone submittals.

11. GENERAL REQUIREMENTS FOR FUNCTION CODE 160(170) – ROADWAY DESIGN – BRIDGE DESIGN.

11.1. Bridge Design Requirements.

The Engineer shall comply with all relevant sections of the latest edition of the TxDOT *Bridge Design Manual - LRFD*, TxDOT *Bridge Project Development Manual*, TxDOT *Bridge Detailing Guide*, and *AASHTO LRFD Bridge Design Specifications*, and respective checklists.

11.2. Bridge Layout Requirements.

A. The Engineer shall conduct preliminary studies as necessary prior to producing the bridge layout. Preliminary studies include the following:

1. Determine the locations of utilities that affect placement of bridge substructure elements.
2. Determine extents of right of way.
3. If necessary, review existing documentation and information for rehabilitation, widening, or replacement of existing structures. Available information may include:
    a. Original plans and shop drawings
    b. Existing specifications
    c. Documentation of previous repairs
    d. Routine bridge inspection report and/or even-driven inspection reports
    e. Inspection reports/condition surveys. Conduct additional inspections as required to fully determine extent of repairs, structural adequacy, and existing condition of structure. Coordinate with the State's project manager to arrange any necessary inspections.
    f. Load rating reports
    g. Soil borings and pile driving record

B. The Engineer shall submit a bridge layout for each structure for approval from the State as a requirement of the 30% milestone submittal .

C. Each bridge or bridge class culvert layout information listed on the Layout checklists in the TxDOT *Bridge Detailing Guide*.

D. The Engineer shall determine the location of each soil boring needed for foundation design in accordance with the TxDOT *Geotechnical Manual*.

11.3. Bridge Replacement, Bridge Widening, and Bridge Class Culvert Structural Detail Requirements.

The Engineer shall prepare each structural design and develop detailed structural drawings of all required details in compliance with the TxDOT *Bridge Design Manual - LRFD*, TxDOT *Bridge Detailing Guide*, TxDOT *Preferred Practices for Steel Bridge Design, Fabrication, and Erection*, and *AASHTO LRFD Bridge Design Specifications*. The Engineer shall prepare any project-specific modified standards necessary for inclusion in the PS&E package. The Engineer shall sign, seal, and date all project-specific modified standards.

11.4. Requirements for Seismic Analysis of Bridge Projects.

If indicated in the work authorization, the Engineer shall perform seismic analysis of bridge structures. The bridge design notes shall indicate the seismic zone and checks performed to ensure that AASHTO criteria are met.

11.5. Requirements for Electronic Copies.

A. The Engineer shall furnish the State in a format acceptable to the State, the final plans in the current graphics format used by the State, .pdf format, and in the TxDOT district's file management system (FMS) format.

B. The Engineer shall also provide in a format acceptable to the State, cross section information (in dgn, XLR, & ASCII formats) for the contractor's use.

C. With the approval of the State, and in lieu of the above, the Engineer may maintain the project files in TxDOT's ProjectWise work areas. The handoff of the electronic files will be via email to the State, with a URN link to the project location in ProjectWise provided in the email.

11.6. Requirements for Documentation of Calculations.

The Engineer shall provide the following documentation of calculations to the State:

A. All quantity and non-structural design calculations.

B. All engineering design calculations, load rating calculations, analysis, input calculations, quantities, and geometric designs (OpenRoads Designer and OpenBridge Designer files), relating to the project's structural elements. Project structural elements include bridges, retaining walls, overhead sign structures, high-mast illumination structures, non-standard culverts, custom headwalls, and drainage appurtenances.

C. Working copies of all spreadsheets and output from any programs utilized in a format acceptable to the State in a universally reliable format.

The Engineer shall provide the calculations in .pdf format. The .pdf file should be submitted in a format acceptable to the State.

11.7. Archiving File for Bridge Design Calculations and Notes.

The Engineer shall scan the design notes (or convert electronic files) and submit a single PDF file for each bridge in accordance with the TxDOT *Bridge Design Manual – LRFD*. In the case of a single design done for twin structures, submit the same notes under two separate NBI numbers.

12. GENERAL REQUIREMENTS FOR FUNCTION CODE 300 (320) – GENERAL FUNCTION – INSPECTION OF WORK IN PROGRESS AND PROJECT RECORDS.

12.1. Utility Construction Management and Verification.

A. The Engineer shall provide a utility coordinator to coordinate all activities with the State, or the State's designee, for the orderly progress and timely completion of the State construction phase.

B. The Engineer shall provide a utility coordinator to perform non-engineering utility coordination services consisting of coordinating with State, or State's designee, all utility-related activities for the orderly progress and timely completion of the construction phase of the project.

TASK DESCRIPTIONS AND FUNCTION CODES

The Engineer shall categorize each task performed to correspond with the Function Codes (FC) and Task Descriptions.

FUNCTION CODE 102 (110) – FEASIBILITY STUDIES

ROUTE AND DESIGN STUDIES

The Engineer shall prepare an alignment and proposed roadway schematic layout that includes projected traffic volumes and existing and proposed typical sections. The Engineer shall furnish Microsoft Office and MicroStation and OpenRoads computer generated media containing the roadway schematic layout to the State. All supporting attachments and exhibits must accompany the schematic layout. All MicroStation and OpenRoads computer generated files containing the roadway design schematic must be fully compatible with the software used by the State without further modification or conversion.

The Engineer shall produce, obtain, review, and evaluate existing and twenty-year projected traffic data for use in the preparation of the schematic design layout. The data must be utilized in accordance with the requirements for schematic development and consistent with the policies of the State.

The Engineer shall prepare preliminary drawings to identify any potential impacts and constraints within the project corridor, including impacts to the nature, cultural, and human environment. The potential impacts and constraints identified must include all existing and

proposed utilities (both public and private), structures, burial grounds, neighborhood communities, historical landmarks, and undeveloped areas. Any potential utility conflicts and structural impediments must be identified as such. The Engineer shall propose alternative alignments that avoid or minimize displacements and damages and prepare any additional attachments or exhibits required to illustrate a preferred alternative alignment. The Engineer shall assist the State with agency meetings during the development of the schematic design as requested by the State. If requested by the State, the Engineer shall prepare a Notice and Opportunity to Comment and assist the State with stakeholder meetings, public meetings, and a public hearing, if requested.

An itemization of the schematic design and engineering work activity to be performed under this contract is detailed below. The Engineer shall prepare all designs in accordance with the latest version of:

A. *Roadway Design Manual*, published by TxDOT
B. *TxDOT Project Development Process Manual*, published by TxDOT;
C. *Policy on Geometric Design of Highways and Streets*, published by the American Association of State Highway and Transportation Officials' (AASHTO);
D. *Standard Specifications for Construction of Highways, Streets, and Bridges*, published by TxDOT;
E. *Texas Manual on Uniform Traffic Control Devices (TMUTCD)*, published by TxDOT;
F. *Highway Capacity Manual (HCM)*, published by the Transportation Research Board (TRB);
G. *Highway Safety Manual (HSM)*, published by AASHTO;
H. *Hydraulic Design Manual*, published by TxDOT;
I. *Access Management Manual*, published by TxDOT; and
J. other State approved manuals and guides.

When design criteria are not identified in these manuals, the Engineer shall notify the State and request direction.

The design schematic horizontal layout must adhere to a design scale of 1 inch = 100 foot (or 1 inch = 200 foot, when directed by the State.) The Engineer shall develop the schematic layout, exhibits, and attachments in English units. All Microsoft Office, MicroStation, Keyhole Markup Language (KML), Keyhole Markup Language Zipped (KMZ), and Bentley OpenRoads computer graphic files furnished to the State must be submitted on USB flash drive (or other format as directed) to the State in their native format, which must be fully compatible with the programs currently used by the State. Schematics must follow TxDOT and Federal Highway Administration (FHWA) standards. The schematic must follow TxDOT's computer-aided design and drafting (CADD) standards. The Engineer shall submit the schematic as an original document, accompanied with an original MicroStation formatted graphics file. Final copies of the schematic design must be signed and sealed by a professional engineer licensed in the state of Texas.

110.2. Schematic Design Work Outline.

A. Develop Base Maps

The Engineer shall develop the base maps to be used for the analysis and proposed schematic layout from existing construction and right of way (ROW) plans as available. The Engineer shall re-establish the existing centerline horizontal alignments for all roadways, identify existing ROW and easements, property owners, and the approximate location of major utilities based on a utility engineering investigation in the preparation of base maps.

B. Planimetrics and Aerial Mapping

The Engineer shall obtain planimetrics, digital terrain modeling (DTM), and aerial photographs from the State, if available.

C. Analyze Existing Conditions

Using collected data and base maps, the Engineer shall develop an overall analysis of the existing conditions to develop the schematic design. The analysis must include the following:

1. ROW and easement determination
2. Horizontal alignment
3. Vertical alignment
4. Pavement cross slopes and pavement type
5. Soil exploration
6. Geotechnical testing
7. Highway-rail grade crossing studies, if applicable
8. Intersection design and analysis
9. Sight distance
10. Large guide signs and roadside signing
11. Level of service
12. Safety (i.e., crash data)
13. Locations of critical constraints
14. Drainage
15. Traffic control and construction phasing sequence

D. Schematic Alternatives

E. The Engineer shall identify and analyze schematic alternatives to minimize potential adverse operational impacts, crash impacts, ROW impacts, environmental impacts, major utility conflicts, structural impediments, or exceptions to the State and FHWA design criteria.Deliverable Schematic

The Engineer shall evaluate and document the following in the analysis to optimize the design:

1. Efficient use of the allocated ROW
2. Control of access (COA) and driveway locations
3. Roadway and intersection geometry

4. Cross sections
5. Bicycle and pedestrian design
6. Drainage and hydraulic design
7. Stopping sight distance
8. Level of service
9. Safety
10. Traffic and signal operations
11. Construction, ROW, easement, and utility costs
12. Construction sequencing
13. Traffic control during construction
14. Roadside safety appurtenances
15. Large guide signage
16. Environmental mitigation (e.g., noise walls, storm water best management practices (BMPs))
17. Bridge layouts and clearance
18. Railroads (if applicable)
19. Interface with existing high occupancy vehicle (HOV) lane, managed lanes, and park-and-ride facilities
20. Accommodation of ultimate corridor configuration.
21. Accommodation of future cross street expansion as described in local thoroughfare plan (if applicable)
22. Avoidance of utility lines (if feasible)
23. Impact of construction delays from utility relocations

F. Project Management and Coordination

1. The Engineer shall direct and coordinate the various elements and activities associated with developing the design schematic.
2. The Engineer shall prepare the detailed graphic project work schedule indicating tasks, critical dates, milestones, deliverables, and State review requirements. The project work schedule must depict the order of the various tasks, milestones, and deliverables. The Engineer shall review the schedule monthly and provide updates regarding its progress on the schedule to the State.
3. The Engineer shall submit written monthly progress reports to the State. More frequent progress reports may be requested by the State.
4. The Engineer shall provide ongoing quality assurance and quality control to ensure completeness of product and compliance with the State procedures.

5. The Engineer shall conduct site visits in both the AM and PM peak hour and develop a technical report that includes photographs outlining the findings and observations.

G. Data Collection

The Engineer shall conduct field reconnaissance and collect data as necessary to complete the schematic design and PS&E development. Data must include the following information. Items 1 through 8 must be obtained from the State, if available. Items 9 through 13 must be obtained from other agencies as required. The Engineer shall notify the State in writing whenever the Engineer finds disagreement with the information or documents.

1. Available corridor major investment studies
2. Design data from record drawings of existing and proposed facilities
3. Existing and future design year traffic data
4. Historical crash data
5. Roadway inventory information, including the number of lanes, speed limits, pavement widths and rating, bridge widths and ratings, and ROW widths
6. Aerial photos, planimetric mapping, and DTM
7. Environmental data
8. Previously prepared drainage studies
9. Adopted land use maps and plans (if available)
10. Federal Emergency Management Agency (FEMA) flood boundary maps and flood insurance studies and models
11. Public and private utility information
12. Plat research for adjacent properties (if available)
13. Local major thoroughfare plan
14. Utility plans and documents from appropriate municipalities and agencies
15. Data, if available from the State, including as-built plans, existing schematics, right of way maps, utility engineering investigation mapping, existing cross sections, existing planimetric mapping, environmental documents, existing channel and drainage easement data, existing traffic counts, accident data, bridge inspection records, project management information system (PMIS) data, identified endangered species, identified hazardous material sites, current unit bid price information, current special provisions, special specifications, and standard drawings.
16. Documents for existing and proposed development along proposed route from local municipalities and local ordinances related to project development.
17. Conduct field reconnaissance and collect data including a photographic record of notable existing features.

H. Roadway Design Criteria

The Engineer shall develop the roadway design criteria based on the TxDOT *Roadway Design Manual* and AASHTO *Policy on Geometric Design of Highways and Streets* guidelines. The design criteria must include the following roadway design elements: design speed, lane and shoulder widths, pavement structure and slopes, horizontal curvatures, horizontal and vertical clearances, range of vertical profile grades, and side slopes. If there is a discrepancy between the two sources, the TxDOT *Roadway Design Manual* will govern unless otherwise directed by the State.

I. Preliminary Design Conference

The Engineer shall prepare and submit a preliminary Design Summary Report (DSR) to the State for review and approval and shall attend an initial kick-off meeting to establish and agree on fundamental aspects, basic features, concepts, and design criteria. This meeting will be coordinated with any adjacent roadway projects to ensure continuity with the design of the adjacent roadway projects. The Engineer shall also prepare and provide the State a meeting agenda, sign-in sheets, and meeting minutes for the preliminary design conference.

110.3. Schematic Design – General Tasks.

A. ROW Property Base Map

The Engineer shall obtain information on existing ROW, easements, and property information from as-built plans, ROW maps, and tax records. The Engineer shall prepare a base map depicting the information.

B. Typical Sections

The Engineer shall develop both existing and proposed typical sections that depict the number and type of lanes, shoulders, median width, curb offsets, cross slope, border width, clear zone widths, and ROW limits.

C. Environmental Constraints

The Engineer shall evaluate and document impacts to environmentally sensitive sites (as identified by the Engineer and verified by the State) during the schematic design process. Environmentally sensitive sites include natural, cultural, and the human environment. Examples are historic and archeological resources, burial grounds, neighborhood communities and residential areas, farmland, floodplains, wetlands, endangered species, rare habitats, wildlife corridors, wildlife crossings, parks and nature preserves, geologic features, undeveloped areas, and significant trees.

D. Drainage

1. The Engineer shall use data from as-built plans provided by TxDOT, survey data, field investigations, and FEMA maps to locate drainage out falls and to determine existing storm sewer and culvert sizes, design flows, and water surface elevations for use in the design of roadway geometry.

   The following drainage structures have been identified on the corridor and will be analyzed using HEC-RAS during the schematic phase:

2. PROVIDE TABLE WITH CROSSINGS, STRUCTURE TYPE, and FEMA ZONE

3. The Engineer shall conduct a preliminary drainage study to determine and evaluate the adequacy of the ROW needed to accommodate the proposed roadway and drainage system. The drainage study must:
    a. identify the impacts to abutting properties and the 100-year floodplain due to proposed highway improvements
    b. identify the water surface elevations for the 2, 5, 10, 25, 50, and 100-year storm events
    c. identify and locate outfalls
    d. provide drainage outfall descriptions
    e. provide overall drainage area map, sub-drainage area map, and storm water detention facilities
    f. provide a drainage study report identifying the results of the study.
4. The drainage report, which must be signed and sealed by a professional engineer licensed in Texas, must include applicable hydrologic and hydraulic models (e.g., HEC-1 and HEC-2, HEC-RAS, HEC-HMS, XP-SWMM). The models must be approved by the local TxDOT district hydraulic engineer prior to generating any reports. If requested, the Engineer shall prepare a final drainage study in accordance with one or more of the following: TxDOT Hydraulic Design Manual, local TxDOT district criteria, and any other specific guidance provided by the State. If requested by the State, the Engineer shall evaluate the adequacy of the existing drainage structures; otherwise, the Engineer shall not evaluate the adequacy of the existing drainage structures.

    The Engineer shall prepare a single drainage study of the project area which includes, but is not limited to, the following:

    a. Drainage report of existing versus proposed conditions evaluation
    b. Scour analyses and stream migration studies
    c. Culvert design
    d. Layout, structure design, and detailing of drainage features
5. e. Verify ditch capacity to ensure the ROW footprint is adequately sized
6. For projects located over the Edwards Aquifer Recharge Zone or Contributing Zone, the Engineer shall follow the Texas Commission on Environmental Quality (TCEQ) Edwards Aquifer rules. The Engineer shall design water quality Best Management Practices (BMP) in accordance with the latest editions of RG-348 – Complying with the Edwards Aquifer Rules Technical Guidance on Best Management Practices (July 2005); RG-348 Addendum Sheet (July 2012), or latest edition. As part of this work, the Engineer shall perform the following:
    a. BMP analysis: The Engineer shall locate all BMPs previously permitted under the TCEQ Edwards Aquifer rules that might be impacted by the project. The Engineer shall determine the amount of total suspended solids (TSS) being treated under these permitted BMPs.

b. TSS load calculations: The Engineer shall develop TSS load calculations to determine the TSS amount required to be treated under the Edwards Aquifer rules. This calculation is based on the increase in the amount of impervious cover within the project area. The Engineer will determine 80% of the increase in TSS load resulting from the development on the project.

c. De facto water quality: The Engineer shall determine the amount of de facto water quality being treated via grassy swales (GS) and vegetative filter strips (VFS). These locations are generally in areas where the existing geometry meets TCEQ standards for water quality and were not permitted as TCEQ BMPs under the Edwards Aquifer rules.

d. TSS removal determination: The Engineer shall utilize the TCEQ calculation spreadsheet to determine the total amount of TSS removal required for the project.

e. Design coordination and water quality report: After the 30% submittal, the Engineer shall meet with the State to discuss the TSS removal required for the project and delineate the design approach for the water quality BMPs. As geometry allows, the Engineer shall first maximize treatment via features in the roadway section (vegetative filter strips and grassy swales). For all other permanent BMP treatment options, the Engineer shall coordinate with the State for preferred treatment options and determine any necessary drainage easements required for the water quality BMP. The Engineer shall identify and document BMPs in the schematic water quality report. The Engineer shall submit a draft schematic water quality report with the 60% submittal, and a final schematic water quality report with the 100% submittal. The Engineer shall provide cost estimates for the BMPs and necessary drainage easements.

E. ROW Requirements

The Engineer shall determine the ROW requirements based on the proposed alignment, typical sections, design cross sections, access control, terrain, construction requirements, drainage, clear zone, maintenance, intelligent transportation system (ITS), and environmental constraints and mitigation requirements.

F. Construction Sequence

The Engineer shall evaluate and document the requirements for construction staging and traffic control throughout the development of schematic design to ensure that the proposed design can be constructed. The Engineer shall provide construction phasing assumptions to the State as requested and provide preliminary traffic control plan (TCP) layouts.

G. Design Exceptions

The Engineer shall identify design exceptions and waivers. The Engineer shall determine the necessity for each design exception or waiver for approval. If the State agrees that design exception or waiver is necessary, the Engineer shall prepare the State's required design exception or design waiver

documentation. The Engineer shall document the operational and safety analysis for comparison of the no-build, build with standard design, and build with proposed design alternatives. For interstate facilities, the safety analysis must include the following:

1. Expected change in crashes from existing conditions to standard design conditions
2. Expected change in crashes from existing conditions to the proposed design

H. Traffic Data and Projections

The Engineer shall obtain the base year traffic data from TxDOT and develop the opening-year, design-year (opening year +20), and pavement design year (opening year + 30) travel forecasts, and related traffic analysis in coordination with the TxDOT Transportation Planning and Programming Division (TPP). The developed traffic projections must be utilized for design and environmental analysis. The Engineer shall develop traffic forecasts for SH 29 for no-build and build alternatives. These projections must include graphic representations of the anticipated daily movements along the corridor (suitable for inclusion in the design schematic and environmental document) and the traffic analysis for highway design table. The Engineer shall prepare a traffic projections methodology memo, based on the information provided in the traffic analysis package. The Engineer shall review the proposed methodology with the State and refine it based on these discussions. The Engineer shall submit the traffic volumes developed by the Engineer to TPP for review and approval. The Engineer shall revise the traffic volumes based on TPP's comments.

I. Financial Plan and Project Management Plan

The Engineer shall prepare a financial plan (FP) and project management plan (PMP), in accordance with the most recent FHWA Financial Plan Guidance, for submission by the State to the FHWA Division Office for review and approval. The purpose of the FP is to document the project cost estimate and revenue structure and provide reasonable assurance that sufficient financial resources will be available to implement and complete the project as planned. The FP must cover topics such as the project cost estimate, revenue structure, funding resources, project implementation over time based on the available financial resources, and the cost and revenue assumptions used in development.

1. The initial FP shall consist of at least five main sections including:
    a. Cost estimate
    b. Implementation plan
    c. Financing and revenues
    d. Cash flow
    e. Risk identification and mitigation factors
2. The Engineer shall prepare for and attend a cost estimate review (CER) workshop with the State and the FHWA to develop and review

information for inclusion in the FP such as cost estimation procedures and tools, identifying funding sources and revenues, and project implementation schedules. In preparation for the CER, the Engineer shall conduct a risk analysis assessment, provide cost spreadsheets and models for input into the FHWA's probability modeling software, review and provide comments on the CER summary report, and update cost information in the initial FP to reflect confidence limits established during the CER.

3. The Engineer shall provide annual updates (AUs) to the initial FP reflecting changes in project finances and funding resources. Each update must include revisions to the five main sections mentioned above as well as discussions of significant cost or revenue changes, comparisons to previous plan estimates, and explanations of mitigating actions taken to adjust for deviations.

4. The Engineer shall submit the PMP, FP, and FP AUs to the State for review and comment. For scoping purposes, it is assumed that the initial drafts of the FP and FP AUs will be reviewed concurrently by the District, the TxDOT Design Division, and TxDOT Finance Division. The Engineer shall address the State's comments and prepare a revised draft for review by the FHWA. The Engineer shall address FHWA comments and prepare the final FP (up to three revision cycles from the State and FHWA) for the State to submit to the FHWA for approval. To document each revision cycle, the Engineer shall develop a comment response forms that includes the comments, comment numbers, page and line numbers of draft where comments originated, page and line numbers where revisions can be located, and the responses.

J. Traffic and Operational Analysis

The Engineer shall review and analyze traffic data (including percent trucks, design hourly volume, and directional distribution), existing roadway features (including ramp locations, weaving sections, number of lanes, offset to obstructions, lane widths, frontage road operations, and intersection operation and geometry), traffic flow patterns, and transit and traffic operations. The Engineer shall conduct capacity analysis studies for designated locations and sections of roadway and make recommendations for improving traffic flow. The Engineer shall use the HCM to analyze and make appropriate recommendations. The analysis must be done for existing/base year, opening year, design year (opening+20 year), and interim year (if needed) for existing and future conditions. Results of this analysis must be incorporated into the schematic design. The Engineer shall develop and submit to TxDOT a traffic and operational analysis report summarizing all analysis performed. If microsimulation is used, the Engineer shall develop and calibrate an existing condition traffic model. The calibration memo must be included in the traffic analysis report. The analysis must be performed using the latest versions of TxDOT-approved software (e.g., HCS, Synchro, VISSIM, CORSIM, SIDRA).

K. Safety Analysis

The Engineer shall review and analyze historical crash data for latest 3 to 5 full calendar years (i.e., January 1 to December 31, inclusive) with respect to crash characteristics such as severity, crash types, frequency, rates, patterns,

clusters, and their relationship to crash contributing factors. The purpose of the historical crash analyses is to determine safety performance of the existing conditions to understand any safety issues within the study area.

Predictive, or quantitative safety analysis, involves using HSM-based methods that use safety performance functions (SPFs) and crash modification factors (CMFs) to estimate anticipated change in crashes from existing condition to the proposed design. The predictive safety analysis must be done for no-build and build conditions for design year. The purpose of the predictive safety analysis is to compare the safety performance of the no-build and build alternatives to help determine the preferred alternative and to determine the countermeasures, if necessary, to improve safety. Predictive safety analysis must be performed using HSM based tools including Interactive Highway Safety Design Model (IHSDM), Enhanced Interchange Safety Analysis Tools (ISATe), HSS, or other tools acceptable to the State. The Engineer shall develop and submit to the State a safety analysis report summarizing all analysis performed.

L. Bicycle and Pedestrian Accommodations

The Engineer shall comply with the *United States Department of Transportation Policy Statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations and Chapter 6, Section 4 and Chapter 7, Section 3 of the Roadway Design Manual*. The inclusion of bicycle and pedestrian facilities must be evaluated when the project is scoped. Public input when applicable, as well as local city and metropolitan planning organization for bicycle and pedestrian plans must be considered in this evaluation.

M. Project Implementation Plan

The Engineer shall develop an implementation plan for prioritizing improvements along the corridor and identify a sequence of improvements to manage future traffic operations and available funding. The implementation plan must consider traffic operation, the ultimate preferred alternative, and potential funding levels and sources to identify a timeline for short and mid-term improvements that accommodate corridor growth while minimizing future throwaway construction. The Engineer shall provide the recommendations for the implementation plan in a project implementation report deliverable and incorporate the recommendations into the engineering summary report. The Engineer shall also provide a Fact Sheet that identifies funding, phasing, and timing of the projects along the corridor. The Fact Sheet shall be updated throughout the contract.

110.4. Conceptual Design Schematics.

The Engineer shall develop conceptual design schematics in MicroStation format to evaluate various methods of handling traffic while providing access in key areas. The Engineer shall develop a single recommended design alternative that optimizes traffic flow and access. The conceptual schematics are to be plan view only. Profile work must be done only to the extent necessary to lay out the proper horizontal geometry.

The schematics must contain the following design elements:

A. Mainlane roadway alignment

B. Pavement edges, face of curbs, and shoulder lines of mainlanes, intersections, interchanges, and connecting highways or streets

C. Typical sections of existing and proposed roadways

D. Anticipated structure locations (including wildlife crossings and fencing structures)

E. Anticipated retaining wall and sound wall locations

F. Anticipated conveyance of major drainage elements

G. Preliminary ROW and easement requirements and control-of-access locations

H. Direction of traffic flow and the number of lanes on all roadways

I. Existing and projected traffic volumes

J. Existing utilities

K. Waters of the United States (WOTUS)

110.5. Geometric Design Schematics.

The Engineer shall develop geometric design schematics based on the conceptual schematics after the basic layout, lane arrangement, and anticipated ROW and easement impacts depicted on the conceptual schematics are approved. The Engineer shall use Bentley OpenRoads tools in performing this task. The geometric design schematics must include both a plan view and profile view. The schematic must conform to the latest version of the *Austin District Schematic Layout Submission Guidelines* and other requirements defined in Chapter 1, Section 3 of the *Roadway Design Manual*.

A. The geometric schematic plan view must contain the following design elements:

1. Bentley OpenRoads calculated roadway alignments for mainlanes, general purpose lanes, ramps, direct connectors, bridges, HOV lanes, managed lanes, express lanes, collector distributor roads, frontage roads and cross streets at major intersections and grade separations
2. Horizontal curve data shown in tabular format
3. Pavement edges, curb lines, and sidewalks for all roadway improvements
4. Typical sections of existing and proposed roadways
5. Proposed bridge structures, including bridge deck, abutment, bent, and rail locations
6. Proposed retaining walls and sound walls
7. Proposed cross-drainage structures with outfall flow arrows and significant drainage features or waterways identified
8. Existing utilities and proposed utilities
9. Existing property lines and respective property ownership information
10. Existing ROW and easements
11. Proposed ROW and easements adequate for preparation of ROW maps

12. Waters of the US (WOTUS)
13. Control-of-access limits
14. Existing and projected traffic volumes
15. Location and text of the existing and proposed guide signs and the preliminary locations for changeable message signs
16. Lane lines, shoulder lines, and direction of traffic flow arrows indicating the number of lanes on all roadways

B. The geometric schematic profile view must contain the following design elements:

1. Calculated profile grade and vertical curve data including “K” values for all curves and sight distance values for crest vertical curves on the mainlanes
2. Existing ground line profiles along the mainlanes
3. Grade separations and overpasses including preliminary abutment and bent locations, girder type, and span lengths
4. Calculated vertical clearances at grade separations and overpasses
5. Anticipated cross-drainage structures with approximate inlet and outfall elevations
6. Proposed ditch grading (special grading), if it does not follow the typical section.
7. Approximate locations of existing and proposed major utility crossings
8. The calculated profile grade for frontage roads, connectors, ramps, and cross streets will be shown on separate Supplemental Profile rolls
9. Depict the 2. 5, 10, 25, 50, and 100-year water surface elevations.

110.6. Cross-Sections.

The Engineer shall use a Bentley 3D OpenRoads model to generate preliminary cross-sections at 50 feet intervals (unless otherwise directed by the State) and at culvert locations in conjunction with the geometric schematic. The cross sections shall depict the 2, 5, 10, 25, 50, and 100-year water surface elevations. The Engineer shall determine earthwork volumes for use in the cost estimate. The Engineer shall prepare 11 inch x17 inch or roll plots of the cross-sections.

110.7. Retaining Walls.

The Engineer shall prepare preliminary retaining wall concepts to be shown on schematics, typical sections, and cross sections.

A. The Engineer shall determine if any additional walls are required and verify the need for and length of the retaining wall as shown on the ultimate schematic.

B. The Engineer shall compute and tabulate retaining wall quantities for preliminary design milestone plans submittal.

110.8. Renderings and Traffic Simulation.

The Engineer shall develop renderings, three-dimensional (3D) models, illustrations, and animations as a means of expression and understanding for what

the owner of a project envisions and what the public perceives. In support of the public outreach effort, the State will choose reasonable build alternatives, which the Engineer shall carry forward into creating one rendering and one traffic animation for each of the various alternatives. The Engineer shall create a 3D model for the reasonable build alternatives from: horizontal and vertical alignments, existing and proposed DTMs, proposed typical sections, traffic counts, and ground photography. When requested by the State, the Engineer shall use aerial video footage captured by unmanned aircraft systems (UAS).

The use of UAS is regulated by the Federal Aviation Administration (FAA). The Remote Pilot in Command (RPIC) must possess a current FAA Remote Pilot Certificate (14 CFR Part 107) and be sufficiently trained, capable, and competent to operate the type of system in the environment in which it is to be operated. The RPIC must be responsible for the safe conduct of the UAS flight. Visual Observers as required must be familiar with UAS operations and in positive two-way communication with the RPIC. Additionally, operators must comply with the general safety protocols established in the TxDOT *Flight Operations Manual*.

The animations and renderings must give the public and stakeholders a clear awareness and appreciation for the reduction of traffic congestion and how traffic is to flow into and out of the project area.

110.9. Preliminary Construction Sequence.
The Engineer shall prepare preliminary construction sequence layouts in conjunction with the geometric design schematic depicting the phasing and traffic detours anticipated to safely convey traffic. The layouts must demonstrate that adequate horizontal and vertical alignments are maintained, sufficient lane widths and shoulder widths or barrier offsets are feasible, and construction zones are adequate for constructability of all proposed features. Proposed construction detours must ensure that adequate superelevation is provided. The layouts must indicate how existing pedestrian and bicycle facilities are accommodated for each phase.

110.10. Preliminary Cost Estimate.
The Engineer shall prepare a preliminary cost estimate for the project, including the costs of construction, required ROW and associated improvements, and eligible utility adjustments using the Average Low Bid Price. Current State unit bid prices must be used in preparation of the estimate. The Engineer shall estimate the total project cost including preliminary engineering, final engineering, right of way (ROW) acquisition, environmental compliance and mitigation, construction, utility relocation, and construction engineering inspection (CEI).

110.11. Engineering Summary Report.
The Engineer shall prepare an engineering summary report to summarize the design criteria, traffic analysis, preliminary cost estimate and basis of estimate, construction sequence description, and utility conflict issues.

110.12. Support or Attendance at Value Engineering Study.
The Engineer shall provide documents and drawings to the State to support the value engineering study. The Engineer shall provide the number and type of personnel requested by the State to attend the value engineering study.

110.13. Agency Coordination and Public Involvement.

A. The Engineer shall assist the State in conducting meetings with property owners, stakeholders, and various agencies to discuss and review the schematic design. The Engineer shall document and respond to issues related to the schematic design.

B. The Engineer shall prepare a Notice and Opportunity to Comment as needed and assist in conducting public meetings and public hearing during the project development process. The Engineer shall prepare schematic exhibits, constraints maps, and other necessary exhibits, and assist the State with all presentations.

C. The Engineer shall coordinate, schedule, reserve, and pay for all meeting locations and facilities.

D. For all public involvement activities, the Engineer shall prepare the adjacent property owner list; mail out and pay for notices; draft letters to public officials; prepare, publish and pay for notices to major and local newspaper; hire court reporter and law enforcement for public meetings and hearing; and provide audio and visual rental equipment and changeable message boards.

E. The Engineer shall attend pre-meetings at the local TxDOT district in preparation for every meeting and hearing, as directed by the State.

F. The Engineer shall compile public comments received and responses to comments and prepare the required documentation for all public involvement activities. The Engineer shall comply with the environmental compliance toolkits related to public involvement.

110.14. Schematic Design Project Deliverables.

In conjunction with the performance of the services included under Function Code 110 of this attachment, the Engineer shall provide the following draft and final documents and associated electronic files as applicable

A. Draft and final copies of the engineering summary report

B. Draft copies of the preliminary drainage study

C. Draft and final copies of the geometric schematic layouts on 11 inch x 17 inch cut sheets or rolls, as requested by the State

D. Draft and final copies of the conceptual design schematics roll plots

E. Draft and final copies of the geometric schematic layouts (1 inch = 100 feet)

F. Draft and final copies of the design schematic profiles rolls

G. Draft and final copies of the design schematic cross-sections on 11 inch x 17inch cut sheets or roll plot format, as requested by the State

H. Copy of the preliminary cross-sections in a roll plot format or 11 inch x17 inch format, as requested by the State

I. Electronic 3D model copy of the preliminary cross-sections created using OpenRoads tools

J. Six final copies of the preliminary drainage study

K. Electronic submittal of the hydrologic and hydraulic model digital files from the drainage study

L. Copies of the preliminary construction sequence layouts in a roll plot or 11 inch x 17 inch format, as requested by the State

M. Copies of the preliminary construction sequence typical sections in 11 inch x17 inch format

N. Electronic copy of the 3D rendering and traffic simulation for the reasonable build alternatives

O. Electronic files shall be furnished to the State on a USB flash drive

P. Traffic data schematics

Q. Traffic projections methodology memo

R. Average daily corridor traffic projections report

S. Risk management plan

T. Participation in CER

U. Draft project management plan

V. Draft financial plan

W. Final project management plan

X. Final financial plan

Y. Line schematics with traffic data shown

Z. Documentation of public involvement activities

AA. Utility plan – electronic file in latest version of MicroStation fully compatible with OpenRoads civil design system

BB. Design exception and design waiver documents

CC. Electronic submittal of the OpenRoads Drainage and Utlities (DU), HEC-RAS, SWIMM, and HMS models and a draft hydraulic report for review and comment

DD. Culvert hydraulic data sheets and preliminary culvert layouts

EE. Drainage report – one hard copy of final drainage report, one electronic copy of the entire drainage report in PDF format, and computer files of hydrologic and hydraulic modeling with appropriate labeling of location, CSJ, and submittal date

FF. Retaining wall layouts

GG. Geotechnical report

HH. Cost estimates for each milestone submittal

II. KMZ or KML file of conceptual design schematic created from applicable DGN files for reviewing in Google Earth

JJ. Final schematic 3D model created using OpenRoads software

KK. Draft and final copies of traffic analysis report

110.14. Travel Time Studies, Traffic Signal Timing Studies, and Traffic Operations Evaluations

A. Data Collection

Engineer shall collect, review, and evaluate the following data:

1. 24-Hour Volume Data. Engineer shall collect, review, and evaluate 24-hour volume data at two locations in each direction, on each arterial in the specific project.

The data collected must include:

a. a typical weekday;

b. a typical Saturday; and

c. a typical Sunday.

2. Collect Turning Movement Volume Data

a. Engineer shall collect, review, and evaluate turning movement volume data at selected intersections during the following four peak periods:

(1) Typical weekday morning peak period;

(2) Typical weekday midday peak period;

(3) Typical weekday afternoon peak period; and

(4) Typical Saturday peak period.

b. Engineer shall determine the peak periods, above, using the 24-hour volume data Engineer collected.

c. Peak periods during which turning movement counts are collected must be a minimum of two hours in length unless otherwise instructed by State's Project Manager.

3. Peak Hour Factor.

Engineer shall determine the peak hour factors for all turning movement data collected.

4. Data Presentation.

Engineer shall submit all turning movement data in both

a. Tabular format and

b. Map format.

B. Travel Time Runs (Studies)

0. Engineer shall conduct travel time studies.

1. Each travel time study must consist of six travel time runs in each direction on each arterial for the morning, midday, afternoon, and Saturday peak periods using PC-Travel software.

a. Three runs are made before implementing new timing.

b. Three runs are made after implementing and fine tuning the new timing.

2. Engineer shall analyze all travel time data collected and provide State before and after comparisons in both tabular and graphical formats.

C. Timing Plan Generation

0. Engineer shall perform timing plan generation.

1. Engineer shall perform capacity analysis at each intersection to evaluate the existing timings and to determine the saturation flow rates and the existing Level of Service (LOS).

2. Engineer shall perform Synchro or PASSER optimization analysis using the existing volumes to determine the best cycle length for each peak period.

3. Determining the best cycle length might require coordination with crossing arterials that are in existing systems.

4. Engineer shall summarize these results in both tabular and graphical formats.

5. For each arterial in each specific project, Engineer shall generate time-space diagrams for the following peak periods:

a. Typical weekday morning peak period;

b. Typical weekday midday peak period;

c. Typical weekday afternoon peak period; and

d. Typical Saturday peak period.

6. Engineer shall submit the generated timing plans and time-space diagrams to State for review.

7. Engineer shall incorporate the appropriate revisions into the timing plans and time-space diagrams and submit the revised timing plans and time-space diagrams to the State along with the Preliminary Report.

8. Engineer shall submit controller timing sheets that are appropriate for each controller manufacturer.

D. Preliminary Report

0. For each signal system retimed by Engineer, Engineer shall submit the following to State for State's review:

a. Preliminary Report summarizing data collection and timing plan generation results;

b. Signal timing plans (i.e. splits and offsets) in a tabular form; and

c. Time-space diagrams for each peak period studied.

1. Engineer may submit the above either physically as a hardcopy or by e-mail in Adobe Portable Document Format (PDF) format.

2. Engineer shall meet State for technical review meeting where Engineer shall discuss the time frame for implementing the timing plans by State or Engineer. Engineer shall incorporate the review comments from this meeting into the Final Report.

E. In Field Final Tuning of Timing Plan

0. For each signal system to be timed, Engineer shall make recommendations and respond to questions in the field during the fine-tuning process. Engineer shall document the field visit and provide documentation to the State.

1. When the new timing plans are operational, Engineer shall provide one or more qualified engineers for on-site fine tuning. The engineer or engineers must observe the actual operation of the new timing plans and recommend field adjustments to improve traffic operations.

2. At State's request, Engineer shall perform field adjustments.

3. Engineer shall notify State at the beginning and ending of the implementation.

4. During implementation, Engineer shall document interim adjustments to an intersection's signal timing on the timing sheet located in that intersection's traffic signal controller cabinet.

5. Once final timing is established, Engineer shall upload each intersection's traffic controller programming into an appropriate database program specified in the work authorization (e. g. Econolite Centracs, Eagle Actra, or Siemen Tactics) and generate the following for each intersection:

a. Controller data file – Engineer shall email controller data file (e.g., *. db or *. int) file to State;

b. PDF file of the signal timing – Engineer shall email PDF file to State; and

c. Hardcopy of the signal timing for each intersection – Engineer shall place the hardcopy of the signal timing for an intersection in that intersection's traffic signal controller cabinet.

F. Construction Project Temporary Signal Timing

Engineer shall perform Construction Project Temporary Signal Timing services.

1. Engineer shall make field adjustments to the signal phasing and timing of signals in a construction project.

2. Engineer shall provide documentation of timing changes as well as document of field visit for each adjustment.

a. Engineer shall document interim adjustments to an intersection's signal timing on the timing sheet located in that intersection's traffic signal controller cabinet.

b. Engineer shall provide other reports if specifically requested in the work authorization.

G. Documenting Visits to Field

1. For each instance Engineer opens a traffic signal controller cabinet or alters the operation of a traffic signal controller, Engineer shall complete and transmit to State a Traffic Signal Maintenance Report within the two business days following that instance.

2. Each Traffic Signal Maintenance Report must include, at a minimum, the name of the person or persons making the visit, the reason for the visit, what was done, the date of the visit, the arrival time, and the departure time.

H. Final Report

1. Engineer shall prepare and submit to State a Final Report that includes the following:

a. Methodology used, alternatives considered, recommendations, and what was done;

b. Two or more high quality photographs of each intersection from each approach;

c. One or more photographs of the interior of each traffic signal controller cabinet;

d. Drawing of each intersection showing phasing, signal indications, pavement markings, signing (including advance signing), and any other relevant information;

e. Turning movement counts and 24-hour counts in tabular format;

f. Turning movement counts in map format;

g. Gantt chart indicating plans that will run throughout the week;

h. Yellow-Change/Red-Clearance Interval Worksheet for each intersection;

i. Signal sequence chart for each plan at each intersection (based on constant vehicle demand); and

j. Railroad preemption form, if required in work authorization.

2. For each signal system timed by Engineer, Engineer shall submit a draft Final Report for review by State. Engineer shall meet with the State to review the draft Final Report.

3. After the meeting with State to review the draft Final Report, Engineer shall incorporate review comments into the Final Report.

I. Traffic Operations Evaluations

1. Engineer shall provide traffic operations evaluation on existing traffic signal operations at assigned intersections.

2. Within one business day of the execution of the work authorization, Engineer shall visit the assigned intersections and provide an initial assessment of the existing traffic signal operations.

3. Traffic operations evaluation requests may include:

a. Field observations, including existing signal operations;

b. Collection of traffic counts;

c. Preparation and implementation of signal timing plans;

d. Preparation of phasing plans;

e. Identifying and correcting hardware problems;

f. Identifying and correcting other operations issues;

g. Developing system maps and intersection graphics for the traffic control system specified in the work authorization (e.g.Tactics or Centracs traffic control systems); and

h. Evaluation of signal operations during railroad preemption.

J. Asset Management Collection and Support:

1. Engineer shall provide asset management collection and support on existing traffic signal operations at assigned intersections.

2. Asset Management Collection and Support may include:

a. Inventorying equipment;

b. Identifying detector types;

c. Identifying Controller Type and Firmware;

d. Identifying Cabinet Type;

e. Determining the type and number of closed loop systems;

f. Determining how the closed loop system is interconnected (e.g., hardwire, spread spectrum radio, broadband radio, fiber);

g. Determining if visual image vehicle detection systems are used and, if so, the number and type of video processors; and

h. Identifying the type (e.g., audible, non-audible) of pedestrian signals used.

K. Traffic System Integration to District Central Network

1. Engineer shall provide traffic system integration support on existing traffic signal operations at assigned intersections.

2. Traffic System Integration to district central network may include:

a. Evaluating existing communication equipment for system upgrade;

b. Preparing traffic signal system integrations schematics for State;

c. Programing communication hardware;

d. Testing equipment before field implementation; and

e. Implementing the traffic signal system hardware with State support.

L. Adaptive and Responsive System

1. Engineer shall design, program, and implement one or more of the following:

a. Adaptive Signal System

b. Responsive Signal System

2. Adaptive or Responsive System Training

a. Engineer shall provide one-on-one training or classroom training.

b. Engineer shall submit a syllabus to the State for approval, prior to scheduling the training.

c. Engineer shall provide manuals or tip sheet to the attendees for each training session.

d. Training for each system must include:

(1) Operations of the System;

(2) System Configuration;

(3) Troubleshooting; and

(4) System Calibration.

M. Automated Traffic Signal Performance Measures

1. Engineer shall provide traffic system integration support on existing traffic signal operations at assigned intersections.

2. Field work and signal performance measures may include:

a. Upgrading the controller to the version approved by the State;

b. Upgrading the malfunction management unit (MMU) firmware to the version approved by the State;

c. Setting up and assigning the detection correctly; and

d. Calibrating and fine-tuning the signal performance measures on TxDOT's central system.

N. Signal Phasing and Timing

1. Engineer shall provide traffic system integration support on existing traffic signal operations at assigned intersections.

2. Signal phasing and timing request may include:

a. Measuring and mapping roadside units and on-board units;

b. Developing and using SPaT and MAP data;

c. Verifying the messages that are being broadcast at the intersection;

d. Configuring the controller to run signal phasing and timing messages;

e. Evaluating existing equipment and troubleshooting equipment as needed; and

f. Integrating and testing equipment with State support.

3. Signal Phasing and Timing Training

a. Engineer shall provide one-on-one training or classroom training.

b. Engineer shall submit a syllabus to the State for approval, prior to scheduling the training.

c. Engineer shall provide manuals or tip sheet to the attendees for each training session.

d. Training may include:

(1) Operations of the system;

(2) System configuration;

(3) Troubleshooting; and

(4) Installation of roadside units and on-board units.

O. Deliverables

1. After the meeting with State to review the draft Final Report, Engineer shall submit:

a. Final Report incorporating the appropriate review comments from the State;

b. Hard copy of 24-hour counts (single-sided, three-hole punched legal-sized paper);

c. Turning-movement counts (single-sided, three-hole punched legal-sized paper);

d. Completed TxDOT railroad preemption forms (if applicable); and

e. An USB flash drive containing final report, all technical data, and all related Synchro, PASSER, and traffic control system (e.g. Centracs) files;

f. SPaT and MAP native data files;

g. Documents related to the integration and testing of devices related to SPaT; and

h. Training materials and installation manuals.

2. Engineer shall provide field notes if specified in the work authorization.

110.15. Design Concept Conference.

In accordance with the TxDOT *Project Development Process Manual*, the Engineer, in cooperation with the State, shall plan, attend, and document the Design Concept Conference (DCC) to be held prior to the 30 percent milestone submittal. In preparation for the DCC, the Engineer shall complete a DSR to serve as a checklist for the minimum required design considerations. The conference will provide for a brainstorming session in which decision makers, stakeholders, and technical personnel may discuss and agree on:

1. Roadway and drainage design parameters

A. Engineering and environmental constraints

B. Project development schedule

C. Other issues as identified by the State

D. Any identified Design Exceptions and Waivers

E. Preliminary Construction Cost Estimate

110.16. Geotechnical Borings and Investigations.

1. The Engineer shall determine the location of proposed soil borings for bridge design, embankment settlement analysis, retaining walls, slope stability and

along storm drain alignment in accordance with the latest edition of the TxDOT *Geotechnical Manual*. The State will review and provide comments for a boring layout submitted by the Engineer showing the general location and depths of the proposed borings. Once the Engineer receives the State's review comments, the Engineer shall perform soil borings (field work), soil testing, and prepare the boring logs in accordance with the latest edition of the TxDOT *Geotechnical Manual* and local TxDOT district's procedures and design guidelines. For estimation purposes assume a depth of 60 feet. A total of two borings per bridge location is assumed for estimation purposes.

A. The Engineer shall perform all geotechnical work in accordance with the latest version of the TxDOT *Geotechnical Manual*. The Engineer shall perform all testing in accordance with TxDOT's Test Procedures, which are available at https://www.txdot.gov/business/resources/testing.html. American Society for Testing Materials (ASTM) test procedures can be used only in the absence of the State's procedures. All soil classification shall be done in accordance with the Unified Soil Classification System.

B. If applicable, the Engineer shall perform any retaining wall analyses to include the settlement analysis. This analysis must include the computation of the factor of safety for bearing capacity, global stability, overturning, and sliding. In addition, the Engineer shall include allowable bearing pressure, passive earth pressure, friction factor, settlement analysis (consolidation report), and lateral earth pressure for the retaining walls.

C. If applicable, the Engineer shall perform soil borings, rock coring, coring for pavement removal items, piezometric readings, testing and analysis to include slope stability analysis, settlement analysis, and foundation design recommendations for retaining walls, overhead sign structures, along proposed storm sewer alignments, bridges, embankments, and any temporary soil retaining systems.

D. The Engineer shall provide a signed, sealed, and dated geotechnical report that contains, but is not limited to, soil boring locations, boring logs, laboratory test results, generalized subsurface conditions, ground water conditions, piezometer data, analyses and recommendations for settlement and slope stability of the earthen embankments, skin friction tables, and design capacity curves including skin friction and point bearing. The skin friction tables and design capacity curves must be present for piling and drilled shaft foundation.

E. If applicable, the Engineer shall perform scour analysis to include grain size distribution curves with D50 value for each soil layer and a D50 grain size for a sample in the stream bed at the upstream face of the bridge in the upper 1-foot of the stream bed.

   In addition, the Engineer shall provide a subsurface profile including the following information for each layer:

   0. Particle Size Analysis (Tex-110-E) including:

   a. Median Grain Size (D50) and percent clay (percent passing No. 200 sieve)

   b. Soil type based on grain dimensions of cohesionless materials

   1. Liquid Limit (Tex-104-E) as required for clayey soils

2. Plastic Limit (Tex-105-E) as required for clayey soils
3. Plasticity Index (Tex-106-E) as required for clayey soils
4. USCS Soil Classification (Tex-142-E) as required for clayey soils

F. The Engineer shall sign, seal and date soil boring sheets to be used in the PS&E package. The preparation of soil boring sheets must be in accordance with a State's District standards.

G. Foundation Studies: The Engineer shall coordinate with the State to determine the location of soil borings to be drilled along the retaining wall alignments. The soil borings must extend a minimum of 35 feet below the footing elevation or deeper as soil conditions warrant. Spacing of soil borings must not exceed 500 feet. The Engineer shall provide a boring layout for the State's review and comment.

H. The Engineer shall incorporate soil boring data sheets prepared, signed, sealed, and dated by the geotechnical engineer. The soil boring sheets must be in accordance with the State's WINCORE software as can be found on the Texas Department of Transportation (TxDOT) website.

I. Pavement Design: If applicable, the Engineer shall incorporate the pavement design developed by the State. If the pavement design is not available, the State may request the Engineer perform pavement design and submit to State for review and approval.

J. Deliverables

0. Preliminary Pavement Design Report
1. Geotechnical Report
2. DGN flies containing drilling log data from Geotechnical analysis

110.17. Geotechnical Engineering

1. General

The Engineer shall perform the following:

3. The Engineer shall conduct tests, other than field tests, at the Engineer's own facilities of State certified commercial laboratories for selected tests.
4. The Engineer shall furnish equipment necessary to drill borings and recover continuous cores for soil classification and testing at the locations and depths specified in the Work Authorization. The Engineer shall perform Texas Cone Penetrometer (TCP) testing in accordance with Test Method Tex-132-E. The Engineer shall:

a. Provide calibrated drilling equipment with an automatic hammer.

b. Provide to the State cone measurement and certified hammer weight records signed and sealed by a professional engineer at the beginning of the contract and every 12-months thereafter.

c. Perform all foundation exploration, drilling, testing, and logging in accordance with the latest version of the TxDOT *Geotechnical Manual* and TxDOT's Test Procedures, which are available at https://www.txdot.gov/business/resources/testing.html, and perform lane

closures in accordance with the latest version of the *Texas Manual on Uniform Traffic Control Devices (TMUTCD)*. American Society for Testing Materials (ASTM) test procedures can be used only in the absence of the State's procedures. All soil classification shall be done in accordance with the Unified Soil Classification System [ASTM D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)] and State procedures (TxDOT test procedures, Tex-141-E, Manual Procedures for Description and Identification of Soils and Tex-142-E, Laboratory Classification of Soil for Engineering Purposes).

d. Perform soil borings, rock coring, piezometric readings, testing and analysis to include slope stability analysis, settlement analysis, and foundation design recommendations for retaining walls, overhead sign structures, along proposed storm sewer alignment, bridges, slopes and embankments, and any temporary soil retaining systems.

e. Perform retaining wall analyses. This analysis shall include the computation of the factor of safety for bearing capacity, global stability, overturning and sliding. In addition, the Engineer shall include allowable bearing pressure, passive earth pressure, friction factor, consolidation report, and lateral earth pressure for the retaining walls.

f. If applicable, perform scour analysis to include grain size distribution curves with D50 value for each soil layer and a D50 grain size for a sample in the stream bed at the upstream face of the bridge in the upper 1-foot of the stream bed.

    In addition, the Engineer shall provide a subsurface profile including the following information for each layer:

    (1) Particle Size Analysis (Tex-110-E) including:

        i. Median Grain Size (D50) and percent clay (percent passing No. 200 sieve)

        ii. Soil type based on grain dimensions of cohesionless materials

    (2) Liquid Limit (Tex-104-E) as required for clayey soils

    (3) Plastic Limit (Tex-105-E) as required for clayey soils

    (4) Plasticity Index (Tex-106-E) as required for clayey soils

    (5) USCS Soil Classification (Tex-142-E) as required for clayey soils

g. Furnish equipment necessary to drill and install piezometers to establish groundwater surface elevations.

h. Submit geotechnical reports to the State in accordance with the schedule agreed upon by the Engineer and State.

    Reports must include, but not be limited to:

    (1) Complete foundation exploration drilling logs using the latest version of Wincore. Each log must include the following:

i. Elevation, coordinate information acquired with a GPS unit, a sketch noting the relative location of each boring to the structure or other pertinent features on the site, and, when available, bore hole station, offset, and elevation;

ii. Soil and rock descriptions of all layers;

iii. Groundwater conditions and depth to groundwater;

iv. Texas Cone Penetration (TCP) test data;

v. Rock Quality Designation (RQD) and Percent Recovery for all rock layers;

vi. Analyses and recommendations for settlement and slope stability;

vii. Grain size distribution curves with D50 value and subsurface profile information for each soil layer, when scour analysis is performed;

viii. Skin friction tables and design capacity curves; and

ix. Lab Test results

(2) A Conclusions and Recommendations section that summarizes the Engineer's evaluation of the data and recommendations to the State.

(3) A report transmittal letter summarizing the work performed under the given work authorization, along with a summary of the conclusions and recommendations.

i. All drilling logs and test data must be reviewed and evaluated by a registered professional engineer. Reports must be signed, sealed, and dated by a registered professional engineer.

j. Provide a qualified logger for sampling, identifying the drilled materials and logging the soil profile. The minimum requirements for the logger are:

(1) Must be a geologist or Engineer in Training (E.I.T.) with at least two years of related experience in local soils and bedrock identification, testing, and data collection techniques or

(2) Must be an engineering technician with at least five years of verifiable experience in local soils and bedrock description, testing, and data collection techniques.

k. Perform testing in accordance with TxDOT's Test Procedures, which are available at https://www.txdot.gov/business/resources/testing.html, ASTM Standards, AASHTO Standard Specifications, and all other specifications and provisions applicable to services under this contract.

l. Coordinate all drilling and testing with the State prior to initial sampling and drilling operation to avoid re-drilling. Any additional drilling activities resulting from poor coordination, driller error, or equipment issues will be the responsibility of the Engineer.

m. Submit draft logs to the State as necessary to assist in selection and assignment of tests. The Engineer shall give at least 72 hours of notice to the State prior to commencing work.

n. Clear each drilling location for all utilities prior to beginning drilling operations and shall avoid damaging properties and utilities. The Engineer shall be held liable for all damages.

o. When directed by the State, perform offshore (barge) geotechnical drilling (water boring). Draft logs for all barge drilling must be submitted to the State within 48 hours. The Engineer shall notify the State of conditions that warrant standby charges on the same day.

p. With the State's assistance, secure access (right-of-entry) to any private property and railroad right-of-way for boring locations and operations that fall outside of the existing right of way. The Engineer shall be responsible for coordination with property owners and the State, and preparation and submission of necessary permits and insurance documents.

q. The Engineer's drill crew shall clean up litter and surplus drilling materials and fill and plug completed holes (on and off pavement) before leaving each location. The Engineer shall also remove all piezometers and plug and fill the hole.

r. When directed by the State, provide equipment to clear heavy brush to provide access to designated drilling sites.

K. Quality assurance

0. As a minimum, the Engineer shall adhere to the following quality assurance program:

a. Use a minimum of a three-man crew, consisting of a driller, a driller's helper, and a logger.

b. Use the same crew(s) on each project to ensure consistency.

c. Each crew shall maintain a copy of the TxDOT *Geotechnical Manual* and Test Methods Tex-132-E and Tex-141-E for reference on the job site. Crews may utilize other references such as ASTM test procedures (only in the absence of the State's procedures) that are accepted methods of field classification of soil.

1. The drilling crew shall make the necessary field adjustments to minimize the disturbance to the cores and to insure maximum possible recovery percentage. Rock core samples with a recovery less than anticipated due to driller error or equipment malfunction shall be considered unacceptable.

2. Laboratory tests that are performed incorrectly are unacceptable and will not be paid for by the State. If required, the Engineer shall collect additional soil samples in a newly drilled hole adjacent to the original hole. The additional samples must be tested using the correct procedures. This work shall not be compensated by the State.

3. Engineering technicians used to provide laboratory testing services must be qualified (certified) in accordance with the TxDOT Quality Assurance

Programs or other Department approved programs. The Engineer shall provide the State with a list of certified personnel and copies of their current certificates before beginning work, when personnel changes are made, and when requested by the State.

4. Approval of engineering technicians by the State does not relieve the Engineer from the responsibility of ensuring that engineering technicians are fully qualified to correctly perform the laboratory testing services being provided.

5. All laboratory equipment shall have a current calibration in accordance with the National Institute of Standards and Technology (NIST), AASHTO, and ASTM requirements and the Engineer shall ensure the equipment meets these requirements. The Engineer shall provide an inventory of pertinent laboratory equipment and current calibration certifications to the State upon request.

6. The Engineer shall be responsible for maintaining all equipment to ensure safe and efficient operation.

7. The Engineer shall complete, review, sign, and seal the geotechnical report and any subsequent retaining wall sheets to be included in the plan set.

110.15. Deliverables for FC 110.

A. Catalog of documents collected

B. Documents collected

C. Preliminary DSR

D. Final DSR

E. Preliminary cost estimate

F. Documentation of DCC

FUNCTION CODE 120 (120) – SOCIAL/ECON/ENV STUDIES

SOCIAL, ECONOMIC, AND ENVIRONMENTAL STUDIES AND PUBLIC INVOLVEMENT

120.1. Environmental Documentation Standards.

Each environmental service provided by the Engineer must have a deliverable. Deliverables must summarize the methods used for the environmental services and the results achieved. The summary of results must be sufficiently detailed to provide satisfactory basis for thorough review by the State, FHWA, and (where applicable) other agencies with regulatory oversight. All deliverables must meet regulatory requirements for legal sufficiency and adhere to the requirements for reports enumerated in the State's National Environmental Policy Act of 1969 (NEPA) Memorandum of Understanding (MOU).

A. Quality Assurance/Quality Control Review

For each deliverable, the Engineer shall perform quality assurance quality control (QA/QC) reviews of environmental documents and on all supporting environmental documentation to determine whether documents conform with:

1. Current Environmental Compliance Toolkit guidance, documentation requirements, and templates published by TxDOT's Environmental Affairs Division (ENV) and in effect as of the date of receipt of the documents or documentation to be reviewed;
2. Current state and federal laws, regulations, policies, guidance, agreements, and memoranda of understanding between the State and other state or federal agencies; and
3. Guidelines contained in Improving the Quality of Environmental Documents, A Report of the Joint AASHTO/ACEC Committee in Cooperation with the Federal Highway Administration (May 2006) for:
    a. Readability, and
    b. Use of evidence and data in documents to support conclusions.

Upon request by the State, the Engineer shall provide documentation that the QA/QC reviews were performed by qualified staff.

B. The Engineer shall maintain the project environmental record in TxDOT's Environmental Compliance Oversight System (ECOS), including project review, completing the work development plan screens, uploading documents, and completing activities as assigned by the District.

C. Deliverables must contain all data acquired during the environmental service and be written to be understood by the public in accordance with the TxDOT's Environmental Toolkit guidance, documentation standards, and current guidelines, policies, and procedures.

D. Electronic versions of each deliverable must be written in software that is fully compatible with the software currently used by the State and provided in the native format of the document for future use by the State. The Engineer shall supplement all hard copy deliverables with electronic copies in searchable Adobe Acrobat (.pdf) format unless another format is specified. Each deliverable must be a single, searchable .pdf file that mirrors the layout and appearance of the physical deliverable. The Engineer shall deliver the electronic files on USB flash drive in both the document's native format and the PDF format.

E. When the environmental service is to apply for a permit (e.g., United States Coast Guard (USCG) permit or USACE permit), the Engineer shall provide the permit and all supporting documentation to the State as the deliverable.

F. Submission of Deliverables

1. Deliverables must consist of documentation to support the preparation of an Environmental Assessment (EA) or an Environmental Impact Statement (EIS), as applicable. Technical reports and documentation must be prepared to support the applicable environmental classification (e.g. EA, or EIS). All deliverables must comply with all applicable state and federal environmental laws, regulations, procedures, and TxDOT's Environmental Compliance Toolkits, documentation requirements, and templates.

2. On the cover page of any environmental documentation, the Engineer shall insert the following language in a way that is conspicuous to the reader:

   "The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried-out by TxDOT pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated December 9, 2019, and executed by FHWA and TxDOT."

G. The State will provide the State's and other agency comments on draft deliverables to the Engineer. The Engineer shall revise the deliverable:

1. To include any State commitments, findings, agreements, or determinations (e.g., wetlands, endangered species consultation, Section 106, or Section 4(f)), required for the transportation activity as specified by the State;
2. To incorporate the results of public involvement and agency coordination;
3. To reflect mitigation measures resulting from comments received or changes in the transportation activity; and
4. To include with the revised document a comment response form (matrix) in the format provided by the State.

H. The Engineer shall provide photographs and graphics that clearly depict details relevant to an evaluation of the project area. Comparable quality electronic photograph presentations must be at least 1200 x 1600 pixel resolution. The State can request images/graphics be provided in another format or quality.

I. In addition to assisting with project scoping and workplan development, the Engineer shall prepare environmental constraints maps to assist with the feasibility study alternative selection process, project scoping, and environmental classification. The Engineer shall update the APD Stage Gate Checklist and EPIC sheet at each milestone submittal to document identified environmental issues. The Engineer shall prepare Right-of-Entry documentation to obtain access to adjacent properties for environmental studies. The Engineer shall prepare Purpose and Need Documentation.

Deliverables:

- Draft and Final ECOS Workplan Development
- Draft and Final Environmental Constraints Maps
- Draft and Final Stage Gate Checklist and EPIC Sheet at milestone submittals
- Draft and Final ROE Forms and Tracking Spreadsheet
- Draft and Final Purpose and Need Documentation

120.2. Environmental Assessment (EA) Content and Format.

A. The Engineer shall provide an EA and ensure that:

1. The EA meets the requirements of 23 CFR §771.119 and TAC, Title 43, Part 1, Chapter 2 and the EA content is sufficiently detailed to meet

regulatory requirements for legal sufficiency and current (at the time of creation) TxDOT ENV guidance and Environmental Compliance Toolkits.

2. Exhibits to be included in reports or EAs must not exceed 11 inches x 17 inches and must be in color. Text pages must be 8.5 inches x 11 inches. Exhibits and text in reports or EAs must be reproducible via photocopying without loss of legibility. The EA documents must be reproduced on plain white paper unless otherwise approved in advance in writing by the State.

3. The EA must use quality maps and exhibits and must incorporate by reference and summarized background data and technical analyses to support the concise discussions of the alternatives and their impacts.

B. Minimum Deliverables:

1. Draft EA
2. Revised Draft EA
3. Draft EA for Public Hearing
4. Final EA
5. Revised Final EA
6. Final EA with FONSI

120.3. Environmental Impact Statement (EIS) Content and Format.

A. The Engineer shall provide an EIS and ensure that:

1. The EIS meets the requirements of 23 CFR §771.115 and 42 TAC §2.84 and the EIS content is sufficiently detailed to meet regulatory requirements for legal sufficiency, and current TxDOT ENV guidance and Environmental Compliance Toolkits

2. Exhibits to be included in reports or EISs must not exceed 11 inches x 17 inches and must be in color. Text pages must be 8.5 inches x 11 inches. Exhibits and text in reports or EISs must be neat and reproducible via photocopying without loss of legibility. Except as noted in specifications in this attachment, EISs must be reproduced on plain white paper unless otherwise approved in advance by the State.

3. The EIS must use quality maps and exhibits and must incorporate by reference and summarize background data and technical analyses to support the concise discussions of the alternatives and their impacts.

4. The format must meet all requirements as specified by the State and comply with the TxDOT Writers Style Guide published by TxDOT's Communications Division.

B. Minimum Deliverables:

1. Draft EIS
2. Revised draft EIS
3. Draft EIS for public hearing
4. Final EIS

5. Revised Final EIS
6. Final EIS with ROD

120.4. Environmental Re-evaluation Form. (OMITTED)

120.5. Environmental Technical Analyses and Documentation.

A. Definition of technical analyses and documentation for environmental services.

In general, technical analyses and documentation for environmental services might include a report, checklist, form, or analysis detailing resource-specific studies identified during the process of gathering data to make an environmental decision.

The State may determine what technical reports and documentation are necessary for any given project. The Engineer shall prepare all technical reports and documentation for the State with sufficient detail and clarity to support environmental determinations. All technical reports must be compliant with TxDOT's Environmental Compliance Toolkits, documentation requirements, and templates. The environmental document must reference the technical reports.

Environmental technical reports and documentation must include appropriate NEPA or federal regulatory language in addition to the purpose and methodology used in delivering the service. Technical reports and forms must use templates and documentation standards as applicable and include sufficient information to determine the significance of impacts.

B. Minimum Deliverables:

1. Draft technical analyses and documentation
2. Final technical analyses documentation

C. The exact environmental technical analyses and documentation will be determined by the State, and can include:

1. Section 4(f) Evaluations

The Engineer shall provide Section 4(f) Evaluations. The Section 4(f) Evaluation must conform to the appropriate TxDOT Section 4(f) checklist for exceptions, de minimus, and programmatic evaluations. For individual Section 4(f) Evaluations, the format and outline must be approved by the State beforehand. All Section 4(f) Evaluations must meet the requirements set forth in TxDOT's Environmental Compliance Toolkits. The 4(f) Section of the environmental document states the reason a Section 4(f) evaluation is being completed. The 4(f) Section of the environmental document discusses the presence of all Section 4(f) properties located in the project area.

Deliverables:

- Draft and Final Section 4(f) de minimis checklist
- Draft and Final Section 4(f) programmatic documentation
- Draft and Final Section 4(f) individual analysis documentation
- Draft and Final TPWD Chapter 26 checklist

2. Section 6(f) Evaluation

   The Engineer shall determine if Land and Water Conservation Fund Act funds were used for the Section 4(f) property in accordance with the regulatory requirements and TPWD guidelines and document.

   Deliverables:

   - Draft and Final Section 6(f) documentation

3. Environmental Public Involvement (23 CFR §771.111)

   The Engineer shall provide public involvement activities, which might include:

   a. Developing a plan for public involvement activities, public involvement plan. The plan must specify all activities to be performed and alternatives to be discussed during public involvement activities. Public involvement activities must be carried out in compliance with Attachment A, Article 38, sections J and K of the contract. The plan must also discuss outreach strategies for both the general public and targeted strategies for environmental justice and limited English proficiency populations

   b. Compiling, maintaining, and updating a mailing list of people, agencies, and organizations interested in the transportation activity

   c. Making all arrangements for public meetings and hearings, including the site of the meetings, mailing and publishing notices, preparation of exhibits, provision for taping or transcription of proceedings, security, and any other arrangements as directed by the State. The Engineer shall not hold public meetings or hearings in the absence of State personnel

   d. Submitting all legal notices to the State for review no less than six weeks prior to publication

   e. Arranging a meeting with the State to review all exhibits and other materials to be used prior to public meetings or hearings

   f. Obtaining the State's approval for all legal notices, exhibits, and other materials

   g. Providing personnel to staff meetings and hearings; including, people to perform registration, make presentations, and answer questions.

   h. Developing and submitting to the State a documentation packet that meets the requirements set forth in TxDOT's Environmental Compliance Toolkits for each meeting or hearing

   i. Developing and sending acknowledgement or response letters to commenters at public meetings or hearings. The Engineer shall not distribute acknowledgement or response letters without prior approval by the State

j. Developing, publishing, and distributing a newsletter on the transportation activity, including compiling and maintaining a mailing list. The Engineer shall not distribute the newsletter without prior approval by the State

k. Submitting to the State a request for development and maintenance of a website to disseminate information on the transportation activity and to gather comments from the public.

l. Providing materials and information regarding the transportation activity to the State to be posted on the State-developed website.

m. Ensuring the website conforms to state law, Texas Department of Information Resources requirements, TxDOT policies and procedures, and TxDOT Brand Guidelines.

n. Arranging logistics, materials, and staffing for stakeholder meetings.

o. Arrange logistics, materials and staffing for property owner meetings.

4. Community Impacts Analysis

The Engineer shall provide community impact analyses. Community impacts includes environmental justice, limited English proficiency, and other issues as addressed in TxDOT environmental guidance. The Engineer shall perform community impact assessments including environmental justice analysis in accordance with Attachment A, Article 38, Sections J and K of the contract. Community impact analyses might include:

a. Community Impacts Assessment Technical Report Form; or

b. Community Technical Report. The report must follow guidance provided in TxDOT's Community Impacts Assessment Toolkit. The assessment may include:

(1) Identification of environmental justice communities within the study area;

(2) A community profile;

(3) A displacement analysis;

(4) An access and travel pattern analysis;

(5) A community cohesion analysis;

(6) Determination if the project would have disproportionately high and adverse impacts on environmental justice communities. All impacts identified in the Community Impact Assessment and other relevant studies (i.e. noise analysis) must be considered to determine if the impacts disproportionately affect environmental justice communities;

(7) Identification of possible mitigation measures to avoid or minimize any adverse impacts to the environmental justice population within the project area;

(8) Summary of public involvement process including methods used to accommodate persons with limited English proficiency; and

(9) Identification of possible mitigation measures including those to avoid and minimize any adverse impacts to the environmental justice population within the project area.

Deliverables:

- Draft and Final Community Impact Assessment

5. Induced Growth Impact Analysis and Cumulative Impacts Analysis

The Engineer shall perform analysis to fulfill the requirements of NEPA and the most current version of the TxDOT *Guidance on Preparing Impact Analyses and Cumulative Impacts Analysis Guidelines* in TxDOT's Environmental Compliance Toolkits. The extent of the analyses will be determined by the State.

Deliverables:

- Draft and Final Induced Growth Analysis
- Draft and Final Cumulative Impacts Analysis

6. Air Quality Studies

The Engineer shall prepare all required technical reports and the air quality section of all environmental documents in accordance with the current version of the TxDOT *Environmental Handbook for Air Quality* and Air Quality Toolkit. The State may determine what technical reports and documentation are required for any given project. The required technical reports and documentation might include:

a. Transportation Conformity Report Form and applicable coordination

b. Hot-Spot Analysis Technical Report and applicable coordination,

c. Carbon Monoxide Traffic Air Quality Analysis technical report,

d. Qualitative mobile source air toxics (MSAT) analysis,

e. Quantitative MSAT technical report and conference call,

f. Congestion management process analysis,

g. Applicable disclosure statements in the environmental document as prescribed in the TxDOT Guidance for Preparing Air Quality Statements,

h. Air quality cumulative and induced growth impacts analysis as specified above in paragraph 120.5, C, 5-Induced Growth Impact Analysis and Cumulative Impacts Analysis of this Attachment and included in the environmental document, and

i. Response to public comments received on air quality issues.

Deliverables:

- Draft and Final Transportation Conformity Report Form

- Draft and Final Qualitative MSAT Analysis
- Draft and Final Hot-Spot Analysis technical report
- Draft and Final Quantitative MSAT Analysis
- Draft and Final CO TAQA technical reportDraft and Final CMP analysis

7. Noise Analysis Technical Reporting

The Engineer shall prepare all necessary noise analyses and technical reporting.

a. Noise Analysis Technical Reporting Requirements. The noise analysis technical reporting might include:

(1) Computer modeling of existing and predicted noise levels;

(2) Field measurements of existing noise levels and validation of existing model;

(3) Determining predicted noise impact contours for undeveloped property;

(4) Barrier analysis for impacted receivers.

b. Noise Analysis General Requirements.

(1) The Engineer shall use TxDOT's .DGN file coordinate system for all traffic noise modeling, so that all design files and traffic noise modeling software coordinate systems are the same.

(2) The Engineer shall provide TxDOT with all .DXF files used for the traffic noise model.

(3) The Engineer shall review all proposed noise barrier locations as part of the traffic noise modeling process.

(4) The Engineer shall not begin identification of noise sensitive land uses unless TxDOT's Environmental Affairs Division's Historical Studies Branch (ENV-Historical Studies) has approved a Project Coordination Request (PCR).

The Engineer shall support the State in conducting noise workshops for the proposed project, including development of materials, distribution lists for notifications and balloting, and final workshop documentation.

Deliverables:

- Draft and Final Traffic Noise Technical Report
- Draft and Final TNM Modeling Files
- Draft and Final Noise Workshop Materials and Distribution Lists
- Draft and Final Noise Workshop Documentation

8. Water Resources Analysis and Documentation

The Engineer shall provide environmental documentation, conduct field surveys, and provide analysis of water resources for compliance with state and federal regulations as described in the *Environmental Guide: Volume 2 Activity Instructions*, http://ftp.dot.state.tx.us/pub/txdot-info/env/toolkit/060-06-gui.pdf, and the associated forms, templates, and guidance found in the Water Resources section of the Natural Resources Toolkit, https://www.txdot.gov/inside-txdot/division/environmental/compliance-toolkits/natural-resources.html. The applicable water resource studies will be determined by the State. In the case that field surveys are required, then the Engineer shall contact TxDOT's Environmental Affairs Division's Natural Resource Management Section (ENV-NRM) for clearance prior to starting fieldwork. ENV-NRM will verify that approved methods and appropriately permitted and experienced staff will be used.

At the request of the State, the Engineer shall provide the following water analysis:

a. Surface Water Analysis Form, including analysis of:
   (1) Section 404 of the Clean Water Act
   (2) Section 303(d) of the Clean Water Act
   (3) General Bridge Act/Section 9 of the Rivers and Harbors Act
   (4) Section 10 of the Rivers and Harbors Act
   (5) Section 401 of the Clean Water Act
   (6) Executive Order 11990, Protection of Wetlands

b. TCEQ Edwards Aquifer Rules Analysis, including:
   (1) Preparation of an Edwards Aquifer Protection Plan
   (2) Geologic Assessment for TCEQ Edwards Aquifer Water Pollution Abatement Plan. A Texas licensed Professional Geoscientist (P.G.) must prepare, sign, and seal the Geologic Assessment, according to current TCEQ standards.
   (3) Geological Assessment in accordance with TCEQ guidance and 30 TAC Chapter 213. Fieldwork for this task must be performed by a State of Texas Licensed Professional Geoscientist. Fieldwork for the GA includes reconnaissance and walking ground surveys, as defined by Veni and Reddell (2002), Barrett (1999), and TCEQ (2004). Positions of all features must be documented using handheld GPS receivers and checked with field maps based on digital imagery. The Technical Expert shall walk in a formation not more than 15 meters (50 feet) apart searching for depressions (both karstic and non-karstic) and other indications of potential aquifer recharge features.

      Deliverables:

      - Draft Geological Assessment, to include

- TCEQ Geologic Assessment form (TCEQ-0585)
- Attachment A – Geologic Assessment Table, (TCEQ-0585-Table)
- Attachment B - Soil Profile and Narrative of Soil Units
- Attachment C – Stratigraphic Column
- Attachment D – Narrative of Site Specific Geology
    - Includes site description, and the results of the field survey for features including photos and descriptions of springs, seeps, and sinkholes
- Site Geologic Maps - not to exceed 11” x 17” in size

▪ Final Geological Assessment

- The Engineer shall revise the draft GA to address the State comments as directed by the State’s POCs. For each round of comments, the State POCs shall comment on the same version of the draft and any internally conflicting comments must be resolved prior to comments being submitted to the Engineer.
- The final GA must be one signed, sealed, and dated original submitted to the AUS District POCs and one electronic copy submitted to all State POCs

(4) The Technical Expert shall provide all portions of the WPAP using current TCEQ forms in accordance with current TCEQ guidance, requirements, and 30 TAC Chapter 213. The State will work with the Engineer to determine which portions of the WPAP deliverables are applicable.

Deliverables:

- Edwards Aquifer Protection Program Roadway Application (TCEQ-20872)
- Geologic Assessment Form (TCEQ-0585)
- Temporary Stormwater Section (TCEQ-0602)
- Core Data Form (TCEQ-10400)
- The draft WPAP must be submitted

electronically to the State POCs. The Engineer shall revise the draft WPAP to address the State comments as directed by the State POCs. For each round of comments, the State POCs will comment on the same version of the draft and any internally conflicting comments must be resolved prior to comments being submitted to the Technical Expert. The final WPAP must address all State comments.

(5) Groundwater Technical Report - Edwards Aquifer. A Texas licensed Professional Geoscientist (P.G.) must prepare, sign, and seal the Groundwater Technical Report.

c. WOTUS Delineation report prepared in accordance with ENV's *Documentation Standard for Waters of the U.S. Delineation Report* using ENV's Template: Waters of the U.S. Delineation Report including all supporting forms and exhibits

d. Section 404/10 Impacts Table prepared in accordance with TxDOT ENV's *Section 404/10 Impacts Table and Instructions – Preparing a Section 404/10 Impacts Table*

e. Section 404/10/9 Permitting Package, including:

(1) USACE PCN Permitting Application prepared in accordance with TxDOT ENV's Documentation Standard for PCN

(2) USACE IP Permitting Application prepared in accordance with TxDOT ENV's Documentation Standard for IP

(3) USACE LOP Permitting Application

(4) USACE RGP Permitting Application

(5) Conditional/Functional Assessment

(6) Permittee-responsible Mitigation Plan

(7) Permittee-responsible Mitigation Plan Implementation

(8) 401 Certification

f. For all WOTUS surveys, the Engineer shall:

(1) Provide the results of the land survey in electronic DGN file format to be incorporated into the schematic and plans. GIS and KMZ files of the land survey must also be provided.

(2) Determine the acres of permanent and temporary impacts and linear feet of impacts at each WOTUS and provide figures of the WOTUS and associated impacts overlaying the schematic and plan sheets.

Deliverables:

- Draft and Final Surface Water Analysis Form
- Draft and Final WOTUS Delineation Report
- Draft and Final Section 404/10 Impacts Table
- Draft and Final USACE PCN Permit Documentation
- Draft and Final USACE IP Permit Documentation
- Draft and Final USACE LOP Permitting Application
- Draft and Final USACE RGP Permitting Application
- Draft and Final Conditional/Functional Assessment
- Draft and Final 401 Certification

9. Biological/Natural Resources Management Analysis and Documentation

The Engineer shall provide environmental documentation, conduct field surveys, and provide analysis of biological natural resources for compliance with state and federal regulations as described in the TxDOT *Environmental Guide: Volume 2 Activity Instructions*, http://ftp.dot.state.tx.us/pub/txdot-info/env/toolkit/060-06-gui.pdf, and the associated forms, templates, and guidance found in the Natural Resources Toolkit, https://www.txdot.gov/inside-txdot/division/environmental/compliance-toolkits/natural-resources.html. . In the case that field surveys are required, then the Engineer must contact ENV-NRM for clearance prior to starting work. ENV-NRM will verify that approved methods and appropriately permitted and experienced staff will be used. At the request of the State, the Engineer shall provide the following biological/natural resource analysis:

a. Species Analysis Documents and Coordination with TPWD, including:

(1) Species Analysis Form

(2) Species Analysis Spreadsheet, which can include a habitat analysis for the entire project area, field surveys for protected species, and presence/absence surveys.

(3) TPWD County List from Rare, Threatened, and Endangered Species of Texas (RTEST) website.

(4) USFWS official species list from Information for Planning and Consultation (IPAC) website.

(5) TPWD BMP Form

b. Farmland Protection Policy Act (FPPA) analysis.

Deliverables:

- Draft and Final Species Analysis Documents.
- Draft and Final FPPA Analysis

10. Initial Site Assessment (ISA) with Hazardous Materials Project Impact Evaluation Report

The Engineer shall provide an ISA with Hazardous Materials Project Impact Evaluation Report for the limits of the proposed project in

accordance with Statement of Work for Hazardous Materials Processes related to NEPA in the TxDOT Hazardous Materials Management Toolkit (http://www.txdot.gov/inside-txdot/division/environmental/compliance-toolkits/haz-mat.html).

Deliverables:

- Draft and Final Hazardous Materials ISA and Impact Evaluation Report

11. Archeological Documentation Services

The Engineer shall provide archeological studies and documentation. All archeological studies must be sufficient to satisfy the current TxDOT Archeological Sites and Cemeteries Toolkit. An archeological background study must be performed prior to field work. If the Engineer was provided with a background study by the State, a new background study is not required.

The Engineer shall provide archeological resource identification, evaluation, and documentation services. In compliance with TxDOT's Environmental Compliance Toolkits, the Engineer shall provide the following archeological services/deliverables:

a. Archeological background study

b. Archeological reconnaissance survey

c. Archeological intensive survey

An archeological survey (reconnaissance or intensive) must be sufficient to satisfy state and federal regulations. . The Engineer shall contact TxDOT's Environmental Affairs Division's Archeological Studies Branch (ENV-ARCH) for approval prior to starting field and survey work. ENV-ARCH will verify that approved methods and appropriately permitted and experienced staff will be used.

Deliverables:

- Draft and Final Archeological Background Study
- Draft and Final Antiquities Permit
- Draft and Final Archeological Survey Report

12. Historic Resource Identification, Evaluation, and Documentation Services

The Engineer shall provide historic resource identification, evaluation, and documentation services. In compliance with TxDOT's Environmental Compliance Toolkits, the Engineer shall provide the following historic resource services/deliverables:

a. Historic Resources PCR, The PCR shall comply with the State Environmental Compliance Toolkits provided by the State's Environmental Affairs Division ~~in effect as of the date of the receipt of the document.~~ The Engineer shall revise the PCR to address comments by the State at no additional cost to the State and may

be required to integrate the findings into another environmental document. The State assumes responsibility for transmitting the findings to the Texas Historical Commission (THC) and any appropriate consulting parties, and for transmitting THC and consulting parties' comments to the Engineer's Technical Expert. Engineer's Technical Expert is an institution, firm, individual, or team that provides professional scientific services, including but not limited to archeologists, biologists, geologists, historians, or other environmental professionals that conduct environmental or cultural assessments required by state or federal law for transportation projects.

b. Historic Resources Research Design, In consultation with the State, the Engineer shall determine the APE and the study limits of the survey area, conduct a literature review appropriate to the project area and its historic resources, and prepare a research design for a reconnaissance survey for historic resources. The research design shall comply with the State's Environmental Compliance documentation standards for historic resources research design. The Engineer shall submit an electronic format copy of the research design to the State.

c. Historic Resource Survey Report, including windshield, reconnaissance, or intensive level documentation. The Engineer shall conduct a reconnaissance-level survey conforming to the methodology outlined in the State-approved research design. The reconnaissance survey shall not be implemented without prior approval of the research design by the State and State ENV. Each historic resource, defined as a building, structure, object, historic district or non-archeological site at least 45 years old at the time of letting in the APE shall be documented from the public ROW with digital photography. The letting date and the cutoff date for historic resources will be determined by the State. The Engineer shall provide photographic and written documentation for each historic-age resource sufficient to satisfy State documentation requirements for Historic Resources Survey Reports for reconnaissance-level surveys. The Engineer shall provide a technical report detailing the results of the reconnaissance survey. In the report the Engineer shall describe the findings of the reconnaissance survey, including preliminary assessments of direct, indirect and cumulative effects on historic properties, and make recommendations to the State for the need, if any, to conduct intensive survey efforts. The technical report shall have sufficient detail and clarity to provide THC with a basis for making determinations of NRHP eligibility without requiring submission of additional documentation or shall have sufficient detail and clarity to make recommendations concerning the scope of the intensive survey. All appropriate NEPA or federal regulatory language shall be included to provide sufficient clarity concerning eligibility determinations.

d. The State assumes responsibility for transmitting the research design and reconnaissance level survey technical report to the

THC, as applicable under the Programmatic Agreement among the Federal Highway Administration, the Texas Department of Transportation, the Texas State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding the Implementation of Transportation Undertakings (PA-TU) and transmitting THC comments to the Technical Expert. The Engineer shall revise the research design and reconnaissance level survey technical report to reflect comments by the State and THC. The research design and the reconnaissance level survey technical report shall be revised pursuant to the State's errors and omissions policy.

All services, except the historic resource PCR, must have prior approval by TxDOT's Environmental Affairs Division's Historical Studies Branch (ENV-HIST) to be performed. The historic resource PCR must be accepted by ENV-HIST prior to survey field work.

Deliverables:

- Draft and Final Historic Resources PCR
- Draft and Final HRRD
- Draft and Final HRSR

13. Floodplain Impacts

The Engineer shall determine whether the transportation activity has the potential to affect floodplains. The Engineer shall document Trinity River Corridor Development Certificate Regulatory Zone requirements (Dallas and Fort Worth Districts), and IBWC requirements (transportation activity within the floodplain of the Rio Grande) if the project is within the area covered by these regulations. Studies for floodplain impacts must fulfill the requirements of Executive Order 11988 and 23 CFR 650, Subpart A. Documentation must:

a. Briefly describe the watershed characteristics of the study area in terms of land uses and changes in land use that may affect stream discharge.

b. Briefly describe the streams in the study area, including evidence of stream migration, down cutting, or aggradations.

c. Identify the presence and nature (e.g., zone A, zone AE, zone AE with floodway) of any FEMA mapped floodplains; including the panel number.

d. Indicate the existence of any significant development associated with the mapped area and identify the jurisdiction responsible for the floodplain.

e. Identify the locations where an alternative might encroach on the base (100-year) floodplain (encroachments), where an alternative might support incompatible floodplain development, and the potential impacts of encroachments and floodplain development. This identification must be included in the text and on a map.

f. Include a list of all jurisdictions having control over floodplains for each alternative.

g. Where an encroachment or support of incompatible floodplain development results in impacts, provide more detailed information on the location, impacts, and appropriate mitigation measures. In addition, if any alternative (1) results in a floodplain encroachment or supports incompatible floodplain development having significant impacts, or (2) requires a commitment to a particular structure size or type, the report must include an evaluation and discussion of practicable alternatives to the structure or to the significant encroachment. The report must include exhibits that display the alternatives, the base floodplains and, where applicable, the regulatory floodplains.

h. For each alternative encroaching on a designated or regulatory floodplain, provide a preliminary indication of whether the encroachment is consistent with or requires a revision to the regulatory floodplain. If the preferred alternative encroaches on a regulatory floodplain, the report must discuss the consistency of the action with the regulatory floodplain. In addition, the report must document coordination with FEMA and local or state agencies with jurisdiction indicating that a revision is acceptable or that a revision is not required.

i. If the preferred alternative includes a floodplain encroachment having significant impacts, the report must include a finding that it is the only practicable alternative as required by 23 CFR 650, Subpart A. The finding must refer to Executive Order 11988 and 23 CFR 650, Subpart A. In such cases the report must document compliance with the Executive Order 11988 requirements and must be supported by the following information:

(1) The reasons why the proposed action must be located in the floodplain;

(2) The alternatives considered and why they were not practicable; and

(3) A statement indicating whether the action conforms to applicable state or local floodplain protection standards

Deliverables:

- Summary of Floodplain regulatory compliance in EA

14. Stormwater Permits (Section 402 of the Clean Water Act)

The Engineer shall:

a. describe the need to use the TPDES General Permit, TX 150000. The text must describe how the project will comply with the terms of the TPDES, including the Stormwater Pollution Prevention Plan; and

b. describe the need for Municipal Separate Storm Sewer System (MS4) notification. List MS4 participating municipalities.

Deliverables:

- Summary of Stormwater regulatory compliance in EA

120.6. Informal Meetings.
The Engineer shall provide technical assistance with, preparation of exhibits for, and minutes of informal meetings that are either requested by the public to discuss the pending impacts to neighborhoods and businesses due to roadway shutdowns, detours, and access restrictions or as deemed necessary by the State. This is not to be confused with the formal public meetings held during the National Environmental Policy Act (NEPA) process during schematic approval for Public Involvement.

120.7. Environmental Permits Issues and Commitments (EPIC) Sheets.
The Engineer shall complete the latest version of the EPIC sheets per information provided by the State. These sheets must be signed, sealed, and dated by the Engineer as indicated in signature block. The final sheets must be submitted for the State's signature.

120.8. Environmental Study Implementation.
The Engineer will implement into the PS&E package. The Engineer shall consider the constructability issues as it relates to the environmental impacts.

120.9. Cut and Fill Exhibits.
If the information is available, the Engineer shall prepare cut and fill exhibits for delineated wetlands.

120.10. Review Environmental Documentation.
The Engineer shall review the final environmental document for implementation into the PS&E package. The Engineer shall consider constructability issues as they relate to the environmental impacts.

120.11. Prepare Environmental Exhibits (Environmental Documentation by Others).
The Engineer shall prepare the necessary exhibits for the environmental study to be performed by others. The Engineer shall follow the directions of the environmental project manager and the State's environmental staff for the preparation of these exhibits.

120.12. Permits.
The Engineer shall prepare exhibits and supporting documentation including permit applications as directed by the State for any permits that may be required such as with the United States Army Corps of Engineers (USACE), Texas Commission on Environmental Quality (TCEQ), Texas Parks and Wildlife, U.S. Fish and Wildlife, and other environmental permits. All permit submissions must be reviewed and approved by District Environmental Staff prior to submission and may be reviewed by ENV depending on the complexity of the permit, at the request of District Environmental Staff. Permit coordination shall include coordination or completion of Environmental Permit Issues and Commitments Sheets (EPIC Sheets) for State signature and processing.

DEL.120. Deliverables for FC 120.

A. Environmental technical reports

B. Environmental Document – Categorical Exclusion (CE), Environmental Assessment (EA), documented re-evaluation and permit or both, as determined by the State.

C. Exhibits for public meeting and hearing

D. Draft public meeting and hearing documentation packet

E. Final public meeting and hearing documentation packet

F. Electronic files of the exhibits and public meeting and hearing documentation packet

FUNCTION CODE 130 (130) – RIGHT-OF-WAY – SURVEY

RIGHT-OF-WAY SURVEY DATA

For Function Codes 130 and 150, the term Surveyor means the firm (prime provider or subprovider) that is providing the surveying services shown in this scope.

The Engineer shall ensure that the following general standards for survey work are followed for Function Codes 130 and 150:

Unless otherwise indicated, any reference in this attachment to a manual, specification, policy, rule or regulation, or law means the version in effect at the time the work is performed. TxDOT manuals are available at: http://onlinemanuals.txdot.gov/manuals/.

All surveys must meet or exceed all applicable requirements and standards provided by: (1) Professional Land Surveying Practices Act, (2) General Rules of Procedures and Practices promulgated by the Texas Board of Professional Engineers and Land Surveyors (TBPELS), and (3) *TxDOT Survey Manual*. The Surveyor shall perform all work in an organized and professional manner. All surveys are subject to the approval of the State.

The Surveyor shall use the *TxDOT ROW Preliminary Procedures for Authority to Proceed Manual* and *TxDOT Survey Manual* as the basis for the format and preparation of all right of way (ROW) documents produced, including ROW maps, written parcel descriptions, parcel plats, and other ROW work products, unless otherwise specified by the State.

Unless otherwise directed by the State, the Surveyor shall use (1) the North American Datum of 1983 (NAD83), Texas Coordinate System of 1983 (State Plane Coordinates) applicable to the zone or zones in which the work is performed, with values in U.S. survey feet, as the basis for all horizontal coordinates derived and (2) the datum adjustment currently in use by TxDOT.

Project or surface coordinates must be calculated by applying a combined adjustment factor (CAF) to State Plane Coordinate values. If provided by the State, the Surveyor shall use a project specific CAF.

Elevations must be based on the North American Vertical Datum 88 (NAVD88), unless otherwise specified by the State.

All work using the Global Positioning System (GPS), whether primary control surveys or other, must meet or exceed the requirements provided by the *TxDOT Survey Manual* to the order of accuracy specified in the categories listed below or in a work authorization. If the order of accuracy is not specified in this attachment or in a work authorization, the work must meet or exceed the order of accuracy specified in the publication listed in this paragraph.

All conventional horizontal and vertical control surveys must meet or exceed the order of accuracy specified in the *TxDOT Survey Manual* unless specified otherwise in the contract.

All boundary determination surveys, whether for ROW acquisition, ROW re-establishment, or other boundary needs, must meet or exceed the accuracy specified in the *TxDOT Survey Manual* unless specified otherwise in the contract.

The State may authorize the Surveyor to use an Unmanned Aircraft System (UAS) to perform services under this contract. The use of UAS is regulated by the Federal Aviation Administration (FAA). All UAS operators must comply with Federal Aviation Administration (FAA) regulations and the *TxDOT Unmanned Aircraft System (UAS) Flight Operations and User's Manual*.

The survey data must be fully compatible with the State's computer system and with programs in use by the State at the time of the submission, without further modification or conversion. The current programs used by TxDOT are: Microsoft Word, Bentley MicroStation, Bentley OpenRoads civil design system, Bentley GEOPAK Survey, Excel, and ESRI ArcGIS. Data collection programs must be compatible with the current import formats allowed by GEOPAK Survey and be attributed with current feature codes. These programs may be replaced at the discretion of the State.

Drawing sizes are defined, based on American National Standards Institute (ANSI) standard paper sizes, as follows: A-size means 8.5 inches by 11.0 inches, B-size means 11.0 inches by 17.0 inches, C-size means 17.0 inches by 22.0 inches, and D-size means 22 inches by 34.0 inches.

Variations from these software applications or other requirements listed above shall only be allowed if requested in writing by the Surveyor and approved by the State.

The Surveyor shall perform quality control/quality assurance on all procedures, field surveys, data, and products prior to delivery to the State. The State may also require the Surveyor to review the survey work performed by others. If, at any time, during the course of reviewing a submittal of any item it becomes apparent to the State that the submittal contains a substantial number of errors, omissions, and inconsistencies, the State may cease its review and return the submittal to the Surveyor immediately for appropriate corrective action. A submittal returned to the Surveyor for this reason is not a submittal for purposes of the submission schedule.

The standards for services that are not boundary-related but that relate to surveying for engineering projects may be determined by the construction specifications, design specifications, or as specified by the State:

130.1. Right-Of-Way Surveys (15.1.1).

This includes the performance of surveys to establish land boundaries, preparation of parcel descriptions and parcel plats, and the preparation of right-of-way (ROW) maps.

The Surveyor shall prepare:

A. boundary surveys and create Property Descriptions (metes and bounds plus plats);

B. create GIS files for ROWD/ Real Property Asset Map system; and

C. traditional ROW map as requested by a TxDOT district.

The standards and deliverables are detailed in Chapter 4, Section 8 of the *TxDOT ROW Preliminary Procedures for the Authority to Proceed Manual*, and the checklist provided by the State.

130.2. Right-Of-Way Mapping – Traditional ROW Map.

If requested, the Surveyor shall conduct traditional ROW mapping.

Traditional ROW mapping includes ground surveying and preparation of parcel maps, legal descriptions also known as metes and bounds descriptions, and ROW maps.

A. Purpose

The purpose of traditional ROW mapping is:

1. To prepare mapping documents suitable for use in the acquisition of real property and the issuance of a title policy.
2. To prepare a map of a resurvey of existing ROW where it is necessary to update or redefine ROW lines.

B. Definitions

In this attachment, the following definitions shall apply:

1. Abstract Map means a scale drawing prepared from record documents depicting proposed ROW lines, existing ROW lines, easement lines, and private property lines with relevant grantee names, recording data, and recording dates.
2. Closure/Area Calculation Sheet means a computer generated print-out of the area and the perimeter bearings, distances, curve data, and coordinates of an individual parcel of land to be acquired, including the degree of angular and distance mis-closure for each individual parcel.
3. Denial of Access Line means a line that indicates specific location where access to the roadway is denied.
4. Owner means the current title holder of record as determined by the Real Property Records.
5. Parent Tract means a unit or contiguous units of land under single ownership, comprising a single marketable tract of land consistent with the principle of highest and best use.

   A parent tract may be described by a single instrument or several instruments. A single parent tract cannot be severed by a public ROW easement, or separate ownership which destroys unity of use.
6. Parent Tract Inset means a small map to an appropriate scale, of the parent tract perimeter placed upon the ROW map in the proximity of the respective parcel. Parent tract insets are used in cases where the parent tract cannot be shown to the same scale as the ROW map. Since parent tract insets are used to identify the limits and location of parent tracts, they must include public ROW, utility easements and fee strips, and identifiable water courses which bound the parent tract.
7. Point of Beginning or POB means a corner of the parcel of land to be acquired, located on the proposed ROW line and being the beginning terminus of the first course of the written property description or plat.
8. Point of Commencing or POC means a monumented property corner identifiable in the real property records that is located outside the

proposed ROW corridor. For title purposes, the POC must be a monumented back corner of the parent tract. In the event a monumented back corner of the parent tract cannot be recovered, the nearest identifiable monumented property corner located outside the proposed ROW corridor may be used.

9. Preliminary ROW Layout means a scaled drawing depicting proposed ROW lines, existing ROW lines, proposed pavement, access denial lines, the proposed centerline alignment, private property lines, easement lines, visible improvements, visible utilities, and the station and offset from the centerline alignment to each point of curvature (PC), point of tangency (PT), and angle point in the proposed ROW lines and to each PC, PT, and the angle point in the existing ROW lines in areas of no proposed acquisition.

10. Property Description means a document prepared as an exhibit for the conveyance of a property interest and issuance of a title policy, reflecting the results of a boundary survey, and signed and sealed by a registered professional land surveyor (RPLS), attached to an acquisition deed as Exhibit A, and consisting of the following two parts:

    a. Written metes and bounds description delineating the area and the boundary and describing the location of an individual parcel of land unique to all other parcels of land.

    b. Parcel plat, which is an A-size scaled drawing depicting the information recited in the metes and bounds description in 10 a. above, which represents the parcel(s) of land to be acquired.

11. ROW Maps means a series of D-size scaled drawings depicting the results of relevant elements of records research, field work, analysis, computation, and mapping required to determine title, delineate areas and boundaries, and locate and describe utilities and improvements to the extent necessary to appraise the value and negotiate the acquisition of individual parcels of private land for a proposed ROW project.

C. Procedure

All standards, procedures, and equipment used by the Surveyor must be such that, at a minimum, the results of the survey is in compliance with the precision and accuracy requirements set forth by the TBPELS rules.

1. Abstract Map

The Surveyor shall prepare an Abstract Map sufficient to determine the following:

a. All interests of public record held in the land to be acquired.

b. The total record holdings to be acquired from an owner contiguous to a land.

c. All interests in land held in common to be acquired (shopping mall parking lots, subdivision reserves, etc.)

d. All improvements proposed by other agencies that might have a bearing on project development.

e. All called monuments, bearings, and distances in recorded information.

2. ROW Map

The Surveyor shall field locate items such as: property corners, existing ROW markers, improvements, and visible utilities. The Surveyor shall verify and update the planimetric file as directed by the State.

Using the State's standard title, index, and plan sheets, the Surveyor shall prepare a ROW map for each proposed ROW project. A ROW map must include a title sheet, an index sheet, a survey control index sheet, a horizontal control data sheet, and sufficient plan sheets to cover the proposed project. If requested by the State, the Engineer shall prepare additional sheets.

By mutual agreement between the TBPELS and the State, ROW maps need not be signed and sealed by a RPLS.

Plan sheets must include the following:

a. Proposed ROW lines. Proposed ROW lines must be labeled with appropriate bearings, distances, and curve data. Curve data must include the radius, delta angle, arc length, and long chord bearing and distance.

b. Existing ROW lines. Existing ROW lines must be labeled with appropriate bearings, distances, and curve data to the extent necessary to describe the individual parcels of land to be acquired. Curve data must include the radius, delta angle, arc length, and long chord bearing and distance.

c. Proposed project baseline alignment. The proposed project baseline alignment must be labeled with appropriate bearings, distances, and curve data. Curve data must include the station of the curve, point of intersection (PI), radius, delta angle, arc length, tangent length, long chord bearing and distance, and the northing (N) and easting (E) coordinates of the curve PI. All alignment PCs, PTs, and even 500 foot stations must be labeled with its station value.

d. Proposed paving lines. Proposed paving lines combined with relevant existing paving lines must be shown to the extent necessary to compile a complete picture of proposed traffic movements. Proposed paving on the final map submitted to the State must be shaded with a dot pattern or highlighted by some other means acceptable to the State.

e. Denial of Access lines. Denial of Access lines must be drawn to clearly indicate areas where access is to be denied and where access is to be permitted.

f. Private property lines. Private property lines must be delineated with appropriate bearings, distances, and curve data to the extent necessary to describe the individual parcels of land to be acquired.

Curve data must include the radius, delta angle, arc length, and long chord bearing and distance.

g. League lines and survey lines. League lines and survey lines must be shown and identified by name and abstract number.

h. County lines and city limit lines. County lines and city limit lines must be located and identified by name.

i. North arrow. A north arrow must be shown on each sheet, in the upper right corner of the sheet.

j. Monuments. Monumentation must be shown with a description of material and size and if the monument is found or set.

k. PC, PT, and angle points. Station and offset must be shown for each PC, PT, and angle point in the proposed ROW lines. Stations and offsets must be shown with respect to the proposed centerline alignment.

l. Intersecting and adjoining public ROW. Intersecting and adjoining public ROW must be shown and identified by name, ROW width, and recording data.

m. Railroads. Railroads must be shown and identified by name, ROW width, and recording data.

n. Utility corridors. Utility corridors must be identified as to easement or fee.

o. Easements and fee strips. Easements and fee strips must be shown and identified by width, owner, and recording data.

p. Set-back lines. Set-back lines (e.g., building lines) must be shown and identified.

q. Improvements. Visible improvements located within the proposed ROW corridor or within 50 feet of a proposed ROW line must be shown and identified.

r. Structures

(1) Structures must be identified as commercial or residential, by number of stories, and as to construction material type (e.g., brick, wood frame).

(2) Structures that are severed by a proposed ROW line must be dimensioned to the extent necessary to completely delineate the severed parts.

(3) Parking areas, billboards, and other on-premise signs that are severed by a proposed ROW line must be dimensioned to the extent necessary to delineate that portion of the parking area, billboard, or sign that is located within the proposed ROW corridor.

(4) For a structure outside of, but within ten feet of, the proposed ROW line, the distance of the structure to the proposed line must be shown. If the location of the structure

is determined using a TxDOT supplied planimetric map, any structure within three feet of the proposed ROW line must be verified by field survey.

s. Utilities. Visible utilities located within the proposed ROW corridor or within 50 feet of a proposed ROW line must be shown and identified.

t. Underground fuel storage tanks. Visible location of vents and filler caps of underground fuel storage tanks situated within the proposed ROW corridor or within 50 feet of the corridor must be determined and shown.

u. Points of commencing and points of beginning. POCs and POBs must be shown and labeled. POBs must be shown with their respective N and E surface coordinates. As an exception, a POC will not be required in the case of a total taking without a remainder.

v. Parcels. Each parcel of land to be acquired must be identified by a parcel number, which must appear in the ownership tabulation and on the ROW map in the proximity of the respective parcel. If the Surveyor is unfamiliar with the criteria used by the State to assign parcel numbers, the Surveyor shall seek the assistance of the State at the time the Abstract Map is complete.

w. Ownership tabulation. An ownership tabulation must be shown that includes the parcel number, existing area of the parent tract, lots and blocks constituting the parent tract when applicable, owner's name, type of conveyance, film code, county clerk's file number, taking area, and remaining area of the parent tract located left or right of the centerline alignment or both. The Surveyor shall provide several blank lines in the tabulation block to facilitate future map additions.

x. Parent tract inset. A parent tract inset must be shown for each parent tract that cannot be shown to scale on the ROW map. When parent tract insets are used, the point of commencing with the appropriate bearing and distance to the point of beginning may be shown on the parent tract inset.

y. Data sources. A note must be included on the title sheet and each map sheet stating the source of bearings, coordinates, and datum used. The note must also include the National Geodetic Survey (NGS) or other basis monument(s) name or identification number, Texas Coordinate System Zone information, epoch information, grid or surface values and the combined adjustment factor or surface adjustment factor.

z. Notes. Appropriate notes must be included on the title sheet and each map sheet stating the following:

(1) Month (or months) and year of the abstracting upon which the map is based.

(2) Month (or months) and year the field surveys were conducted upon which the map is based.

(3) Month and year the map was completed by the Surveyor.

aa. ROW CSJ number. The ROW CSJ number, if available, must be shown on each ROW map sheet.

bb. Tick marks. The Surveyor shall place four tick marks, one in each quadrant of the map sheet, showing the latitude and longitude (Lat/Long) in decimal degrees and the surface coordinate of each mark. The tick marks may be placed on the match lines of each map sheet, if convenient. A foot note must also be placed on the sheet defining the tick marks as Lat/Long in decimal degrees.

3. Property Descriptions

The Surveyor shall prepare a Property Description for each parcel (or tract for surplus property) consisting of two parts: (1) a metes and bounds description of the property and (2) a parcel plat. Each part of a Property Description must be signed and sealed by a RPLS.

a. Metes and bounds description

The Surveyor shall prepare a metes and bounds description for each parcel of land to be acquired. The Surveyor shall use the TxDOT standard format for metes and bounds descriptions. Metes and bounds descriptions must be submitted in Microsoft Word format and must include the following information:

(1) State, county, and original land grant survey within which the proposed parcel of land to be acquired is located.

(2) Reference to unrecorded and recorded subdivisions by name, lot, block, and recording data to the extent applicable.

(3) Reference by name to the grantor and grantee, date and recording data of the most current instrument(s) of conveyance describing the parent tract.

The Surveyor shall use the execution date when citing deed references. The Surveyor shall use the recording or filing dates, making clear which date is being used if the execution date is not explicit on the face of the document.

(4) A POC.

(5) A POB with the N and E surface coordinates.

(6) A series of courses, identified by number and proceeding in a clockwise direction, describing the perimeter of the parcel of land to be acquired, and labeled with appropriate bearings, distances, and curve data.

(7) Curve data must include the radius, delta angle, arc length, and long chord bearing and distance.

(8) Each course must be identified either as a proposed ROW line, an existing ROW line, or a property line of the parent tract. Each property line of the parent tract must be described with an appropriate ad joiner call.

(9) A description of all monumentation set or found, which must include size and material.

(10) A reference to the source of bearings, coordinates, and datum used.

b. Parcel plat

The Surveyor shall prepare a parcel plat for each parcel of land to be acquired using the State's standard format. Parcel plats must include each and every item of information 1) written in the metes and bounds description and 2) shown on the ROW map (if requested by the State) for the individual parcel.

D. Adherence to Standards

For purposes of clarity, consistency, and ease of understanding, the State, as an acquiring agency of private property for public use, has adopted standards and formats for a ROW map to facilitate the processes of negotiation, appraisal, relocation assistance, and condemnation. The Surveyor shall adhere to these standards and formats to every extent possible.

E. General Specifications

The following general specifications for 1) description, 2) plat, and 3) ROW mapping apply:

1. Completed ROW maps must be submitted to the State in both Bentley MicroStation Design File (DGN) and Adobe Portable Document Format (PDF) format. The maps must have a layout that will produce a D-size final print with a 0.5 inch border.
2. Parcel plats must be submitted to the State on A-size bond paper with a 0.5 inch border. Match lines must be used where more than one sheet is required.
3. ROW maps must be drawn to a scale of 1 inch = 50 feet. Scales other than 1 inch = 50 feet may be used with prior approval by the State.
4. The minimum lettering size for ROW maps is 0.1 inches at print scale.
5. Parcel plats must be drawn to a scale of 1 inch = 50 feet. Scales other than 1 inch = 50 feet may be used with prior approval by the State. In the case of large parcels which are difficult to fit on a single A-size sheet, the Surveyor shall use multiple A-size sheets with match lines.
6. The minimum size lettering for a parcel plat is 0.3 inches at print scale.
7. Property Descriptions shall be submitted on A-size bond paper.

F. General Requirements

The Surveyor shall adhere to the following general requirements:

1. Copies of instruments of record submitted to the State must be indexed by parcel number.
2. Coordinates appearing on ROW maps, on parcel plats, and in written property descriptions must be surface coordinates based on the Texas State Plane Coordinate System. The appropriate combined adjustment

factors (sea level factor multiplied by the scale factor) for each zone of the coordinate system, which have been developed by the State, must be noted.

To obtain surface coordinates, the Surveyor shall multiply grid coordinates by the appropriate combined adjustment factor for each zone, as provided by the State.

3. Line and curve tables may be used when necessary.
4. The number of centerline alignment stations shown on a single plan sheet shall be limited to allow approximately four inches between match lines and sheet borders for future details and notes.
5. A minimum four-inch by four-inch space must be reserved at the bottom right corner of each map sheet for future revision notes.
6. If requested by the State, the Surveyor shall set a 5/8-inch rebar with a TxDOT aluminum ROW cap (or another appropriate monument) on the proposed ROW line. and replace the rebar at a later date with a TxDOT Type II ROW marker.

   When the 5/8” rebar with a TxDOT rod cap is set for PCs, PTs, PIs, and 1500 foot stations, the double asterisk symbol (**) must be shown on the map sheets and written into and shown in the Property Description and must be accompanied by the following note:

   **The monument described and set may be replaced with the State’s Type II ROW marker upon the completion of the construction project, under the supervision of a RPLS, either employed or retained by the State.

   When new ROW lines intersect boundary lines of properties creating new boundary corners in the new ROW line, the Surveyor shall place a 5/8-inch rebar with the State’s 2-inch aluminum property corner rod cap.

G. GIS Submission Requirements and Standards

All ROW mapping project work authorizations are subject to the standards and required ArcGIS deliverables detailed in Chapter 4, Section 8 of the *TxDOT ROW Preliminary Procedures for the Authority to Proceed Manual*.

H. Electronic ROW Map Standards

The primary purpose of this section is to provide instructions on the graphics standards, file management structure, and naming conventions, for ROW mapping electronic deliverables submitted to the TxDOT Right of Way Division by surveying services providers, as part of the ROW package.

The Surveyor shall adhere to the following requirements for electronic map submittals:

1. Bentley MicroStation

   All graphic files for map sheets and parcel plats must be native Bentley MicroStation DGN files created using Bentley OpenRoads civil design system with TxDOT’s current seed files, resource files, workspace environment, and settings.

2. Level Library Files

   The Surveyor shall use the TxDOT's current MicroStation level library files for ROW mapping. The files contain all the predefined levels that are typically needed for ROW mapping and include levels for existing utilities.

3. Separate DGN Files for Each Map Sheet

   The Surveyor shall provide one DGN file for each map sheet. Each file must be spatially registered to the project coordinate system.

   The sheet file naming convention is "ROW CSJ_Sheet Number.dgn((e.g., 212104065_S01.dgn).

   In the example above, the first nine numbers "212104065" is the ROW CSJ number for the project and "S01" is the sheet number, beginning with number 1 as the cover sheet.

4. Naming convention for the Master Design File or Master ROW Files and Map Sheet.

   The recommended naming prefix for design files is MDF (for master design file). Therefore, the prefix must be different for the ROW files because the location of the existing and proposed ROW in the design files from the schematic will change to some degree after an on-the-ground survey is made for a ROW map. Therefore, the prefix might be MRF for master ROW file.

   The Surveyor shall provide the corrected Master ROW Files to the design engineer to be used in the final plans, specifications, and estimate (PS&E) so that all features of construction and the relocation of utilities will be correctly placed in relation to the highway ROW and the ROW of cross streets or roadways.

   The master ROW file naming convention is: "MRF ROW CSJ_Logical Name.dgn", with examples as follows:

   MRF212104065_Schematic90.dgn (for schematic layout 90% submittal)

   MRF212104065_Schematic100.dgn (for schematic layout 100% submittal)

   MRF212104065_SchemApprov.dgn (for final approved [State & FHWA] schematic)

   MRF212104065_PSEDesign.dgn (for final PS&E design)

   MRF212104065_ExROW.dgn (for existing ROW determined by RPLS)

   MRF212104065_PropROW.dgn (for proposed ROW of final design)

   MRF212104065_DeedPlot.dgn (for deed record)

   MRF212104065_Planimetric.dgn (for aerial mapping topography)

   MRF212104065_ROWTopo.dgn (for improvements data collection)

   MRF212104065_DesignTopo.dgn (for design level data collection topography)

MRF212104065_ExUtil.dgn (for existing utilities)

All sheet files with a plan view must have the MRF referenced to allow more than one sheet file to be worked on at the same time.

5. File Structure of Master and Reference DGN Files

   If possible, the file structure should not contain subfolders.

6. Lines Weights, Line Styles, Colors, Text Size, Text Fonts, Scale, and Annotations

   Legibility is the primary concern when choosing the scale, line weights and text size. Sheets must be legible at full scale sheet size (i.e., D-size drawing) and when reduced to half scale sheet size (B-size drawing size). It is not sufficient that originals or first generation plots are legible, reproductions (copies) must retain legibility.

   The normal scales for a full-sized sheet (i.e., D-size) is 1 inch = 50 feet (urban) and 1 inch = 100 feet (rural). For a half-sized sheets (i.e., B-size) the scale is 1 inch = 100 feet (urban) and 1 inch = 200 feet (rural).

   The standard cell library is: TxdotSurv_04.cel or current State cell files; The standard font is Leroy. The standard State color table is: V256COLR.ctb or Txgpk.ctb.

   The Surveyor shall use the TxDOT's current GEOPAK Survey SMD file that sets up new feature codes in SMD file for alignment chains, parcel chains and survey chains that can be drawn by GEOPAK Survey from the GPK file with the correct line styles, colors and weights to the designated levels loaded into the DGN by the TxDOT's current level library files.

   The Surveyor shall use MicroStation Packager for the submission of electronic deliverables, which captures any non-State standard files (e.g., rsc, cel, text) that were used in the map that look and plot differently in the TxDOT's MicroStation workspace.

7. Text and Line Color considerations

   Text and line colors must be legible when using background imagery.

8. Required Data in the GEOPAK ROW GPK File

   Alignments, chains of proposed and existing ROW lines, parent tracts and taking parcels, and all other points collected in the field (start with schematic or design GPK file) are required.

   If the design GPK file is too detailed for ROW use, the Engineer shall create input files for the information needed for the design GPK file to load into the ROW GPK file.

9. Surface Coordinate and the ROW GIS Geo-Database

   Surface adjustment factors and basis of datum must be well documented in the electronic deliverables "file structure/deliverables read me" file.

10. Requirements for Electronic Deliverables

a. Native MicroStation DGN files (reference files, sheets files, and parcel plats files);

b. GEOPAK Survey GPK files;

c. Separate comma delimited point files (ASCII file) in the following coordinate systems: Surface or Projected Coordinates, Grid Coordinates (Texas Coordinate System of 1983 in U.S. Survey feet) and Geographic Coordinates (WGS-84 in decimal degrees). The file will have the following format: point number, northing or latitude, easting or longitude, elevation, feature code, and point description. File naming convention is: ROWCSJ_Type of Coordinates.csv (e.g., 212101065_Surface.csv, 212101065_Grid.csv, and 212101065_WGS84.csv);

d. PDF files created in MicroStation of map sheets (both D-size and B-size sheets), one set in black and white and another set in color if there is orthoimagery for the background;

e. PDF files and Microsoft Word documents of signed and sealed Property Descriptions and Surveyor's Reports;

f. Raw and processed GPS files including adjustment reports.

I. ROW Mapping Tasks to be Completed

The Surveyor shall perform the following tasks:

1. Abstracting

The Surveyor shall obtain copies of all existing ownership documents for the parent tracts along with all subdivision plats and recorded documents defining existing easements within, along or intersecting the existing ROW, and prepare an Abstract Map.

2. Field Surveys

The Surveyor shall locate and set additional horizontal and vertical control points, as necessary, at the maximum spacing distance of 1,500 feet; field locate property corners, existing ROW markers, improvements, and visible utilities; verify and update the planimetric file; and as directed by the State, perform the following:

a. Obtain right-of-entry to survey on private property and prepare a spreadsheet of the information.

b. Locate existing horizontal and vertical control and verify the control information, locate property corners, and update the planimetric information with any missing visible improvements or visible utilities.

The Surveyor shall base all field work and calculations on the current controls and datum provided by the State.

3. Property Description

a. The Surveyor shall prepare a Property Description(s) for each parcel or tract in the form of a preliminary and a final deliverable(s). Each part of a Property Description shall be signed and sealed by

an RPLS. The Surveyor shall prepare preliminary Property Description(s)- for review by the State.

Metes and bounds descriptions

The Surveyor shall prepare a metes and bounds description for each parcel of land to be acquired. The Surveyor shall follow the standard formats for metes and bounds descriptions that TxDOT has developed. If requested by the Surveyor, the State will provide copies of the standard formats for metes and bounds descriptions for all purposes of the work authorizations.

Parcel plats

The Surveyor shall prepare a parcel plat for each parcel of land to be acquired. The Engineer shall follow the standard formats for parcel plats that the State has developed. If requested by the Engineer, the State will provide copies of the standard formats. Parcel plats must include all items of information shown on the ROW map that concerns the individual parcel.

b. The Surveyor shall prepare final deliverables.

The Surveyor shall set appropriate monuments on the proposed ROW lines at intersecting property lines, and at all points of curvature (PC), points of tangency (PT), angle points, intersecting ROW lines of side streets, and at 1,500 foot stations.

The Surveyor shall set appropriate monuments on the existing ROW lines in areas of no acquisition at all PCs, PTs, angle points, and 1,500 foot stations, and as directed by the State.

The Surveyor shall set appropriate monuments at intersecting property lines with the new ROW lines.

The Surveyor shall prepare the final ROW (ArcGIS) database template “ROW_Parcels_Edits” populated with the final parcels, final alignment, and project control points in ArcGIS 10.6.1 format or the current version in use by the State.

The Surveyor shall prepare final, signed, sealed, and dated Property Descriptions.

4. Traditional ROW Map

The Surveyor shall prepare a traditional ROW map for the specific work location consisting of the existing and proposed ROW lines.

The Surveyor shall work closely with adjoining surveyors to incorporate all relevant information.

The Surveyor shall provide the following:

a. The Surveyor shall prepare a preliminary ROW map for review purposes.

b. The Surveyor shall prepare an initial ROW map for review purposes

c. The Surveyor shall prepare a final ROW map.

5. The Surveyor shall prepare a ROW project cover sheet using the Microsoft Word document template. The ROW project cover sheet must contain the highway, project limits, county, RCSJ, CCSJ, length of project, equations and exceptions, begin and end project information, datum statement, utility table, and signature lines for acquisition.

6. Quality Assurance and Quality Control (QA/QC)

   The Surveyor shall conduct a QA/QC review and prepare a check list for each task performed.

   The Surveyor shall prepare a surveyor's report regarding their survey procedures, findings, and decisions made.

J. ROW Mapping Deliverables

The Surveyor shall provide the following:

1. Scanned copies of the ownership documents and one D-size paper copy of the Abstract Map and the associated MicroStation graphics files for review purposes.

2. Field Survey Data

   a. A spreadsheet of the property owners and right-of-entry information.

   b. Scanned copies of the field notes, control data sheets, and a graphics file of all field survey data.

3. Property Description Submittals

   a. Preliminary Property Description Submittals

      the preliminary Property Description(s) for review purposes marked "Preliminary – Not to be used for recording purposes", and an electronic copy of each Property Description in PDF format.

      The ROW (ArcGIS) database template "ROW_Parcels_Edits" populated with the preliminary parcels, alignment, and project control points in ArcGIS 10.6.1 format or the current version in use by TxDOT.

   b. Final Property Description Submittals

      the final Property Description(s) showing the metes and bounds descriptions and parcel plats, signed and sealed by a RPLS, and the associated electronic files in PDF and Word formats.

      Bentley MicroStation parcel plat graphics files and master reference files (MRF).

      The ROW (ArcGIS) database template "ROW Parcels Edits" populated with the final parcels, final alignment, and project control points in ArcGIS 10.6.1 format or the current version in use by the State.

4. ROW Map Submittals

   a. Preliminary ROW Map Submittals

PDF format of the preliminary ROW map with the note “Preliminary – Not to be used for recording purposes”, and the associated MicroStation graphics files.

b. Final R.O.W. Map Submittals

PDF format of the final ROW map, and the associated Bentley MicroStation and GIS graphics files.

5. Two A-size paper copies of the ROW project cover sheet and the associated Word document file.

6. QA/QC

Documentation stating that the appropriate monuments were set on the proposed ROW lines at intersecting property lines, PC’s, PT’s, angle points, ROW lines of side streets .

Documentation stating that the appropriate monuments were set on the existing ROW lines in areas of no acquisition at intersecting property lines, PC’s, PT’s, angle points, ROW lines of side streets .

A copy of TxDOT’s ROW map checklist signed by the surveyor, if required.

A copy of the surveyor’s report signed by the surveyor.

130.3. State Land Surveying (15.5.1).

State Land Surveying consists of the following activities when the resulting field notes or maps are to be filed with the General Land Office: (1) determining by survey the location or relocation of original land grant boundaries and corners; (2) calculating area and the preparing field note descriptions of surveyed and un-surveyed land or any land in which the state or the permanent school fund has an interest; (3) the preparation of maps showing such survey results. (Reference: Tex. Occ. Code §1071.002(8)).

A. Purpose

The purpose of state land surveying is to survey all state-owned real property under the management of the General Land Office (GLO) or the School Land Board (SLB), to be used by the State for highway purposes.

A survey performed by a Texas Registered Professional Land Surveyor (RPLS) is acceptable except in those circumstances in which the anticipated improvements may cause permanent shoreline alteration or other change or modification of a GLO property shoreline boundary. In such cases, a coastal boundary survey in the form and manner provided by Section 33.136, Texas Natural Resources Code, must be performed by a Texas Licensed State Land Surveyor (LSLS).

B. Tasks to be Completed by a Licensed State Land Surveyor

When requested by the State, the Surveyor shall provide state land surveying services. State land surveying services include the following:

1. Surveying coastal and water boundaries, navigable streams or rivers, and other waters that are tidally affected and that require the

determination of the gradient boundary or the mean high water, as appropriate.

2. Surveying the profile of the waterway, along the proposed baseline of the highway.

3. Surveying original land grant boundaries and un-surveyed lands.

4. Preparing field note descriptions, area calculations, parcel plats, and update to the current ROW maps, to be filed in the GLO.

C. Ground Control Accuracy Standards

The Surveyor shall provide:

1. Horizontal ground control in accordance with the current project datum.

2. Vertical ground control in accordance with the current project datum.

D. Deliverables For State Land Surveying

The Surveyor shall prepare all deliverables and presentations according to current ROW mapping standards.

130.4. ROW Hearing Services.

A. ROW Hearing Services

The Engineer shall prepare color exhibits for eminent domain hearing cases (assume XX exhibits). The exhibits must depict the subject property boundaries and the proposed ROW acquisition shown on an aerial map background. The exhibits must also show the pavement edges, drainage or other structures, and driveways.

The Engineer shall prepare for the eminent domain hearings by reviewing the approved design schematic and associated reports, cross-sections, ROW maps, and pertinent plan sheets provided by others, including those showing roadway, bridge, grading, drainage, signals, signs, intelligent transportation systems (ITS), illumination, traffic control plan, and other elements or data.

The Engineer shall attend by teleconference pre-hearings (assume XX meetings) for eminent domain proceedings. The Engineer shall also attend, in person, pre-hearings (assume XX meetings) for eminent domain proceedings near the project location.

Deliverables include all services and documents stated in this section.

B. Expert Witness Services

The Engineer shall attend and provide expert witness services for eminent domain hearings (assume XX hearings) . Assume that hearings, on average, last no longer than four hours.

The Engineer shall prepare for and provide expert testimony in eminent domain trial cases (assume XX trials) at the county courthouse near the project location. Preparation includes developing color exhibits, reviewing material, and providing depositions. Assume that depositions, on average, last no longer than four hours and that trial cases, on average, last no longer than two days.

Deliverables include all services and documents stated in this section.

130.5. Access Management.
The Engineer shall coordinate and evaluate access management within the project limits in accordance with the latest TxDOT *Access Management Manual* or as directed by the State.

DEL.130. Deliverables for FC 130.

A. Scanned copies of the ownership documents in PDF format

B. An electronic copy in PDF format of the abstract map and the associated MicroStation graphics DGN files

C. Spreadsheet showing property owners and right of entry information in Excel format

D. Scanned copies of the field notes, control data sheets and a graphics file of all field survey data in PDF format.

E. An electronic copy in PDF format of the preliminary property descriptions

F. Preliminary ROW (ArcGIS) database template populated with the preliminary parcels, alignment, and project and project control points in the current version of ArcGIS in use by TxDOT

G. An electronic copy in PDF format final property descriptions, signed and sealed by an RPLS, and the associated electronic files in Word formats

H. Bentley MicroStation parcel plat graphics DGN files and master reference files (MRF)

I. Final ROW (ArcGIS) database template populated with the final parcels, final alignment, and project control points in the current version of ArcGIS in use by TxDOT

J. An electronic copy in PDF format of the preliminary ROW map and the associated MicroStation and GIS graphics files

K. An electronic copy in PDF format of the final ROW map and the associated MicroStation and GIS graphics files

L. An electronic copy in PDF format ROW project cover sheet and the associated Word document file.

M. Documentation stating that the appropriate monuments were set on the existing and proposed ROW lines

N. A copy of TxDOT's ROW map checklist signed by the surveyor in PDF format

O. A copy of the surveyor's report signed by the surveyor in PDF format

FUNCTION CODE 135 (135) – RIGHT-OF-WAY – UTILITY ACTIVITIES

RIGHT-OF-WAY UTILITY ACTIVITIES

135.1. Utility Engineering Investigation.
Utility engineering investigation includes utility investigations subsurface and above ground prepared in accordance with ASCE/CI Standard 38-02

[(http://www.fhwa.dot.gov/programadmin/asce.cfm)] and Utility Quality Levels.

A. Utility Quality Levels (QL)

Utility Quality Levels are defined in cumulative order (least to greatest) as follows:

1. Quality Level D - Quality level value assigned to a utility segment or utility feature after a review and compilation of data sources such as existing records, oral recollections, locations marked by DIGTESS, and data repositories.
2. Quality Level C - Quality level value assigned to a utility segment or utility feature after surveying aboveground (i.e., visible) utility features and using professional judgement to correlate the surveyed locations of these features with those from existing utility records.
3. Quality Level B - Designate: Quality level value assigned to a utility segment or subsurface utility feature whose existence and position is based upon appropriate surface geophysical methods combined with professional judgment and whose location is tied to the project survey datum. Horizontal accuracy of Designated Utilities is 18” (including survey tolerances) unless otherwise indicated for a specific segment of the deliverable. Quality Level B incorporates quality levels C and D information. A composite plot is created.
4. Quality Level A – Quality level value assigned to a portion (x, y, and z geometry) of a point of a subsurface utility feature that is directly exposed, measured, and whose location and dimensions are tied to the project survey datum. Other measurable, observable, and judged utility attributes are also recorded (per District Best Practices). The utility location must be tied to the project survey datum with an accuracy of 0.1 feet (30-mm) vertical and to 0.2 feet (60-mm) horizontal. As test holes may be requested up front or during the project, test holes done prior to completion of QL D, C, or B deliverables must be symbolized on the QL B deliverable with a call out indicating test holes number. This is in addition to and not in lieu of the test hole.

B. Utility Investigations Methodology

1. Utility Investigation Quality Level D

   The Engineer shall:

   a. Perform records research from all available resources. Sources include: Texas811, Railroad Commission of Texas (Texas RRC), verbal recollection, as-built information from plans, plats, permits and any other applicable information provided by the utility owners or other stakeholders.
   b. Document utility owners and contact information.
   c. Create a utility base map drawing of information gathered.

2. Utility Investigation Quality Level C

   The Engineer shall:

   a. In combination with existing Quality Level D information, utilize surveyed above-ground utility features and professional judgement

to upgrade Quality Level D information to Quality Level C. For those utilities unable to be upgraded, retain as Quality Level D.

b. Overhead utilities information must be gathered and depicted. Sag elevations of lowest utility must be documented at road crossings, per best practices document.

c. Storm and sanitary sewer information must be gathered from Level D and upgraded to Level C as possible, unless otherwise directed by the state.

d. Mapping of underground vaults may be requested by the state.

e. Create composite utility base map drawing of information gathered.

3. Designate (Quality Level B)

Designate means to indicate the horizontal location of underground utilities by the application and interpretation of appropriate non-destructive surface geophysical techniques and reference to established survey control. Designating (Quality Level B) services are inclusive of Quality Levels C and D.

The Engineer must:

a. As requested by the State, compile "as-built" information from plans, plats and other location data as provided by the utility owners.

b. Coordinate with utility owner when utility owner's policy is to designate their own facilities at no cost for preliminary survey purposes. The Engineer shall examine utility owner's work to ensure accuracy and completeness.

c. Designate, record, and mark the horizontal location of the existing utility facilities using non-destructive surface geophysical techniques.

d. Using both active and passive scans to attempt to locate any additional utilities, including unrecorded and abandoned storm and sanitary sewer facilities, at the direction of the state, may be investigated using additional methods such as rodding that would then classify them as Quality Level B. A non-water based pink paint or pink pin flags must be used on all surface markings of underground utilities.

e. Correlate utility owner records with designating data and resolve discrepancies using professional judgment. The Engineer must prepare and deliver to State a color-coded composite utility facility plan with utility owner names, quality levels, line sizes and subsurface utility locate (test hole) locations. The Engineer and State acknowledge that the line sizes of designated utility facilities detailed on the deliverable will be from the best available records and that an actual line size is normally determined from a test hole vacuum excavation. A note must be placed on the designate deliverable only that states "lines sizes are from best available records". All above-ground utility feature locations must be included

in the deliverable to the State. This information must be provided in the latest version of MicroStation and be fully compatible with OpenRoads civil design system used by the State. The Engineer shall deliver the electronic file on USB flash drive, as requested by the State. A hard copy is required and must be signed, sealed, and dated by the registered engineer overseeing the utility engineering investigation. When requested by the State, the designated utility information must be over laid on the State's design plans.

f. Determine and inform the State of the approximate electronic utility depths at critical locations as determined by the State. The limits of this additional information should be determined and agreed upon prior to the commencement of work. This depth indication is understood by both the Engineer and the State to be approximate only and is not intended to be used preparing the ROW and construction plans.

g. Provide a monthly summary of work completed and in process with adequate detail to verify compliance with agreed work schedule. More frequent updates may be requested by the State.

h. Close-out permits as required.

i. Clearly identify all utilities that were discovered from Quality Levels C and D investigation but cannot be depicted in Quality Level B standards. These utilities must have a unique line style and symbology in the designate (Quality Level B) deliverable.

j. Comply with all applicable TxDOT policy and procedural manuals.

4. Subsurface Utility Locate (Test Hole) Service (Quality Level A)

Locate is the process used to obtain precise horizontal and vertical position, material type, condition, size, and other data that may be obtainable about the utility facility and its surrounding environment through exposure by non-destructive excavation techniques that ensures the integrity of the utility facility. Subsurface Utility Locate (Test Hole) Services (Quality Level A) are inclusive of Quality Levels B, C, and D.

The Engineer must:

a. Review requested test hole locations and advise the State in the development of an appropriate locate (test hole) work plan relative to the existing utility infrastructure and proposed highway design elements.

b. Coordinate with utility owner inspectors as may be required by law or utility owner policy.

c. Place Texas 811 ticket 48 hours prior to excavation.

d. Neatly cut and remove existing pavement material, such that the cut does not exceed 0.10 square meters (1.076 square feet) unless unusual circumstances exist.

e. Measure and record the following data on an appropriately formatted test hole data sheet that has been sealed and dated by the Engineer:

   (1) Elevation of top of utility tied to the datum of the furnished plan.

   (2) Minimum of two benchmarks utilized. Elevations must be within an accuracy of 15mm (.591 inches) of utilized benchmarks.

   (3) Elevation of existing grade over utility at test hole location.

   (4) Horizontal location referenced to project coordinate datum.

   (5) Outside diameter of pipe or width of duct banks and configuration of non-encased multi-conduit systems.

   (6) Utility facility materials.

   (7) Utility facility condition.

   (8) Pavement thickness and type.

   (9) Coating/wrapping information and condition.

   (10) Unusual circumstances or field conditions.

f. Excavate test holes in such a manner as to prevent any damage to wrappings, coatings, cathodic protection, and other protective coverings and features. Water excavation can only be utilized with written approval from the appropriate TxDOT district office.

g. Be responsible for any damage to the utility during the locating process. In the event of damage, the Engineer must stop work, notify the appropriate utility facility owner, the State, and appropriate regulatory agencies. The regulatory agencies include: the Railroad Commission of Texas and the Texas Commission on Environmental Quality. The Engineer shall not resume work until the utility facility owner has determined the corrective action to be taken. The Engineer is liable for all costs involved in the repair or replacement of the utility facility.

h. Back fill all excavations with appropriate material, compact backfill by appropriate mechanical means, and restore pavement and surface material. The Engineer is responsible for the integrity of the backfill and surface restoration for a period of three years.

i. Furnish and install a permanent above-ground marker (as specified by the State, directly above center line of the utility facility.

j. Provide complete restoration of work site and landscape to equal or better condition than before excavation. If a work site and landscape is not appropriately restored, the Engineer shall return to correct the condition at no extra charge to the State.

k. Plot utility location position information to scale and provide a comprehensive utility plan signed and sealed by the responsible professional engineer. This information must be provided in the

latest version of MicroStation and be fully compatible with the OpenRoads civil design system used by the State. The electronic file will be delivered on USB flash drive as requested. When requested by the State, the locate information must be over laid on the State's design plans.

l. Return plans, profiles, and test hole data sheets to the State. If requested, conduct a review of the findings with the State.

m. Close-out permits as required.

135.2. Utility Engineering Investigation (Subsurface Utility Engineering (SUE)).

A. Existing Records (Quality Level D)

The Engineer shall:

1. Perform records research from all available resources. Sources might include: Texas811, Railroad Commission of Texas (Texas RRC), verbal recollection, as-built information from plans, plats, permits and any other applicable information provided by the utility owners or other stakeholders.
2. Document utility owners and contact information
3. Create a utility drawing of information gathered

B. Surface Visible Feature Survey (Quality Level C)

The Engineer shall:

1. In combination with existing Quality Level D information, utilize surveyed above-ground utility features and professional judgement to upgrade Quality Level D information to Quality Level C. For those utilities unable to be upgraded, retain as Quality Level D.
2. Gather and depict overhead utilities information. Sag elevations of lowest utility must be documented at road crossings, per best practices document
3. Gather storm and sanitary sewer information from Level D and upgrade to Level C as possible, unless otherwise directed by the State
4. Include mapping of underground vaults
5. Create composite utility drawing of information gathered

C. Designate (Quality Level B)

The Engineer shall:

1. Compile as-built information from plans, plats, and other location data as provided by the utility owners
2. Coordinate with utility owner when utility owner's policy is to designate their own facilities at no cost for preliminary survey purposes. Examine utility owner's work to ensure accuracy and completeness
3. Designate, record, and mark the horizontal location of the existing utility facilities and their service laterals to existing buildings using non-destructive surface geophysical techniques. No storm sewer facilities are to be designated unless authorized by the State. Use a non-water base

paint, utilizing the American Public Works Association (APWA) color code scheme, on all surface markings of underground utilities.

4. Correlate utility owner records with designating data and resolve discrepancies using professional judgment. Prepare and deliver to the State a color-coded composite utility facility plan with utility owner names, quality levels, line sizes and subsurface utility locate (test hole) locations. Deliver the electronic file in a format acceptable to the State. Submit a hard copy of the utility facility plan that has been signed, sealed, and dated by the Engineer to the State. When requested by the State, overlay the designated utility information on the State's design plans.
5. Determine and inform the State of the approximate utility depths at critical locations as determined by the State
6. Provide a monthly summary of work completed and in process with adequate detail to verify compliance with agreed work schedule
7. Close-out permits as required and provide documentation of close-out to the State.
8. Clearly identify all utilities that were discovered from quality levels C and D investigation that cannot be depicted in quality level B standards. These utilities must have a unique line style and symbology in the designate (Quality Level B) deliverable.
9. Comply with all applicable State policy and procedural manuals

D. Subsurface Utility Locate (Test Hole) Service (Quality Level A)

The Engineer shall:

1. Determine appropriate test hole locations and advise the State of an appropriate locate (test hole) work plan relative to the existing utility infrastructure and proposed highway design elements.
2. Coordinate with utility owner inspectors as required by law or utility owner policy.
3. Measure and record the following data on an appropriately formatted test hole data sheet that has been sealed and dated by the Engineer:
    a. Elevation of top and bottom of utility tied to the datum of the furnished plan
    b. Minimum of two benchmarks utilized. Elevations must be within an accuracy of 15mm (.591 inches) of utilized benchmarks
    c. Elevation of existing grade over utility at test hole location
    d. Horizontal location referenced to project coordinate datum
    e. Outside diameter of pipe or width of duct banks and configuration of non-encased multi-conduit systems
    f. Utility facility material
    g. Utility facility condition
    h. Pavement thickness and type

i. Coating/wrapping information and condition

j. Unusual circumstances or field conditions

4. Excavate test holes in such a manner as to prevent any damage to wrappings, coatings, cathodic protection, and other protective coverings and features. Water excavation must not be utilized without prior written approval from the appropriate TxDOT district office.

5. Back fill all excavations with appropriate material, compact backfill by mechanical means, and restore pavement and surface material. The Engineer is responsible for the integrity of the backfill and surface restoration for a period of three years. Install a marker ribbon throughout the backfill.

6. Furnish and install a permanent above ground marker (as specified by the State, directly above center line of the utility facility.

7. Neatly cut and remove existing pavement material. Provide complete restoration of worksite and landscape to equal or better condition than before excavation. If a worksite and landscape is not appropriately restored, the Engineer shall return to correct the condition at no extra charge to the State.

8. Submit plans, profiles, and test hole data sheets to the State. Conduct a review of the findings with the State.

9. Close-out permits as required

10. Plot utility location position information to scale and provide a comprehensive utility plan signed and sealed by the responsible engineer.

135.3. Utility Adjustment Coordination.

The Engineer shall provide utility adjustment coordination services including utility coordination meetings with individual utility companies, communication and coordination with utilities, and preparation of utility agreement assemblies including utility agreements, joint use agreements, and advanced funding agreements.

A. Utility Coordination

The Utility Coordinator must perform utility coordination and liaison activities with involved utility owners, their consultants, and the State to achieve timely project notifications, formal coordination meetings, conflict analysis, and conflict resolution.

1. The Utility Coordinator must coordinate all activities with the State, or their designee, to facilitate the orderly progress and timely completion of the State design phase. The Utility Coordinator must:

a. Work Plan.

Coordinate a work plan including a list of the proposed meetings and coordination activities, and related tasks to be performed, a schedule and an estimate

b. Orientation.

Prepare and present, in collaboration with State staff, instruction and orientation sessions as required by the State. The instruction must introduce the subsurface utility engineering process, demonstrate the technology, and facilitate the preparation of work orders, billings, and contract related documentation.

c. Initial Project Meeting.

Attend an initial meeting and an on-site inspection (when appropriate) to ensure familiarity with existing conditions and project requirements and prepare a written report of the meeting.

d. External Communications.

Coordinate all activities with the State and its engineering contractors and other contractors or representatives, as authorized by the State. Provide the State copies of diaries, correspondence and other documentation of work-related communications between the Utility Coordinator, utility owners and other outside entities when requested by the State.

e. Permits and rights of entry.

Obtain all necessary permits from city, county, municipality, railroad, or other jurisdiction to allow the Engineer to work within existing streets, roads, or private property for additional designating and subsurface utility locating.

f. Progress Meetings.

Implement a schedule of periodic meetings with each utility company and owner or owner's representatives for coordination purposes. Such meetings must commence as early as possible in the design process and continue until completion of the project. Notify the State at least two business days in advance of each meeting to allow the State the opportunity to participate in the meeting. Provide and produce meeting minutes of all meetings with utility companies, owners or owners' representatives within seven business days. The frequency of meetings must be appropriate to the matters under discussion with each utility owner.

2. The Utility Coordinator must coordinate with the local utilities committees to present a footprint of the State's projects with represented utility companies and owners. If needed, the Utility Coordinator must coordinate with any other utility committees which might include county, city, or other officials.

3. The Utility Coordinator must provide initial project notification letters (NOPC) and U-NORA letters to all affected utility companies, owners, and other concerned parties.

4. The Utility Coordinator must provide the State and all affected utility companies and owners a utility contact list for each project with all information such as:

a. Owner's Name

b. Contact Person

c. Telephone Numbers

d. Emergency Contact Number

e. E-mail addresses

f. All pertinent information concerning their respective affected utilities and facilities, including, at a minimum: size, number of poles, material, and other information that readily identifies the facilities of the utility company.

5. The Utility Coordinator must provide a utility conflict matrix (UCM) as part of the final schematic.

6. The Utility Coordinator must provide a utility conflict matrix (UCM) as part of the 30% submittal for PS&E.

7. The Utility Coordinator must provide Utility layouts and exhibits as part of the final schematic or as part of the 30% submittal for PS&E.

8. The Utility Coordinator must advise utility companies and owners of the general characteristics of the Project and provide an illustration of the project footprint for mark-up of the utility facility locations that occupy the project area.

9. The Utility Coordinator must update the established utility conflict matrix (UCM) throughout PS&E and maintain a utility layout in the current approved version of OpenRoads Civil Design system used by TxDOT. This layout must include all existing utilities that are to remain in place or be abandoned, and all adjusted utilities. This layout must be utilized to monitor the necessity of relocation and evaluate alternatives.

B. Utility Agreements for Utility Adjustments.

The Utility Coordinator must coordinate with utilities that conflict with highway construction or the Utility Accommodation Rules (UAR) and make the utility company aware of these conflicts. The Utility Coordinator must assist the utility companies in the preparation of required agreements associated with the funding of adjustments and the occupation of State right of way.

1. Utility Agreement Assemblies: a packaged agreement consisting of a utility joint use acknowledgement, standard utility agreements, plans on 11x17 sheets, Statement of contract work form, affidavit form and copy of recorded easement, schedule of work and various attachments as detailed in the UAR and the TxDOT *ROW Utilities Manual*.

2. The Utility Coordinator must electronically submit the executed copies of the utility agreement assemblies, which include the appropriate forms as detailed in the UAR and supplied by the State, a copy of the recorded easement deed, plans, and estimate to the State by letter recommending approval. The transmittal must also provide a description of the work being done as well as the estimated cost and schedule of work. The transmittal letter for each submittal must include the following statement "The proposed utility adjustment will not conflict with proposed highway construction and will comply with UAR. The utility should be reimbursed

eligible costs incurred within their easement limits for replacement in kind.

The Utility Coordinator must determine which utilities will be installed by agreement between the utility and State. The Utility Coordinator must process all form Joint Use Agreement Acknowledgement (ROW-U-JUAA) forms and utility agreements, determine necessity of any escrow agreements, and forward to the State for final approval.

The Engineer, with the assistance of the Utility Coordinator, shall be responsible for the timely coordination, review, and submittal of all documentation to be included in all the utility agreements. The Engineer, with the assistance of the Utility Coordinator, shall assist in the preparation, compilation, gathering, and collection of all required and supporting documents to be included with the Utility Agreements.

3. For each Utility, the Utility Coordinator must obtain the records for all utility owners' costs, in a format that is compatible with the estimate attached to the utility adjustment agreement and with sufficient detail for analysis. The totals for labor, overhead, construction costs, travel, transportation, equipment, materials, supplies and other services shall be shown in such a manner as to permit comparison with the approved estimate.

   The Engineer shall maintain a complete set of records for all utility adjustment costs for each utility for a period of time sufficient to complete all final payments to the utility companies or owners.

135.4. Utility Adjustment Monitoring and Verification.

A. The Engineer shall schedule a pre-construction meeting for each utility adjustment for which the Engineer is required to perform field verification and inspection duties. The Engineer shall ensure the necessary State representatives are present.

B. Verification:

1. The Utility Engineer must field verify all utility adjustments to ensure that the new facilities are located according to plans, specifications, and the Proposed Utility Layout. This shall include all surveying and right of way staking as needed to clear the proposed construction.

2. The Utility Engineer must ensure that the utility is in compliance with the *TMUTCD*, "Storm Water Pollution Prevention Plan" (SW3P), backfill specifications, and restoration of right of way upon completion of work.

C. Status Reports:

The Engineer shall provide the State with a status report for all utility adjustments on a monthly basis. The State will provide the status report format to the Engineer.

D. Review Payment Request:

The Engineer shall review all payment requests for conformance with the utility estimate and verify the work has been performed.

E. As-Installed Drawings and GPS File:

The Engineer shall, in accordance with the work authorization, provide a GPS file showing all bends, installation types, casings, and above ground appurtenances of the as-installed utility. This file must be supplied upon completion of the utility work in a format specified by the State. The drawings and GPS files must also include all utility adjustments and installations that are not to be constructed as a part of the highway project. A set of 11" x 17" as-installed drawings, signed and sealed by the Engineer along with the electronic files, transmitted in a manner acceptable to the State, shall be submitted prior to final payment and acceptance of all utility coordination activities.

DEL.135. Deliverables for FC 135.

. The Engineer shall provide the following:

1. Utility Contact List
2. NOPC letters – to be delivered electronically
    a. ROW_U_NOPC letter template signed by TxDOT PM
    b. Notice of Utility Coordination for Upcoming Project,
    c. Use DocuSign to confirm receipt
3. Utility Conflict Matrix – Austin District templates to use as a guide
4. Existing Utility Layout - depicting SUE QL-D, C, B, & A, along with stationing and roadway improvements, Microstation V8 dgn file, Google Earth (.kmz) file and 11” x 17” plan sets electronic copy (.pdf) for TxDOT review with
    a. separate line styles for QLD- C/D and QLD-B,
    b. industry accepted color codes for each utility type;
    c. include legend on each page denoting utility owners;
    d. Each linear foot of Level C & D should include records research and survey of above ground appurtenances such as overhead utility poles, water valves, telecom pedestals, gas line vents and markers.
        i. Attached telecoms should be considered as part of the Level C & D level of effort. Additional survey time may be required to determine attached telecom owners.
        ii. Quantity (linear feet) of Level C & D and Level B for each utility should be noted in a table on each page.
        iii. *Use of survey data by others is not an acceptable substitution for this level of effort.*
    e. utility conflict numbers labeled to match conflict matrix,
    f. Final existing layout sheets should be signed & sealed
5. Cross Sections – Existing utilities to be referenced into proposed cross sections at known distance from ROW due to Level B SUE, depth to be assumed from UAR required minimum depth of cover.
6. Final SUE Test Hole Data Sheets - signed & sealed
7. Proposed Utility Layout - showing existing, abandoned, removal and proposed facilities, as a Microstation V8 dgn file, Google Earth (.kmz) file depicting each proposed location (location from ROW and other utilities),
and 11” x 17” plan sets electronic copy (.pdf)
8. NORA Letters – to be delivered electronically
    a. Use DocuSign to confirm receipt
    b. Include Austin District clearance letter ready for signature
9. Standard Utility Agreement (SUA) - use the most up-to-date version of Austin District standard utility agreement fillable form template (.pdf)

a. Standard Estimate Tool (MS Excel cost estimate template) - must be used to prepare cost estimates included in standard utility agreements.
b. Existing-Proposed Table Exhibit- created in Microsoft Excel, a table that lists the material types, sizes and quantities of the Existing and the Proposed utility facilities, and has cross-references to the utility plan sheets.
c. Advanced approval required for UAR exceptions, Forced Betterment, and Easement Values prior to agreement draft submission.
d. SUA Checklist for Consultants- required to be completed and submitted with all standard utility agreement drafts.

10. Utility Records/As-Builts obtained from utility owners
11. Copies of diaries, correspondence and other work-related communication documentation
12. All meeting minutes (delivered electronically)
13. Invoices and monthly progress reports
14. Notification of demobilization
15. As-installed utility drawings and GPS file

FUNCTION CODE 145 (145, 164) – MANAGING CONTRACTED/DONATED PE

PROJECT MANAGEMENT AND ADMINISTRATION

145.2. Contract Management and Administration.

The Engineer shall:

A. Act as an agent for the State.

B. Produce a complete and acceptable deliverable for each environmental service performed for environmental documentation.

C. Incorporate environmental data into identification of alternatives.

D. Notify the State of its schedule, in advance, for all field activities.

E. Notify the State as soon as practical, by phone and in writing, if performance of environmental services discloses the presence or likely presence of significant impacts (in accordance with 40 Code of Federal Regulations (CFR) 1500-1508). Inform the State of the basis for concluding there are significant impacts and the basis for concluding that the impacts might require mitigation.

F. Notify the State as soon as practical, by phone and in writing, if performance of environmental services results in identification of impacts or a level of controversy that might elevate the transportation activity's status from a categorical exclusion or environmental assessment. The State will reassess the appropriate level of documentation.

145.3. Project Management and Administration

The Engineer, in association with the State's Project Manager shall be responsible for directing and coordinating all activities associated with the project to comply with State policies and procedures, and to deliver that work on time.

A. Project Coordination

The Engineer shall coordinate all subconsultant activity to include quality and consistency of deliverables and monthly progress reports. The Engineer shall coordinate with necessary local entities.

B. Project Management

The Engineer shall manage activities including preparing correspondence and progress reports; and reviewing schedules.

The Engineer shall:

1. Prepare monthly written progress reports for each project.
1. Prepare and submit a project quality management plan.
3. Develop and maintain a detailed project schedule to track project conformance to Exhibit C – Work Schedule. The schedule submittals shall be electronic format.
4. Meet on a scheduled basis with the State to review project progress.
5. Prepare, distribute, and file both written and electronic correspondence.
6. Prepare and distribute meeting minutes.
7. Document phone calls and conference calls as required during the project to coordinate the work for various team members.
8. If at any time during the contract period, the Engineer encounters unforeseen circumstances that may materially affect the scope, complexity, or character of the work authorized by the State, the Engineer shall notify the State in writing immediately with a complete description of the circumstances encountered.

DEL.145. Deliverables for FC 145.

. Quality management plan

A. Monthly progress reports

B. Project schedule, updated monthly

C. Meeting minutes

D. Documentation of phone calls

FUNCTION CODE 160 (150) – ROADWAY DESIGN

DESIGN SURVEYS

150.1. Design Survey.

A. Definitions

1. Design Survey (15.2.1)

A design survey gathers data in support of transportation systems design. A design survey includes the research, field work, analysis, computation, and documentation necessary to provide detailed topographic (3-dimensional) mapping of a project site (e.g. locating

existing ROW, surveying cross-sections or developing data to create cross-sections and digital terrain models, horizontal and vertical location of utilities and improvements, collecting details of bridges and other structures, review of ROW maps, establishing control points).

B. Technical Requirements for Design Surveys

1. Design surveys surveys must be performed under the supervision of a RPLS currently registered with the TBPELS.

2. All control must meet the of accuracy requirements of the State.

   The Surveyor shall comply with the standards of accuracy for control traverses provided in the *TxDOT Survey Manual* or the *TSPS Manual of Practice for Land Surveying in the State of Texas*, as may be applicable.

3. Short traverse procedures used to determine horizontal and vertical locations must meet the following criteria:

   a. Short traverses must begin and end on horizontal and vertical ground control as described above.

   b. Required horizontal accuracy (unless otherwise stated):

      (1) Bridges and other roadway structures: less than 0.1 feet.

      (2) Utilities and improvements: less than 0.2 feet.

      (3) Cross-sections and profiles: less than 1 foot.

      (4) Bore holes: less than 3 feet.

   c. Required vertical accuracy:

      (1) Bridges and other roadway structures: less than 0.02 feet.

      (2) Utilities and improvements: less than 0.1 feet.

      (3) Cross-sections and profiles: less than 0.2 feet.

      (4) Bore holes: less than 0.5 feet.

C. Data Requirements for Design Surveys

1. Planimetric DGN files must be fully compatible with the version of the MicroStation graphics program currently used by TxDOT without further modification or conversion.

2. Electronically collected and processed field survey data files must be fully compatible with TxDOT's computer systems without further modification or conversion. All files must incorporate only those feature codes currently being used by TxDOT.

3. Digital terrain models (DTMs) must be fully compatible with the version of the Bentley OpenRoads civil design system currently used by TxDOT without further modification or conversion. All DTM must be fully edited to provide a complete digital terrain model with all necessary break lines.

150.2. Design Survey (15.2.1).

A. Tasks to be Completed – Design Surveys

If requested by the State, the Surveyor shall perform one or more Design Surveys. Design Survey tasks include the following:

1. Collect data to create cross-sections and DTMs.
2. Locate existing utilities.
3. Locate existing improvements.
4. Provide details of existing bridge structures, including bridge limits, bents, columns, retaining walls, and natural ground elevations.
5. Locate details of existing drainage features including culverts, manholes, retention and detention ponds, flowlines, and associated features.
6. Locate all waters of the United States (WOTUS), including wetlands.
7. Review existing ROW maps and locate the existing ROW.
    a. Review existing ROW maps

        The Surveyor shall review ROW maps prepared by others for completeness using the current schematic and the checklist provided by the TxDOT district.

    b. Locate existing ROW

        The Surveyor shall resurvey the existing ROW where it is necessary to update or redefine ROW lines. All standard surveying procedures must be adhered to including record research, recovering existing monuments, and replacing monuments as appropriate. The Surveyor shall prepare an abstract map, preliminary map, final map, GIS graphics file, and a Surveyor's report. The final map must also include a monument table showing the property monuments that were found and set, and certified by the Surveyor. The Surveyor shall prepare maps either in standard map sheets format or roll map format as requested by the TxDOT district.
8. Locate boreholes.
9. Perform hydrographic surveys, according to details requested by the TxDOT district.
10. Verify the condition and usefulness of existing control points including verification of the values. Establish additional control as needed. Tie to other control points in the project vicinity including points established by the National Geodetic Survey (NGS), the Federal Emergency Management Agency (FEMA), and any other local entities as directed by the State.
11. Update existing control information and prepare new survey control data sheets, as directed by the State to be included in the construction plan set as described below:
    a. The Surveyor shall prepare, sign, seal, and date a survey control index sheet and horizontal and vertical control sheet(s) to be inserted into the plan set.

b. The survey control index sheet provides an overview of the primary project control and must include:

(1) An unscaled vicinity map showing the general location of the project in relation to nearby towns or other significant cultural features.

(2) A scaled project map showing the extents of the project and the location of the primary control points. The map must show street networks, selected street names, control point identification, and significant cultural features necessary to provide a general location of the primary control.

(3) A table containing the primary control point values including the point number, northing, easting, elevation, stationing, and stationing offset values.

(4) Map annotation including a graphic scale bar, north arrow, and standard TxDOT title block. The title block shall contain a section for the district name, county, highway, and CSJ number. The title block shall also contain a section for a Texas registered engineer to sign, seal and date the sheet to include the following statement, “The survey control information has been accepted and incorporated into this PS&E.” The required format of the survey control index sheet can be downloaded from the TxDOT website.

(5) In the title block under the heading “Notes”, identification of the horizontal and vertical datum on which the primary control is based with the date of the current adjustment, the surface adjustment factor used, and unit of measure. The Surveyor shall include a note stating that the coordinates are State Plane and a notation specifying either grid or surface adjusted coordinates.

c. The Surveyor shall prepare horizontal and vertical control sheets providing detailed information about the construction, location, and monumentation of the primary control, which must include:

(1) An unscaled location map for each primary control point showing the location of the monument in relation to physical features located in the vicinity. The location map must include a north arrow, the monument designation, the monument northing, easting, and elevation.

(2) Directly below the location map a text description of the monument including size, material, and construction followed by a description of the location of the monument starting with the county and state followed by a description suitable to locate the monument on the ground.

(3) Map annotation including a graphic scale bar, north arrow, and a standard TxDOT title block. The title block must contain a section for the district name, county, highway, and CSJ number and contain a section for a Texas registered

engineer to sign, seal and date the sheet to include the following statement, “The survey control information has been accepted and incorporated into this PS&E.” The required format of the survey control index sheet can be downloaded from the TxDOT website.

(4) In the title block under the heading “Notes”, identification of the horizontal and vertical datum on which the primary control is based with the date of the current adjustment, the surface adjustment factor used, and unit of measure. The Surveyor shall include a note stating that the coordinates are either grid or surface adjusted coordinates.

150.3. Construction Survey (15.2.2) (OMITTED)

150.4. Deliverables for Design Surveys.

The Surveyor shall prepare and submit the deliverables as specified in individual work authorizations for design surveys and construction surveys. The deliverables might be any combination of the following:

A. Digital terrain models (DTM) and the triangular irregular network (TIN) files in a format acceptable by the State.

B. Maps, plans, or sketches prepared by the Surveyor showing the results of field surveys.

C. Computer printouts or other tabulations summarizing the results of field surveys.

D. Digital files or media acceptable by the State containing field survey data (ASCII data files).

E. Maps, plats, plans, sketches, or other documents acquired from utility companies, private corporations, or other public agencies, the contents of which are relevant to the survey.

F. Field survey notes, as electronic copies.

G. TxDOT Form 2462 for each primary and secondary control point. This form must be submitted electronically in PDF format.

H. A digital copy of all computer printouts of horizontal and vertical conventional traverses, GPS analysis and results, and survey control data sheets.

I. All GEOPAK files and OpenRoad files.

J. Survey reports in a format requested by the State.

150.5. Mapping (15.3).

Mapping includes the geospatial data collection and mapping by means of aerial photogrammetry, terrestrial (close range) photogrammetry, terrestrial LiDAR, mobile LiDAR, aerial LiDAR and other remote sensing technologies.

A. Purpose

The purpose of mapping is to provide map and related data to support transportation projects including project design and other uses.

B. Definitions

1. Aerial Photogrammetry (15.3.1) – Aerial Photogrammetry means the collection and processing of photography acquired from an airborne platform to develop DGN and DTM files.
2. Terrestrial Photogrammetry (15.1.2) – Terrestrial Photogrammetry means the collection and processing of photography acquired at or near ground level to develop DGN and DTM files.
3. Airborne LiDAR (15.3.4) – Airborne LiDAR means laser scanning equipment mounted on a helicopter or other airborne platform to collect data to process for DGN and DTM files.
4. Terrestrial LiDAR (15.3.3) – Terrestrial LiDAR means laser scanning equipment operated from a stationary base on the earth's surface to collect data to process for DGN and DTM files.
5. Mobile LiDAR (15.3.4) – Mobile LiDAR means laser scanning equipment mounted on a moving vehicle operating on the earth's surface to collect data to process for DGN and DTM files.
6. UAS means Unmanned Aircraft Systems (e.g., drones).
7. UAS LiDAR means laser scanning equipment on an unmanned aerial vehicle (e.g., drones) to collect data to process for DGN and DTM files.

150.6. Aerial Mapping Using a Metric Camera and Manned Aircraft.

Aerial mapping using a metric camera and manned aircraft includes the collection of digital aerial imagery using a calibrated large-format metric aerial camera, performing relative orientation of the imagery through the collection of tie and pass points between adjacent aerial photo frames, performing a least-squares bundled absolute orientation adjustment using ground control points supplemented with airborne GPS and inertial measurement unit (IMU) data, and deriving data from the processed imagery including compilation of planimetric and topographic maps, creation of point cloud digital elevation model (DEM) and digital terrain model (DTM) data, and production of orthophotography.

The Surveyor shall provide the services of a certified Photogrammetrist to perform or oversee the tasks under function code 150.6. The Surveyor remains ultimately responsible and shall ensure that the work is performed as required.

A. Purpose

The purpose of aerial mapping using a metric camera and manned aircraft is to provide map and related data to support transportation projects including project design and other uses.

B. Definitions

In 150.6, 150.7, and 150.8 the following definitions apply:

1. Photogrammetrist means an American Society for Photogrammetry and Remote Sensing (ASPRS) Certified Photogrammetrist with a current certification.
2. Mapping Scientist means an American Society of Photogrammetry and Remote Sensing (ASPRS) Certified Scientist-UAS with a current certification.

3. Metric Aerial Photograph means a vertical photograph taken from a manned aircraft using a large-format calibrated digital metric aerial mapping camera.
4. Non-Metric aerial photograph means a vertical or oblique photograph taken from a fixed- or rotary-wing unmanned aircraft system (UAS) aircraft using a non-metric small format consumer-grade digital camera.
5. Large-format digital metric camera means a camera using charge-coupled device (CCD) or complementary metal oxide semiconductor (CMOS) technology to capture an image with a minimum final image size of 11500 by 7500 pixels.
6. Analytical triangulation means the process of developing absolute orientation parameters for individual photogrammetric stereo models through the use of image tie and pass points combined with ground control in a fully weighted least-squares bundle adjustment. Airborne GPS and IMU data may be used to reduce the number of ground control points.
7. Ground control means points established on the ground by the Surveyor and for which the Northing, Easting, and Elevation coordinates have been determined sufficient in number and geospatial distribution to allow analytical triangulation and mapping to meet the required project accuracy. Ground control can be targeted using paint or other marker material or can be non-targeted.
8. Airborne GPS/IMU – An airborne GPS receiver on-board the aircraft recording GPS and orientation data to be included in the analytical triangulation with the purpose of reducing the number of ground control points required for a metric aerial mapping task. IMU data to supplement the analytical triangulation is optional and its use is at the discretion of the Certified Photogrammetrist or Mapping Scientist.
9. KML means an uncompressed Google Keyhole Markup Language file, which is a two- or three- dimensional map showing a location on the earth.
10. KMZ means a compressed Google Keyhole Markup Language file, which is a two- or three- dimensional map showing a location on the earth.
11. DEM means digital elevation model, which is a three-dimensional DGN and/or point cloud in ASPRS LAS 1.2 file format containing all features located in the project area including features both on and above the ground surface.
12. DTM means digital terrain model, which is a three-dimensional DGN and/or point cloud in ASPRS LAS 1.2 format containing only features located on the ground surface.
13. Field Check means a ground survey validation of the deliverable map product with the purpose of ensuring that the required mapping accuracy has been met.
14. Flight Map means a map depicting the flight line and ground control layout over the project area.

15. Low Altitude Metric Aerial Photography means a metric aerial photography with a nominal ground pixel size of 5 cm or less.
16. DGN means a two or three-dimensional graphics file produced using Bentley MicroStation. The file may contain features and improvements plotted in a horizontal plane along the N and E axes which correspond to the Texas Coordinate System. The file may contain 2D or 3D elements representing topographic, existing, proposed, schematic, and general layout features.
17. Medium Altitude Photography means aerial photography with a film photo scale of 1:12,000 or a digital image with ground pixel size of 20 cm.
18. Project Photo Length means the distance over which photographs are required to be taken.

C. Procedure for Aerial Mapping Using a Metric Camera and Manned Aircraft

1. Ground Control

   The positioning and density of ground control is at the discretion of the Photogrammetrist. Ground control is required to be sufficient to meet the accuracy standard required for the final mapping products. Chapter 3 of the TxDOT Survey Manual provides guidance for the location and density of the ground control. The Photogrammetrist must determine the approximate position for ground control points. The Surveyor shall locate and mark the ground control points in the field using surveying methods.

2. Metric Digital Aerial Photography

   The Photogrammetrist must acquire metric digital aerial photography using a large-format calibrated metric aerial mapping camera. Unless otherwise stated, the imagery will be low altitude with a maximum nominal ground sampling distance of 5.0 cm. The Photogrammetrist must ensure that all imagery acquisition requirements including all flight parameters are met such that the imagery is suitable for intended use.

3. Analytical Triangulation

   The Photogrammetrist must process the metric digital aerial photography, ground control, and airborne GPS/IMU data (if collected) to develop an absolute orientation of the imagery suitable for map compilation at the required accuracy.

4. Aerial Mapping

   The Photogrammetrist must prepare the following:

   a. A two-dimensional DGN file containing planimetric map features.
   b. A three-dimensional DGN file containing DTM features.
   c. Orthophotography

   The Photogrammetrist must provide orthorectified aerial imagery covering the project area.

D. Technical Requirements

1. Aerial mapping using a metric camera and manned aircraft must be performed under the direct supervision of an ASPRS Certified Photogrammetrist.
2. Unless otherwise stated, aerial mapping must meet or exceed the requirements for ASPRS Class 1 mapping at a 1 inch = 40 feet equivalent scale with a one-foot indicated contour interval.

E. Data Requirements

1. Planimetric DGN files must be fully compatible with the current Bentley OpenRoads version graphics program used by TxDOT without further modification or conversion.
2. Electronically collected and processed field survey data files must be fully compatible with TxDOT's computer systems without further modification or conversion. All files must incorporate only those feature codes currently being used by the State.
3. DTM must be fully compatible with the current version of Bentley OpenRoads civil design system used by TxDOT without further modification or conversion. All DTM must be fully edited to provide a complete digital terrain model with all necessary break lines.
4. File features and level structure must be in accordance with the State's current photogrammetry mapping legend.
5. Minimum text size is 0.1 inches when plotted at a scale of 1 inch = 40 feet.

F. Deliverables for Aerial Mapping Using a Metric Camera and Manned Aircraft

The Photogrammetrist must submit the following:

1. Digital orthophotography delivered on USB flash-drive or hard-drive in Tagged Image File format (TIF) compatible with Bentley MicroStation software and including georeferenced world files.
2. A photo index map in DGN and KMZ format showing the location of each digital image frame. The index map must be overlaid on a base map to provide general location information.
3. An orthophoto index map in DGN, KMZ, and PDF format showing the location of each orthophoto panel. The PDF format index map must be overlaid on a base map to provide general locational information.
4. An analytical triangulation report signed and sealed by the Photogrammetrist providing a narrative of the aerial photography project and processing results. The report must include the number of flight strips, overall number of photo frames, the number of ground control points used, the use of airborne GPS and IMU data, and the results of the fully weighted least-squares bundled adjustment. The Photogrammetrist must include a description and results of the analytical triangulation.
5. DGN files for the planimetric and DTM mapping.

150.7. Aerial Mapping Using a Non-Metric Camera and Unmanned Aircraft System (UAS).

Aerial mapping using an Unmanned Aircraft System (UAS) includes the collection of digital aerial imagery using either a fixed- or rotary-wing aircraft; the use of a non-metric small-format consumer-grade camera; performing relative orientation of the imagery through the collection of tie and pass points between adjacent aerial photo frames; performing a least-squares bundled absolute orientation adjustment using ground control points supplemented with airborne GPS and IMU data; and deriving data from the processed imagery including compilation of planimetric and topographic maps, creation of point cloud digital elevation model (DEM) and digital terrain model (DTM) data, and production of orthophotography as required.

All UAS operations, including operations conducted using internal equipment and those done by external consultants/contractors and their sub providers must follow the TxDOT Unmanned Aircraft System (UAS) Flight Operations and User's Manual. All UAS flights are required to have: An approved flight plan providing information about the proposed flight (form AVN-557), a Project Risk Assessment (PRA) completed prior to the flight, and appropriate liability insurance.

The Surveyor shall provide the services of a certified Photogrammetrist or Mapping Scientist to perform or oversee the tasks under function code 150.7. The Surveyor remains ultimately responsible and shall ensure that the work is performed as required.

A. Purpose

The purpose of aerial mapping using UAS is to provide map and related data to support transportation projects including project design and other uses.

B. Procedure for Aerial Mapping Using a Non-Metric Camera and Unmanned Aircraft System (UAS)

1. Ground Control

The positioning and density of ground control is at the discretion of the Photogrammetrist or Mapping Scientist. Ground control is required to be sufficient to meet the accuracy standard required for the final mapping products. The Photogrammetrist or Mapping Scientist must determine the approximate position for ground control points. The Surveyor shall locate and mark the ground control points in the field using surveying methods.

2. Aerial Photography

The Photogrammetrist or Mapping Scientist must acquire digital aerial photography using a non-metric small-format consumer-grade digital camera. The Photogrammetrist or Mapping Scientist is responsible for ensuring that all imagery acquisition requirements including all flight parameters are met such that the imagery is suitable for intended use.

3. Analytical Triangulation

The Photogrammetrist or Mapping Scientist must process the non-metric digital aerial photography, ground control, and airborne GPS/IMU data (if

collected) to develop an absolute orientation of the imagery suitable for map compilation at the required accuracy.

4. Aerial Mapping

   The Photogrammetrist or Mapping Scientist must prepare the following:

   a. A two-dimensional DGN file containing planimetric map features.

   b. A three-dimensional DGN file containing DTM features.

5. Orthophotography

   The Photogrammetrist or Mapping Scientist must provide orthorectified aerial imagery covering the project area.

C. Technical Requirements

1. Aerial mapping using a non-metric camera UAS must be performed under the direct supervision of an ASPRS Certified Photogrammetrist or Certified Mapping Scientist-UAS.

2. Aerial mapping using a non-metric camera and UAS must be performed in compliance with the TxDOT Unmanned Aircraft System (UAS) Flight Operations and User's Manual.

3. Unless otherwise stated, aerial mapping must meet or exceed the requirements for ASPRS Class 1 mapping at a 1 inch = 40 feet equivalent scale with a one-foot indicated contour interval.

D. Data Requirements

1. Planimetric DGN files must be fully compatible with the State's current Bentley MicroStation version graphics program used by TxDOT without further modification or conversion.

2. Electronically collected and processed field survey data files must be fully compatible with the TxDOT's computer systems without further modification or conversion. All files must incorporate only those feature codes currently being used by the State.

3. DTM must be fully compatible with the current version of Bentley OpenRoads civil design system used by TxDOT without further modification or conversion. All DTM must be fully edited to provide a complete digital terrain model with all necessary break lines.

4. File features and level structure must be in accordance with the State's current photogrammetry mapping legend.

5. Minimum text size is 0.1 inches when plotted at a scale of 1 inch = 40 feet.

E. Deliverables for Aerial Mapping Using a Non-Metric Camera and Unmanned Aircraft System (UAS)

The Photogrammetrist or Mapping Scientist must submit the following:

1. Digital orthophotography delivered on USB flash-drive or hard-drive in Tagged Image File format (TIF) compatible with Bentley MicroStation software and including georeferenced world files.

2. A photo index map in DGN and KMZ format showing the location of each digital image frame. The index map must be overlaid on a base map to provide general location information.

3. An orthophoto index map in DGN, KMZ, and PDF format showing the location of each orthophoto panel. The PDF format index map must be overlaid on a base map to provide general locational information.

4. An analytical triangulation report signed and sealed by the Photogrammetrist or Mapping Scientist providing a narrative of the aerial photography project and processing results. The report must include the number of flight strips, overall number of photo frames, the number of ground control points used, the use of airborne GPS and IMU data, and the results of the fully weighted least-squares bundled adjustment. The Photogrammetrist or Mapping Scientist must include a description and results of the analytical triangulation.

5. DGN files for the planimetric and DTM mapping.

150.8. Field Check Survey for Aerial Mapping Using Manned Aircraft or UAS.

Field checking of aerial mapping projects involves surveying a statistical sampling of discreet features shown on the map. It is a collaborative effort between the Photogrammetrist or Mapping Scientist-UAS and the Surveyor to validate that the map derived photogrammetrically meets the required accuracy standard. Because not all features shown on the map are good candidates for checking, it is necessary for the Photogrammetrist or Mapping Scientist to select discreet and unambiguous points that can then be surveyed and effectively evaluated between both the photogrammetric and field survey data sets.

The Photogrammetrist or Mapping scientist-UAS will provide a minimum of twenty 20 check point locations randomly distributed throughout the mapping area. The descriptions of the points must be sufficient to eliminate any ambiguity of the exact point to be surveyed.

A. Purpose

The purpose of a field check for aerial mapping is to validate that map accuracy requirements have been met.

B. Definitions

In 150.8, the following definition applies:

Check Point – A randomly distributed point captured in the DGN mapping file selected by the Photogrammetrist or Mapping Scientist and provided to the Surveyor to be used to verify that the mapping accuracy requirement has been met.

C. Procedure to Field Check Survey for Aerial Mapping Using Manned Aircraft or UAS

1. The Photogrammetrist or Mapping Scientist-UAS must prepare and provide the Surveyor a listing of points to be validated in the field. Sufficient detail and description of the point is required to eliminate the possibility of a misidentification of the point during the field survey. A minimum of 20 horizontal and 20 vertical check points are required. Any

single point can be used for both horizontal and vertical data as appropriate. A check point must not be part of the analytical triangulation least-squares adjustment.

2. The Surveyor shall locate and measure the provided validation points on the ground using equipment and methodologies with a higher level of accuracy than the map being checked.

3. Using the results from the field survey, the Surveyor shall prepare a map accuracy assessment report detailing the results of the field check. The report must include the number of check points used, the field surveying technique used for validation, and the results of the root mean square error (RMSE) and 95% confidence computations.

4. Using the validation data provided by the Surveyor, the Photogrammetrist or Mapping Scientist must prepare a final report detailing the results of the map check. The report must include both the following Statements of Accuracy, if applicable:

   a. “This map was compiled to meet the ASPRS Standard for Class 1 map accuracy.”

   b. “This map was checked and found to conform to the ASPRS Standard for Class 1 map accuracy.”

D. Technical Requirements

The Surveyor shall:

1. Determine the northing, easting, and elevations of the check points provided by the Photogrammetrist or Mapping Scientist using a surveying method of greater accuracy than that used to produce the map being checked.

2. Perform RMSE and 95% confidence computations on the check points using the following methodology:

   For each horizontal coordinate, the Surveyor shall subtract the Northing value of the map coordinate from the Northing value derived from the field survey and square the resulting value. The Surveyor shall perform the same operation for the Easting coordinate and then add the two squared values. The Surveyor shall repeat the procedure for each check point. The Surveyor shall add up all of the resulting squared values and divide the sum by the number of check points used (i.e., average the squares). Finally, the Surveyor shall calculate the square root of the average. The Surveyor shall report the resulting value as the RMSE value for the horizontal check point analysis. The Surveyor shall multiply the final RMSE value by 1.7308 and shall report the resulting value as the 95% confidence value for the horizontal check point analysis.

   For each vertical coordinate, the Surveyor shall subtract the elevation value of the map coordinate from the elevation value derived from the field survey and square the resulting value. The Surveyor shall repeat the procedure for each check point. The Surveyor shall add up all of the resulting squared values and divide the sum by the number of check point used (i.e., average the squares). Finally, the Surveyor shall

calculate the square root of the average. The Surveyor shall report the resulting value as the RMSE value for the vertical check point analysis. The Surveyor shall multiply the final RMSE value by 1.96 and shall report the resulting values as the 95% confidence for the vertical check point analysis.

3. Provide the results of the RMSE and 95% confidence computations to the Photogrammetrist.

E. Data Requirement

The Surveyor shall deliver the result of the field check as a report in PDF format.

F. Deliverables

The Photogrammetrist or Mapping Scientist must provide a map accuracy assessment report detailing the methodology used and results of the map accuracy assessment.

150.9. Horizontal and Vertical Control for Aerial Mapping.

Placement and survey of horizontal and vertical control for aerial mapping establishes ground control for aerial mapping projects.

A. Purpose

The purpose of an aerial photography control survey is to provide ground control for aerial mapping projects.

B. Definitions

In 150.9, Aerial Photography Control Survey means reconnaissance, field work, analysis, computation, and documentation necessary to provide horizontal and vertical position of specific ground points. The ground control points are used in photogrammetric processing.

C. Procedure for Horizontal and Vertical Control for Aerial Mapping

The Surveyor shall:

1. Prepare and submit for approval an aerial ground control layout in DGN and KML format based on the target positions selected by the Certified Photogrammetrist. The layout must show the location of the proposed primary project control and aerial ground control points.
2. Establish and determine the horizontal and vertical coordinates of the primary project control points and aerial ground control points.
3. Place aerial ground control targets at the point location and maintain the targets until the aerial flight has been completed.

D. Technical Requirements

1. Aerial photography control surveys must be performed under the direct supervision of a RPLS currently registered with the TBPELS.
2. The horizontal and vertical coordinates of the aerial control points must be based on acceptable methods, conducted by the Surveyor, and must meet the standards of accuracy as set forth below:

Survey Level 3 accuracy, as described in the *TxDOT Survey Manual*, latest edition, or the equivalent level of accuracy described in the *TSPS Manual of Practice for Land Surveying in the State of Texas*.

E. Data Requirement

The Surveyor shall perform post processing of field data, which will be reviewed by the State. Data processed by standard calculators, computers, and other business hardware and software normally maintained and used by the Surveyor will be considered acceptable.

F. Deliverables

The Surveyor shall submit the following:

1. A final aerial control point layout in DGN and KML format showing the location of the primary control and target points labeled with their respective alpha-numeric designation.
2. A plot and computer graphics of an B-size index map showing an overall view of the project and the relationship of primary monumentation and control used in the preparation of the project, signed and sealed by a RPLS, and as directed by the State.
3. A plot and computer graphics of a B-size horizontal and vertical control sheet showing the primary survey control monumentation used in the preparation of the project, signed and sealed by a RPLS, and as directed by the State.
4. An A-size data sheet for each aerial ground control point, which must include a location sketch, a physical description of the point, surface coordinates, elevation, and datums used.
5. A USB flash drive containing the graphics files and scanned images of the control data sheets.
6. A written statement describing the datum used along with copies of all relevant NGS and data sheets.
7. A written tabulation of all aerial control points with their respective alpha-numeric designations and horizontal and vertical coordinates.

150.10. Mapping Services to be Provided.

The Surveyor shall provide the following mapping services as requested by the State:

A. Aerial Photogrammetry

The Surveyor shall prepare planimetric design (DGN), digital terrain model (DTM), and triangulated irregular network (TIN) MicroStation graphics files and orthophotography files covering the specific work location, meeting standards and specifications as required.

B. Terrestrial Photogrammetry

The Surveyor shall prepare planimetric design (DGN), digital terrain model (DTM), and triangulated irregular network (TIN) MicroStation graphics files covering the specific work location, meeting standards and specifications as required.

C. Terrestrial Lidar

The Surveyor shall prepare planimetric design (DGN), digital terrain model (DTM), and triangulated irregular network (TIN) MicroStation graphics files covering the specific work location, meeting standards and specifications as required.

D. Mobile and Aerial Lidar

The Surveyor shall prepare planimetric design (DGN), digital terrain model (DTM), and triangulated irregular network (TIN) MicroStation graphics files covering the specific work location, meeting standards and specifications as required.

E. Mapping Tasks to be Completed

The Surveyor shall perform the following tasks as requested for each mapping service.

1. Horizontal and Vertical Control for Aerial Mapping

    a. The Surveyor shall prepare and submit an aerial ground control layout showing the proposed aerial ground control points, for approval by the State.

    b. The Surveyor shall establish and determine the coordinates of the aerial ground control points.

    c. The Surveyor shall establish and determine the elevations of the aerial control points.

    d. The Surveyor shall place aerial ground control target material at the established points and maintain until the photographs from the flight are approved.

    e. The Surveyor shall prepare, to scale, a survey control index sheet for the aerial control points.

    f. The Surveyor shall be prepared to locate additional points, as determined by the American Society for Photogrammetry and Remote Sensing (ASPRS) certified Photogrammetrist, if any panel points are not visible from the air.

2. Deliverables for Horizontal and Vertical Control for Aerial Mapping

    The Surveyor shall provide the following deliverables:

    a. A final aerial control point layout showing the location of the points and labeled with their respective alpha-numeric designations.

    b. A plot and computer graphics of an B-size index map showing an overall view of the project and the relationship of primary monumentation and control used in the preparation of the project, signed and sealed by a RPLS, and as directed by the State.

    c. An A-size data sheet for each aerial ground control point, which must include a location sketch, a physical description of the point, surface coordinates, the elevation, and datums used.

d. A USB flash drive containing the graphics files and scanned images of the control data sheets.

e. A written statement describing the datum used along with copies of all relevant NGS and data sheets.

f. A written tabulation of all aerial control points with their respective alpha-numeric designations, surface coordinates (for center panel points only), and elevations.

3. Prepare Planimetric and DTM Data

The Surveyor shall perform the following tasks for each requested mapping service:

a. The Surveyor shall provide low altitude aerial mapping to cover an area 1,200 feet wide centered on the roadway unless otherwise specified, with cross flights as directed by the State.

The Surveyor shall follow all standards and specifications in accordance with established guidelines and recommended or approved by the State.

b. The Surveyor shall prepare planimetric design (DGN), digital terrain model (DTM), and triangulated irregular network (TIN) Bentley MicroStation graphics files and orthophotography files covering the specific work location, meeting standards and specifications as required.

(1) The Surveyor shall collect supplemental planimetric and DTM survey data.

(2) The Surveyor shall update aerial 2D and 3D mapping with ground surveys.

(3) The Surveyor shall maintain the current DGN level structure and legend used by TxDOT.

(4) The Surveyor shall maintain the current DTM level structure and legend used by TxDOT.

(5) The Surveyor shall use file features and level structures in compliance with TxDOT's current photogrammetry mapping legend.

(6) The Surveyor shall locate, and field check random points.

c. The Surveyor shall conduct quality assurance and quality control (QA/QC) for each task performed and prepare a Surveyor's Report.

4. Deliverables for Planimetric and DTMs

The Surveyor shall provide the following:

a. Certification that the photographs or LiDAR imagery were taken on the date indicated, signed by the airplane pilot or aerial photographer.

b. The DGN, DTM, and TIN files on a medium and in a format acceptable to the State, delivered on USB flash-drive or hard-drive.

(1) Orthophotography (created using the DTM) delivered on USB flash drive, or hard-drive in tiff format (3 banded) with world files.

(2) TxDOT's photogrammetry mapping legend and supplements.

c. A tabulation showing the field-check points.

d. Quality Assurance and Quality Control (QA/QC) and Statement of Map Accuracy.

(1) Statement of map accuracy.

(2) A surveyor's report signed and sealed by an RPLS.

150.11. Horizontal And Vertical Control (15.3.5).

This includes the establishment of horizontal and vertical control for survey projects.

A. Overview of Horizontal and Vertical Control

A horizontal control survey is performed for the purpose of placing geographic coordinates of latitude and longitude on permanent monuments for referencing lower levels of surveys. A projection is used to place the coordinates on a plane of northing and easting values for simplified measurements. Scale and elevation factors are applied to make the distance measurements applicable to the exact location on the working surface and the type of projection chosen is an "equal angle" type.

A vertical control survey is performed for accurately determining the orthometric height (elevation) of permanent monuments to be used as bench marks for lower quality leveling. Spirit leveling is the usual method of carrying elevations across country from "sea level" tidal gauges. However, Global Positioning System (GPS) can be used indirectly but with less accuracy. Height measurements from the ellipsoid (as opposed to the "sea level" geoid) can be determined very accurately with GPS and only GPS. Trigonometric leveling, with a total station, is not acceptable for vertical control work.

B. Definitions

1. BM means bench mark, which is a relatively permanent object whose elevation above or below an adopted datum is known.

2. CORS means continuously operating reference station, which is a network of the highest quality horizontal stations, forming the National Spatial Reference System (NSRS).

3. Control Survey means a survey providing positions (horizontal or vertical) of points to which supplemental surveys are adjusted.

4. Datum means a mathematical model of the earth designed to fit part or all of the geoid.

5. Datum Point Rod or Deep Rod Monument means a monument driven to refusal by a power driver, used for major project control.

6. GPS means the Global Positioning System, which is based on a constellation of 24 satellites orbiting the earth at a very high altitude.

7. Horizontal Control Survey means placing geographic coordinates of latitude and longitude on permanent monuments.
8. Level 1 survey means RRP, CORS or major control densification.
9. Level 2 Survey means primary project control.
10. Level 3 Survey means secondary project control.
11. NGS means National Geodetic Survey
12. RRP means Regional Reference Point, which is a TxDOT Continuously Operating Reference Point.
13. Type II Monument means a disk driven onto a length of 5/8-inch rebar with the hole filled flush with concrete.
14. Vertical Control Surveys means a survey performed for accurately determining the orthometric height (elevation) of permanent monuments to be used as bench marks for lower quality leveling.

C. Procedure for Horizontal and Vertical Control

1. The Surveyor shall establish horizontal and vertical control points, including offsite points. The Surveyor shall prepare signed survey control data sheets, a survey control index sheet, and a composite layout of the horizontal and vertical controls, and as directed by the State.
2. The Surveyor shall update existing control information and prepare new survey control data sheets, as directed by the State, to be included in the construction plan set as described in Item 150.11, D.

D. Technical Requirements for Horizontal and Vertical Control

The Surveyor shall adhere to the following technical requirements.

1. Horizontal and vertical controls must be performed under the supervision of a RPLS currently registered with the TBPELS.
2. Horizontal ground control used for design surveys and construction surveys, furnished to the Surveyor by the State or based on acceptable methods conducted by the Surveyor, must meet the standards of accuracy required by the State.

   The Surveyor shall comply with the standards of accuracy for horizontal control traverses, as described in the *TxDOT Survey Manual* or the *TSPS Manual of Practice for Land Surveying in the State of Texas*, as may be applicable.
3. Vertical ground control used for design surveys and construction surveys, furnished to the Surveyor by the State or based on acceptable methods conducted by the Surveyor, must meet the standards of accuracy required by the State.

   The Surveyor shall comply with the standards of accuracy for vertical control traverses, as described in the *TxDOT Survey Manual* or the *TSPS Manual of Practice for Land Surveying in the State of Texas*, as may be applicable.
4. Monuments

The Surveyor shall install survey monuments for a horizontal and vertical control survey that are reasonably permanent and substantial. The monuments shall be easily identified and afforded reasonable protection against damage and or destruction.

a. Offsite primary control points whether set by GPS or conventional survey methods must be set in pairs approximately 2000 feet apart outside of the project on side roads. Offsite points must be constructed approximately every 2 miles and set approximately 6 inches below natural ground and must be inter-visible between each pair of points.

b. Secondary control points must be set approximately 6 inches below ground at a maximum distance of 1,500 feet apart.

5. Side shots or short traverse procedures for total stations used to determine horizontal and vertical locations must meet the following criteria:

   a. Short traverses and instrument setups for side shots must begin and end on horizontal and vertical ground control as described above.

   b. Standards, procedures, and equipment (e.g., GPS Equipment, LiDAR, Total Stations) used must be such that horizontal locations relative to the control can be reported within the specification to allow the engineer to accurately create the design to the following limits:

      (1) Bridges and other roadway structures: less than 0.02 feet.

      (2) Utilities and improvements: less than 0.2 feet.

      (3) Cross-sections and profiles: less than 0.2 feet.

      (4) Bore holes: less than 0.5 feet.

   c. Standards, procedures, and equipment (e.g., GPS Equipment, LiDAR, Total Stations) used must be such that vertical locations relative to the control may be reported to within 0.02 feet.

6. The Surveyor shall update existing control information and prepare new survey control data sheets, as directed by the State, to be included in the construction plan set as described below:

   a. The Surveyor shall prepare, sign, seal, and date a survey control index sheet and horizontal and vertical control sheets to be inserted into the plan set.

   b. The Surveyor shall prepare a survey control index sheet that provides an overview of the primary project control and must include:

      (1) An unscaled vicinity map showing the general location of the project in relation to nearby towns or other significant cultural features.

(2) A scaled project map showing the extents of the project and the location of the primary control points. The map must show street networks, selected street names, control point identification, and significant culture features necessary to provide a general location of the primary control.

(3) A table containing the primary control point values including the point number, northing, easting, elevation, stationing, and stationing offset values.

(4) Map annotation including a graphic scale bar, north arrow, and standard TxDOT title block. The title block must contain a section for the district name, county, highway, and CSJ number. The title block must also contain a section for a Texas registered engineer to sign, seal, and date the sheet to include the following statement, “The survey control information has been accepted and incorporated into this PS&E”.

The Surveyor shall download the required format of the survey control index sheet from the TxDOT website.

(5) In the title block under the heading “Notes”, identification of the horizontal and vertical datum on which the primary control is based with the date of the current adjustment, the surface adjustment factor used, and unit of measure. The surveyor shall include a note stating that the coordinates are State Plane and a notation specifying either grid or surface adjusted coordinates.

E. Data Requirement

The Surveyor shall perform post processing of field data, which will be reviewed by the State. Data processed by standard calculators, computers, and other business hardware and software normally maintained and used by the Surveyor will be considered acceptable.

F. Tasks to be Completed

The Surveyor shall perform the following tasks:

1. The Surveyor shall establish horizontal and vertical control points, including offsite points. The Surveyor shall prepare signed survey control data sheets, a survey control index sheet, and a composite layout of the horizontal and vertical controls, and as directed by the State.
2. The Surveyor shall set primary offsite control points in pairs, approximately 2 miles apart outside of the project area.
3. The Surveyor shall set secondary control points approximately 6 inches below ground at a maximum distance of 1,500 feet apart.
4. The Surveyor shall establish horizontal and vertical control from the TxDOT Virtual Reference Station (VRS) Network, and as directed by the State.

5. The Surveyor shall tie and tabulate horizontal and vertical control to other control points and datums in the vicinity established by other sources such as the National Geodetic Survey (NGS), the Federal Emergency Management Agency (FEMA), TxDOT VRS Network, and as directed by the State.

G. Deliverables

The Surveyor shall provide the following:

1. An electronic PDF format and MicroStation graphics files of the index map showing an overall view of the project and the relationship of the primary monuments and control points established for the project, signed and sealed by a registered professional land surveyor (RPLS), and as directed by the State.
2. PDF form 2462 for each primary control point which shall include, but need not be limited to, a location sketch, a physical description of the point, surface coordinates, the elevation, and the datum used.
3. A USB flash-drive containing the graphics files and scanned images of the control data sheets.
4. A written statement describing the datum used, signed and sealed by a RPLS, along with copies of all relevant NGS and TxDOT data sheets.

DEL.150. Deliverables for FC150.

. TxDOT Form 2462 for each primary and secondary control point. This form must be submitted electronically in PDF format and in the original format of its creation. This must be signed and sealed by the responsible RPLS.

A. Digital Terrain Models (DTM) and the Triangular Irregular Network (TIN) files in a format acceptable by the State.

B. Maps, plans, or sketches prepared by the Surveyor showing the results of field surveys

C. Computer printouts or other tabulations summarizing the results of field surveys

D. Digital files or media acceptable by the State containing field survey data (ASCII Data files)

E. Maps, plats, plans, sketches, or other documents acquired from utility companies, private corporations, or other public agencies, the contents of which are relevant to the survey

F. Field survey notes, as electronic and hard copies

G. A digital copy of all computer printouts of horizontal and vertical conventional traverses, GPS analysis and results, and survey control data sheets

H. All OpenRoads files

I. Survey reports in a format requested by the State

FUNCTION CODE 160 (160) – ROADWAY DESIGN

ROADWAY DESIGN CONTROLS

160.1. Geometric Design.

A. Design Exceptions, Waivers, and Deviations

The Engineer shall identify, prepare exhibits, perform traffic and safety analysis (including Safety scoring tool), and complete all necessary forms for design exceptions, waivers, and Texas Highway Freight Network (THFN) deviations within project limits. Submit draft document prior to the 30% submittal. Submit final document to the State for coordination and processing of approvals.

B. Preliminary Geometric Project Layout.

The Engineer shall develop the following for the full length of the project to be reviewed and approved by the State prior to the Engineer proceeding with the 30% milestone submittal package:

1. A preliminary geometric project layout (Layout)
2. A preliminary 3D corridor model
3. Alternatives for design (e.g., flush or raised curb median) with recommendations and cost estimates for each alternative. Prior to proceeding with the final preliminary geometric layout the Engineer shall present the alternatives to the State for review and approval.
4. Documentation of meetings and discussions that describe the design alternatives that were considered, the points or issues that were evaluated, and the outcome of the meeting or discussion, including a description of the decisions that were made.
5. A final geometric layout and 3D Corridor model

160.2. Roadway Design – Plan and Profile Drawings.

The Engineer shall prepare roadway plan and profile drawings that consist of a planimetric file of existing features and files of the proposed improvements. The roadway base map must contain line work that depicts existing surface features obtained from the schematic drawing. Existing major subsurface and surface utilities must be shown if requested by the State. Existing and proposed right of way lines must be shown. Depending on the width of the pavement, the plan view and profile view may be shown on separate sheets or the same sheets for the following roadways:

A. Main lanes

B. Frontage roads

C. Direct connectors

D. Ramps

E. Side streets

F. U-turns

G. Pedestrian facilities

H. Bicycle facilities

160.3. Safety Analysis

The Engineer shall prepare a safety analysis utilizing the current TxDOT Safety Scoring tool.

160.4. Typical Sections.

A. The Engineer shall prepare existing typical sections for all existing roadways. Existing typical sections must reflect existing pavement structures.

B. The Engineer shall prepare proposed typical sections for all proposed roadways.

160.5. Side Street Intersection Layouts.

The Engineer shall provide an intersection layout detailing the pavement design and drainage design at the intersection of each side street. The layout must include the horizontal alignments, curb returns, geometrics, transition length, stationing, pavement, drainage details, and *Americans with Disabilities Act Accessibility Guidelines (ADAAG)* and *PROWAG* compliance items. The Engineer shall design for full pavement width to the ROW and provide a transition to the existing roadway. The Engineer shall prepare intersection layouts for the side streets shown in Table 160.5 -Side Streets.

Table 160.5 – Side Streets	
Side Street Name	**Left or Right**

160.6. Grading Plans.

The Engineer shall provide layouts detailing intersection grading plans including either contours or spot elevations, for the intersections shown in Table 160.6 – Intersections.

Table 160.6 – Intersections

160.7. Cut and Fill Quantities.

A. The Engineer shall develop an OpenRoads generated 3D corridor model to be used for an earthwork analysis to determine cut and fill quantities.

B. The Engineer shall provide final design cross sections at intervals to be determined by the State along the mainlanes and major side streets. Cross sections must be created from the 3D corridor model and must be delivered in the standard TxDOT format on 11”x17” sheets or roll plots and electronic files. The Engineer shall provide all templates and corridors used to generate the design cross sections. Cross sections and quantities must include existing pavement removals. Annotation must include, at a minimum, existing and

proposed ROW, side slopes (front & back), and profiles. Existing utilities must be shown on the cross sections at each milestone submittal starting with 30%. Existing utilities identified to be in conflict with the proposed design must include SUE Level A data location information as part of the 60% milestone submittal

C. The Engineer shall submit the current OpenRoads generated 3D corridor model for each submittal. Existing utilities must be shown in the OpenRoads generated 3D corridor model at each milestone submittal starting with 30%. Existing utilities identified to be in conflict with the proposed design must include SUE Level A data location information as part of the 60% milestone submittal.

160.8. Profile Workshop.

Prior to the 30% submittal, the Engineer shall schedule and attend a workshop to review profiles, OpenRoads 3D corridor models, and cross-sections with the State.

160.9. Supporting Roadway Plan Sheet Preparation.

The Engineer shall prepare the necessary supporting roadway plan sheets for the proposed improvements for the following:

A. Project Layouts

B. Horizontal Alignment Data Sheets

C. Superelevation Diagrams

D. Driveway Details

E. Summary of roadway quantities

F. Removal Plans

G. Miscellaneous Details

160.10. Wetlands Information.

The Engineer shall stake and fence wetland areas. The Engineer shall survey the delineated wetlands and calculate the volumes for the delineated areas. The survey data must be electronically transferred to the plan and profile (P&P) sheets and the volumes calculated for the delineated areas.

160.11. Roadway Standards.

The Engineer shall select roadway standards.

160.12. Pavement Design.

A. Incorporate Pavement Design Developed by the State

When required in the work authorization, the Engineer shall incorporate the pavement design developed and provided by the State into the project.

B. Perform Pavement Design

When required in the work authorization, the Engineer shall provide the pavement design and submit a pavement design report to the State.

160.13. Roadway Quantities.

The Engineer shall calculate roadway quantities.

DEL.160. Deliverables for FC 160.

. Design exception and design waiver forms and exhibits

A. Preliminary geometric layout and 3D corridor model

B. Final geometric layout and 3D corridor model

C. Roadway plan and profile drawings

D. Existing typical sections

E. Proposed typical sections

F. Intersection layouts

G. Grading plan layouts

H. OpenRoads 3D corridor model used for computing cut and fill quantities

I. Final design cross sections

J. Cut and fill quantities

K. Supporting roadway plan sheets

L. Wetlands survey data

M. Wetland volumes

N. Roadway standards selected by the Engineer

O. Pavement design report, if applicable

P. Roadway quantities

FUNCTION CODE 160 (161) – ROADWAY DESIGN

DRAINAGE DESIGN

161.1. Drainage.

The Engineer shall prepare a comprehensive drainage study report and plan sheets for the drainage design elements for the project. The report must include a summary of the hydrological and hydraulic design considerations and analyses for the project limits, including any temporary drainage facilities necessary to allow staged construction of the project, maintain positive flow and to conform with the phasing of adjacent construction projects without significant impact to the hydraulic capacity of the area. The Engineer shall use information collected via field survey, field observations, review of as-built construction plans, the effective FEMA models (if available) and consider pedestrian facilities, utility impacts, driveway grades, retaining wall and concrete traffic barrier to develop hydrologic and hydraulic modeling data for existing and proposed structures. The Engineer shall use software acceptable to the State. The Engineer shall prepare hydrologic and hydraulic analysis for the structures/systems shown in Table 161.1 – Structure/System.

Table 161.1- Structure/System

Structure/System Type	Description	Approximate Station(s)

A. Hydrologic Analysis

1. Drainage Areas

The Engineer shall delineate the drainage area boundaries for each structure or system including temporary drainage structures within, or contributing to, the project area using United States Geological Survey (USGS) or suitable topographic maps, available LiDAR elevation data, and other appropriate information.

2. Runoff Computations

The Engineer shall:

a. Compute the peak runoff for the full range of frequencies (50%, 20% 10%, 4%, 2%, and 1% annual exceedance probability (AEP)) using an approved methodology. The Engineer shall select the methodology depending on the size of watershed and site conditions for each of the following:

(1) Ditches

(2) Culverts

(3) Bridges

(4) Storm drains

(5) Temporary drainage for phased construction

b. Determine an appropriate hydrologic check method and compute peak runoff rates for discussion and inclusion in the drainage report.

c. Obtain any existing FEMA effective hydrologic data if available. Verify FEMA data prior to utilizing for FEMA coordination and modeling.

d. Determine if area drains are needed due to site conditions and determine additional ROW or easements required as a result.

3. Prepare (11”x17”) drainage area maps and hydrologic data sheets for the project for inclusion in the plans, specifications, and estimate (PS&E) and the drainage report

B. Hydraulic Analysis

The Engineer shall:

1. Model the existing conditions using an appropriate method for each structure or system type, including the following:

a. Ditches

b. Culverts

c. Bridges

d. Storm drain systems

e. Detention and retention systems

f. Pump systems

2. Model the proposed conditions using an appropriate method for the structure or system type, for the full range of frequencies (50%, 20% 10%, 4%, 2%, 1%, and 0.2% AEP). . Evaluate the design with the objective of reducing flooding potential, protecting structures from erosion and scour, mitigating potential impacts on flood levels and flow rate, and minimizing impacts to Waters of the United States. Prepare hydraulic models for the following:

   a. For ditches, determine the ditch typical section with the hydraulic capacity to convey the calculated design storm event

   b. Culverts

   c. Bridges

   d. For storm drain systems, determine trunk-line sizes, lateral sizes, outfall sizes, and inlet locations to accommodate the proposed design storm event and taking into account the hydraulic grade line of the system. Verify that storm drains can be developed for gravity flow to outfalls based on the proposed roadway profile.

   e. For detention facilities, determine alternate flow routes, detention and retention, to relieve system overload. Evaluate the amount of the total detention storage to control runoff for the approved design frequency based on hydrograph routing for the full range of frequencies (50%, 20% 10%, 4%, 2%, 1%, and 0.2% AEP). Determine if on-site detention volume is available. When oversized storm drains are used for detention, the Engineer shall evaluate the hydraulic gradeline throughout the entire system, within project limits, for the design frequency or frequencies. The Engineer shall coordinate with the State any proposed changes to the detention systems. The State will assess the effects of such changes on comprehensive drainage studies.

   f. For pump systems, determine pump requirements and specifications to meet design criteria approved by the State.

   g. Develop plans for temporary drainage facilities that are necessary to allow staged construction of the project and to conform with the phasing of adjacent construction projects without significant impact to the hydraulic capacity of the area.

3. Develop the following Zone AE hydraulic models (if applicable)

   a. Corrected existing hydraulic model

   b. Updated FEMA model

   c. Floodway models, with defined floodways only

4. Develop a 3D model of the proposed drainage structures using the drainage utility (DU) capabilities of the OpenRoads product.

5. Complete a scour analysis of bridges and bridge class structures and provide the State the potential scour depths, envelope, and any recommended countermeasures including bridge design modifications and revetment.
6. Determine if there are any underground utility crossings that may conflict with the proposed design.
7. Determine if additional ROW or easements will be required due to drainage structures/system designs.
8. Determine areas requiring trench protection, excavation, shoring, and de-watering.
9. Hydraulic Computation Sheets
    a. Prepare (11” x 17”) hydraulic data sheets for the project for inclusion in the drainage report and PS&E that summarize the input parameters and hydraulic results in tabular format for proposed and temporary structures and systems. At locations where there are existing and proposed structures and systems, provide a comparison of the input parameters and hydraulic results in tabular format for the existing and proposed structures and systems
    b. Prepare (11” x 17”) hydraulic data sheets for each bridge or FEMA Zone A/AE drainage structure for inclusion in the drainage report and PS&E. At locations where there are existing and proposed structures and systems, provide a comparison of the input parameters and hydraulic results in tabular format for the existing and proposed structures and systems
    c. Coordinate with bridge designers and depict scour envelopes on bridge layouts for inclusion in the drainage report and submission to the district bridge engineer.

C. Structure and System Layouts

The Engineer shall:

1. Determine the ditch typical section that conveys the approved design capacity and incorporate the ditch section into the roadway typical sections and design cross-sections.
2. Develop (11” x 17”) culvert layouts depicting the plan and profile for each culvert on the project at a scale approved by the State.
3. Develop (11”x17”) storm drain and inlet layouts depicting the plan and profile for the storm drain systems on the project at a scale approved by the State.
    a. Select any necessary standard details from State or District’s list of standards for items such as inlets, manholes, junction boxes and end treatments.
    b. Prepare details for non-standard inlets, manholes, and junction boxes.

c. Identify existing ground elevation profiles at the ROW lines on storm sewer plan and profile sheets.

d. Determine locations that require trench excavation protection.

4. Prepare drainage details for outlet protection, outlet structures, and utility accommodation structures.

5. Develop (11”x17”) detention and retention storage basin plan and profile layouts and details for the project at a scale approved by the State and include associated outlet structure details.

6. Develop (11”x17”) structural design and detailing layouts for pump systems that include:

a. Site layout of controls building and pump locations

b. All structural details for control building and sump

c. All electrical and piping connection details

d. All stormwater pump details including controls

e. All details for load bank installation

f. All details for supporting equipment and software for notification of status

7. Develop (11”x17”) layouts for proposed temporary drainage facilities/structures.

D. The Engineer shall prepare coordination documentation for the determination of any 408 Permits (due to levees), Nationwide Permits or Individual Permits (including mitigation and monitoring), U.S. Coast Guard and U.S. Army Corps of Engineers §10 Permits required for the project.

E. The Engineer shall compute and tabulate drainage facility quantities.

F. The Engineer shall prepare miscellaneous drainage design elements including:

1. Layouts for subsurface drainage at retaining walls

2. Layouts for bridge deck drainage systems, including internal drainage piping within the bents where required on structures

3. Identification of pipe strength requirements

DEL.161. Deliverables for FC 161.

A. Drainage study report

B. Hydrologic data sheets

C. Hydraulic data sheets

D. Scour data sheets, if applicable

E. Culvert layout sheets

F. Storm drain plan/profile sheets

G. Detention and retention pond layouts

H. Detention and retention pond details, including associated outlet structures

I. Pump system layouts

J. Driveway culvert details

K. Miscellaneous drainage details

L. 3D model of the proposed drainage structures

M. Drainage summaries and quantities

FUNCTION CODE 160 (162) – ROADWAY DESIGN

SIGNING, PAVEMENT MARKINGS, AND SIGNALIZATION (PERMANENT)

162.1. Signing and Pavement Markings.

The Engineer shall prepare drawings, specifications, and details for all signs and pavement markings.

A. The Engineer shall:

1. Provide a 3D corridor model with the proposed pavement markings stenciled onto the model
2. Coordinate with the State (and other Engineers as required) for overall interim and final signing and pavement marking strategies and placement of signs outside contract limits
3. Prepare existing signing layouts, to reflect existing signs to be removed by the contractor
4. Prepare signing and pavement marking layout sheets for interim and final signing strategies and placement of signs outside contract limits. The layouts must designate the shields to be attached to guide signs. Proposed signs must be illustrated and numbered on layout sheets.
5. Prepare sign detail sheets for large guide signs showing dimensions, lettering, shields, borders, corner radii, and other relevant details
6. Designate the shields to be attached to guide signs
7. Select a foundation for each sign based on TxDOT sign standards

B. The Engineer shall prepare detail sheets to show:

1. Large sign details
2. Overhead sign structure elevations
3. Dimensioning (letters, shields, borders, and other relevant dimensions)

C. The Engineer shall prepare a summary of quantities for each of the following:

1. Large and small signs to be removed, relocated, or replaced
2. Small signs
3. Large signs, including all guide signs
4. Overhead sign structures

5. Pavement markings and delineation

D. The Engineer shall select signing and pavement marking standards.

162.2. Traffic Signal Warrant Studies.

A. The Engineer shall conduct traffic signal warrant studies for the intersections shown in Table 162.2(A) – Intersections.

Table 162.2(A) – Intersections

B. The Engineer shall prepare a traffic signal warrant study to support its recommendation for the continuous activation of an existing traffic signal or a proposed traffic signal based on projected volumes. Each warrant study must include addressing pedestrian signals along with obtaining both traffic and pedestrian counts.

For the traffic signal warrant study, the Engineer shall:

1. Perform manual turning movement counts at the study location during a weekday (Tuesday, Wednesday or Thursday) for the following periods: 6:00 – 9:00 a.m., 11:00 –2:00 p.m., and 4:00-6:00 p.m., or as directed by the State. Counts must be recorded at 15 minute and hourly intervals.
2. Perform 24-hour traffic counts (15 minute and hourly intervals) at the study location or the designated section of roadway
3. Perform pedestrian and bicycle volume counts on each approach at the study location for the 12-hour time period mentioned above or as directed by the State
4. Conduct a spot speed study at each study location
5. Conduct a crash analysis at each study location utilizing the TxDOT Crash Records Information System (CRIS) database
6. Conduct a site inspection at the study location and record traffic characteristics observed in the field. The field work may include taking measurements, locating utilities, locating existing signal equipment, identifying existing conditions, taking digital photographs of the intersection (with a minimum of one photograph per approach), and recording other relevant site condition information.
7. Prepare condition diagram showing details from site inspection and field work mentioned above
8. Prepare a site map of the area where the study is requested. Information shown on the site map must consist of existing control devices at the intersection and all existing signals for one mile along the major roadway
9. Develop and include a timing plan for each signal
10. Prepare and submit the following reports to the State, which summarize the findings of the traffic and pedestrian counts and field inventories for

each location. The Engineer shall address all the State's review comments before submitting the final reports.

a. One report must include:

(1) Existing condition diagrams

(2) Field photographs

(3) Traffic and pedestrian counts

b. The other report must include the signed and sealed engineering warrant study.

162.3. Traffic Signals.

Based upon the results of the traffic signal warrant studies, the Engineer shall identify and prepare traffic signal plans for all warranted traffic signals. The Engineer shall confirm the power source for all signals and coordinate with the appropriate utility agency. The Engineer shall develop all quantities, general notes, and specifications and incorporate the appropriate agency standards required to complete construction.

A. The Engineer shall prepare traffic signal plans for the intersections shown in Table 162.3(A) – Intersections.

Table 162.3(A) – Intersections

B. Traffic Signal Plans.

The Engineer shall provide the following information for each traffic signal:

1. Existing Intersection and Signal Layout
2. Estimate and quantity sheet
3. Basis of estimate sheet (list of materials)
4. General notes and specification data
5. Condition diagram
6. Plan sheet(s)
7. Elevation sheets
8. Conductor and conduit schedule
9. Vehicle detection
10. Foundation layout
11. Notes for plan layout
12. Phase sequence diagram(s)
13. Construction detail sheets(s)
14. Marking details (when applicable)
15. Aerial or underground interconnect details (when applicable)

C. The Engineer shall:

1. Contact local utility company to confirm power source and provide written documentation of this communication
2. Prepare governing specifications and special provisions list
3. Prepare project estimate

D. The Engineer shall select traffic signal standards for insertion into the plan set.

162.4. Intersection Safety Scoring Tool.

A. When specified in the work authorization, the Engineer shall prepare an analysis for all existing and proposed intersections within the limits of the project using the Intersection Scoring Tool spreadsheet developed by TxDOT.

The Engineer shall obtain the data needed to complete this analysis, including Annual Average Daily Traffic (AADT) and crash data, using the links contained in the Intersection Scoring Tool spreadsheet.

B. The Engineer shall complete internal quality assurance and quality control (QA and QC) checks of the analysis for each of the intersections in the project.

C. The Engineer shall submit an electronic file of the Safety Scoring Tool spreadsheet and a printout that includes the safety score and summary of results for each intersection.

DEL.162. Deliverables for FC 162.

A. Existing signing layouts
B. Signing and pavement marking layout sheets
C. Large sign detail sheets
D. Summary of large and small signs to be removed, relocated, or replaced
E. Overhead sign structure elevations sheets
F. Summary of quantities for:
G. Small signs
H. Large signs
I. Overhead sign structures
J. Pavement markings
K. Traffic Signal Warrant Studies
L. Traffic Signal Plans
M. Specifications and special provisions
N. Estimate of costs
O. Traffic Signal Standards
P. Safety Scoring Tool spreadsheet and printout for each intersection

FUNCTION CODE 160 (163) – ROADWAY DESIGN

MISCELLANEOUS ROADWAY

163.1. Utility Engineering.

Utility engineering includes the identification of utility conflicts, coordination, compliance with the UAR, and resolution of utility conflicts. The Engineer shall coordinate all activities with the State, or the State's designee, to facilitate the orderly progress and timely completion of the State's design phase.

A. Coordination Of Engineering Activities

1. The Engineer shall represent existing and proposed utilities in a 3D MicroStation subsurface utility design and analysis (DU) model, or current Bentley model.

2. Utility Layout

   The Utility Engineer must utilize the layout of existing utilities as prepared, if available, and make a determination of the following:

   a. Facilities in conflict with the proposed project that are to be relocated

   b. Facilities to be abandoned in place

   c. Facilities to remain in service and in place as a result roadway design adjustments and meeting the current UAR

3. If there are additional facilities, not shown in the SUE documents, which require relocation, the Engineer shall coordinate this information with the State immediately upon discovery.

4. For facilities with unknown owner that require utility accommodation, the Utility Engineer must coordinate with State for possible hot tap and removal. Engineer shall furnish all documents and exhibits to State. When construction sequence and adjustments must be included in the PS&E package, the Utility Engineer must coordinate with the PS&E design engineer for the construction sequence in regard to the utility adjustments. The Utility Engineer must include this in the PS&E package.

B. Public and Individual Meetings with Utility Companies

To facilitate utility conflict identification and resolution, the Engineer shall:

1. Establish contact with all existing utilities within and adjacent to the project limits and set up utility coordination meetings to discuss concepts and options for construction.

2. Schedule all utility coordination meetings and ensure compatibility with the schedule of the State.

3. Set agenda for all coordination meetings as directed by the State. Establish and promote the desired agenda and methodologies for utility construction within the project limits. The agenda and methodologies must consist primarily of promoting the construction of utilities as a part of the highway contract.

4. Prepare and present, in collaboration with the State, instruction and orientation sessions as required. The instruction must introduce the SUE Plans, the proposed utility layout, processes, demonstrate the technology, and facilitate the preparation of work orders, billings, and contract related documentation as it pertains to utility adjustment work.
5. Attend an initial project meeting and an on-site inspection (when appropriate) to ensure familiarity with existing conditions and project requirements and prepare a written report of the meeting.
6. Develop a work plan including a list of the tasks to be performed, a schedule, and an estimate. The work plan must satisfy the requirements of the project and must be approved by the State prior to commencing work.
7. Meet with the State periodically to coordinate the work effort and resolve problems and prepare a written report of all progress meetings.

C. Review Of Utility's Proposed Adjustments

1. Evaluate alternatives

   The Engineer shall evaluate alternatives in the adjustment of utilities balancing the needs of both the State and the utility.

2. Review estimates and schedules

   The Engineer shall review the utility adjustment estimates for reasonableness of cost and the timely scheduling of the adjustment.

3. The Engineer shall review plans for compliance with UAR and proposed location data. The responsibility for quality and accuracy of utility adjustment plans will remain with the utility company.
4. The Engineer shall inspect traffic control setup. Ensure necessary traffic control, labor and equipment is utilized where applicable during the utility relocation process. The Engineer shall ensure compliance with the regulations of the most recent edition of the *TMUTCD*. The Engineer must obtain approval from the State concerning the proposed method of handling traffic prior to allowing commencement of work.

D. Proposed Utility Layout.

The Engineer shall prepare signed and sealed proposed utility plans in the latest version of OpenRoads Civil Design system used by the State that can be overlaid (11" x 17") on the base file with drainage. The Engineer shall:

1. Ensure all facilities conflicts have been resolved
2. Ensure all stakeholders have concurred with the various alignments
3. Establish the sequence of construction for all utility relocation work whether it is included as a part of the Highway Construction or not
4. Determine which utilities will be built as part of the contract
5. Determine which facilities will be relocated prior to construction or during construction
6. Assist in the creation and maintenance of a utility management plan

E. PS&E for all utilities.

The Engineer shall coordinate, develop, or review PS&E for all utilities included in the construction contract.

F. Utility Certification and Special Provisions.

The Engineer shall prepare a utility certification document or a special provisions report. The utility certification document or special provisions report must certify that all utilities are clear for highway construction. However, if the utility adjustments are not complete prior to highway project letting, the Engineer shall prepare a special provision outlining all outstanding utility conflicts and their effects on highway construction. The Engineer shall also provide a utility clearance schedule, signed by the utility owner, with the certification as noted above. The formats for the certification and the clearance schedule will be provided by the State. The engineer shall prepare a construction management plan for all utility relocations certified not clear of the project prior to letting.

163.2. Utility Coordination.

A. Utility Base Map

The Engineer shall obtain information on existing utilities from utility owners and shall conduct investigations to identify and evaluate all known existing and proposed public and private utilities. The Engineer shall identify potential conflicts and attempt to minimize the potential adverse utility impacts in the preparation of the schematic design. The Engineer shall prepare a base map depicting the utility locations. The Engineer shall create and maintain a utility conflict matrix along with a utility conflict exhibit through the duration of the contract identifying potential known conflicts. The format of the matrix and exhibit must be consistent with the latest version of the San Antonio District Utility Conflict Matrix and Utility Conflict Exhibit or other examples provided by the State.

B. Utility Coordination

The Engineer shall assist the State in conducting utility coordination meetings with utility companies, as required, to facilitate utility conflict identification and resolution.

1. The Engineer shall establish contact with all existing utilities within and adjacent to the project limits and set up utility coordination meetings to discuss concepts and options for design and construction. This process must also be extended to utilities that approach the State, regarding plans to install facilities within the project limits after the project has been initiated.
2. The Engineer shall establish and conduct workshop meetings, both individually with each utility and with all utilities that incorporate the State’s project team to review and resolve conflicts.
3. The Engineer shall create agenda and exhibits for all coordination meetings as directed by the State.
4. The Engineer shall establish and promote the desired agenda and methodologies for utility construction within the project limits. This shall

consist primarily of promoting the construction of utilities as a part of the highway contract.

5. The Engineer shall schedule and conduct a utility kick-off meeting to obtain more information on existing facilities within the project limits. Major utility facilities must be discussed and analyzed to avoid relocation, if possible.

6. The Engineer shall schedule and conduct milestone meetings (or as-needed meetings) with the State to coordinate the work effort and resolve problems. The Engineer shall prepare a written report of these meetings. The meetings must include review of the following:

   a. Existing facilities including major facilities to be avoided with the project, if possible

   b. Utility Conflict Matrix

   c. Utility Conflict Exhibit

   d. Long lead items that could potentially impact the schedule during PS&E

C. Deliverables

1. Utility Conflict Matrix along with Utility Conflict Exhibit. The Utility Conflict Exhibit must be on 11x17 sheets and include callouts to indicate the conflict ID#, utility owner, type of line (water, sewer, high pressure gas, etc.), material (if it is an AC pipe line), and size (if known).

2. Utility Contacts list in excel and pdf format

3. Utility Summary to indicate major utility facilities or time sensitive items pertaining to utilities that need to be addressed in PS&E.

163.3. Geotechnical Borings and Investigations.

A. The Engineer shall determine the location of proposed soil borings for bridge design, embankment settlement analysis, retaining walls, slope stability and along storm drain alignment. The Engineer shall prepare a boring layout showing the general location and depths of the proposed borings. The Engineer shall provide the boring layout to the State for review and comment. Once the Engineer receives the State's review comments, the Engineer shall perform soil borings (field work), soil testing, and prepare the boring logs in accordance with the latest edition of the *TxDOT Geotechnical Manual* and the local TxDOT district's procedures and design guidelines.

B. The Engineer shall perform soil borings, rock coring, coring for pavement removal items, piezometric readings, testing and analysis to support pavement designs, bridge design, embankment settlement analysis, retaining walls and slope stability analysis. Locate soil borings every 500 feet along the storm sewer alignment and take piezometric readings at 2000 feet intervals. Spacing of soil borings must not exceed 500 feet. The Engineer shall perform geotechnical borings and investigations for the structures and pavements summarized in Table 163.2 (A) – SUM – Boring/Coring Summary and detailed in the tables referenced within this summary table.

Table 163.2(B)-SUM – Boring/Coring Summary (this table Summarizes the 163.2(B) tables)		
Soil Borings	**Total Quantity**	**Total Feet**
Bridge (Table 163.2(B)-BRG)		
Retaining Wall (Table 163.2(B)-RW)		
Noise Wall (Table 163.2(B)-NW)		
Slope Stability (Table 163.2(B)-SS)		
Overhead Sign Structure (Table 163.2(B)-OSS)		
Traffic Signal Foundation (Table 163.2(B)-TSF)		
High-Mast Lighting (Table 163.2(B)-HML)		
ITS Pole (Table 163.2(B)-ITS)		
Culvert (Table 163.2(B)-CUL)		
TOTAL		
Pavement Coring	**Total Quantity**	**Total Feet**
Existing (Table 163.2(B)-EP)		
Proposed (Table 163.2(B)-PP)		
TOTAL		

Table 163.2(B)-BRG – Soil Borings: Bridge				
Structure	**Approximate Limits**		**Quantity**	**Depth (feet)**
	Beginning Station	**Ending Station**		

Table 163.2(B)-RW – Soil Borings: Retaining Wall				
Structure	**Approximate Limits**		**Quantity**	**Depth (feet)**
	Beginning Station	**Ending Station**		

Table 163.2(B)-NW – Soil Borings: Noise Wall				
Structure	**Approximate Limits**		**Quantity**	**Depth (feet)**
	Beginning Station	**Ending Station**		

Table 163.2(B)-SS – Soil Borings: Slope Stability				
Structure	**Approximate Limits**		**Quantity**	**Depth (feet)**
	Beginning Station	**Ending Station**		

Table 163.2(B)-OSS – Soil Borings: Overhead Sign Structure				
Structure	**Approximate Limits**		**Quantity**	**Depth (feet)**
	Beginning Station	**Ending Station**		

Table 163.2(B)-TSF – Soil Borings: Traffic Signal Foundation				
Structure	**Approximate Limits**		**Quantity**	**Depth (feet)**
	Beginning Station	**Ending Station**		

Table 163.2(B)-HML – Soil Borings: High-Mast Lighting				
Structure	**Approximate Limits**		**Quantity**	**Depth (feet)**
	Beginning Station	**Ending Station**		

Table 163.2(B)-ITS – Soil Borings: ITS Pole

Structure	Approximate Limits		Quantity	Depth (feet)
	Beginning Station	Ending Station		

Table 163.2(B)-CUL – Soil Borings: Culvert				
Structure	Approximate Limits		Quantity	Depth (feet)
	Beginning Station	Ending Station		

Table 163.2(B)-EP – Pavement Coring: Existing				
Structure	Approximate Limits		Quantity	Depth (feet)
	Beginning Station	Ending Station		

Table 163.2(B)-PP – Pavement Coring: Proposed				
Structure	Approximate Limits		Quantity	Depth (feet)
	Beginning Station	Ending Station		

C. The Engineer shall provide a signed, sealed and dated geotechnical report that contains soil boring locations, boring logs, laboratory test results, generalized subsurface conditions, ground water conditions, piezometer data, analyses and recommendations for settlement and slope stability of the earthen embankments, skin friction tables, and design capacity curves including skin friction and point bearing. The skin friction tables and design capacity curves must be present for piling and drilled shaft foundation.

D. If applicable, the Engineer shall perform scour analysis to include grain size distribution curves with D50 value for each soil layer and a D50 grain size for a sample in the stream bed at the upstream face of the bridge in the upper 1-foot of the stream bed.

In addition, the Engineer shall provide a subsurface profile including the following information for each layer:

1. Particle Size Analysis (Tex-110-E) including:
    a. Median Grain Size (D50) and percent clay (percent passing No. 200 sieve)
    b. Soil type based on grain dimensions of cohesionless materials
2. Liquid Limit (Tex-104-E) as required for clayey soils
3. Plastic Limit (Tex-105-E) as required for clayey soils
4. Plasticity Index (Tex-106-E) as required for clayey soils
5. USCS Soil Classification (Tex-142-E) as required for clayey soils
6. The Engineer shall prepare and sign, seal, and date soil boring sheets to be used in the PS&E package.

E. All geotechnical work must be performed in accordance with the latest version of the *TxDOT Geotechnical Manual*. All testing must be performed in accordance with TxDOT's Test Procedures, which are available at https://www.txdot.gov/business/resources/testing.html. American Society for Testing Materials (ASTM) test procedures may be used only in the absence of the TxDOT procedures. All soil classification must be done in accordance with the Unified Soil Classification System.

F. If applicable, the Engineer shall perform any retaining wall analyses including the settlement analysis. This analysis must include the computation of the factor of safety for bearing capacity, global stability, overturning, and sliding, internal stability. In addition, the Engineer shall include allowable bearing pressure, passive earth pressure, friction factor, settlement analysis (consolidation report), and lateral earth pressure for the retaining walls.

G. The Engineer shall sign, seal, and date soil boring sheets to be used in the PS&E package. The preparation of soil boring sheets must be in accordance with a State's Austin District standards.

H. Foundation Studies: The Engineer shall coordinate with the State to determine the location of soil borings to be drilled along the retaining wall alignments. The soil borings must extend a minimum of 35 feet below the footing elevation or deeper as soil conditions warrant. Spacing of soil borings shall not exceed 500 feet. The Engineer shall provide a boring layout for the State's review and comment.

I. The Engineer shall incorporate soil boring data sheets prepared, signed, sealed, and dated by the geotechnical engineer overseeing the work. The soil boring sheets shall be in accordance with the State's WINCORE software, which is available on the Texas Department of Transportation (TxDOT) website.

J. Pavement Design: If applicable, the Engineer shall incorporate the pavement design developed by the State. If the pavement design is not available, the State may request the Engineer perform pavement design and submit to State for review and approval.

K. Deliverables

1. Preliminary Pavement Design Report

2. Geotechnical Report
3. DGN flies containing drilling log data from Geotechnical analysis

163.4. Retaining Walls and Miscellaneous Structures.

A. Retaining wall design

Prior to preparation of retaining wall layouts, the Engineer shall prepare a comparative cost analysis of different types of retaining walls versus roadway embankment, pavement, soil stabilization, retaining walls type, and available ROW to determine optimum selection based on economics, construction time duration, ROW encroachments (need for construction easements) and construction feasibility, including temporary shoring layouts and detailed, if required by the State.

The Engineer shall notify the State of the type of retaining walls that will be used for each cut and fill location.

B. Retaining wall layouts and details

The Engineer shall provide layouts (scale 1"=100'), elevations, quantity estimate, summary of quantities, typical cross sections and structural details of all retaining walls within the project. Approximate lengths of the retaining walls as shown on the schematic are provided in Table 163.3(B) – Proposed Retaining Walls. The Engineer shall determine if any additional walls are required and verify the need for and length of the retaining walls as shown on the schematic.

Table 163.3(B) – Proposed Retaining Walls

Retaining Wall Name	Approximate Limits		Wall Type	Wall Length (feet)
	Beginning Station	Ending Station		

C. The Engineer shall develop each retaining wall design.

The Engineer shall:

1. The Engineer shall perform any needed retaining wall analyses to include the settlement analysis. This analysis must include the computation of the factor of safety for bearing capacity, global stability, overturning and sliding. In addition, the Engineer shall include allowable bearing pressure, passive earth pressure, friction factor, settlement analysis (consolidation report) and lateral earth pressure for the retaining wall
2. Calculate retaining wall quantities
3. Provide retaining wall summary sheets
4. Select retaining wall standards for insertion into the plan set

163.5. Traffic Control Plan, Detours, Sequence of Construction.

The Engineer shall prepare traffic control plans (TCP) including TCP typical sections, for the project. The Engineer shall complete Form 2229-Significant Project Procedures along with Page 4 of Form 1002, specifically titled Accelerated Construction Procedures and Form 1204. The Engineer shall interface and coordinate phases of work, including the TCP, with adjacent engineers.

The Engineer shall:

A. Prepare Traffic Control Plans (TCP) for the project

Determine the existing and proposed traffic control devices (e.g., regulatory signs, warning signs, guide signs, route markers, construction pavement markings, barricades, flag personnel, temporary traffic signals) to be used to handle traffic during each construction sequence.

B. Prepare TCP typical sections for the project.

C. Provide a written narrative of the construction sequencing and work activities per phase that:

1. Describes the type of work to be performed for each phase of sequence of construction and any special instructions (e.g., storm drain, culverts, bridges, railing, illumination, signals, retaining walls, signing, paving surface sequencing or concrete placement, ROW restrictions, utilities) that the contractor should be made aware including limits of construction, obliteration, and shifting or detouring of traffic prior to the proceeding phase.

2. Includes the work limits, the location of channelizing devices, positive barrier, location and direction of traffic, work area, stations, pavement markings, and other information deemed necessary for each phase of construction.

D. Prepare layouts and show the limits for temporary shoring on the applicable TCP

E. Prepare temporary roadway plan and profile layouts

F. Prepare temporary ramp plan and profile layouts

G. Prepare temporary structure (including shoo-fly) plan and profile layouts

H. Prepare detour plans to maintain continuity during construction phasing.

I. Design temporary drainage to replace existing drainage disturbed by construction activities or to drain detour pavement

J. Prepare interim signing for every phase of construction. The Engineer shall interface and coordinate phases of work, including the TCP, with adjacent Engineers, which are responsible for the preparation of the PS&E for adjacent projects

K. Develop a list of each abutting property along the roadway alignment. Notify the State in the event existing access must be eliminated and must receive approval from the State prior to any elimination of existing access. Prepare exhibits for and attend meetings with the public, as requested by the State.

L. Identify and coordinate with all utility companies for relocations required.

M. Identify and delineate any outstanding ROW parcels

N. Delineate areas of wetlands on traffic control plans

O. Design the TCP phasing by creating a phased 3D corridor model, as specified by the State

P. Calculate traffic control quantities

Q. Provide traffic control summary sheet(s)

R. Select traffic control standards for insertion into the plan set

S. Attend District Safety Review Team (DSRT) Meetings

T. Prepare Smart Work Zone Go-No-Go spreadsheet

163.6. Temporary Traffic Signals and Illumination.

The Engineer shall:

A. Address the adjustment or realignment of traffic signal heads and the use of detection for mainlanes and side streets on the plans as directed by the State. Obtain traffic movement counts to address any new timing plans to minimize the impact during construction and to determine the storage length needed for left and right turn movements.

B. Prepare temporary traffic signal plans for the intersections shown in Table 163.5(B) – Intersections.

Table 163.5(B) – Intersections (including Temporary Lighting)

C. Address temporary lighting of signalized intersections and coordinate with local utilities as approved by the State.

163.7. Illumination.

The Engineer shall:

A. Integrate existing illumination within the project limits into the proposed design.

B. Coordinate with the State to determine the location of proposed lighting for the following lighting types:

1. high-mast
2. conventional
3. underpass lighting
4. safety lighting as part of each design on each flashing beacon and traffic signal

C. Provide a preliminary layout for initial review and approval by the State. For high mast lighting, the Engineer shall prepare photometric data layout and submit for review and approval before beginning detailed design.

D. Prepare layouts and details including circuit wiring diagrams showing the number of luminaires on each circuit, electrical conductors, length of runs, and service pole assemblies

E. Calculate illumination quantities

F. Prepare illumination summary sheet(s)

G. Select illumination standards for insertion into the plan set

163.8. Storm Water Pollution Prevention Plans (SWP3).

The Engineer shall:

A. Develop SWP3, in conformance with the TCP, to minimize potential impact to receiving waterways. The SWP3 must be shown on separate sheets from the TCP unless the State specifically directs the Engineer to show the SWP3 and the TCP on the same set of sheets.

B. Calculate SWP3 quantities

C. Prepare SWP3 summary sheet(s)

D. Select SWP3 standards for insertion into the plan set

163.9. Plan Preparation.

The Engineer shall prepare and assemble plans for the proposed improvements for each of the following milestones:

A. 30%

B. 60%

C. 90%

D. 95%

E. 100%

Refer to the Milestone Design Deliverables section of this attachment for the contents of these deliverables.

163.10. Special Utility Details (ex., Water, Sanitary Sewer).

The Engineer shall develop special details to accommodate or adjust utilities. Prior to developing any special utility detail, the Engineer shall notify the State in writing regarding each utility conflict that might require an accommodation. As directed by the State, the Engineer shall coordinate with each utility to develop each special detail. The Engineer shall prepare each plan sheet, detail sheet, special specification, special provision, and special note required to incorporate the details into the State's plans.

163.11. Miscellaneous Structural Details.

The Engineer shall provide necessary details required to supplement standard details.

163.12. Agreements (Railroad or other Agency) and Layouts.

A. The Engineer shall prepare each railroad or other agency agreement, exhibit, and layout sheet in accordance with the requirements of each railroad and as directed by the State. The Engineer shall coordinate with each railroad or

agency and the State to determine submittal requirements, processing schedules, and exhibit formats. The Engineer shall submit each exhibit to the State for review and processing. The Engineer shall develop and submit the following:

1. Rail Agreement Exhibit “A”
2. Rail Agreement Exhibit “B”
3. Hydraulic analysis
4. Track outage exhibit(s)
5. Railroad scope of work matrix
6. Metes and bounds property description(s)
7. Location exhibit(s)
8. Cost estimate(s)
9. Traffic signal pre-emption (if needed)
10. Design conformance to railroad guidelines report (if needed)
11. Typical section report (if needed)

B. The Engineer shall:

1. Coordinate with TxDOT district railroad coordinator, TxDOT rail division, or railroad manager
2. Visit the site with a TxDOT representative and railroad representative

C. The Engineer shall prepare railroad agreement exhibits for the locations shown in Table 163.11(C) – Railroad Crossings.

Table 163.11(C) – Railroad Crossings

DOT Crossing	Railroad Owner	Crossing Roadway	Railroad Subdivision	Crossing Type

163.13. Testimony for Right of Way Hearings.

The Engineer shall support and testify in possible right of way hearings. As requested by the State or the Attorney General’s office, the Engineer shall:

A. Research, study, analyze and review the project and the assigned parcels for acquisition

B. Prepare litigation designs and standard 8.5 x 11-inch, 11 x 17-inch, or 24 x 36-inch paper exhibits. These deliverables are litigation documents (i.e., not engineering documents) so are not required to be sealed by a professional engineer.

C. Be available to prepare for and testify at hearings, depositions, and trials

D. Be available to assist and consult with the Attorney General’s Office, for case preparation

163.14. Estimate.

The Engineer shall independently develop and report quantities necessary to construct the contract in standard State bid format at the specified milestones and final PS&E submittals. The Engineer shall prepare each construction cost estimates using Estimator or any approved method. The Engineer shall provide the estimate at each milestone submittal or in electronic (TxDOTCONNECT) format at the 60%, 90% and final PS&E submittals per State's district requirement.

163.15. Contract Time Determination.

The Engineer shall prepare a detailed contract time estimate to determine the approximate time required for construction of the project in calendar and working days (based on the State standard definitions of calendar and working days) at the 60%, 90% and final PS&E milestone. The Engineer shall provide assistance to the State in interpreting the schedule.

163.16. Specifications and General Notes.

A. The Engineer shall identify necessary standard specifications, special specifications, special provisions, and the appropriate reference items and provide them in the format required by the State.

B. The Engineer shall prepare general notes from the district's master list of general notes, for inclusion in the plans and bidding documents.

163.17. Constructability Review.

The Engineer shall provide independent quality review of the constructability of the PS&E sets.

The Engineer shall perform constructability reviews at major project design milestones (e.g., 30%, 60%, 90%, and final plan) to identify potential constructability issues and options that would provide substantial time savings during construction.

DEL.163. Deliverables for FC 163.

A. Utility layout

B. Proposed utility layout

C. Utility certifications, if applicable

D. Special provision and special provisions report, if applicable

E. Utility clearance schedule, if applicable

F. Boring layout

G. Geotechnical report

H. Soil boring sheets

I. Pavement design

J. Retaining wall cost analysis

K. OpenRoads 3D corridor model that includes retaining walls

L. Retaining wall layouts

M. Retaining wall details

N. Retaining wall standards
O. Retaining wall quantities
P. Traffic control plans
Q. Traffic control typical sections
R. Traffic control narrative
S. Temporary shoring layouts, if applicable
T. Plan and profile layouts for temporary roadways, ramps, and structures
U. Phased OpenRoads 3D corridor model showing TCP phasing
V. Traffic control standards
W. Traffic control quantities
X. Temporary traffic signal and illumination plans
Y. Illumination layouts
Z. Illumination details
AA. Illumination standards
BB. Illumination quantities
CC. SWP3 layouts
DD. SWP3 summary sheets
EE. Environmental layout sheets
FF. SWP3 standards
GG. SWP3 quantities
HH. Special utility detail sheets, specifications, special provisions, and notes
II. Miscellaneous structural details, if applicable
JJ. Railroad exhibit packages
KK. Litigation exhibits
LL. Construction cost estimates
MM. Contract time estimate
NN. Constructability review log

FUNCTION CODE 160 (165) – ROADWAY DESIGN

TRAFFIC MANAGEMENT SYSTEMS (PERMANENT)

165.1. Traffic Management Systems.

A. The Engineer shall design and provide details as a part of the State's Intelligent Transportation System. The Engineer shall prepare the design and details including conduit and cable, support structures, control equipment, and

other equipment necessary to implement the system. Design specifications will be defined in the work authorization.

B. The Engineer shall ensure all existing ITS devices are to remain operational during construction. This may include temporary ITS fiber or temporary ITS device locations. Radio communication will only be allowed with the approval by the District Traffic management Systems Supervisor. New or relocated ITS equipment may require additional sheets that indicate how these requirements are phased with other work.

C. The engineer shall show the ROW lines on the ITS sheets. The engineer shall provide details where ITS elements are in close proximity (horizontally or vertically) to existing utilities or other features that must remain in place.

D. The proposed equipment and locations for this project shown in Table 165.1(D)-LUCS – Lane-Use Control Signal (LUCS), Table 165.1(D)-VMS – Variable Message Signs (VMS), Table 165.1(D)-CCTVC – Closed-Circuit Television Camera (CCTVC), and Table 165.1(D)-VDD – Vehicle Detection Device (VDD).

Table 165.1(D)-LUCS – Lane-Use Control Signal (LUCS)		
LUCS #	**Roadway**	**Approximate Station**

Table 165.1(D)-VMS – Variable Message Signs (VMS) or Dynamic Message Signs (DMS)		
VMS/DMS #	**Roadway**	**Approximate Station**

Table 165.1(D)-CCTVC – Closed-Circuit Television Camera (CCTVC)		
CCTVC #	**Roadway**	**Approximate Station**

Table 165.1(D)-VDD – Vehicle Detection Device (VDD)		
VDD #	**Roadway**	**Approximate Station**

E. The Engineer shall calculate Traffic Management System quantities.

F. The Engineer shall provide traffic management system summary sheet(s)

G. The Engineer shall select traffic management system standards for insertion into the plan set.

DEL.165. DEL.165.Deliverables for FC 165.

. Traffic management system details

A. Traffic management system quantities

B. Traffic management system summaries

C. Traffic management system standards

FUNCTION CODE 160 (170) – ROADWAY DESIGN

BRIDGE DESIGN

170.1. Bridge Condition Survey Report.

The Engineer shall prepare a bridge condition survey report for each existing bridge to remain, including bridges to be widened. The Engineer shall prepare bridge condition survey reports for each of the bridges shown in Table 170.1 – Existing Bridges.

Table 170.1 – Existing Bridges

Bridge Name	Roadway Name	NBI#	County

170.2. Bridge Cost Comparative Study.

Prior to preparation of each bridge layout, the Engineer shall prepare a comparative cost analysis of bridge structures to determine:

A. the optimum bridge beams for vertical clearance over railroads, roadway, or waterways

B. the optimum bridge structure versus roadway embankment, pavement, soil stabilization, and retaining walls

C. the optimum bridge beams for the direct connectors

170.3. Bridge Layout.

The Engineer shall:

A. Prepare a bridge layout plan sheet for each bridge and submit a 3D bridge model utilizing OpenBridge Modeler (OBM). When the 3D bridge model is referenced into the 3D corridor, the bridge must align, both vertically and horizontally, in the bridge location of the 3D corridor. The 3D bridge model must consist of 3D elements for slab, beams, abutments, wingwalls, caps, columns, and foundations. Quantities and geometry from OBM 3D bridge model must be verified by other means.

Prepare Bridge Layouts and 3D models for the locations shown in Table 170.3(A) – Bridges.

Table 170.3(A) – Bridges				
Bridge Name	**Control-Section-Job (CSJ) Number**	**Girder Type**	**Length (feet)**	**Width (feet)**

B. Prepare a bridge layout plan sheet for each bridge class culvert and prepare a 3D model using OpenRoads Designer.

Prepare Bridge Class Culvert Layouts and 3D models for the locations shown in Table 170.3(B) – Culverts.

Table 170.3(B) – Culverts					
Culvert #	**Approximate Station**	**Crossing**	**Standard or Non-Standard**	**Description**	**Length (feet)**

C. The Engineer shall incorporate aesthetics as directed by the State including the following: aesthetic theme of the region, form-liners, decorative retaining walls, painting, and other aesthetic elements.

170.4. Bridge Structural Details.

The Engineer shall prepare each structural design and develop detailed structural drawings of all required details:

A. Perform calculations and determine elevations for design of the bridge foundation.

B. Perform calculations and determine elevations for design of the bridge superstructure

C. Perform load rating calculations.

D. Prepare necessary foundation details and plan sheets, if required.

E. Prepare plan sheets for abutment and bent design and additional abutment and bent details, if required.

F. Prepare framing plan, slab plan sheets, and perform calculations for bridge slab design, if required.

G. Prepare tables for slab and bearing seat elevations, dead load deflections, and other necessary bridge information.

H. Prepare beam design tables, if required.

I. Prepare special provisions and special specifications, if required.

J. Prepare any additional required details specific to the project

K. Prepare bridge summary sheet(s)

L. Select bridge standards for insertion into the plan set.

170.5. Bridge Detail Summary.

The Engineer shall prepare total bridge quantities, estimates, and summary sheets for each bridge or bridge class culvert.

170.6. Independent Analysis.

The Engineer shall provide independent analysis of TxDOT's or third-party engineer's design of complex or exotic bridge projects. The Engineer shall review project requirements, plan sheets, specifications, reports, and project manuals. The Engineer shall verify the plan sheets and other construction documents result in a bridge that meets the following requirements:

A. complies with the TxDOT *Bridge Design Manual – LRFD*, including the version of *AASTHO LRFD Bridge Design Specifications* indicated in that manual;

B. follows appropriate engineering standards; and

C. is representative of the project's complexity through all stages of construction up to and including in service design.

DEL.170. Deliverables for FC 170.

. Bridge condition survey report

A. Bridge cost comparative study

B. Bridge and culvert layouts

C. Bridge typical sections

D. 3D bridge model

E. Bridge design calculations

F. Bridge special provisions and special specifications

G. Bridge detail sheets

H. Bridge standards

I. Summary of bridge quantities

J. Bridge cost estimate

K. Independent analysis report (if required by work authorization)

FUNCTION CODE 300 (351) – DESIGN VERIF/CHANGES/ALTER

CONSTRUCTION PHASE SERVICES

351.1. Construction Phase Services.

The Engineer shall provide construction phase services at the written request of the State's project manager. The written request must include a description of the work requested, a mutually agreed upon time limit, and any special instructions for coordination and submittal.

The Engineer shall provide the following construction phase services:

A. Attend preconstruction meeting

B. Attend partnering meeting

C. Attend field meetings and make visits to site

D. Calculate quantities and assist the area engineer in preparing change orders

E. Review and approval of shop drawings

F. Review and approval of forming details

G. Respond to requests for information (RFIs)

H. Provide minor redesign (major redesign should be handled with a contract supplement), which will include changes to the affected plan sheets and an updated copy of the 3D corridor model.

I. Answer general questions

J. Provide clarification

K. Perform other project related tasks in support of the State during construction

L. Monitor intersection operations and provide traffic signal timing updates as needed for each major construction phase

M. Provide utility-related construction phase services including:

1. Hold or attend monthly utility coordination meetings

2. Conduct one on one utility meetings as design related changes occur (2 meetings per month)

3. Review utility permits for corridor development

N. Attend field meetings for potential issues

O. Attend bi-weekly coordination meetings with TxDOT area office and construction engineering and inspection (CEI) consultant during construction

DEL.351. Deliverables for FC 351

. Meeting minutes or notes

A. Change order documentation and quantities

B. Responses to RFIs

C. Minor redesign sheets and quantities

D. OpenRoads 3D corridor model, updated to show minor redesigns

E. Documentation of traffic signal timing updates

F. Documentation of utility coordination meetings

MILESTONE DESIGN DELIVERABLES

DELIVERABLES FOR PS&E DEVELOPMENT MILESTONES

The Engineer shall submit the following deliverables to the State:

DEL.1. 30% Plans Submittal.

A. An electronic set of 11” x 17” plan sheets for the State review.

B. Bridge Layouts and or Retaining Wall Layouts. An electronic set of 11” x 17” bridge and retaining wall layouts including bridge typical sections for the State Review. External stability analysis for retaining walls.

C. Estimate of construction cost

D. Engineer’s internal QA and QC markup set

E. Updated Design Summary Report, Form 1002 and Design Exceptions with existing and proposed typical sections, location map, and design exception exhibits

F. A preliminary 3D corridor model, in the most current format, created using Bentley’s OpenRoads tools, including existing utility locations and with enough detail to verify the design of the 30% plan sheets

G. If applicable, a preliminary 3D bridge model utilizing OpenBridge Modeler (OBM), and with enough detail to verify the design of the 30% plan sheets. When the 3D bridge model is referenced into the 3D corridor, the bridge must align, both vertically and horizontally, in the bridge location of the 3D corridor.

H. Any other additional information required by the State.

DEL.2. Between 30% Submittal and 60% Submittal.

A. Formal response to comments provided by the State as part of their preliminary review process and revised Bridge Layouts and Retaining Wall Layouts if necessary.

B. Engineer’s internal QA and QC marked up set

C. One set of a roll format TCP phasing layouts, one .pdf of plan sheets for TCP concept, and the completed significant project procedures form (TxDOT Form 2229) to present at the TCAT for the State review

D. One set of a roll format of illumination plan concept for State review

E. For division hydrologic and hydraulic review of existing and proposed bridges and bridge class culverts, five sets of 11” x 17” preliminary bridge and bridge class culvert plan and profile sheets, hydrology & hydraulics sheets, scour analysis, project title sheet, and project layout sheet

F. A preliminary 3D corridor model, in the most current format, created using Bentley’s OpenRoads tools, and with enough detail to verify the design of the bridge and retaining wall layouts.

G. If applicable, a preliminary 3D bridge model utilizing Bentley’s OpenBridge Modeler (OBM), and with enough detail to verify the design of the bridge and retaining wall layouts.

H. Any other additional information required by the State.

DEL.3. 60% Plans Submittal.

A. Three hard copy sets and an electronic set of 11” x 17” plan sets for the State review.

B. Estimate of construction cost.

C. Updated Design Summary Report and Form 1002.

D. Draft Project Certifications and Utility Construction Management Plan

E. Engineer's internal QA and QC marked up set.

F. One set of a roll format TCP phasing layouts, one .pdf of plan sheets for TCP concept, and significant project procedures form (State Form 2229) to present at the TCAT for the State review.

G. A preliminary 3D corridor model, in the most current format, created using Bentley's OpenRoads tools, including existing utility locations with elevation information and with enough detail to verify the design of the 60% plan sheets. The level of detail of the surface and subsurface features must be at the direction of the State.

H. If applicable, a preliminary 3D bridge model utilizing OpenBridge Modeler (OBM), and with enough detail to verify the design of the 60% plan sheets. When the 3D bridge model is referenced into the 3D corridor, the bridge must align, both vertically and horizontally, in the bridge location of the 3D corridor. The 3D bridge model must consist of 3D elements for slab, beams, abutments, wingwalls, caps, columns, and foundations. The level of detail of the bridge elements must be at the direction of the State.

I. Any other additional information required by the State.

DEL.4. Between 60% and 90% Submittal

A. Seven hard copy sets and an electronic set of all bridge plan sheets and hydrologic and hydraulic plan sheets and models.

B. A preliminary 3D corridor model, in the most current format, created using Bentley's OpenRoads tools, and with enough detail to verify the design of the Bridge layouts

C. A preliminary 3D bridge model utilizing Bentley's OpenBridge Modeler (OBM), and with enough detail to verify the design of the of the Bridge Layouts.

DEL.5. Review Submittal (90%).

A. Three hard copy sets and an electronic set of 11" x 17" plan sheets for the State review

B. Estimate of construction cost in Excel and TxDOTCONNECT

C. Updated Design Summary Report, if required and Form 1002

D. Final Project Certifications and Utility Construction Management Plan

E. Marked up general notes

F. Construction schedule

G. New special specifications and special provisions if applicable

H. Engineer's internal QA and QC marked up set

I. Other supporting documents

J. A detailed 3D corridor model, in the most current format, created using Bentley's OpenRoads tools, including existing utility locations with elevation information and with enough detail to verify the design of the 90% plan sheets. The level of detail of the surface and subsurface features must be at the direction of the State.

K. If applicable, a 3D bridge model utilizing OpenBridge Modeler (OBM), and with enough detail to verify the design of the 90% plan sheets. When the 3D bridge model is referenced into the 3D corridor, the bridge must align, both vertically and horizontally, in the bridge location of the 3D corridor. The 3D bridge model must consist of 3D elements for slab, beams, abutments, wingwalls, caps, columns, and foundations. The level of detail of the bridge elements must be at the direction of the State.

L. Any other additional information required by the State.

DEL.6. District Review Submittal (95%).

A. Three hard copy sets and an electronic set of 11" x 17" plan sheets for the State review

B. Estimate of construction cost in Excel and TxDOTCONNECT

C. List of governing specifications and special provisions in addition to those required

D. Marked up general notes

E. Form 1002

F. Final Project Certifications and Utility Construction Management Plan

G. New special specifications and special provisions if applicable

H. Triple zero special provisions

I. Engineer sign, seal, and date supplemental sheets (8.5" x 11")

J. Contract time determination summary

K. Significant project procedures form

L. Right of way and utilities certification

M. Temporary road closure letters

N. Construction speed zone request

O. Engineer's internal QA and QC marked-up set

P. Other supporting documents

Q. A detailed 3D corridor model, in the most current format, created using Bentley's OpenRoads tools, including existing utility locations with elevation information and with enough detail to verify the design of the 95% plan sheets. The level of detail of the surface and subsurface features must be at the direction of the State.

R. If applicable, a 3D bridge model utilizing OpenBridge Modeler (OBM), and with enough detail to verify the design of the 95% plan sheets. When the 3D bridge model is referenced into the 3D corridor, the bridge must align, both vertically and horizontally, in the bridge location of the 3D corridor. The 3D bridge model

must consist of 3D elements for slab, beams, abutments, wingwalls, caps, columns, and foundations. The level of detail of the bridge elements must be at the direction of the State.

S. Any other additional information required by the State.

DEL.7. Final submittal (100%).

A. PDF portfolio of all plan sheets

B. Revised supporting documents that address the 95% review comments

C. A final 3D corridor model, in the most current format created using Bentley's OpenRoads tools. The level of detail of the surface and subsurface features will be at the direction of the State.

D. A final 3D earthwork model in either .XML or .ICM format (as directed by the State) created using Bentley's OpenRoads tools. The level of detail of the surface and subsurface features will be at the direction of the State.

E. If applicable, a final 3D bridge model utilizing OpenBridge Modeler (OBM). When the 3D bridge model is referenced into the 3D corridor, the bridge must align, both vertically and horizontally, in the bridge location of the 3D corridor. The 3D bridge model must consist of 3D elements for slab, beams, abutments, wingwalls, caps, columns, and foundations. The level of detail of the bridge elements must be at the direction of the State.

F. The Engineer shall prepare a letter report which includes the findings of the comparison of OBM 3D bridge model geometry and quantities verified by alternate methods. The report must include a detailed discussion of the differences and proposed enhancements and issues in OBM software.

G. Any other additional information required by the State.