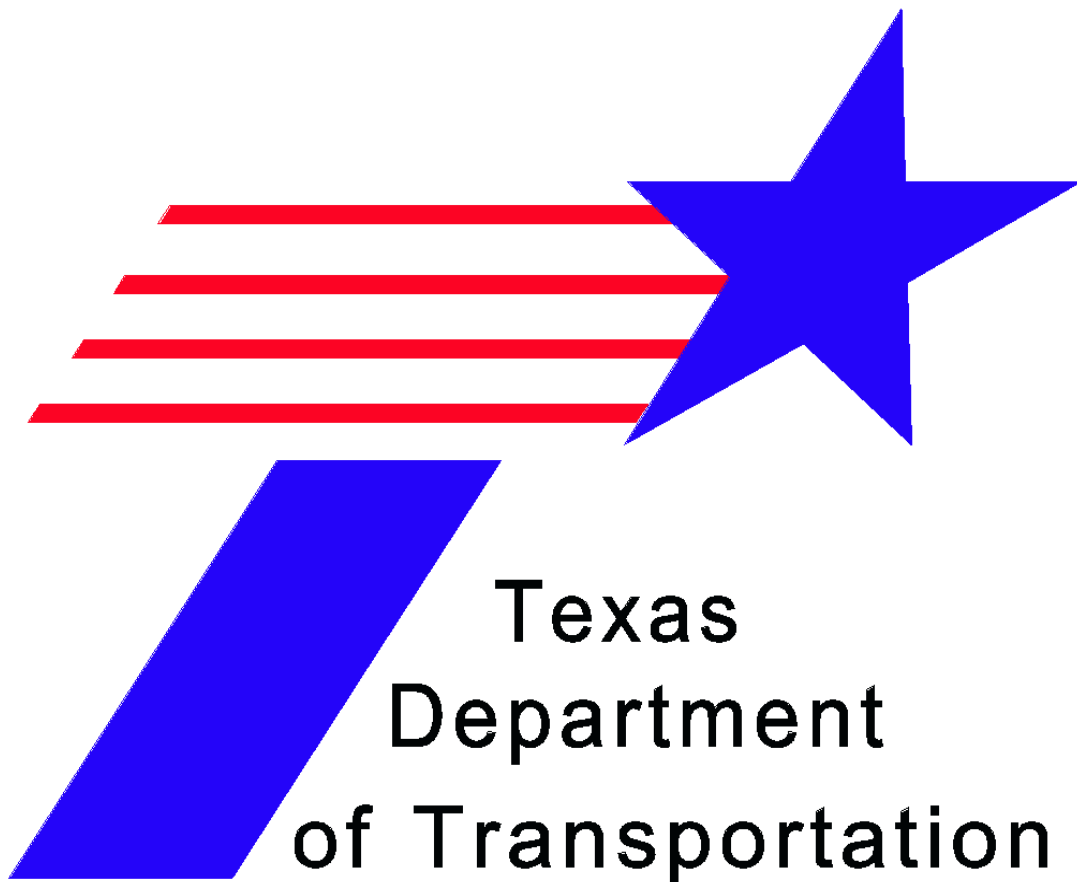


Quality Assurance Program  
for  
Design-Build Projects with an Optional 15-Year  
Capital Maintenance Agreement



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# SECTION 1 - INTRODUCTION

## 1.1 General

The Quality Assurance Program (QAP) for design-build Projects established by the Texas Department of Transportation (TxDOT) ensures that materials and workmanship incorporated into the highway construction project are in reasonable conformance with the approved plans and specifications, including any approved changes.

This program is developed based on 23 CFR 637B and Federal Highway Administration (FHWA) Technical Advisory T6120.3, which are available at the following links:

- 23 CFR 637B - [http://www.access.gpo.gov/nara/cfr/waisidx\\_03/23cfr637\\_03.html](http://www.access.gpo.gov/nara/cfr/waisidx_03/23cfr637_03.html)
- TA 6120.3 - <http://www.fhwa.dot.gov/legsregs/directives/techadvs/t61203.htm>

The program consists of a quality control program, an acceptance program and an independent assurance (IA) Program. The QAP allows for the use of contractor-performed quality acceptance (QA) test results as part of an acceptance decision if the QA results are validated by the Owner Verification (OV) testing results performed by TxDOT.

The purpose of this manual is to provide statewide consistency and a programmatic approach to quality assurance for design-build projects where the contractor's test results are used in the acceptance decision regardless of how the project is funded. It clarifies federal requirements relating to quality assurance and statistical analysis procedures. The content of this program is developed for projects with an optional 15-year maintenance agreement as part of the design-build CDA with no Special Experimental Project 15 (SEP-15) exceptions with respect to quality assurance. This document is to be included (or referenced) in the RFP, CDA and other key preconstruction project documents and approvals by TxDOT and FHWA. Any modification to this QAP requires review and approval by TxDOT and FHWA ninety days prior to construction.

The use of contractor tests results as part of the acceptance decision should be carefully evaluated for each project because a significant TxDOT owner verification program is instrumental to its success.

Acronyms and definitions for terms used in the QAP are provided in [Appendix A – Acronyms and Definitions](#).

The QAP is comprised of several components and the relationships between the parties and functions are shown in Figure 1.

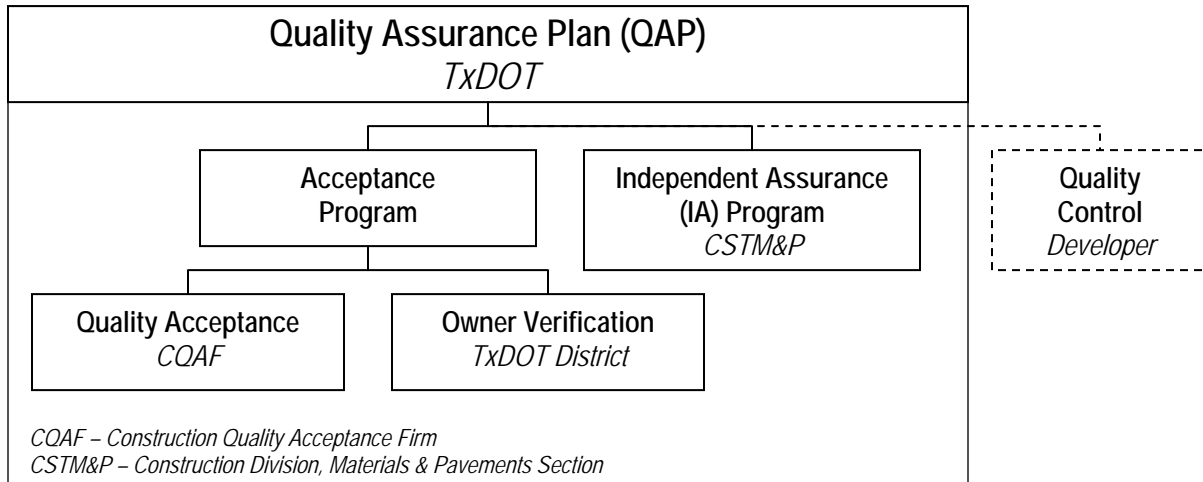


Figure 1 – Components and Relationship in the QAP

## 1.2 Construction Quality Management Plan

Developer's Construction Quality Management Plan (CQMP) shall consist of both quality control (QC) and QA with respect to performance of the Work. Requirements for the QC portion of the CQMP are described in Section 2 – Quality Control Program. Requirements for the QA portion of the CQMP are described in Section 3 – Acceptance Program. The CQMP shall establish a clear distinction between QC and QA activities and the persons performing each function. Developer shall submit the CQMP to TxDOT for review and approval.

## 1.3 Owner Verification Testing and Inspection Plan

TxDOT's Owner Verification Testing and Inspection Plan (OVTIP) shall describe TxDOT's commitments to perform owner verification (OV) of the Developer's QA testing and inspection. Requirements for the OVTIP are described in Section 3 – Acceptance Program.

## 1.4 Conflict of Interest

To avoid an appearance of a conflict of interest, any qualified laboratory shall perform only one of the following types of testing on the same project:

- A. Quality control testing;
- B. Quality acceptance testing;
- C. Owner verification testing;
- D. Independent assurance testing; or
- E. Referee testing.

## SECTION 2 - QUALITY CONTROL PROGRAM

### 2.1 General

Developer shall be responsible for the quality of the Work. Project quality will be enhanced through the daily efforts of all the workers involved with the Work, supported by Developer's CQMP. Developer's QC portion of the CQMP shall include the internal procedures used by Developer that will ensure that the Work is delivered in accordance with the released-for-construction plans, approved shop drawings, working drawings, and specifications. This involves the active participation of the entire work force in working to achieve "quality" initially and to minimize/eliminate re-work. Developer's QC shall not be part of the acceptance program.

### 2.2 Developer Quality Control Requirements

Developer's CQMP shall establish a systematic approach to define the processes, methods, procedures, and documentation for delivery of QC on the Project. These methods and procedures shall clearly define the authority and responsibility for the administration of Developer's QC plan.

#### 2.2.1 Staffing

Developer shall assign an on-site Construction Quality Control Manager (CQCM) who shall be responsible for management of the quality control aspect of the CQMP. The CQCM shall not be involved with scheduling or production activities, and shall report directly to Developer's management team. The CQCM shall see that the methods and procedures contained in the approved CQMP are implemented and followed by Developer and Subcontractors in the performance of the Work. The CQCM shall be a Registered Professional Engineer.

Developer's and Subcontractors' construction work force are all considered to be members of Developer's quality control staff as each and everyone is responsible for the quality of the Work. Personnel responsible for performing the quality control inspection shall be knowledgeable and receive training to perform their quality control duties. Personnel performing quality control sampling and testing shall be knowledgeable in the testing methods and procedures.

Although not used for acceptance, QC testing and inspection shall ensure quality has been incorporated into all elements of work prior to requesting acceptance testing and inspection. The QC program should be sufficient in scope to remedy repeated discoveries of non-compliant work by those performing acceptance inspection and testing. Repeated observations of QC quality shortfalls shall be considered a breakdown of the QC program and shall be cause for investigation and corrective action prior to commencement of work areas affected. Corrective action may include the addition of new QC procedures, revision to existing QC procedures, re-training of QC personnel, removal and replacement of QC personnel, or other such actions which will restore the effectiveness of the QC program.

#### 2.2.2 CQMP Requirements

Developer's CQMP shall clearly address, at the minimum, how the Developer's QC staff will address the following requirements:

- A. A construction quality control organizational chart and staffing plan, which shall include the period of time that the QC staff members will be present on the site and the experience/knowledge/skill levels of QC staff.
- B. Procedures to ensure that the education, training, and Qualification of personnel performing CQMP activities are achieved and maintained and that all Work is performed in accordance with the approved designs, plans, and specifications.
- C. Procedures to ensure that Developer, Suppliers, and Subcontractors designate individuals on each crew responsible for performing daily field inspections of their own Work and for preparing a daily QC report to document the inspection performed. Report forms to be used by the responsible quality control personnel shall be included in the Developer's CQMP.
- D. Documents specifying that all activities undertaken by or on behalf of Developer affecting the quality of the Work shall be prescribed and accomplished by documented instructions, procedures, and appropriate drawings. Such instructions, procedures and drawings shall include quantitative and qualitative criteria to be used to determine compliance.
- E. Procedures to ensure that critical elements of the Work are not started or continued without QA personnel on site for acceptance inspection and testing. Inspection or hold points shall be identified and communicated to the CQAF, CQCM, and TxDOT. Procedures to proceed beyond inspection or hold points shall be developed.
- F. Procedures for inspecting, checking, and documenting the Work. Inspection, examinations and measurements shall be performed for each operation of the Work to assure quality.
- G. Procedures for identification and control of materials, equipment, and elements of the Work. These procedures shall ensure that identification of an item is maintained by appropriate means, either on the item or on records traceable to the item, as necessary, throughout fabrication, erection, installation and use of the item.
- H. Procedures to ensure that materials, equipment or elements of the Work that do not conform to requirements of the CDA Documents, the Governmental Approvals, applicable Law or the Design Documents are not used or installed. These procedures shall include identification, documentation, segregation, disposition and notification to TxDOT and, if appropriate, Governmental Entities and other affected third parties, as well as procedures for TxDOT to review Nonconforming Work.
- I. Procedures for processing a request for information (RFI) to resolve discrepancies and/or questions in the plans and specifications so that all changes are documented and approved by Developer's design engineers and TxDOT.
- J. Procedures to indicate, by the use of markings such as stamps, tags, labels, routing cards, or other suitable means, the status of inspections and tests performed upon individual items of the Work.
- K. A program for coordination of all CQAF inspections and testing with Governmental Entities and Utility Owners.
- L. A program to ensure performance of all testing required to demonstrate that all materials, equipment and elements of the Work will perform satisfactorily for the purpose intended and meet the standards specified in the CDA Documents. It shall specify written test procedures which include provisions for ensuring that all prerequisites for the given test have been met and that adequate test instrumentation is available and used. The CQMP shall require test results be documented and evaluated by the CQCM to ensure that test requirements have been satisfied.

- M. Measures to ensure that tools, gauges, instruments, and other measuring and testing devices used in activities affecting quality are properly maintained, controlled, calibrated, certified and adjusted at specified periods to maintain accuracy within industry standards.
- N. The preparation of all Portland cement concrete, soil-lime treatment, soil-cement treatment, and hot mix asphaltic concrete mix designs by personnel who hold the required certifications as specified in the CDA Documents. Additionally, the designs shall be reviewed and sealed by a Registered Professional Engineer attesting that the design meets TxDOT requirements for the specified class or grade for which it was prepared.
- O. Sampling and testing of all materials during the production or manufacturing processes so that only materials meeting the specifications are supplied for ultimate incorporation into the Work.
- P. Procedures to control the handling, storage, shipping, cleaning and preservation of materials and equipment to prevent damage or deterioration.
- Q. Procedures to ensure that conditions adverse to quality, such as failures, malfunctions, deficiencies, defective material and equipment, deviations and other Nonconforming Work are promptly identified and corrected. The procedures shall ensure that the cause of the condition is determined and corrective action taken to preclude repetition. The identification of the significant condition adverse to quality, the cause of the condition and the corrective action taken shall be documented and reported in writing to TxDOT and to appropriate levels of Developer's management to ensure corrective action is promptly taken.
- R. Measures to control the receipt and issuance of documents, such as instructions, procedures, training manuals and drawings, including changes thereto, which prescribe activities affecting quality. These measures shall ensure that approved documents, including authorized changes thereto, are reviewed for adequacy and approved for release by authorized personnel of Developer and are distributed to and used at the location where the prescribed activity is performed. Changes to documents shall be reviewed and approved by the same organizations that performed the original review and approval unless TxDOT consents, in writing, to another responsible organization.
- S. Requirements and methods for controlling documents.
- T. Procedures for checking and verifying the accuracy and adequacy of construction stakes, lines, and grades established by the Developer.
- U. Procedures for ensuring that construction alignment and grades are in accordance with the requirements contained in the current TxDOT Survey Guide.

### 2.2.3 Reporting, Record Keeping, and Documentation

Developer shall maintain construction workmanship and materials quality records of all inspections and tests performed per the approved CQMP. These records shall include factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, deviations, causes for rejection, etc.; proposed remedial action; and corrective actions taken. These records shall cover both conforming and defective or deficient features, and shall include a statement that all supplies and materials incorporated in the Work are in full compliance with the terms of the CDA Documents. These records shall be furnished to TxDOT in format and content as specified in the CQMP.

Quality control inspection reports and process control material sampling/testing results, and control charts shall be updated within forty-eight (48) hours following the inspection or test and readily available for CQAF and TxDOT review or audit.



## SECTION 3 - ACCEPTANCE PROGRAM

### 3.1 General

There are two types of acceptance on design-build projects. The first type of acceptance is TxDOT-performed acceptance where frontline acceptance testing and inspection are performed by TxDOT. The second type of acceptance is contractor-performed acceptance where frontline acceptance testing and inspection are performed by the Developer's CQAF.

Under TxDOT-performed acceptance, only TxDOT's testing and inspection results are used in the acceptance decision. Under contractor-performed acceptance, OV and QA together are the basis for the acceptance decision. Contractor-performed QA results may be used for acceptance when they are statistically validated and/or verified by the OV results. QA is performed by the Developer and the OV is performed by TxDOT.

Developer's QA portion of the CQMP shall include the internal procedures used by the Developer's CQAF to ensure that the Work is inspected and tested to verify compliance with the released-for-construction plans, approved shop drawings, working drawings, and specifications. Developer's QA shall be separate from the Developer's QC program. TxDOT's OV program shall include internal procedures used by TxDOT to ensure that Developer's frontline acceptance is performed in accordance with the approved CQMP and to verify QA testing and inspection.

#### 3.1.1 TxDOT-Performed Acceptance

TxDOT will perform acceptance testing as part of its Quality Monitoring Program (QMP). The CQAF shall perform job control tests (as defined by the TxDOT Guide Schedule of Sampling and Testing) on materials listed on the Aggregate Quality Monitoring Program (AQMP). Materials which are not monitored or not pre-approved by TxDOT under the QMP are subject to QA and OV sampling and testing as part of contractor-performed acceptance.

Under the QMP, Developer shall furnish to TxDOT samples of materials to be incorporated into the Work at TxDOT's request. Manufacturers' warranties, guarantees, instruction sheets, parts lists and other materials that are furnished with articles or materials incorporated into the Work shall be made available to TxDOT upon request.

**TxDOT Services.** TxDOT may perform the inspection and testing at all approved steel structure fabrication plants, pipe manufacturing plants, commercial precast prestressed and non-stressed concrete products plants and any job site prestressed concrete plants.

As may be requested by the Developer and agreed upon by TxDOT, the cooperative use of TxDOT resources for materials testing and inspection services at a point in Texas where the State routinely provides resident inspection services for its own highway materials, and at other location throughout the contiguous United States, will be accepted by the Developer. Upon election by the Developer to use TxDOT services, the Developer shall prepare work orders in full compliance with the terms of the CDA Documents.

### 3.1.2 Contractor-Performed Acceptance

Under contractor-performed acceptance, both the QA and OV testing make up the acceptance decision. Section 3.2 – Sampling and Testing describes sampling and testing requirements for both the QA and OV groups. Section 3.3 - Developer Quality Acceptance Requirements describes materials acceptance specific to QA requirements and Section 3.4 – Owner Verification Requirements describes owner verification testing, statistical analysis, and reporting requirements specific to OV requirements.

## 3.2 Sampling and Testing

This section provides FHWA and TxDOT's guidance on sampling, testing, inspection, and acceptance requirements to be used in the acceptance decision.

### 3.2.1 Sample Types and Uses

Sampling is either random or fixed, depending on whether the location was selected randomly (random) or if a specific location was subjectively identified (fixed). Sampling is also either independent or dependent, based on whether the location was independently selected (independent) or whether is based on the location of another sample (dependent/split). The F- and t- tests described in Section 3.4.3 – FHWA Reporting are only valid when using random independent samples.

However, split samples may be used outside of the statistical analysis for owner verification of contractor-performed acceptance tests under TxDOT's Owner Verification Program. A comparison process for performing and analyzing split samples between TxDOT and CQAF is necessary during the initial implementation of the QAP. These samples will be analyzed by TxDOT and the results discussed with the CQAF to assure laboratory and technician test results compare favorably. When the acceptable tolerance limits in Appendix B – Split Sample Tolerance Limits are exceeded, corrective actions for either or both parties will be identified and corrective actions will be incorporated as appropriate. This process will help provide initial alignment of the TxDOT and CQAF laboratories and testing procedures.

Split samples may also be performed throughout the life of the project as necessary to investigate non-validating material categories and verify or realign testing equipment and personnel.

### 3.2.2 Notification

The Developer shall, on a weekly basis, provide the CQAF and TxDOT with a three-week look-ahead schedule of planned activities. The Developer shall also, on a daily basis, communicate changes to the scheduled work, for each current day to the CQAF and TxDOT, and shall notify the CQAF and TxDOT when materials are ready for sampling and testing.

### 3.2.3 Quantities and Testing Frequency

The CQAF shall continuously track and record the quantity of material incorporated into the Project. This report shall be generated weekly to ensure CQAF compliance with TxDOT's Guide Schedule of Sampling and Testing. TxDOT shall use the report to verify compliance of both the QA and OV testing frequency.

The CQAF shall perform material sampling at locations and timing defined in TxDOT's Guide Schedule of Sampling and Testing. At a minimum, material sampling and testing shall be conducted at the frequency of sampling specified in TxDOT's Guide Schedule of Sampling and Testing. This minimum testing frequency must be met with random independent samples as defined in Section 3.2 – Sampling and Testing. During

the start-up of new categories of work and when there are any concerns over the quality of material, the CQAF shall conduct testing at a higher testing frequency as described in the preamble of TxDOT's Guide Schedule of Sampling and Testing.

While the testing of random independent samples are required to meet the guide schedule testing requirements, the CQAF shall perform additional (fixed) tests when the quality of material is questionable at a location other than the randomly selected location. This fixed test shall constitute an acceptance test and a failing result shall be addressed in a similar manner to a failing random independent test. Fixed tests shall not count towards meeting minimum CQAF testing frequencies.

TxDOT, or their designee, will perform oversight inspection and material verification sampling/testing. To verify QA test results, OV testing shall be performed at a frequency shown in Appendix C – Material Test Categories for Statistical Validation subject to project-specific recommendations to be approved by TxDOT CSTM&P. OV testing frequency shall be established at TxDOT's sole discretion. Split sample testing defined in Appendix D does not replace or relieve the requirements found in Section 4.0 – Independent Assurance Program.

### 3.3 Developer Quality Acceptance Requirements

Developer's CQMP shall establish a systematic approach to define the processes, methods, procedures, and documentation for delivery of QA on the Project. These methods and procedures shall clearly define the authority and responsibility for the administration of Developer's QA plan.

#### 3.3.1 Staffing

Developer's CQAF shall assign an on-site Construction Quality Acceptance Manager (CQAM) who shall be responsible for management of the quality acceptance aspect of the CQMP. The CQAM shall be a Registered Professional Engineer and shall be an employee of the CQAF. The CQAM shall report jointly to Developer's management team and TxDOT. The CQAM shall not report to any person or party directly responsible for design or construction production.

The CQAM shall review, approve, authorize, examine, interpret and confirm any methods or procedures requiring the "Engineers' review, approval, authorization, examination, interpretation, confirmation, etc." which are contained in the TxDOT Standard Specifications.

A quality acceptance inspection and material sampling/testing staff shall be provided under the direction of the CQAM to perform inspection and material sampling/testing of all Work performed and materials incorporated into the Project by any member of Developer's group. If approved in writing in advance by TxDOT, qualified individuals who are employees of or retained by manufacturers, Vendors or Suppliers may inspect certain portions of Work.

The quality acceptance inspection staff shall be employees of the CQAF and shall have been trained in the applicable inspection and material sampling and testing procedures. The quality acceptance staff shall be experienced in highway inspection and material testing. The training and experience of the quality acceptance staff shall be commensurate with the scope, complexity, and nature of the activity to be inspected and tested. Qualifications shall include appropriate TxDOT or State Highway Agency certification for testing and inspection as well as appropriate nationally recognized certifications applicable to inspection or testing activities. CQAF testing personnel must be qualified under the IA program described in Section 4

– Independent Assurance Program. Documentation of the training and certification shall be maintained by the CQAF and available for review and audit.

The size of the CQAF's quality acceptance staff shall reflect the volume of quality acceptance activities necessary for the Work in progress and shall be maintained in accordance with the approved CQMP.

The CQAF's staffing requirements shall be updated as necessary throughout the term of the Work to reflect changes in the actual construction schedule. Developer shall ensure that adequate CQAF staff are available and that CQMP activities are undertaken in a manner consistent with the Project Schedule and in a manner that will enable Developer to achieve the Substantial Completion and Final Acceptance deadlines.

### 3.3.2 Quality Acceptance Facilities and Equipment

Developer's CQAF shall use a laboratory meeting the requirements described in Section 4 – Independent Assurance Program for acceptance testing. Unless otherwise approved by TxDOT, the laboratory or field laboratory shall be located on site or within ten (10) miles of the Project.

### 3.3.3 CQMP Requirements

Developer's CQMP shall clearly address, at the minimum, how the Developer's QA staff will address the following requirements:

- A. Methods and procedures that clearly define the authority and responsibility for the administration of Developer's CQMP.
- B. Procedures for inspecting, checking, and documenting the Work for acceptance. Inspection, examinations and measurements shall be performed for each operation of the Work to assure quality.
- C. Procedures to ensure that the education, training, and certification of personnel performing CQMP activities are achieved and maintained and that all Work is performed in accordance with the approved designs, plans, and specifications.
- D. Procedures to documenting and tracking the disposition of any identified noncompliance with the plans and specifications. These procedures shall include a clearly defined process for communicating identified noncompliances to TxDOT and the Developer.
- E. Measures to ensure that purchased materials, equipment, and services conform to the CDA Documents, the Governmental Approvals, applicable Laws, Rules, and the Design Documents. These measures shall include provisions for source evaluation and selection, objective evidence of quality furnished by Subcontractors and Suppliers, inspection at the manufacture or vendor source, and examination of products upon delivery.
- F. Measures to ensure that tools, gauges, instruments, and other measuring and testing devices used in activities affecting quality are properly maintained, controlled, calibrated, certified and adjusted at specified periods to maintain accuracy within industry standards.
- G. A comprehensive system of planned and periodic audits of Developer's CQMP to determine adherence to and the effectiveness of the CQMP. CQAF personnel shall perform the audits in accordance with the written procedures or checklists. Audit results shall be documented, reviewed,

transmitted to TxDOT, and acted upon by Developer. Follow-up action, including re-audit of deficient areas following corrective action, shall be taken where indicated.

- H. The requirements and methods for controlling documents. Developer's document control system shall be compatible with TxDOT's.
- I. Inspection of all Work to verify and document that the Work has been constructed in conformance with the released-for-construction plans, specifications, and approved working and shop drawings.
- J. Procedures on how quality acceptance material sampling and testing will be performed including the process for generating random test locations, tracking material samples, processing material samples, review and approval of test records, tracking compliance with material testing frequency.
- K. Procedures for addressing failed tests. For a failed random independent test, a fixed test at the original failing test location and a new random independent test at a new location in the same lot are required. For a failed fixed test, a new fixed test is required at the original failing test location.
- L. Procedures for reviewing QA test results for compliance with mutually agreed-upon processes and naming conventions to ensure data integrity for accurate statistical analyses.
- M. Procedures for auditing of QC and QA records, documentation, procedures, and processes to verify compliance with the CDA Documents and approved CQMP.
- N. Procedures for the review and approval of all Portland cement concrete, soil-lime treatment, soil-cement treatment, and hot mix asphaltic concrete mix designs by a Registered Professional Engineer. The CQAF shall also verify trial batches.
- O. Procedures for ensuring quality acceptance testing shall be performed at the frequency stipulated in the TxDOT's Guide Schedule of Sampling and Testing.
- P. Procedures for ensuring quality acceptance staff shall provide oversight and perform audits of the quality control inspection and material sampling/testing operation.
- Q. Procedures for ensuring that pre-approved materials used on the project maintain their approved status on the AQMP. Materials which do not maintain AQMP approval shall be sampled and tested on a project-level basis.

#### 3.3.4 Reporting, Record Keeping, and Documentation

The Developer shall document and maintain documentation showing how the CQAF has complied with the CQMP requirements in Section 3.3.3.

The Developer's CQAF shall maintain electronically and transmit to TxDOT daily inspection reports within twenty-four (24) hours after the work shift in a format acceptable to TxDOT. The daily inspection reports shall document the day's events, activities, identify inspections conducted, results of inspections, location and nature of defects found, causes for rejection, and remedial or corrective actions taken or proposed. The responsible inspector and supervisor shall sign the daily inspection reports.

The CQAF shall be responsible for establishing an electronic system for recording all material test results. The responsible technician and his/her supervisor shall sign the daily test reports and the results of the daily tests shall be provided to TxDOT within two days of test completion. The CQAF's material test results shall be electronically transmitted to TxDOT in an XML format to be coordinated with TxDOT's Construction Division. This electronic reporting is intended to allow the Developer and TxDOT to make timely and accurate decisions on workmanship and material quality issues.

The CQAF inspection and material test results shall be simultaneously transmitted to both TxDOT and the Developer. The Developer shall not receive the CQAF inspection or material test results prior to TxDOT.

### 3.4 Owner Verification Requirements

#### 3.4.1 General

TxDOT has the ultimate responsibility for verifying that the Project is designed and constructed in compliance with the CDA Documents. As such, TxDOT will perform owner verification testing and inspection, and conduct audits to verify the Developer's compliance with the approved CQMP.

TxDOT shall establish a system for managing the materials acceptance process. This process shall include the performance and approval of OV tests at the stipulated test frequency, review of QA test results, performance of statistical analysis on OV and QA test results, and any associated tasks arising out of the statistical analysis.

TxDOT's OV laboratory shall meet the requirements described in Section 4 – Independent Assurance Program.

#### 3.4.2 Owner Verification Testing and Inspection Plan

TxDOT or their designated agent will develop a comprehensive Owner Verification Testing and Inspection Plan (OVTIP) and submit it to TxDOT for approval.

TxDOT's OVTIP shall clearly address, at the minimum, how TxDOT's OV staff will address the following requirements:

- A. Methods and procedures that clearly define the authority and responsibility for the administration of OVTIP.
- B. Procedures for overseeing and inspecting the Work for compliance with the Developer's CQMP for each operation.
- C. Procedures to ensure that the education, training, and certification of personnel performing OV activities are achieved and maintained and that all Work is performed in accordance with the approved OVTIP.
- D. Procedures to oversee the status and disposition of any identified noncompliance with the plans and specifications.
- E. Measures to ensure that tools, gauges, instruments, and other measuring and testing devices used in activities affecting quality are properly maintained, controlled, calibrated, certified and adjusted at specified periods to maintain accuracy within industry standards.
- F. A system of planned and periodic audits of Developer's CQMP to determine adherence to and the effectiveness of the CQMP. Audit results shall be documented, reviewed, sent to TxDOT and the Developer. Follow-up action, including re-audit of deficient areas following corrective action, shall be taken where indicated.

- G. A system of planned and periodic audits of the OV firm to determine adherence to and the effectiveness of the OVTIP. Audit results shall be documented, reviewed, sent to TxDOT. Follow-up action, including re-audit of deficient areas following corrective action, shall be taken where indicated.
- H. Procedures for performing periodic inspection of Work to verify that the CQAF has performed work in compliance with the released-for-construction plans, specifications, and approved working and shop drawings. The procedure should identify a target oversight inspection rate, methods for performing verification inspections for all QC and CQAF inspectors.
- I. Procedures on how OV material sampling and testing will be performed including the process for generating random test locations, tracking material samples, processing material samples, review and approval of test records, tracking compliance with material testing frequency.
- J. Procedures for reviewing QA and OV test results for compliance with mutually agreed-upon processes and naming conventions to ensure data integrity for accurate statistical analyses.
- K. Procedures for ensuring that only tests performed by qualified CQAF testing personnel are submitted to TxDOT.
- L. Procedures for auditing of QC and QA records, documentation, procedures, and processes to verify compliance with the CDA Documents and approved CQMP.
- M. Procedures for reviewing Portland cement concrete, soil-lime treatment, soil-cement treatment, and hot mix asphaltic concrete mix designs.
- N. Procedures for ensuring OV testing shall be performed at the frequency stipulated in this QAP.
- O. Procedures for performing statistical analyses in compliance with procedures outlined in this QAP.

### 3.4.3 FHWA Reporting

TxDOT will submit periodic reports to FHWA for concurrence with TxDOT's compliance with the approved QAP. Approved reports shall be distributed to the CQAF after receiving FHWA concurrence. The reporting period for specific pay items or materials is dependent on the pace of construction and the number of tests performed in each analysis category, the time period of the sampling, and the specification and quality requirements. Each report shall cover a period of construction not greater than three months.

The FHWA report shall address the following areas.

- A. Statistical analysis results, to include specification requirements and status of validation process during start-up and completion of an item;
- B. Non-validation investigation;
- C. Non-conformance log;
- D. Engineering judgment log; and
- E. Construction certification

**3.4.3.1 Statistical Analysis.** F-tests and t-tests will be used to analyze OV and QA data. The F-test is a comparison of variances to determine if the OV and QA population variances are equal. The t-test is a comparison of means to determine if the OV and QA population means are equal. In addition to these two

types of analyses, independent verification and observation verification will also be used to validate the QA test results. The type of analysis and recommended level of significance for specific tests are shown in Appendix C – Material Test Categories for Statistical Validation. A project-specific analysis of risks should be performed and recommended changes to Appendix C – Material Test Categories for Statistical Validation shall be presented to TxDOT CSTM&P for approval.

Before performing any statistical analyses, it is important to ensure that the data contained in each analysis categories are in reasonable compliance with the underlying assumptions of the F-test and t- test. The implementation of controlled vocabulary lists (CVLs) is essential to parse data into appropriate analysis categories.

**3.4.3.2 Non-Validation Investigation.** If the OV test results do not validate the QA test results, an investigation shall be conducted to determine the reason for not verifying. Assuming that the analysis categories were established appropriately, other areas for investigation include data integrity and accuracy, testing equipment and procedures, sampling variability and material variability. Material quality when non-validation occurs is further discussed in Section 3.5 – Dispute Resolution. Results of the investigation should be reported for the non-validating categories.

**3.4.3.3 Engineering Judgment Log.** Material test results that indicate reasonable conformance with specification requirement, but did not meet the minimum specification requirements, may be adequate for their intended use. As such, TxDOT has allowed the CQAF to exercise Engineering Judgment to accept such material. However, each occurrence has to be properly documented. Documentation shall include the location where the material is incorporated, the specification requirement, the recorded test value, and the Engineering Judgment applied to allow use of that material. If the CQAF does not choose to exercise Engineering Judgment to accept material failing specifications, the material in question may still be accepted through the NCR process, brought into conformance with specifications, or removed from the project.

**3.4.3.4 Non-Conformance Log.** Materials that do not meet the minimum specification requirements may be adequate for their intended use. However, the incorporation of the material in questions is subject to the review and approval by the design engineer and has to be documented through the Nonconformance Record (NCR) process.

Developer shall identify, document and report to TxDOT all instances of Work that have not been constructed with the strictest adherence to the approved drawings and specifications and with the requirements of the CDA Documents, the Governmental Approvals and applicable Law. This reporting shall be in the form of an NCR as described below and shall be submitted to TxDOT in writing within twenty-four (24) hours of Developer obtaining knowledge of the same. Developer shall simultaneously send a copy of each NCR to Developer's design engineer and the CQAF.

The NCR shall clearly describe the element of Work that is non-conforming and the reason for the non-conformance. The engineer who stamped and sealed the drawings for the Work, shall evaluate the effect of the Nonconformance on the performance, safety, durability, and effect of the long-term maintenance of the project and the specific element affected. If the Engineer in Responsible Charge determines remedial actions are necessary, the proposed remedial action shall be documented and bear the stamp of the original responsible Registered Professional Engineer or the responsible Registered Professional Engineer from the same firm assigned to replace the original one.



Developer shall maintain a log of all NCRs and submit this log to TxDOT and the CQAF on a bi-weekly basis. Each NCR shall be numbered sequentially, given a brief description, a status and, if it is not closed, an expected date for closure. All NCRs must be closed with the stamp of Design Firm's qualified engineer in charge and TxDOT approval or the responsible Registered Professional Engineer from the same firm assigned to replace the original one.

**3.4.3.5 Construction Certification.** The CQAM shall provide a monthly written certification by the CQAM, delivered to TxDOT with each payment request, indicating that the CQMP and all of the measures and procedures provided therein are being fully complied with and are functioning properly. The CQAF shall maintain and submit records monthly that include factual evidence that required activities and tests have been performed, including the following: (i) type, number, and results of CQMP activities, including reviews, inspections, tests, audits, monitoring of Work performance and materials analysis; (ii) related data such as qualifications of personnel, procedures and equipment used; (iii) the inspector or data recorder, the type of test or observation employed, the results and the acceptability of the Work and action taken in connection with deficiencies; (iv) nature of Nonconforming Work and causes for rejection; (v) proposed corrective action for Nonconforming Work; (vi) corrective actions taken with respect to Nonconforming Work; and (vii) results of such corrective actions.

## 3.5 Dispute Resolution

Through the life of the Project, there may be differences in material test results or statistical sample populations between the CQAF and TxDOT. Due to the natural variability in construction materials testing and unavoidable biases in sampling and testing, these differences are often difficult to avoid. It is important to recognize the difference between material quality and statistical validation.

Material quality is measured by whether a test passes or fails and is an indication of whether material will perform its intended purpose. Engineering judgment may be used to substantiate the use of material failing to meet the specification if the material still meets the intended purpose. Statistical validation is a measure of whether the OV and QA populations are statistically equal. It does not represent the quality of material being incorporated into the Project.

### 3.5.1 Non-Validation and Status of Material Quality

When OV test results do not statistically validate the QA test results as outlined in Section - 3.4.3.1 Statistical Analysis, TxDOT and CQAF jointly investigate the source of non-validation. If the non-validation persists over five consecutive Level 1 F- and t- analyses per Appendix D, a process NCR shall be issued to formally document and seek resolution to the non-validation.

In addition to the need to investigate the non-validation, the material in question has to be immediately evaluated to determine if it can be left in place or has to be removed, reworked or repaired. If material is to remain incorporated into the Project, the material in question will be evaluated using the process described in this section. The appropriate (CQAF or TxDOT) party may exercise Engineering Judgment to determine that the material will perform its intended purpose. There are four possible combinations of passing and failing results between the QA and OV test results.

1. Both the QA and OV test results pass specification limits

Although statistical validation has not occurred, both the CQAF and OV test results are passing the established specification limits. Thus, material quality in question is considered acceptable.

2. QA test results fail and OV test results pass specification limits

Material may be left in place if the CQAF determines that Engineering Judgment may be used to accept the material or if the material is accepted through the NCR process.

3. Both the QA and OV test results fail the specification limits

Material may be left in place if the CQAF determines that Engineering Judgment may be used to accept the material or if the material is accepted through the NCR process. The acceptance of material is subject to one of the two scenarios below.

- a. OV test result indicates reasonable conformance with specification requirements and TxDOT exercises Engineering Judgment to concur with acceptance of material based on the CQAF's Engineering Judgment or through the NCR process.
- b. OV test result does not indicate reasonable conformance with specification requirement and the CQAF must perform an additional fixed test at the OV failed test location. Based on the results of CQAF test result and subsequent investigation discussions between TxDOT and the Developer, a determination is made and documented on whether the material may be left in place.

4. QA test results pass but OV test results fail specification limits

Material may be left in place if the CQAF determines that Engineering Judgment may be used to accept the material or if the material is accepted through the NCR process. This is subject to TxDOT response in the two scenarios below.

- a. OV test result indicates reasonable conformance with specification requirements and TxDOT exercises Engineering Judgment to concur with acceptance of material based on the CQAF's Engineering Judgment or through the NCR process.
- b. OV test result does not indicate reasonable conformance with specification requirement and the CQAF must perform an additional fixed test at the OV failed test location. Based on the results of CQAF test result and subsequent investigation discussions between TxDOT and the Developer, a determination is made and documented on whether the material may be left in place.

### 3.5.2 Referee Testing

Disputes over specific test results may be resolved in a reliable, unbiased manner by referee testing and evaluation performed by a referee laboratory. The referee laboratory shall be the Construction Division, Materials & Pavements Section (CSTM&P) central laboratory or a testing laboratory qualified according to Section 4.0, Independent Assurance Program, and approved by TxDOT. The decision by the referee laboratory shall be final.

# SECTION 4 - INDEPENDENT ASSURANCE PROGRAM

## 4.1 General

TxDOT's, or their designee, shall implement the Independent Assurance (IA) program. This IA program evaluates all sampling and testing procedures, personnel, and equipment used as part of an acceptance decision. The IA program evaluates the qualified sampling and testing personnel and testing equipment and is established using the system approach. The system approach bases frequency of IA activities on time, regardless of the number of tests, quantities of materials, or numbers of projects tested by the individual being evaluated.

This program provides uniform statewide procedures to ensure that tests are performed by qualified personnel and that laboratory facilities and equipment are adequate to perform the required sampling and testing methods. The following frequencies and activities are required for evaluating sampling and testing personnel and equipment under the system approach to IA.

*Table 1 – Independent Assurance Observation and Qualification Frequencies*

Frequencies and Activities	
Time	Activity
Prior to performing acceptance sampling and testing.	Qualification is required under <u>Sections 4.2 and 4.3</u> of this QAP.
Within 12 months after Observation and Qualification.	Each qualified technician is required to participate in one proficiency or split sample test for each test method requiring IA. Results must compare to the IA test results to within the established tolerance.
Within 24 months after Observation and Qualification.	Each qualified technician is required to participate in one proficiency or split sample test for each test method requiring IA. Results must compare to the IA test results to within the established tolerance.
Within 36 months of Qualification.	Qualification is again required under the Sections 4.2 and 4.3 of this QAP.

*NOTE: For American Concrete Institute (ACI) certification, the above frequency is extended to five years for Concrete Field Technician – Grade I and Concrete Laboratory Technician – Level I, and six years for Concrete Strength Technician. Maintaining technician qualification under the IA systems approach requires continuation of the above cycle of qualification and successful split or proficiency sample testing.*

## 4.2 Personnel Qualifications

Personnel performing tests on the Project must be qualified in the appropriate test methods.

### 4.2.1 Required Certifications

Sampling and testing personnel must obtain and keep current the following certifications unless otherwise waived by governing specifications:

- A. ACI Concrete Field Testing Technician – Grade I;
- B. ACI Concrete Strength Testing Technician;
- C. TxAPA HMA Plant Production Specialist – Level 1A;

- D. TxAPA HMA Roadway Specialist – Level 1B;
- E. TxAPA HMA Mix Design Specialist – Level 2;
- F. TxAPA Properties Specialist – SB 101;
- G. TxAPA Field Specialist – SB 102;
- H. TxAPA Materials Analysis Specialist – SB 103;
- I. TxAPA Strength Specialist – SB 201;
- J. TxAPA Compressive Strength Specialist – SB 202.

Reciprocity may be granted to individuals who have been successfully qualified under another state's program. These situations will be considered on a case-by-case basis and must meet the approval of the Director of CSTM&P.

For those testing procedures not covered by the above certifications, the following personnel may qualify an individual to perform the required sampling and testing of materials:

- A. Other independent sources, such as the Texas Asphalt Pavement Association (TxAPA) and the American Concrete Institute (ACI) when required by specifications. Certifications received from these institutions must be approved by the Director of CSTM&P.
- B. Qualified Independent Assurance Laboratory which has been authorized by TxDOT to perform personnel qualifications.
- C. Construction Division, Materials & Pavements Section (CSTM&P) personnel.

#### 4.2.2 QA, OV and IA Personnel

Any individual who performs tests on materials for acceptance must be qualified to perform tests in the areas of hydraulic cement concrete, soils and aggregates and bituminous materials.

Appendix D – Test Methods for Personnel Qualification provides test methods for which individuals are to be qualified. There may be other tests that are required based on project-specific specification and may require qualification.

To qualify, an individual must successfully perform the specific test and the necessary calculations required to determine specification compliance in the presence of an authorized evaluator. Successful performance is defined as demonstrating the ability to properly perform the key elements for each test method. If the individual fails to demonstrate the ability to perform a test, the individual will be allowed one retest per test method at the evaluator's convenience.

After successful performance of a test method, the individual must also pass a written examination (minimum score of 80%) administered by an authorized evaluator. An individual failing the written examination may request a retest. The retest must be scheduled and administered within thirty days of notification of failure. Failure to pass the second written examination shall be considered as failing the entire qualification.

If an individual fails to qualify on a specific test method or the qualification is revoked, the individual must obtain additional training before the individual can retest on that specific test.

In addition, for tests that CSTM&P requires an annual split/proficiency sample evaluation, the individual must participate in split/proficiency samples given by the qualification authority to validate the qualification.

Appendix E – Test Methods for Split/Proficiency Evaluation provides a list of testing procedures required for split/proficiency evaluation. CSTM&P determines the qualification authority for the split/proficiency sample. The results of the samples will be evaluated against TxDOT's acceptable tolerance limits. If the comparisons of the test results do not comply with the tolerances, an engineering review of the test procedures and equipment will be performed immediately to determine the source of the discrepancy. Corrective actions must be identified and incorporated as appropriate, prior to the individual performing additional testing on that test method.

Under unique circumstances, the qualification authority may grant a verbal examination upon request. The reason(s) for requesting a verbal examination must be presented and documented prior to the individual being allowed to take the examination.

Unless otherwise stated, qualification of an individual is valid for not more than three years, after which the individual must be re-qualified. Under the Independent Assurance (IA) system approach, annual split/proficiency will be required as specified in Table 1 – Independent Assurance Observation and Qualification Frequencies.

#### 4.2.2 Documentation

The responsible CQAF, OV, and IA laboratory managers are responsible for maintaining documentation of all individuals qualified under their authority who perform required tests for acceptance of materials. Documentation to be maintained includes:

- A. Sampling and testing personnel qualification in an electronic format that list all of the testing procedures the individual has been qualified to perform;
- B. A qualification worksheet listing the key elements of the test method. The evaluator conducting the observation uses the form to record the results;
- C. Copies of the qualification certificates issued with expirations dates;
- D. Copies of written examination results; and
- E. Results of annual proficiency testing results.

Documentation retention will be for the life of the qualification. Qualification authority must be shown on the certificate given to each individual.

#### 4.2.3 Disqualification

Accusations of neglect or abuse of the rights and responsibilities are made to the responsible Owner representative. The difference between neglect and abuse is intent and shall be determined by the responsible Owner representative.

Penalties are implemented upon recommendation by the responsible Owner representative, and the penalties range from a minimum of ninety days suspension to a maximum of permanent revocation of the certification:

- A. The first instance of neglect results in a ninety-day suspension; any subsequent instance shall be considered as and treated the same as abuse;
- B. The first instance of abuse results in a six-month suspension;
- C. The second instance of abuse results in permanent revocation of the certification; and

- D. Permanent revocation of a certification results in that individual being ineligible for certification at any level.

Certifications are considered as statewide and, therefore, any suspensions and/or revocations will apply statewide.

### 4.3 Laboratory Qualifications

Laboratories where IA, QA, and OV tests will be performed must be qualified. Appendix H provides the minimum qualification requirements for laboratories.

#### 4.3.1 Laboratory Qualification Responsibility

The CSTM&P central laboratory will be accredited under the American Association of State Highway and Transportation Officials (AASHTO) Laboratory Accreditation Program.

CSTM&P is responsible for overseeing the statewide laboratory qualification program and for qualifying the IA laboratory. The IA laboratory is responsible for qualifying QA and OV laboratories.

#### 4.3.2 Laboratories to be Qualified

All laboratories performing testing for TxDOT require qualification. These include, but are not limited to the following:

- A. CSTM&P central laboratory;
- B. CSTM&P field laboratories;
- C. IA laboratory
- D. Referee laboratory
- E. QA laboratory;
- F. Contractor laboratories;
- G. Vendor laboratories (material suppliers).

#### 4.3.3 Qualification Process

The laboratory qualifying authority will:

- A. Identify the scope of testing to be performed;
- B. Verify that manuals and/or test methods used to perform tests are available and up-to-date;
- C. Document that the laboratory has the required equipment to perform the tests; and
- D. Check the calibration/verification records for each piece of equipment, to include:
  - a. Description of equipment;
  - b. Identification of any traceable standard used;
  - c. Frequency of calibration;
  - d. Date of last calibration;
  - e. Date of next calibration;
  - f. Procedure used to calibrate equipment; and
  - g. Procedure used to identify equipment not in compliance.

In addition, all equipment may be subjected to calibration verification or other inspection by the qualifying authority.

#### 4.3.4 Independent Assurance Testing Equipment

CSTM&P will qualify IA laboratory testing equipment used for IA sampling and testing, according to Section 4.3 - Laboratory Qualifications.

The IA laboratory will qualify all other department testing equipment and AASHTO accredited commercial laboratory equipment used for IA sampling and testing.

Qualify testing equipment according to these guidelines:

- A. Frequency for qualifying IA sampling and testing equipment will not exceed one (1) year;
- B. Calibration/verification is required whenever the laboratory or equipment is moved; and
- C. IA equipment shall be other than that used for performing owner verification (OV), quality acceptance (QA) or quality control (QC) testing.

Any equipment used to perform OV, QA, and/or QC sampling and testing in making an acceptance decision will be evaluated by IA sampling and testing personnel. This evaluation includes calibration checks and split or proficiency sample tests. The requirements for, and frequency of, equipment calibrations are shown in TxDOT's test procedures, as referenced in Section 4.3.5 – Calibration Standards for Laboratory Equipment. Acceptable tolerance limits for the comparison of test results from split or proficiency samples are shown in Appendix B –Split Sample Tolerance Limits.

#### 4.3.5 Calibration Standards for Laboratory Equipment

The standards for calibration and the frequencies for laboratory equipment calibrations are shown in "Tex-198-E, Minimum Standards for Acceptance of a Laboratory for Soils and Flexible Base Testing;" "Tex-237-F, Minimum Standards for Acceptance of a Laboratory for Hot Mix Testing;" and "Tex-498-A, Minimum Standards for Acceptance of a Laboratory for Concrete and Aggregate Testing" .

#### 4.3.6 Frequency for Laboratory Qualification

Laboratories are qualified at an interval not to exceed three (3) years. Calibration/verification is required whenever the laboratory or equipment is moved. Equipment used in IA sampling and testing will be verified at intervals not to exceed one (1) year.

#### 4.3.7 Documentation

The project Owner is responsible for verifying that laboratories are qualified to perform TxDOT testing. Documentation will be required to be kept by the qualified laboratory and the project Owner. Calibration records will be maintained for three (3) years, unless another agency requires a longer period.

#### 4.3.8 Non-Compliance

A laboratory that does not meet the above requirements is subject to disqualification. Any equipment in a qualified laboratory failing to meet specified equipment requirements for a specific test method shall not be used for that test method.

#### 4.3.9 Dispute Resolution

The next higher qualification authority will resolve disputes concerning calibration and verification of equipment. For disputes that cannot be resolved at the project level, CSTM&P will be the final authority.

#### 4.3.10 AASHTO Accreditation

In addition to TxDOT laboratory qualification, QA, OV, IA, and referee laboratories shall be accredited under the AASHTO Accreditation Program (AAP). The accreditation must be maintained throughout the life of the project. The laboratory must also participate in the AASHTO Materials Reference Laboratory /Concrete and Cement Reference Laboratory (AMRL/CCRL) proficiency programs. A copy of AAP accreditation certificate(s) shall be transmitted to TxDOT upon their receipt by the testing laboratory. The AAP accreditation shall include all test methods equivalent to that of TxDOT's test methods as shown in Appendix H.

#### 4.4 Annual Report

CSTM&P shall compose and submit an annual report to the Federal Highway Administration (FHWA) Division Administrator summarizing the results of TxDOT's systems approach IA program. This report shall identify:

- A. Number of sampling and testing personnel evaluated by the systems approach IA testing;
- B. Number of IA evaluations found to be acceptable;
- C. Number of IA evaluations found to be unacceptable; and
- D. Summary of any significant system-wide corrective actions taken.



## Appendix A Acronyms and Definitions

The following terms and definitions are referenced in this manual and have the meanings set forth below:

AAP	AASHTO Accreditation Program
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AMRL	AASHTO Materials Reference Laboratory
AQMP	Aggregate Quality Monitoring Program
CCRL	Concrete and Cement Reference Laboratory
CDA	Comprehensive Development Agreement
CFR	Code of Federal Regulations
CSTM&P	TxDOT Construction Division, Materials and Pavements Section
CQAF	Construction Quality Acceptance Firm
CQAM	Construction Quality Acceptance Manager
CQCM	Construction Quality Control Manager
CQMP	Construction Quality Management Plan
CVL	Controlled Vocabulary List
FHWA	Federal Highway Administration
IA	Independent Assurance
NCR	Nonconformance Record
OV	Owner Verification
OVTIP	Owner Verification Testing and Inspection Plan
QA	Quality Acceptance
QAP	Quality Assurance Program
QC	Quality Control
QMP	Quality Monitoring Program
RFI	Request for Information
SEP-15	Special Experimental Project Number 15 or SEP-15 derives
TxDOT	Texas Department of Transportation

Acceptance Program shall mean the all factors that comprise the State highway agency's program to (SHA) determine quality of the product as specified in the contract requirements. These factors include acceptance and verification sampling, testing, and inspection and may include results of quality control sampling and testing.

CDA Documents shall have the meaning set forth in he executed agreement between TxDOT and Developer.

Controlled Vocabulary List shall mean the list of agreed-upon nomenclature used to uniquely identify each QA and OV testing report.

Construction Quality Acceptance Firm shall mean the independent construction quality acceptance firm required as part of the Developer's team.

**Design Firm** shall mean the qualified Registered Professional Engineer's firm responsible for the design of the Project.

**Design Documents** shall mean all drawings (including plans, profiles, cross-sections, notes, elevations, sections, details and diagrams), specifications, reports, studies, calculations, electronic files, records and submittals necessary for, or related to, the design of the Project and/or the Utility Adjustments in accordance with the CDA Documents, the Governmental Approvals and applicable Law.

**Developer** shall mean the entity identified in the Agreement to perform Work under the Project, together with its successors and assigns.

**Engineer in Responsible Charge** shall mean the professional engineer accountable for direction, control and supervision to assure that the Work has been critically examined and evaluated for compliance with appropriate professional standards and the requirements of the CDA Documents and the Maintenance Agreement Documents, as applicable.

**Engineering Judgment** shall mean determinations as to whether a material failing to meet specification requirements and not within applicable tolerances should be accepted, or not accepted, shall be based upon sound engineering principles, experience, and/or related results of applicable material tests, and be made by a Texas Licensed Professional Engineer.

**Final Acceptance** shall mean the occurrence of all of the events and satisfaction of all of the conditions set forth in the CDA Documents, as and when confirmed by TxDOT's issuance of a certificate of Final Acceptance

**F-test** shall mean the statistical analysis to compare the variances of two sets of data.

**Governmental Approval** shall mean any permit, license, consent, concession, grant, franchise, authorization, waiver, variance or other approval, guidance, protocol, mitigation agreement, or memoranda of agreement/understanding, and any amendment or modification of any of them provided by Governmental Entities, including State, local, or federal regulatory agencies, agents, or employees, which authorize or pertain to the Work or the Project, but excluding any such approvals given by or required from any Governmental Entity in its capacity as a Utility Owner.

**Governmental Entities** shall mean any federal, State or local government and any political subdivision or any governmental, quasi-governmental, judicial, public or statutory instrumentality, administrative agency, authority, body or entity other than TxDOT.

**Independent Assurance Program** shall all activities that are included in an unbiased and independent evaluation program for all the sampling and testing procedures used in the Acceptance Program.

**Law or Laws** means (a) any statute, law, code, regulation, ordinance, rule or common law, (b) any binding judgment (other than regarding a Claim or Dispute), (c) any binding judicial or administrative order or decree (other than regarding a Claim or Dispute), (d) any written directive, guideline, policy requirement or other governmental restriction (including those resulting from the initiative or referendum process, but excluding those by TxDOT within the scope of its administration of the CDA Documents) or (e) any similar form of decision of or determination by, or any written interpretation or administration of any of the

foregoing by, any Governmental Entity, in each case which is applicable to or has an impact on the Project or the Work, whether taking effect before or after the Effective Date, including Environmental Laws. "Laws", however, excludes Governmental Approvals.

**Level of Significance (alpha)** shall mean the probability of erroneously rejecting the null hypothesis when it should have been accepted.

**Nonconforming Work (Nonconformance)** shall mean Work that has not been constructed with the strictest adherence to the approved drawings and specifications and with the requirements of the Contract Documents, the Governmental Approvals and applicable Law.

**Nonconformance Record (NCR)** shall mean a record of how Nonconforming Work was accepted for incorporation into the Work.

**Proficiency samples** shall mean homogenous samples that are distributed and tested by two or more laboratories and/or personnel. The test results are compared to assure that the laboratories and/or personnel are obtaining the same results.

**Project** shall have the meaning set forth in Recital B to the Agreement.

**Qualification** shall mean a quality, ability, or accomplishment that makes a person technically competent for a particular position or task.

**Quality acceptance** shall mean all planned and systematic actions performed by the CQAF as defined in the CDA for their portion of the acceptance decision.

**Quality assurance** shall mean all planned and systematic actions necessary to provide confidence that a product or service will satisfy given requirements for quality.

**Quality Assurance Program** shall mean the program for quality management and control of the Project and Work, as described in the CDA Documents.

**Quality control** shall mean all contractor/vendor operational techniques and activities that are performed or conducted to fulfill the contract requirements.

**Random Sampling** shall mean a process whereby each element of the population has an equal chance of being selected.

**Registered Professional Engineer** shall mean a person who is duly licensed and registered by the Texas Board of Professional Engineers to engage in the practice of engineering in the State.

**Rules** shall mean Texas Administrative Code.

**Substantial Completion** shall mean the occurrence of all of the events and satisfaction of all of the conditions set forth in the Agreement, as and when confirmed by TxDOT's issuance of a Certificate of Substantial Completion.

**Subcontractor** shall mean any parties with whom Developer has entered into any Subcontract to perform any part of the Work or provide any materials, equipment or supplies for the Project on behalf of Developer and any other party with whom any Subcontractor has further subcontracted any part of the Work, at all tiers.

**Supplier** shall mean any Person not performing work at or on the Site which supplies machinery, equipment, materials, hardware, software, systems or any other appurtenance to the Project to Developer or to any Subcontractor in connection with the performance of the Work. Persons who merely transport, pick up, deliver or carry materials, personnel, parts or equipment or any other items or persons to or from the Site shall not be deemed to be performing Work at the Site.

**TxDOT Standard Specifications** shall mean the Texas Department of Transportation Standard Specifications for Construction of Highways, Streets and Bridges, adopted by the Texas Department of Transportation including all revisions thereto applicable on the effective date of the agreement.

**t-test** shall mean the statistical analysis to compare the variances of two sets of data.

**Utility or utility** shall mean a public, private, cooperative, municipal and/or government line, facility or system used for the carriage, transmission and/or distribution of cable television, electric power, telephone, telegraph, water, gas, oil, petroleum products, steam, chemicals, hydrocarbons, telecommunications, sewage, storm water not connected with the drainage of the Project, and similar substances that directly or indirectly serve the public.

**Utility Owner** shall mean the owner or operator of any Utility (including both privately held and publicly held entities, cooperative utilities, and municipalities and other governmental agencies).

**Vendor** shall mean a supplier of project-produced material that is not the contractor.

**Verification Testing** shall mean sampling and testing performed to validate the quality of the product. The sampling and testing are to be performed by qualified testing personnel employed by the SHA or its designated agent, excluding the contractor and vendor.

**Work** shall mean all of the work required under the CDA Documents, including all administrative, design, engineering, real property acquisition and occupant relocation, support services, utility adjustment work to be furnished or provided by Developer, reimbursement of Utility Owners for utility adjustment work furnished or provided by such Utility Owners or their contractors and consultants, procurement, professional, manufacturing, supply, installation, construction, supervision, management, testing, verification, labor, materials, equipment, maintenance, documentation and other duties and services to be furnished and provided by Developer as required by the CDA Documents, including all efforts necessary or appropriate to achieve Final Acceptance, except for those efforts which such CDA Documents expressly specify will be performed by parties other than the Developer-related entities.

## Appendix B Split Sample Tolerance Limits

PROCEDURE	TEST METHOD	TOLERANCE
<b>Embankment</b>		
Liquid Limit	Tex-104-E	15% of mean *
Plasticity Index	Tex-106-E	20% of mean *
Linear Shrinkage	Tex-107-E	± 2
Gradation	Tex-110-E	> No. 4 sieve: ± 5% (pts.)
		≤ No. 4 sieve: ± 3% (pts.)
Moisture-Density	Tex-114-E	2.0 pcf of mean *
In-place Density	Tex-115-E	± 2.5%
<b>Retaining Wall – Non-Select Backfill</b>		
Liquid Limit	Tex-104-E	15% of mean *
Plasticity Index	Tex-106-E	20% of mean *
Linear Shrinkage	Tex-107-E	± 2
Gradation	Tex-110-E	> No. 4 sieve: ± 5% (pts.)
		≤ No. 4 sieve: ± 3% (pts.)
Moisture-Density	Tex-114-E	2.0 pcf of mean *
In-place Density	Tex-115-E	± 2.5%
<b>Retaining Wall – Select Backfill</b>		
Gradation	Tex-110-E	> No. 4 sieve: ± 5% (pts.)
		≤ No. 4 sieve: ± 3% (pts.)
In-place Density	Tex-115-E	± 2.5%
pH	Tex-128-E	± 0.1
Resistivity	Tex-129-E	± 1,000 ohm-cm
<b>Untreated &amp; Treated Subgrade and Base Courses</b>		
Moisture Content	Tex-103-E	± 1% (point)
Liquid Limit	Tex-104-E	15% of mean *
Plasticity Index	Tex-106-E	20% of mean *
Linear Shrinkage	Tex-107-E	± 2
Gradation	Tex-110-E	> No. 4 sieve: ± 5% (pts.)
		≤ No. 4 sieve: ± 3% (pts.)
Moisture-Density	Tex-113-E	2.0 pcf of mean *
In-place Density	Tex-115-E	± 2.5%
Wet Ball Mill	Tex-116-E	10% of mean *
Compressive Strength	Tex-117-E	10 psi of mean *
Thickness	Tex-140-A	0.25 in.
<b>Asphalt Stabilized Base</b>		
Gradation	Tex-200-F	> No. 4 sieve: ± 5% (pts.)
		≤ No. 4 sieve: ± 3% (pts.)
Liquid Limit	Tex-104-E	15% of mean *
Plasticity Index	Tex-106-E	20% of mean *

PROCEDURE	TEST METHOD	TOLERANCE
Wet Ball Mill	Tex-116-E	10% of mean *
Thickness	Tex-140-E	0.25 in.
Percent Asphalt	Tex-236-F	± 0.3%
In-place Density (Cores)	Tex-207-F	± 1%
Sand Equivalent	Tex-203-F	± 5
Decantation	Tex-217-F	20% of mean *
Coarse Aggregate Angularity	Tex-460-A	± 5
<b>Surface Treatment Aggregate</b>		
Gradation	Tex-200-F	> No. 4 sieve: ± 5% (pts.)
		≤ No. 4 sieve: ± 3% (pts.)
Deleterious Material	Tex-217-F	± 0.3%
Decantation	Tex-217-F	20% of mean *
Coarse Aggregate Angularity	Tex-460-A	± 5
<b>Hydraulic Cement Concrete Coarse Aggregate</b>		
Gradation	Tex-401-A	> No. 4 sieve: ± 5% (pts.)
		≤ No. 4 sieve: ± 3% (pts.)
Decantation	Tex-406-A	20% of mean *
Deleterious Material	Tex-413-F	± 0.3%
<b>Hydraulic Cement Concrete Fine Aggregate</b>		
Sand Equivalent	Tex-203-F	± 5
Gradation: 3/8" thru No. 200	Tex-401-A	± 3% (pts.)
Fineness Modulus	Tex-402-A	± 0.2
Deleterious Material	Tex-413-F	± 0.3%
<b>Hydraulic Cement Concrete Complete Mixture</b>		
Slump	Tex-415-A	± 1"
Entrained Air Content	Tex-414-A	± 1%
	Tex-416-A	
Temperature	Tex-422-A	2°F
Compressive Strength	Tex-418-A	17% of mean * (4x8")
		14% of mean * (6x12")
Flexural Strength	Tex-448-A	± 19%
<b>Hot-Mix Asphalt Coarse Aggregate</b>		
Gradation	Tex-200-F	> No. 8 sieve: ± 5% (pts.)
		≤ No. 8 sieve: ± 3% (pts.)
Deleterious Material	Tex-217-F	± 0.3%
Decantation	Tex-217-F	20% of mean *
<b>Hot-Mix Asphalt Coarse Aggregate</b>		
Gradation: No. 10 thru No. 200	Tex-200-F	± 3% (pts.)
Linear Shrinkage	Tex-107-E	± 2
<b>Hot-Mix Asphalt Combined Aggregate</b>		
Gradation	Tex-200-F	> 5/8" sieve: ± 5% (pts.)
		5/8" thru No. 200: ± 3% (pts.)
		Pass. No. 200: ± 1.5% (pts.)
Sand Equivalent	Tex-203-F	± 5

PROCEDURE	TEST METHOD	TOLERANCE
<b>Hot-Mix Asphalt Complete Mixture</b>		
Asphalt Content	Tex-228-F	± 0.3%
	Tex-236-F	± 0.3%
Maximum Theoretical Specific Gravity	Tex-227-F	± 0.020
Laboratory Molded Density	Tex-207-F	± 1.0%
Laboratory Molded Bulk Specific Gravity	Tex-207-F	± 0.020
Moisture Content	Tex-212-F	± 0.2 mL
In-place Air Voids (Core)	Tex-207-F	± 1.0%

\* The difference between compared test results shall not exceed the indicated percentage of the mean of the compared test results where the mean is the average of the two test results.

NOTE: The above tolerances are to be used when comparison of test results is by split samples. A tolerance of plus or minus two (2) standard deviations shall be used when comparison of test results is by proficiency samples.

## Appendix D – Material Test Categories for Statistical Validation

### Start-Up Requirements

During start-up operations, the CQAF (Construction Quality Acceptance Firm) and OV (owner verification) firm will perform split sample testing for all tests listed as Level 1 or Level 2. The OV firm will evaluate split sample results against TxDOT's split sample tolerance limits contained in Appendix B. For those test methods that do not validate during start-up operations, both the CQAF and OV firm will collaborate to determine the cause(s) of the non-validation and will both take appropriate corrective actions during the early phases of material production to align the testing operations. For tests listed as Level 3, the OV firm will observe and review the CQAF's initial start-up testing operations.

The level of significance ( $\alpha$ ) used for statistical analyses are provided below unless otherwise approved in writing by TxDOT.

MATERIAL CATEGORY	LEVEL OF SIGNIFICANCE ( $\alpha$ )
Embankment, Subgrades, Backfill, and Base Courses	0.01
Asphalt Stabilized Base (Plant Mix)	0.01
Surface Treatments	0.01
Hydraulic Cement Concrete – Structural	0.025
Hydraulic Cement Concrete – Non Structural	0.01
Hydraulic Cement Concrete Pavements	0.025
Asphalt Concrete Pavement (Items 341, 342, 344, and 346)	0.025
Asphalt Concrete Pavement (Items 330 and 334)	0.01
Asphalt Concrete Pavement (Item 340)	0.025

### Level 1 Tests: F & t-test and Split Samples

F- and t- Tests: The OV firm will perform continuous F- and t- test analyses on Level 1 tests with the OV testing frequency at approximately ten percent of the QA testing frequency. The continuous analysis, as described in Appendix H – I2MS 3.0 Continuous Analysis Algorithm, will be run daily with new OV test results being added to the OV sample population as older OV test results are removed. The analyses will be performed against the corresponding QA CQAF sample population.

### Level 2 Tests: Independent Verification and Split Samples

Independent Verification: The OV firm will perform independent verification on Level 2 tests with the OV testing frequency once per quarter with lower frequency tests missed during one quarter being specifically targeted the next quarter. This verification shall be performed by comparing the independent OV test results with a group of corresponding QA test results as an independent check of the QA test results.

### Level 3: Observation Verification

The OV firm will observe and review the CQAF's initial start-up testing operations and periodically during ongoing production operations to verify compliance with test procedures.



Levels for Analysis		Level 1	Level 2	Level 3
<b>EMBANKMENTS, SUBGRADES, BACKFILL, AND BASE COURSES</b>				
MATERIAL OR PRODUCT		TEST FOR	TEST NO.	TxDOT RECOMMENDED
EMBANKMENT (CUTS & FILLS)		Liquid Limit	Tex-104-E	2
		Plasticity Index	Tex-106-E	1
		Linear Shrinkage	Tex-107-E	2
		Gradation	Tex-110-E	2
		Moisture/Density	Tex-114-E	3
		In-Place Density	Tex-115-E	1
RETAINING WALL (NON-SELECT BACKFILL)		Liquid Limit	Tex-104-E	2
		Plasticity Index	Tex-106-E	1
		Linear Shrinkage	Tex-107-E	2
		Gradation	Tex-110-E	2
		Moisture/Density	Tex-114-E	3
		In-Place Density	Tex-115-E	1
RETAINING WALL (SELECT BACKFILL)		Gradation	Tex-110-E	2
		Resistivity	Tex-129-E	2
		pH	Tex-128-E	2
		Soundness	Tex-411-A	3
		In-Place Density	Tex-115-E	1
UNTREATED BASE COURSES		Liquid Limit	Tex-104-E	2
		Plasticity Index	Tex-106-E	1
		Linear Shrinkage	Tex-107-E	2
		Gradation	Tex-110-E	2
		Moisture/Density	Tex-113-E	3
		Wet Ball Mill	Tex-116-E	2
		Triaxial	Tex-117-E	2
		In-Place Density	Tex-115-E	1
		Moisture Content	Tex-103-E	2
		Thickness	Tex-140-E	1
	TREATED SUBGRADE AND BASE COURSES	New Base Material	Liquid Limit	Tex-104-E
Plasticity Index			Tex-106-E	1
Linear Shrinkage			Tex-107-E	2
Gradation			Tex-110-E	2
Moisture/Density			Tex-113-E	3
Wet Ball Mill			Tex-116-E	2
Triaxial			Tex-117-E	2
In-Place Density			Tex-115-E	1
Moisture Content			Tex-103-E	2
Thickness			Tex-140-E	1
Complete Mixture		Pulverizatin Gradation	Tex-101-E, Part III	2
		Moisture Content	Tex-103-E	2
		In-Place Density	Tex-115-E	1

		Thickness	Tex-140-E	1
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Levels for Analysis	Level 1	Level 2	Level 3
<b>ASPHALT STABILIZED BASE (Plant Mix)</b>			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
AGGREGATE	Gradation	Tex-110-E	2
	Liquid Limit	Tex-104-E	2
	Plasticity Index	Tex-106-E	1
	Linear Shrinkage	Tex-107-E	2
	Wet Ball Mill or L. A. Abrasion	Tex-116-E or Tex-410-A	3
	Coarse Aggregate Angularity	Tex-460-A, Part I	3
	Sand Equivalent	Tex-203-F	3
	Decantation	Tex-217-F, Part II	2
COMPLETE MIXTURE	Laboratory Density and/or Strength	Tex-126-E	1
	Percent Asphalt	Tex-236-F	1
	In-Place Density	Tex-207-F	1
	Moisture Susceptibility	Tex-530-C	3
	Thickness	Tex-140-E	1

Levels for Analysis	Level 1	Level 2	Level 3
<b>SURFACE TREATMENTS</b>			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
AGGREGATE	Gradation	Tex-200-F, Part I	1
	L. A. Abrasion	Tex-410-A	3
	Magnesium Soundness	Tex-411-A	3
	Pressure Slake	Tex-431-A	3
	Freeze Thaw	Tex-432-A	3
	Unit Weight	Tex-404-A	3
	24 hr Water Absorption	Tex-433-A	3
	Coarse Aggregate Angularity	Tex-460-A	2
	Deleterious Material	Tex-217-F	2
	Decantation	Tex-406-A	2
	Flakiness Index	Tex-224-F	3
	MicroDeval	Tex-461-A	3

Levels for Analysis		Level 1	Level 2	Level 3
<b>HYDRAULIC CEMENT CONCRETE – STRUCTURAL</b> (Classes: C, F, H, S, DC, CO, K, LMC, or SS)				
MATERIAL OR PRODUCT		TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
MINERAL AGGREGATE	COARSE AGGREGATE	Decantation	Tex-406-A	2
		Sieve Analysis	Tex-401-A	2
		Deleterious Materials	Tex-413-A	2
		Los Angeles Abrasion	Tex-410-A	3
		5-cycle Magnesium Sulfate Soundness	Tex-411-A	3
	FINE AGGREGATE	Sand Equivalent	Tex-203-F	2
		Organic Impurities	Tex-408-A	2
		Sieve Analysis	Tex-401-A	2
		Fineness Modulus	Tex-402-A	2
		Deleterious Material	Tex-413-A	2
		Acid Insoluble Residue	Tex-612-J	3
		Sieve Analysis	Tex-401-A	3
	MINERAL FILLER	Sieve Analysis	Tex-401-A	3
CONCRETE	Compressive Strength	Tex-418-A	1	
	Slump	Tex-415-A	2	
	Entrained Air (When not waived by plans)	Tex-416-A or Tex-414-A	1	
	Temperature of Concrete	Tex-422-A	3	

Levels for Analysis		Level 1	Level 2	Level 3
<b>HYDRAULIC CEMENT CONCRETE – NON-STRUCTURAL</b> (Classes: A, B, D, or E)				
MATERIAL OR PRODUCT		TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
CONCRETE		Compressive Strength	Tex-418-A	3
		Entrained Air (When not waived by plans)	Tex-416-A or Tex-414-A	3

Levels for Analysis		Level 1	Level 2	Level 3
<b>HYDRAULIC CEMENT CONCRETE PAVEMENTS</b> (Classes: P, DC, CO, LMC, K, or HES)				
MATERIAL OR PRODUCT		TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
MINERAL AGGREGATE	COARSE AGGREGATE	Decantation	Tex-406-A	2
		Sieve Analysis	Tex-401-A	2
		Deleterious Materials	Tex-413-A	2
		Los Angeles Abrasion	Tex-410-A	3
		5-cycle Magnesium Sulfate Soundness	Tex-411-A	3
	FINE AGGREGATE	Sand Equivalent	Tex-203-F	2
		Organic Impurities	Tex-408-A	2
		Sieve Analysis	Tex-401-A	2
		Fineness Modulus	Tex-402-A	2
		Deleterious Material	Tex-413-A	2
	MINERAL FILLER	Acid Insoluble Residue	Tex-612-J	3
		Sieve Analysis	Tex-401-A	3
CONCRETE		Strength	Tex-448-A or Tex-418-A	1
		Slump	Tex-415-A	2
		Entrained Air (When not waived by plans)	Tex-416-A or Tex-414-A	1
		Temperature	Tex-422-A	3
		Thickness	Tex-423-A	1

Levels for Analysis	Level 1	Level 2	Level 3
<b>ASPHALT CONCRETE PAVEMENT (Items 341, 342, 344, and 346)</b>			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
COARSE AGGREGATE	L. A. Abrasion	Tex-410-A	3
	Magnesium Sulfate Soundness	Tex-411-A	3
	Gradation	Tex-200-F	3
	MicroDeval	Tex 461-A	3
	Flat and Elongated Particles	Tex-280-F	3
	Coarse Aggregate Angularity	Tex-460-A Part I	3
	Deleterious Material and Decant	Tex-217-F	3
RAP	Decant	Tex-217-F	3
	Plasticity Index	Tex-106-E	3
FINE AGGREGATE	Bar Linear Shrinkage	Tex-107-E	3
	Organic Impurities	Tex-408-A	3
	Gradation	Tex-200-F	3
MINERAL FILLER	Bar Linear Shrinkage	Tex-107-E	3
	Gradation	Tex-200-F	3
COMBINED AGGREGATE	Sand Equivalent	Tex-203-F	3

Levels for Analysis	Level 1	Level 2	Level 3
<b>ASPHALT CONCRETE PAVEMENT (Items 341, 342, 344, and 346)</b>			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
COMPLETE MIXTURE	Asphalt Content (%)	Tex-236-F	1
	Voids in Mineral Aggregates (VMA)	Tex-207-F	3
	Gradation	Tex-236-F	2
	Boil Test	Tex-530-C	3
	Indirect Tensile – Dry	Tex-226-F	3
	Moisture Content	Tex-212-F Part II	3
	Lab Molded Density	Tex-207-F	1
	Drain Down Test	Tex-235-F	3
	Hamburg Wheel Tracker	Tex-242-F	3
ROADWAY	In-Place Air Voids	Tex-207-F	1
	Segregation Profile	Tex-207-F Part V	3
	Joint Density	Tex-207-F Part VII	3
	Tack Coat Adhesion	Tex-243-F	3
	Thermal Profile	Tex-244-F	3
	Permeability	Tex-246-F Part I	3

Levels for Analysis	Level 1	Level 2	Level 3
<b>ASPHALT CONCRETE PAVEMENT (Items 330 and 334)</b>			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
COARSE AGGREGATE	L. A. Abrasion	Tex-410-A	3
	Magnesium Sulfate Soundness	Tex-411-A	3
	Gradation	Tex-200-F	3
	MicroDeval	Tex-461-A	3
	Flat and Elongated Particles	Tex-280-F	3
	Coarse Aggregate Angularity	Tex-460-A Part I	3
	Deleterious Material and Decant	Tex-217-F	3
FINE AGGREGATE	Bar Linear Shrinkage	Tex-107-E	3
	Organic Impurities	Tex-408-A	3
	Gradation	Tex-200-F	3
MINERAL FILLER	Bar Linear Shrinkage	Tex-107-E	3
	Gradation	Tex-200-F	3
COMBINED AGGREGATE	Sand Equivalent	Tex-203-F	3
COMPLETE MIXTURE	Asphalt Content (%)	Tex-236-F	1
	Voids in Mineral Aggregates (VMA)	Tex-207-F	3
	Gradation	Tex-236-F	2
	Boil Test	Tex-530-C	3
	Moisture Content	Tex-212-F Part II	3
	Hydrocarbon-Volatile Content	Tex-213-F	3
	Lab Molded Density	Tex-207-F	1
	Hveem Stability	Tex-208-F	1
ROADWAY	Tack Coat Adhesion	Tex-243-F	3

Levels for Analysis	Level 1	Level 2	Level 3
<b>ASPHALT CONCRETE PAVEMENT (Item 340)</b>			
MATERIAL OR PRODUCT	TEST FOR	TEST NUMBER	TxDOT RECOMMENDED
COARSE AGGREGATE	L. A. Abrasion	Tex-410-A	3
	Magnesium Sulfate Soundness	Tex-411-A	3
	Gradation	Tex-200-F	2
	MicroDeval	Tex 461-A	3
	Flat and Elongated Particles	Tex 280-F	3
	Coarse Aggregate Angularity	Tex-460-A Part I	3
	Deleterious Material and Decant	Tex-217-F	3
RAP	Decant	Tex-217-F	3
	Plasticity Index	Tex 106-E	3
FINE AGGREGATE	Bar Linear Shrinkage	Tex-107-E	3
	Organic Impurities	Tex-408-A	3
	Gradation	Tex-200-F	2
MINERAL FILLER	Bar Linear Shrinkage	Tex-107-E	3
	Gradation	Tex-200-F	3
COMBINED AGGREGATE	Sand Equivalent	Tex-203-F	2
COMPLETE MIXTURE	Asphalt Content (%)	Tex-236-F	1
	Voids in Mineral Aggregates (VMA)	Tex-207-F	2
	Gradation	Tex-236-F	2
	Boil Test	Tex-530-C	3
	Indirect Tensile – Dry	Tex-226-F	3
	Lab Molded Density	Tex-207-F	1
	Hamburg Wheel Tracker	Tex-242-F	3
ROADWAY	Tack Coat Adhesion	Tex-243-F	3
	Air Voids	Tex-207-F	1

## Appendix D

### Test Methods for Personnel Qualifications

Test Procedure	TxAPA Soils and Flexible Base Testing Certifications
	Level SB 101
Tex-100-E	Surveying and Sampling of Soils for Highways
Tex-101-E	Preparing Soil and Flexible Base Materials for Testing (Part I & II)
Tex-103-E	Determining Moisture Content in Soil Materials
Tex-104-E	Determining Liquid Limit of Soils
Tex-105-E	Determining Plastic Limit of Soils
Tex-106-E	Calculating the Plasticity Index of Soils
Tex-107-E	Determining Bar Linear Shrinkage of Soils
Tex-110-E	Particle Size Analysis of Soils (Part I)
Tex-116-E	Ball Mill Method for Determining the Disintegration of Flexible Base Material
Tex-400-A	Sampling Stone, Gravel, Sand, and Mineral Aggregates
	Level SB 102
Tex-100-E	Surveying and Sampling of Soils for Highways
Tex-101-E	Preparing Soil and Flexible Base Materials for Testing (Part I & II)
Tex-103-E	Determining Moisture Content in Soil Materials
Tex-115-E	Field Method for Determining In-Place Density of Soils and Base Materials
Tex-140-E	Measuring Thickness of Pavement Layer
	Level SB 103
Tex-100-E	Surveying and Sampling of Soils for Highways
Tex-101-E	Preparing Soil and Flexible Base Materials for Testing (Part I & II)
Tex-128-E	Determining Soil pH
Tex-129-E	Measuring the Resistivity of Soils
Tex-145-E	Determining Sulfate Content in Soils, Colorimetric Method
Tex-146-E	Conductivity Test for Field Detection of Sulfates in Soil
Tex-400-A	Sampling Stone, Gravel, Sand, and Mineral Aggregates
	Level SB 201
Tex-100-E	Surveying and Sampling of Soils for Highways
Tex-101-E	Preparing Soil and Flexible Base Materials for Testing (Part I & II)
Tex-113-E	Laboratory Compaction Characteristics & Moisture-Density Relationship of Base Materials
Tex-114-E	Laboratory Compaction Characteristics & Moisture-Density Relationship of Subgrade & Embankment Soil
Tex-400-A	Sampling Stone, Gravel, Sand, and Mineral Aggregates
	Level SB 202
Tex-100-E	Surveying and Sampling of Soils for Highways
Tex-101-E	Preparing Soil and Flexible Base Materials for Testing (Part I & II)
Tex-117-E	Triaxial Compression for Disturbed Soils and Base Materials
Tex-120-E	Soil-Cement Testing
Tex-121-E	Soil-Lime Testing



Test Procedure	TxAPA Hot-Mix Asphalt Testing Certifications
	<b>Level 1A</b>
Tex-200-F	Sieve Analysis of Fine and Course Aggregate
Tex-205-F	Laboratory Method of Mixing Bituminous Mixtures
Tex-206-F	Compacting Specimens Using the Texas Gyrotory Compactor (TGC)
Tex-207-F	Determining Density of Compacted Bituminous Mixtures
Tex-212-F	Determining Moisture Content of Bituminous Mixtures
Tex-221-F	Sampling Aggregate for Bituminous Mixtures, Surface Treatments, and Limestone Rock Asphalt
Tex-222-F	Sampling Bituminous Mixtures
Tex-225-F	Random Selection of Bituminous Mixture Samples
Tex-227-F	Theoretical Maximum Specific Gravity of Bituminous Mixtures
Tex-233-F	Preparing Control Charts for Asphaltic Concrete Paving Projects
Tex-236-F	Determination of Asphalt Content of Bituminous Mixtures by the Ignition Method
Tex-241-F	Superpave Gyrotory Compacting of Test Specimens of Bituminous Mixtures
Tex-500-C	Sampling Bituminous Materials, Pre-Molded Joint Fillers and Joint Sealers
Tex-530-C	Effect of Water on Bituminous Paving Mixtures
	<b>Level 1B</b>
Tex-207-F	Determining Density of Compacted Bituminous Mixtures
Tex-222-F	Sampling Bituminous Mixtures
Tex-239-F	Asphalt Release Agent
Tex-243-F	Tack Coat Adhesion
Tex-244-F	Thermal Profile of Hot Mix Asphalt
Tex-246-F	Permeability or Water Flow of Hot Mix Asphalt
Tex-1001-S	Operating Inertial Profilers and Evaluating Pavement Profiles

Test Procedure	TxAPA Hot-Mix Asphalt Testing Certifications
	Level 2
Tex-107-F	Determining Bar Linear Shrinkage of Soils
Tex-203-F	Sand Equivalent Test
Tex-204-F	Design of Bituminous Mixtures
Tex-205-F	Laboratory Method of Mixing Bituminous Mixtures
Tex-206-F	Compacting Specimens Using the Texas Gyrotory Compactor (TGC)
Tex-207-F	Determining Density of Compacted Bituminous Mixtures (VMA Calculation)
Tex-217-F	Determining Deleterious Material and Decantation Test for Coarse Aggregates (Bituminous Mixtures) (Part I & II)
Tex-226-F	Indirect Tensile Strength Test
Tex-227-F	Theoretical Maximum Specific Gravity of Bituminous Mixtures
Tex-235-F	Determining Draindown Characteristics in Bituminous Materials
Tex-236-F	Determining Asphalt Content from Asphalt Paving Mixtures by the Ignition Method
Tex-241-F	Superpave Gyrotory Compacting of Test Specimens of Bituminous Mixtures
Tex-242-F	Hamburg Wheel-tracking Test
Tex-245-F	Cantabro Loss
Tex-280-F	Determining Flat and Elongated Particles
Tex-408-F	Organic Impurities in Fine Aggregate for Concrete
Tex-460-A	Determining Crushed Face Particle Count
Tex-461-A	Degradation of Coarse Aggregate by Micro-Deval Abrasion

Test Procedure	American Concrete Institute (ACI) Certifications
	Concrete Field Testing Technician – Grade I
Tex-407-A	Sampling Freshly Mixed Concrete
Tex-414-A	Air Content of Freshly Mixed Concrete by the Volumetric Method
Tex-415-A	Slump of Portland Cement Concrete
Tex-416-A	Air Content of Freshly-Mixed Concrete by the Pressure Method
Tex-417-A	Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
Tex-422-A	Measuring Temperature of Freshly Mixed Portland Cement Concrete
Tex-447-A	Making and Curing Concrete Test Specimens (Part I)
	Concrete Strength Testing Technician
Tex-418-A	Compressive Strength of Cylindrical Concrete Specimens
Tex-448-A	Flexural Strength of Concrete Using Simple Beam Third-Point Loading

	Concrete Laboratory Technician – Level I
Tex-418-A	Compressive Strength of Cylindrical Concrete Specimens
Tex-448-A	Flexural Strength of Concrete Using Simple Beam Third-Point Loading

## Appendix E

### Test Methods for Split / Proficiency Evaluation

#### Requirements for Proficiency Testing

After observation and qualification, each qualified technician is required to participate annually in one proficiency or split sample test for each test method requiring independent assurance. Results must compare to the independent assurance test results to within the established tolerance as described in Appendix B – Split Sample Tolerance Limits. The following table describes the testing procedures required for proficiency evaluation.

Proficiency Testing Procedures	
Test Procedure	Description
Tex-104-E	Determining Liquid Limit of Soils
Tex-105-E	Determining Plastic Limit of Soils
Tex-106-E	Calculating the Plasticity Index of Soils
Tex-107-E	Determining the Bar Linear Shrinkage of Soils
Tex-110-E	Particle Size Analysis of Soils
Tex-401-A	Sieve Analysis of Fine and Coarse Aggregate
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregate
Tex-203-F	Sand Equivalent Test
Tex-206-F	Compacting Test Specimens of Bituminous Mixtures
Tex-207-F	Determining Density of Compacted Bituminous Mixtures
Tex-227-F	Theoretical Maximum Specific Gravity of Bituminous Mixtures
Tex-236-F	Determining Asphalt Content from Asphalt Paving Mixtures by the Ignition Method
Tex-414-A	Air Content of Freshly Mixed Concrete by the Volumetric Method
Tex-415-A	Slump of Portland Cement Concrete
Tex-416-A	Air Content of Freshly Mixed Concrete by the Pressure Method
Tex-418-A	Compressive Strength of Cylindrical Concrete Specimens

## Appendix F Material Certification Example Letter

The intent of the material certification is to ensure that the quality of all materials incorporated into the project is in conformance with the plans and specifications, thus ensuring a service life equivalent to the design life. Any material represented by an acceptance test that does not meet the criteria contained in the plans and specifications is considered an exception. Exceptions should be investigated to determine if in fact the material is in reasonably close conformity with the plans and specifications. Nonconforming materials and workmanship will be tracked, monitored and appropriately addressed.

Submit a monthly CQAM Material Certification Letter in the FHWA Statistical Analysis Report. An example follows.

Date\_\_\_\_\_

To\_\_\_\_\_

From\_\_\_\_\_

Project No.\_\_\_\_\_

RE: Monthly CQAM Material Certification

This is to certify that:

The results of the tests used in the acceptance program indicate that the materials incorporated in the construction work, and the construction operations controlled by sampling and testing, were in conformity with the approved plans and specifications.

Exceptions to the plans and specifications are as follows:

1. Description
2. Description

\_\_\_\_\_  
CQAM Signature Block

## Appendix G

### Minimum Qualification Requirements for Laboratories

All laboratories performing testing for TxDOT require qualification, at a minimum, in the test procedures identified in the tables below. Project-specific requirements may necessitate qualifications in additional test procedures. Qualification will be required through the AASHTO Accreditation Program (AAP) for those test methods identified in the tables below. The accreditation must be maintained throughout the life of the project and the laboratory must participate in the AASHTO Materials Reference Laboratory/Concrete and Cement Reference Laboratory (AMRL/CCRL) proficiency programs. In addition, TxDOT CSTM&P, or their designee, will qualify the laboratory in TxDOT test methods. The laboratory technicians must participate in the TxDOT Hot-Mix Asphalt and Soils statewide proficiency programs with the results documented as indicated in Section 4 of this manual.

SOIL			
ASTM	AASHTO	TxDOT	Description
D421	T87	TEX-101-E	Preparing Soil and Flexible Base Materials for Testing
D2216	T265	TEX-103-E	Moisture Content in Soil Materials
D4318	T89 / T90	TEX-104-106-E	Liquid Limit; Plastic Limit; Plasticity Index
D427	---	TEX-107-E	Bar Linear Shrinkage
---	T311	TEX-110-E	Particle Size Analysis
D1140	---	TEX-111-E	Amount of Material in Soils Finer than the 75 $\mu\text{m}$ (No. 200) Sieve
D1557	T180	TEX-113-E	Compaction and Moisture-Density Relationship of Base Materials
D698	T99	TEX-114-E	Compaction and Moisture-Density Relationship of Subgrade, Embankment Soils, and Backfill Material
D6938	T310	TEX-115-E	Field Method for In-Place Density of Soils and Base Materials
---	---	TEX-116-E	Ball Mill Method for Disintegration of Flexible Base Material
---	---	TEX-117-E	Triaxial Compression for Disturbed Soils and Base Materials
D558	T134	TEX-120-E	Soil-Cement Testing
D5102	---	TEX-121-E	Soil-Lime Testing
---	---	TEX-124-E	Potential Vertical Rise
D4972	---	TEX-128-E	Soil pH
---	---	TEX-129-E	Resistivity of Soil Materials
---	---	TEX-140-E	Thickness of Pavement Layer
D2487	---	TEX-142-E	Laboratory Classification of Soils for Engineering Purposes
---	---	TEX-145-E	Sulfate Content in Soils— Colorimetric Method
---	---	TEX-146-E	Conductivity Test for Field Detection of Sulfates in Soil
D3740	---	TEX-198-E	Minimum Standards for Acceptance of a Laboratory (Soils/Base)
E329	---	---	Standard Specification for Inspection and Testing

HOT-MIX ASPHALT (HMA)			
ASTM	AASHTO	TxDOT	Description
D5444	T30	TEX-200-F	Sieve Analysis of Fine and Coarse Aggregates
D2419	T176	TEX-203-F	Sand Equivalent
D3203	T269	TEX-206-F	Compacting Specimens Using the Texas Gyrotory Compactor
D2726	T166	TEX-207-F	Density of Compacted Bituminous Mixtures (SSD Method)
D6752	T331	TEX-207-F	Density of Compacted Bituminous Mixtures (Vacuum Method)
D1461	T110	TEX-212-F	Moisture Content
---	---	TEX-217-F	Deleterious Materials and Decantation for Coarse Aggregate
D75	---	TEX-221-F	Sampling Aggregate for Bituminous Mixtures, Surface Treatments, and Limestone Rock Aggregate
D979	---	TEX-222-F	Sampling Bituminous Mixtures
D6931	---	TEX-226-F	Indirect Tensile Strength
D2041	T209	TEX-227-F	Theoretical Maximum Specific Gravity of Bituminous Mixtures
D6307	T308	TEX-236-F	Asphalt Content by the Ignition Method
D3666	---	TEX-237-F	Minimum Standards for Acceptance of a Laboratory (HMA)
D6925	T312	TEX-241-F	Superpave Gyrotory Compacting of Test Specimens
---	---	TEX-244-F	Thermal Profile of Hot Mix Asphalt
---	---	TEX-530-C	Effect of Water on Bituminous Paving Mixtures
E329	---	---	Standard Specification for Inspection and Testing

AGGREGATE			
ASTM	AASHTO	TxDOT	Description
C128	T84	TEX-201-F	Bulk Specific Gravity and Water Absorption of Fine Aggregate
C702	T248	TEX-400-A	Sampling Stone, Gravel, Sand, and Mineral Aggregates
C136	T27	TEX-401-A	Sieve Analysis of Fine and Coarse Aggregate
---	---	TEX-402-A	Fineness Modulus of Fine Aggregate
C127	T85	TEX-403-A	Saturated Surface-Dry Specific Gravity and Absorption
C117	T11	TEX-406-A	Material Finer than the 75 µm (No. 200) Sieve in Mineral Aggregate
C40	T21	TEX-408-A	Organic Impurities in Fine Aggregate for Concrete
C566	T255	TEX-409-A	Free Moisture and Water Absorption
C131	T96	TEX-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine
C88	T104	TEX-411-A	Sodium or Magnesium Soundness
C142	T112	TEX-413-A	Deleterious Materials
D5821	---	TEX-460-A	Crushed Face Particle Count
C1077	---	TEX-498-A	Minimum Standards for Acceptance of a Laboratory (Concrete & Aggregate)
E329	---	---	Standard Specification for Inspection and Testing

HYDRAULIC CEMENT CONCRETE			
ASTM	AASHTO	TxDOT	Description
C172	T141	TEX-407-A	Sampling Freshly Mixed Concrete
C143	T119	TEX-415-A	Slump of Freshly Mixed Concrete
C231	T152	TEX-416-A	Air Content by the Pressure Method
C138	T121	TEX-417-A	Unit Weight, Yield, and Air Content (Gravimetric)
C39	T22	TEX-418-A	Compressive Strength of Cylinders
C1064	T309	TEX-422-A	Temperature of Freshly Mixed Portland Cement Concrete
---	---	TEX-423-A	Pavement Thickness by Direct Measurement
C31	T23	TEX-447-A	Making and Curing Specimens
C617	T231	TEX-450-A	Capping Specimens
C1231	---	TEX-450-A	Unbonded Caps
C1077	---	TEX-498-A	Minimum Standards for Acceptance of a Laboratory (Concrete & Aggregate)
E329	---	---	Standard Specification for Inspection and Testing

	Preferred test procedure for AASHTO Accreditation
	Acceptable test procedure for AASHTO Accreditation
	Test procedure qualified by TxDOT CSTM&P, or designated IA Laboratory

# Appendix H

## I2MS 3.0 Continuous Analysis Algorithm

The following describes the I2MS 3.0 algorithm used in the continuous statistical analysis referenced in Appendix D – Material Test Categories for Statistical Validation.

### Categorizing For Analysis

When a test version record is saved to I2MS, the first step is to assign it to any applicable analysis categories. A test record must have Sample Type “Random-Independent” or “Random-Split” to be associated with any category.<sup>1</sup> Assignment to a category is done immediately when the record enters the system, but the record will not be included in any analyses until it is set “For Analysis” (i.e. it is Approved or intermediate break data is Reviewed).

Note: A new version of an existing record can actually belong to a different analysis category than a previous version if the header values were changed. This is not a problem, as an analysis run represents a snapshot of the current data in the system at the time the analysis was done.

### Finding Categories to Analyze

Every night, I2MS scans data in the system for categories that need to be analyzed. A category is triggered for analysis whenever a NEW OV record appears. A record is new if it is For Analysis and has never been analyzed before. Some examples of new OV records are:

- A test was added and approved today.
- A test was added a month ago and approved/reviewed today.
- A test that was added and analyzed last week was revised and reapproved. This new version has never been analyzed, so it will trigger an analysis the same as if it were the first version of the record.

### Analyzing a Category

The first step in the analysis is to find the date range of the analysis populations. The age of a record is determined by its SAMPLED DATE.

I2MS has a desired maximum number of days that can be configured in Project Settings. By default, this is 90 days. Also configurable is the desired maximum number of OV records to include in one analysis run. This defaults to 25 records.

The end date of analysis will always be the current date. The start date of the analysis is determined by the following:

- If there is an unanalyzed record for either the OVF or CQAF that is OLDER than 90 days, the start date is that record’s Sampled Date. We will analyze ALL records from that date forward.
- If there are less than 25 OV records within the last 90 days, the start date will be 89 days before the current date (i.e. 90 days total in the analysis).

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<sup>1</sup> These restrictions can be reconfigured at the analysis-group level (e.g. Concrete, Asphalt, etc.) if the list of Sample Types or the business rules change.



- If there are 25 OV records or more within the last 90 days, we will use a smaller date range. The Sampled Date of the 25<sup>th</sup> OV record back from the current date will be the start date of the analysis.

The next step is to pull all of the data points for the analysis. We pull values for all “For Analysis” OV and CQAF records between the start date and the end date, using ONLY the latest versions of those records.

Last, we perform the F and t statistical analysis and save the P-values for review by the materials manager. The analysis requires at least two points from each population to calculate. If there are less than two data points for either OV or CQAF, we skip the analysis. The category will be picked up again the next time an approved OV record comes in.

## Appendix I Archived Versions

The following archived versions of this document are available:

- Effective November 2008–February 2010:  
[ftp://ftp.dot.state.tx.us/pub/txdot-info/cst/qap\\_db\\_1108.pdf](ftp://ftp.dot.state.tx.us/pub/txdot-info/cst/qap_db_1108.pdf)