TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

June 13, 2019

Justin Bower
Senior Planner
Houston-Galveston Area Council
3555 Timmons Lane, Suite 120
Houston, TX 77227

Re: Cypress Creek Watershed Protection Plan Modeling Quality Assurance Project Plan (QAPP)
Federal Grant Number: 99614623

Dear Mr. Bower:

Enclosed please find the hard-copy version of the above-referenced QAPP, approved effective today, June 13, 2019. A pdf version of the QAPP and approval letter has been sent to your e-mail address.

Please ensure the QAPP and any subsequent amendments are distributed in a timely manner to the appropriate entities listed in Section A3 of the QAPP. This approval letter must be available for review during a quality systems audit.

Should you have questions, feel free to contact me at (512) 239-6340 or at sharon.coleman@tceq.texas.gov .

Sincerely,

Sharon R. Coleman

Sharon R. Coleman
TCEQ Quality Assurance Manager and Acting Lead NPS Quality Assurance Specialist

Enclosure

cc: Jessica Uramkin, TCEQ NPS Project Manager, MC-203

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Enclosure

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Cypress Creek Watershed Protection Plan Modeling Quality Assurance Project Plan (QAPP)

Houston-Galveston Area Council
Houston, Texas 77227

Funding Source:

Nonpoint Source (NPS) Program CWA §319(h)
Prepared in cooperation with the Texas Commission on Environmental Quality
and the U.S. Environmental Protection Agency
Federal ID #9961423
QTRAK#_____

Effective Period: Three years from date of final approval

Questions concerning this QAPP should be directed to:

Justin Bower
Senior Planner
3555 Timmons Lane, Suite 120
Houston, Texas 77227
(713) 499-6653
Justin.bower@h-gac.com

Houston-Galveston Area Council

5/30/19
Justin Bower, Project Manager Date

Jean Wright 5/30/19
Jean Wright, QA Officer Date

Thushara Ranatunga, Lead Modeler Date

6/3/19
William Hoffman, Data Manager Date

Houston-Galveston Area Council (H-GAC) will secure written documentation from additional project participants stating the organization's awareness of and commitment to requirements contained in this QAPP and any amendments or revisions of this plan. H-GAC will maintain this documentation as part of the project's quality assurance records. This documentation will be available for review. Copies of this documentation will also be submitted as deliverables to the TCEQ NPS Project Manager within 30 days of final TCEQ approval of the QAPP. (See sample letter in Appendix D of this document.)

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A3 DISTRIBUTION LIST

The Lead NPS QA Specialist will provide approved versions of this QAPP and any amendments or revisions of this plan to the TCEQ NPS Project Manager and the H-GAC Project Manager. The TCEQ NPS Project Manager will provide approved copies to the EPA Project Officer within two weeks of approval. The TCEQ NPS Project Manager will document transmittal of the plan and maintain this documentation as part of the project's quality assurance records. This documentation will be available for review in the event of an audit.

U.S. Environmental Protection Agency Region 6
Water Quality Protection Division
Assistance Program Branch
1445 Ross Avenue
Suite # 1200
Dallas, TX 75202-2733

Anthony Suttice, Project Officer
(214) 665-8590

A4 PROJECT/TASK ORGANIZATION

TCEQ

Monitoring Division

Sharon Coleman, Acting Lead NPS QA Specialist
Assists the TCEQ NPS Project Manager in QA related issues. Participates in the planning, development, approval, implementation, and maintenance of the QAPP. Determines conformance with program quality system requirements. Coordinates or performs audits, as deemed necessary and using a wide variety of assessment guidelines and tools. Concurs with proposed corrective actions and verifications. Provides technical expertise and/or consultation on quality services. Recommends to TCEQ management that work be stopped in order to safe guard project and programmatic objectives, worker safety, public health, or environmental protection.

Water Quality Planning Division

Faith Hambleton, Team Leader
NPS Program
Responsible for management and oversight of the TCEQ NPS Program. Oversees the development of QA guidance for the NPS program to be sure it is within pertinent frameworks of the TCEQ. Monitors the effectiveness of the program quality system. Reviews and approves all NPS projects, internal QA audits, program corrective actions, work plans, and contracts. Enforces program corrective action, as required. Ensures NPS personnel are fully trained and adequately staffed.

Jessica Uramkin
TCEQ NPS Project Manager
Maintains a thorough knowledge of work activities, commitments, deliverables, and time frames associated with projects. Develops lines of communication and working relationships between the contractor, the TCEQ, and the EPA. Tracks deliverables to ensure that tasks are completed as specified in the contract. Responsible for ensuring that the project deliverables are submitted on time and are of acceptable quality and quantity to achieve project objectives. Serves on planning team for NPS projects. Participates in the development, approval, implementation, and maintenance of the QAPP. Conducts independent technical review of the QAPP to ensure compliance with project needs and requirements. Responsible for verifying that the approved QAPP is implemented by the contractor. Notifies the TCEQ Lead NPS QA Specialist of particular circumstances which may adversely affect the quality of data derived from the collection and analysis of samples. Monitors and enforces corrective action.

Jessica Uramkin
NPS Quality Assurance Coordinator
Assists Lead QA Specialist with NPS QA management. Serves as liaison between NPS management and Agency QA management. Responsible for NPS guidance development related

work plan specifications. Provides the point of contact for the TCEQ Data Manager to resolve issues related to the data.

U.S. EPA Region 6

Anthony Suttice
EPA Project Officer
Responsible for managing the CWA Section 319 funded grant on behalf of EPA. Assists the TCEQ in approving projects that are consistent with the management goals designated under the State's NPS management plan and meet federal guidance. Coordinates the review of project workplans, draft deliverables, and works with the State in making these items approvable. Meets with the State at least annually to evaluate the progress of each project and when conditions permit, participates in a site visit on the project. Fosters communication within EPA by updating management and others, both verbally and in writing, on the progress of the State's program and on other issues as they arise. Assists in grant close-out procedures ensuring all deliverables have been satisfied prior to closing a grant.

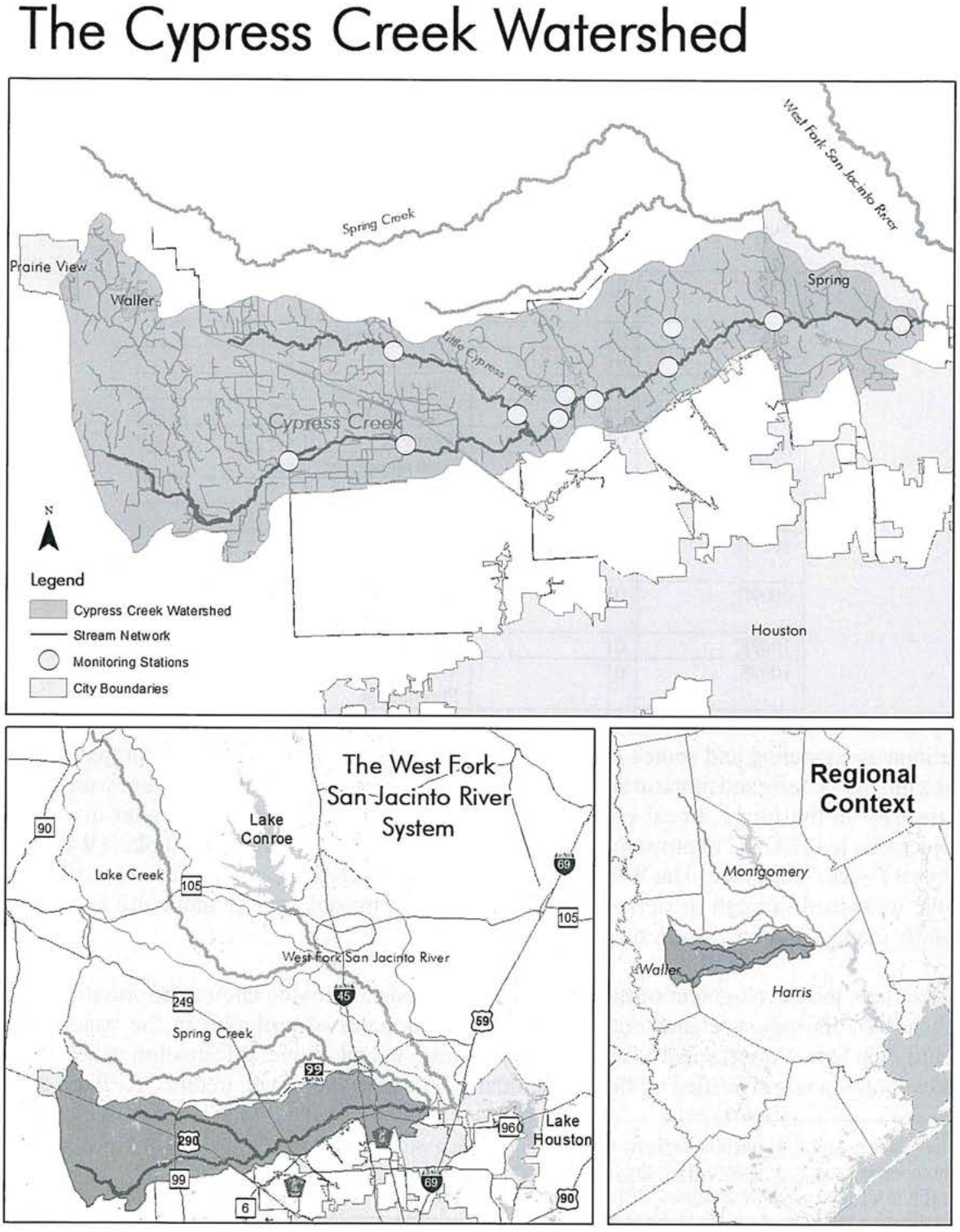

Figure A5.1 – The Cypress Creek Watershed

to generate the information needed to guide decisions and allow for feedback and revision from the stakeholders. To ensure that the data generated (and subsequent decisions which rely on it) are defensible and of appropriate quality, H-GAC will conduct its modeling and data evaluation tasks in a manner consistent with this QAPP.

The purpose of the QAPP is to clearly delineate H-GAC's QA policy, management structure, and procedures to implement the QA requirements necessary to verify, calibrate, and validate the output of the modeling process associated with this project. This QAPP is reviewed and approved by the TCEQ to help ensure that the outputs and data generated for the purposes described within are of known quality and deemed accepted for their intended use. This process will facilitate the use of project outputs and data by the NPS program and other programs deemed appropriate by the TCEQ.

A6 PROJECT/TASK DESCRIPTION AND SCHEDULE

The data needs described in A5 relate to characterizing water quality and updating or refining[1] data concerning causes and sources of pollution to guide stakeholder decisions in the development of the WPP. Based on a review of the concerns and impairments, bacteria, and depressed dissolved oxygen (DO) are the water quality issues of greatest concern to the waterways.

Specifically, H-GAC will conduct modeling and data evaluation efforts to:

- evaluate trends and variability in current and historical water quality data, including the use of Statistical Analysis Software (SAS);
- refine and update previous modeling efforts to define the spatial distribution and amount of pollutant loading using the Spatially Explicit Load Enrichment Calculation Tool (SELECT) model; and
- update and refine the characterization various pollutant concentrations in varying flow conditions and identify the bacteria reductions necessary to meet applicable standards instream using load duration curves (LDCs).

Water Quality Analysis

The acquisition and analysis of water quality data will be conducted for Cypress Creek and Spring Creek[2] based on existing data in the Surface Water Quality Monitoring Information System (SWQMIS), data collected during the project under the Clean Rivers Program's (CRP) existing monitoring QAPP, and sanitary sewer overflow (SSO) and discharge monitoring reports (DMRs)

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goals may be developed by the stakeholders as part of the public engagement process, for contaminants or issues for which standards and/or numeric criteria do not exist (nutrients, trash, etc.). Data generated under the efforts covered by this QAPP (water quality analysis, etc.) may assist stakeholders in identifying solutions that achieve multiple benefits, or coordinate efforts with existing programs.

[1] All references to updating or refining water quality analyses or modeling efforts (SELECT, LDCs, etc.) should be taken to refer to the work completed under project 582-15-56349 "West Fork, San Jacinto River and Lake Creek Watershed Protection Plan (WPP) and Characterization of Spring and Cypress Creek" and its corresponding QAPP.

[2] Data acquired and evaluated for Cypress Creek will be used for the purpose of developing the Cypress Creek WPP. Data acquired and evaluated for Spring Creek will be used for the update of the Spring Creek characterization and for the purpose of supporting a future WPP effort for Spring Creek.

area will be weighted as 25%. The "buffered" approach utilizes a weighting factor to accentuate the probability of proximate load to waterways having greater impact[1]

Load Duration Curves

This project effort will develop updated and revised LDCs[2] for bacteria and DO. The LDCs will be used to update derived load reductions for bacteria and to evaluate any patterns in exceedances of the water quality standard based on flow conditions for all constituents. This work will be completed in the timeframe between approval of the QAPP and quarter 8 of the contract.

Updated LDCs will be completed for 4 stations in the project watersheds, utilizing quality assured water quality data from SWQMIS and/or CRP sources and flow data from USGS gauges[3]. If stakeholders indicate an LDC is needed for an area without enough flow data, and there is sufficient flow data available to calibrate a flow estimation model, H-GAC will employ the ArcSWAT model to create a simple hydrological/runoff application that uses existing spatial and climate data to generate a 10-year period of estimated flow data[4]. Prior to developing the LDCs, H-GAC will evaluate the preliminary information from water quality data analyses to confirm that selected LDC sites are appropriate for characterizing their respective water bodies. If additional or amended locations are needed after water quality data analysis is completed, this QAPP will be amended prior to work being initiated on amended locations. The outputs of the LDC analysis will be visual characterizations of the relationship between flow levels and constituent concentrations, and reduction estimates for constituent loading. The use of this effort will be to help identify variation in loading based on flow and to inform stakeholder decisions regarding scale and type of management measures. The USGS stream gauge and monitoring site locations for LDCs are summarized in Table A6.1.

Table A6.1. LDC Monitoring Site Locations

USGS Gage	Site Description	TCEQ Site ID
08068720	Cypress Creek at Katy-Hockley Rd near Hockley, TX	20457
08068740	Cypress Creek at House-Hahl Rd near Cypress, TX	11333
08068800	Cypress Creek at Grant Rd near Cypress, TX	11332
08069000	Cypress Creek near Westfield, TX	11328

[1] This relationship would be detailed in more complex modeling approaches like SWAT, which are not being utilized for this project. SELECT does not account for the effects of proximity on bacteria transmission, which may skew source contribution ratios and impact stakeholder decisions. The weighting approach is based on previous WPP approaches (Plum Creek, Bastrop Bayou, San Bernard River, Cedar Bayou) using some extent of the same approach, as developed by, and approved by, stakeholders.

[2] Additional information on the use and methodology of the load duration curve model being used for this and previous efforts can be found at https://www.epa.gov/sites/production/files/2015-07/documents/2007_08_23_tmdl_duration_curve_guide_aug2007.pdf .

[3] Potential additional LDC sites include CRP monitoring stations 14159 and/or 20456 on Little Cypress Creek, 17496 on Faulkey Gully, 17481 on Spring Gully, and 11330 on Cypress Creek.

[4] A QAPP amendment would be initiated to include ArcSWAT parameters and calibration/validation data in Section B if stakeholders required this. It is not currently expected to be part of the contract efforts.

QAO. Amendments shall be reviewed, approved, and incorporated into a revised QAPP during the annual revision process or within 120 days of the initial approval in cases of significant changes.

Annual QAPP Reviews and Revisions

This QAPP shall be reviewed in its entirety and certified annually by the H-GAC Project Manager and the TCEQ NPS Project Manager. A letter certifying this annual review must be submitted to the TCEQ NPS Project Manager no later than 90 days prior to the QAPP anniversary date. Amendments approved since QAPP approval (or most recent annual review, if applicable) should be included as an attachment along with the letter. Only nonsubstantive changes not affecting the project design or quality or quantity of work to be performed can be included in the annual certification letter. This includes organizational changes or schedule changes based on a contract amendment that do not impact data deliverables. If changes beyond these are necessary, a QAPP amendment must be submitted and approved before the annual review may be certified. The TCEQ NPS Project Manager is required to review the QAPP and provide certification of annual reviews to the TCEQ QA Manager and EPA Region 6 Project Officer no later than 30 days before QAPP anniversary dates. If the QAPP expires, work described within this document must be halted.

If the project will extend beyond the third QAPP anniversary date, a full QAPP revision is required. This is accomplished by submitting a cover letter, a document detailing changes made if any, and three full copies of the fully updated QAPP (including three sets of signature pages).

A7 QUALITY OBJECTIVES AND CRITERIA FOR MODEL INPUTS/OUTPUTS

The general quality objectives for the project are to produce data analyses and updated modeling outcomes that accurately characterize conditions in the watershed and are a sufficient platform on which to base stakeholder decisions concerning the selection and scale of management measures. This is generally achieved through the use of best available data (quality-assured[1] as applicable), review of products and inputs with stakeholders and knowledgeable partners, and adhering to the preponderance of literature (as amended by reasonable stakeholder review) for modeling assumptions. These goals are fostered by continual and robust engagement with stakeholders, especially partners with specific technical experience.

Data quality objectives for each component effort are described below. For all acquired/existing data sources quality assured data from SWQMIS as collected through CRP or other submitting programs will be used if available.

Water Quality Analysis

The primary data quality objectives for this effort are to ensure data inputs are from quality assured sources, and that analysis outputs accurately reflect water quality trends in the watershed. The

[1] For the purpose of water quality trends analyses, modeling inputs, and in support of decision-making for the WPP, water quality data used will be limited to quality-assured data processed through a TNI-accredited lab, unless it meets an exception as indicated in 30 TAC, Chapter 25.6. Volunteer data (e.g. Texas Stream Team, or other non-accredited lab data) will only be used for anecdotal purposes or for general watershed information.

spatial data used in SELECT is from sources that are quality-assured or are widely-used data products appropriate for this task. Performance criteria for outputs include modeling outcomes that are sufficient to guide stakeholder discussion, and which are demonstrably defensible based on the source and vetting of data and assumptions. The outputs will be acceptable if these criteria are met (this is a qualitative measure, as no model calibration or validation of data other than initial validation in submission to SWMQIS is performed for SELECT). The intended uses of these outputs will be to generate potential pollutant load estimates and characterize their spatial relationship, and to guide stakeholder discussions of the scope of management measures. Hardware and software to be used will conform to industry standard (e.g. Microsoft Office products, and the SELECT model utilized in a Windows/ArcGIS environment). Configuration of SELECT assumptions analyses will be based on similar SELECT analyses to ensure the data is comparable with those of other regional and regulatory efforts.

Data completeness will be based on whether enough data is available to generate loads using SELECT. Data representativeness will be evaluated based on whether spatial data and assumptions are indicative of conditions throughout the watersheds. Because the selection of assumptions and the stakeholder review process can introduce some subjectivity in decision-making, some level of bias in the outcomes is expected. Bias will be considered reasonable if modifications to outputs or assumptions are based on reasonable expectations that local knowledge or data is more appropriate than more general values. Systemic uncertainty is inherent to the use of assumptions and literature value. However, these sources of uncertainty are endemic to SELECT modeling and do not compromise the objectives for this modeling effort. SELECT is not intended to be a model of a precision level that would be impacted by these levels of bias and/or uncertainty. Table A7.1 indicates assumptions or literature values that will be applied to the models.

Table A7.1 Modeling Assumptions

Assumption/ Literature Value	Model	Review with Stakeholders?	Source	Value
Feral Hog density	SELECT	Yes	Texas A&M Agrilife Research (AgriLife) densities.	AgriLife has used a variety of hog densities, with a generic Texas range of 1.3-2.5 hogs per square mile[1], depending on land cover type. This value is expected to be heavily modified by local stakeholders to reflect area or subwatershed populations.
Livestock populations	SELECT	Yes	United States Department of Agriculture National Agricultural Statistics	County-level data is used to derive a ratio of animals per land cover type. This ratio is then

[1] http://irnr.tamu.edu/media/355507/sp-472.pdf

Assumption/ Literature Value	Model	Review with Stakeholders?	Source	Value
				stakeholders and area-specific reconnaissance.
Deer Populations	SELECT	Yes	TPWD	TPWD Resource Management Unit (RMU) data is used to define regional deer population estimates, which are applied to appropriate land cover types, as in Teague, 2009.
Bird populations/fecal concentrations	SELECT	Yes	TPWD, Stakeholders, EPA, TSSWCB	Bird populations are based primarily on TPWD staff knowledge (if available) and stakeholder knowledge. Of primary concern are the presence of colonial rookeries, swallow nesting sites over water, gulls concentrated at landfills, and other large concentrations of birds. EPA and TSSWCB values[1] for bird fecal rates are used if stakeholder input indicates substantial, or substantially proximate (swallow colonies over bridges, etc.), numbers of birds exist on an annual basis to model. Values dependent on species of concern.
WWTF outfall locations	SELECT	No	TCEQ spatial data	WWTF outfalls are spatially explicit data.

Load Duration Curves

The primary data quality objectives for this effort are to ensure data inputs are from quality assured sources; that modeling assumptions are based on the existing LDCs from the preliminary runs,

[1] Based on studies referenced by EPA and TSSWCB, including http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2771205/ and http://www.tsswcb.texas.gov/files/docs/BBBB_Report_23Sep13_Clean.pdf

potential use of SWAT in general and for the specific purpose of generating flow data) on a variety of watershed projects including preliminary runs for this watershed and have attended multiple formal training events on SELECT and LDCs. Additionally, they have advanced knowledge of data quality needs and objectives common to modeling approaches in general based on experience and training. The SWAT tool will use existing data resources, and staff are already trained in its use and application for these purposes, so no additional training is required if it needs to be employed, after a QAPP amendment.

The data manager and QAO for this project are the H-GAC lead staff for CRP data analysis, and have extensive training in data management, quality assurance, and SAS operation (data manager). They routinely attend training specific to SWQMIS procedures, and/or SAS operation. Their daily activities have heavy focus on this type of data analysis and quality assurance. Records of educational credentials, training, demonstrations of competency, assessments, and corrective actions are retained by project management and are available for review.

All staff members have worked with QAPPs under prior projects. No additional training is expected to be needed to complete the project efforts.

A9 DOCUMENTATION AND RECORDS

All digital and paper documentation for the project is kept for a period of seven years. The H-GAC Project Manager has final responsibility for ensuring project files are compiled in accordance with this QAPP. The QAO and Data Manager will ensure that the PM has appropriate documentation for water quality data analyses and records for data from acquired data sources including but not limited to SWQMIS and CRP data. The Lead Modeler will ensure that all modeling records, notes, literature referenced, and other records from modeling efforts are maintained during the project and relinquished to the Project Manager for proper retention. Electronic data on the project computers and the network server are backed up daily to the network drive and weekly to external storage. In the event of a catastrophic systems failure, the tapes can be used to restore the data in less than one day's time. Data generated on the day of the failure may be lost but can be reproduced from raw data in most cases. Quarterly progress reports disseminated to the individuals listed in section A3 will note activities conducted in connection with the water quality modeling project, items or areas identified as potential problems, and any variations or supplements to the QAPP.

In addition to general information regarding data and modeling activities, any stakeholder input received, or notes generated regarding input, will be included with modeling files and project documentation.

Modeling Log

Modeling notes created by the Lead Modeler will be recorded electronically with model files, on paper, or in a separate electronic file (e.g., Word document). All electronic files will be stored in the same folder as the modeling files, and all paper files will be retained by the modeler until the end of the project. At that time, they will be included with project files maintained by the Project Manager.

SECTION B: MEASUREMENT AND DATA ACQUISITION

The primary source of data for these data analysis and modeling efforts will be SWQMIS data produced under previous QAPPs (e.g. Clean Rivers Program data, etc.).

B1 SAMPLING PROCESS DESIGN
Not Relevant – This QAPP does not cover any sample collection activities.

B2 SAMPLING METHODS
Not Relevant - No new sampling data will be collected under this QAPP during this project.

B3 SAMPLE HANDLING AND CUSTODY
Not Relevant - No new sampling data will be collected under this QAPP during this project.

B4 ANALYTICAL METHODS
Not Relevant - No new sampling data will be collected under this QAPP during this project.

B5 QUALITY CONTROL
Not Relevant - No new sampling data will be collected under this QAPP during this project.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE
Not Relevant - No new sampling data will be collected under this QAPP during this project.

B7 MODEL CALIBRATION

No formal calibration (or sensitivity analysis) is used for the data analyses (SAS), SELECT, or standard LDCs. Informal adjustment of the model inputs or outputs may be applied based on stakeholder feedback and more specific local knowledge compared to general assumptions.

B8 INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES
Not Relevant - No new sampling data will be collected under this QAPP during this project

B9 NON-DIRECT MEASUREMENTS (DATA ACQUISITION REQUIREMENTS)

The modeling and water quality data analysis efforts described in this QAPP will make use of non-direct/acquired data from a variety of sources. The sources and their characteristics are included in Table B9.1.

The primary sources of data for model development are:

- Water quality monitoring data from SWQMIS;
- DMRs, SSO violation data, other permit reporting data from TCEQ databases;
- Regional demographic forecasting data created by H-GAC;
- OSSF location data created by H-GAC for TCEQ;
- Developed data (LDC runs, etc.) from the preliminary modeling effort for this watershed[1];

[1] As produced under the West Fork San Jacinto River and Lake Creek Watershed Protection Plan QAPP

TCEQ Permit and Violation Data
This project will make use of data from TPDES and other permittees acquired and maintained by TCEQ. This will include DMRs, SSO violation data, TPDES permit information and compliance history, and other data relevant to TCEQ or EPA-permitted facilities in the watershed. This data is assumed to be of acceptable quality based on inclusion in TCEQ- or EPA-approved datasets, including those prepared by H-GAC for TCEQ under QAPP-covered efforts funded by 604(b) Water Quality Management Plan projects. H-GAC will work with TCEQ staff to identify, acquire, and update these data sources.

Regional Demographic Forecasting
H-GAC conducts regional demographic forecasting as part of a quality-assured effort. Data to be used for this project include current and future population projections, land cover change projections, and household and job change projections. This data source is the standard for the region and is used in comparable QAPP-covered planning efforts as well as broader regional planning efforts.

OSSF Location Data
H-GAC maintains a spatial database of permitted OSSF locations for the region, including the project area. This database was developed and maintained under a TCEQ-approved QAPP as part of an ongoing Clean Water Act 604(b) Water Quality Management Plan partnership between H-GAC and TCEQ.

Existing Modeling
The SELECT and LDC data for the existing preliminary modeling efforts for this watershed will be used as a basis for updating and revising SELECT and LDCs, as described in A6. These LDCs were developed under approved QAPP coverage.

Geospatial Data
The H-GAC Community & Environmental Planning Department's Data Management Plan, (Appendix E) outlines how both tabular (non-geographic) and spatial (geographic) datasets are captured, manipulated, analyzed, stored, and displayed within the Geospatial/Geographic Information Systems (GIS) environment as it relates to sharing of data, development of geospatial applications, cartography, and underlying GIS resources (see Appendix A for more detail). Existing geospatial data resources at H-GAC will be combined with additional data from appropriate local, regional, state, and federal organizations as needed. Geospatial data used for modeling exercise will be of acceptable quality based on the data quality objectives of this project and will have been published with appropriate metadata. The publishing of geospatial data by various organizations implies that the data is of known quality, that is has been subject to review and approval by the publishing organization and has required metadata to prove its accuracy and completeness.

All outside data sources will be reviewed to determine level of quality, compatibility and completeness. Procedures used to collect these outside sources will also be reviewed to determine compatibility and determine level of sampling bias and uncertainty. Generally, data used from outside sources will be acceptable if it was collected under an existing QAPP, published in peer review literature or if sufficient and documented QA/QC procedures were employed during project

Table B9.1 Non-Direct Measurements

Type of Measurement or Analysis	Type of Data (time series, rate, constant, statistic, taxa, etc.)	Units	Source (web link when available)	Quality Assurance Documentation	Use	Date Range
Ambient water quality monitoring data	Periodic water quality	Various	SWQMIS	www.tceq.state.tx.us/waterquality/monitoring/swqm_guides.html	Used as observed values for modeling efforts	Various, depending on station
DMRs	Periodic water quality reporting	Various	TPDES permittees via TCEQ	N/A	Used to characterize WWTF loading	Various, depending on station
SSO violation data	Episodic violation reporting	Various	TPDES permittees via TCEQ	N/A	Used to characterize collection system loading	Various, depending on station
Regional growth forecast	Modeled projections	Various	H-GAC	http://www.h-gac.com/regional-growth-forecast/documents/read-documentation.pdf	Used to characterize land cover and population change	2015-2040
OSSF locations	Spatial database	Individual OSSF records	H-GAC	Completed under H-GAC Regional Geospatial Data QAPP	Used to characterize OSSF loads	Various-2015
Existing LDCs	Model outputs	Various	H-GAC	Completed under the West Fork San Jacinto River and Lake Creek QAPP	Used to inform LDC update	Various
Existing SELECT outputs	Model outputs	Various	H-GAC	Completed under the West Fork San Jacinto River and Lake Creek QAPP	Used to inform SELECT update	Various
GIS layers	Geospatial datasets	Various	Various	The quality assurance processes are specific to the individual layers. More information on the quality of geospatial source data follows this chart.	Used to develop models and for cartographic purposes	Various
Literature values	Various	Various	Various	The quality assurance for the studies and other methods that developed literature values are specific to each value, as noted in project reports.	Used to develop models/tools	Various

Complete original data sets are archived on permanent media (tape drives) and retained on-site by H-GAC for a retention period specified in Table A9.1 Project Documents and Records. Additional discussion of archiving procedure is indicated in Appendix E.

Backup/Disaster Recovery

All work and file storage takes place on a shared network drive(s) which are continuously backed up on the network servers and archived on a regular basis. In the event of a catastrophic systems failure, the archival backups can be used to restore the data in less than one day's time. Data generated on the day of the failure may be lost but can be reproduced from raw data in most cases.

SECTION C: ASSESSMENT AND OVERSIGHT

C1 ASSESSMENTS AND RESPONSE ACTIONS

The following table presents types of assessments and response action for activities applicable to this QAPP.

Table C1.1 Assessments and Response Actions

Assessment Activity	Approximate Schedule	Responsible Party	Scope	Response Requirements
Status Monitoring Oversight, etc.	Continuous	H-GAC Project Manager	Monitoring of the project status and records to ensure QAPP requirements are being fulfilled. Monitoring and review of subcontractors performance and data quality	Report to TCEQ in Quarterly/Monthly Report. Ensure project requirements are being fulfilled.
Technical Systems Audit	Dates to be determined by TCEQ	TCEQ QAS	The assessment will be tailored in accordance with objectives needed to assure compliance with the QAPP	30 days to respond in writing to the TCEQ to address corrective actions

Internal Assessment

Since this project is primarily a modeling endeavor, traditional performance and system audits are not appropriate. Instead, the data generated as part of the modeling results will be evaluated during the validation and model output interpretation processes. H-GAC and the TCEQ NPS Program will continually assess model performance as described in the validation and calibration processes, and by evaluation of tasks listed in Section D.

Modeling data and project deliverables will be internally quality controlled by the TCEQ NPS Project Manager's in-house review. The TCEQ NPS Project Manager will maintain overall

- Establish timelines and provide a schedule
- Document the corrective action

C2 REPORTS TO MANAGEMENT

Reports to H-GAC Project Management

H-GAC project staff will report to the H-GAC PM on an ongoing basis, but at a frequency no less than once a week. These reports will be informal unless corrective action, relevant modeling notes, or other documentation as discussed in this QAPP apply.

Reports to TCEQ Project Management

Progress Report – Submittal of progress reports will be at least quarterly. Format of the submitted progress report will be as specified in the contract or work orders. Reports should provide enough information so the TCEQ NPS Project Manager can evaluate the modeling effort.

Water Quality Trends Analysis Report – H-GAC will submit a water quality Trends Analysis Report subsequent to the water quality trends analysis in quarters 3 (Draft) and 8 (Final) respectively.

Modeling Report – H-GAC will submit a Modeling report at the culmination of modeling activities in quarter 3 (Draft) and 30 days after TCEQ comments are received (Final).

Watershed Protection Plan – H-GAC will submit to TCEQ a WPP for Cypress Creek subsequent to stakeholder approval of the draft WPP in quarter 8 of the contract.

Final Report – H-GAC will submit a final report, in the form of a Final QPR with substantive summary of the project, within 15 days of the end of the last fiscal quarter of the project. Any comments from TCEQ will be summarized in a comment response document in the interim.

Corrective Action Plan (CAP) – Identifies any deficiencies and nonconformances. The cause(s) and program impacts are discussed. The completed corrective actions are documented, and the report is submitted to the TCEQ NPS Project Manager within 14 days of the deficiency occurring.

Audit Report and Response – Following any audit performed by the H-GAC a report of findings, recommendations, and responses are sent to the TCEQ NPS Project Manager in the quarterly/monthly progress report. Such reports will include model performance assessments, calibration, and validation performance determination.

Reports by TCEQ Project Management

Contractor Evaluation – H-GAC is evaluated in a Contractor Evaluation by the TCEQ annually for compliance with administrative and programmatic standards. Results of the evaluation are submitted to the TCEQ Financial Administration Division, Procurements and Contracts Section.

by stakeholders. This process is not intended as a technical validation.

D3 RECONCILIATION WITH USER REQUIREMENTS

The primary purposes of the data outputs from these analysis and updated modeling efforts are to characterize the conditions in the watershed and guide stakeholder decision-making. The user requirements for WPP development are to provide a high-level understanding of the causes and sources of pollutants in spatial and flow contexts. The modeling framework developed for this project will be used to evaluate contaminant loading in the Cypress Creek watershed. It will provide information pertaining to historical trends in water quality[1], updated relationship of pollutant loads to flow regimes and bacteria reductions (LDCs) and updated potential loading from pollutant within the watershed (SELECT). These analyses will provide critical information for the stakeholders to support the development of the Cypress Creeks WPP.

The user requirements do not assume a detailed and complex hydrologic model with predictive linkage between source loading and instream concentrations. Source load reduction projections sufficient to guide stakeholder decisions will be obtained by applying load reduction percentages generated through updated LDCs to source loads generated in updated SELECT analyses.

The outputs will be evaluated at several levels. First, H-GAC project staff will review outputs for obvious inconsistencies and errors, for compliance with QAPP procedures, and against best professional judgment. Secondly, outputs will be reviewed with TCEQ project staff. Lastly, outputs will be reviewed with stakeholders and technical advisors to ensure local input is acquired and incorporated as appropriate. Additional review will follow revised model runs and scenarios. The final data will be reviewed to ensure that it meets the requirements as described in this QAPP. CARs will be initiated in cases where invalid or incorrect data have been detected. Data that have been reviewed, verified, and validated will be summarized for their ability to meet the data quality objectives of the project and the informational needs of water quality agency decision-makers. The sufficiency of the data to support stakeholder requirements will be based on review of the data with the stakeholders and agency staff.

Some limitations are assumed for the use of the model outputs. The usability of the updated modeling results will be limited to their intended purposes as part of an EPA 9-element WPP development process. The model results are not intended or designed to provide a level of accuracy or precision beyond what is described or the stated ability of the models. Model results are not intended to be used for legal purposes, to describe property conditions in lieu of environmental assessments, or to be used for other official purpose not stated in this QAPP. The design of the modeling approach is intended to allow the flexibility, as described, to incorporate stakeholder input on assumptions, outputs, and specific locales or events in the watershed. The limitations on the use of the data

[1] The methodology, uses, and data types for the water quality trends analysis are described in detail in Section A7, under the subsection Water Quality Analysis.

Scope of Work

The Cypress Creek Watershed in northwestern Harris County is comprised of mixed land uses ranging from rapidly urbanizing areas in its eastern extent, to rural prairieland at the edge of growth in its western headwaters. Cypress Creek and its tributaries face bacteria impairments and concerns for depressed dissolved oxygen (DO), elevated nutrients, and impaired macrobenthic communities. Further development in the watershed, especially to the western extent, is expected to exacerbate existing water quality issues in the future. Flooding issues in the watershed also have a negative impact on water quality and stream hydrology.

The Cypress Creek WPP project will engage stakeholders to develop a plan to address listed impairments, concerns, and stakeholder-identified water quality priorities in the waterways of the Cypress Creek Watershed. The WPP will conform to EPA's nine key elements for a watershed-based plan (WBP) and will utilize existing watershed characterization data as a starting point for technical analysis.

The Performing Party will establish and facilitate a watershed partnership representing all stakeholders in the project area. As part of this effort, the Performing Party will hold regular stakeholder meetings, coordinate between local partners, and promote the project to the public via the press, direct contact, social media, and other appropriate means. The Performing Party will conduct targeted education and outreach efforts in coordination with local partners, including hosting education events, partnering on joint events, publicity of related partner programs (i.e. AgriLife workshops), and attendance at local events/meetings as appropriate. Existing materials will be used or adapted to the greatest degree practicable. These efforts will assist in reaching project goals by growing general awareness, maintaining a representative array of stakeholders to participate in WPP development, and fostering commitment to future implementation.

The Performing Party will update existing water quality analysis with additional data acquired from the Clean Rivers Program (CRP) and the TCEQ. The Performing Party will also refine modeling analyses (SELECT, load duration curves) from the characterization study. Refinement will utilize stakeholder review and update of data sources as needed. The modeling will inform stakeholder decisions by indicating the potential causes, extent, and required reductions necessary to achieve and maintain water quality.

The Performing Party will facilitate stakeholder progress through the development and submittal of a nine-element WPP for Cypress Creek. The Performing Party will acquire and assess water quality data from the adjacent Spring Creek watershed, including ambient sampling data (from the Clean Rivers Program (CRP)), Data Monitoring Reports (DMRs) and sanitary sewer overflow (SSO) data to update an existing characterization report.

Subtask 1.7: Contract Budget Updates — The Performing Party will discuss annual fiscal year budgets with the TCEQ Project Manager on a quarterly basis. Starting in the second year of the project, the Performing Party will provide an Annual Budget Update that details state fiscal year spending projections as associated with planned project activities. These updates will be discussed quarterly at a minimum. They will be revised when fiscal year spending projections change by ten percent or more, or upon request by the TCEQ Project Manager. The update in the final year of the project will include a budget for all remaining project activities. The template for the Annual Budget Update will be provided by the TCEQ Project Manager.

Deliverables:

- QPRs
- Reimbursement forms
- Post-Award Meeting and notes
- Conference call notes and action items
- Coordination meeting with EPA (upon request)
- Annual Report article and pictures (upon request)
- Contract Budget updates
- Annual Budget updates

Task 2: Quality Assurance

Objective: To refine, document, and implement data quality objectives (DQOs) and quality assurance/quality control (QA/QC) activities that ensure data of known and acceptable quality are generated by this project.

Subtask 2.1: QAPP Planning Meetings — The Performing Party will schedule a QAPP planning meeting with the TCEQ Project Manager, QA staff, technical staff, and contractors within 30 days of Contract execution, to implement a systematic planning process based on the elements in the TCEQ NPS QAPP Shell. The information developed during this meeting will be incorporated into a QAPP. The storage location of data records, and how data should be coded, will also be determined during these meetings. The Performing Party may conduct additional meetings to determine whether changes to an existing QAPP are needed.

Subtask 2.2: Modeling and Data Acquisition QAPP — The Performing Party will develop and submit to TCEQ a QAPP with project-specific DQOs consistent with the EPA Requirements for QAPP for Modeling QA/G-5M format 120 days or more prior to the scheduled initiation of environmental data operations associated with modeling or data acquisition activities. The QAPP will be developed by the Performing Party in consultation with the TCEQ Project Manager, QA staff, technical staff, and contractors. The QAPP must be signed/fully approved by TCEQ, and if necessary, EPA, before any environmental data operation begins.

Activities covered under this QAPP:

- Administration of the QAPP
- Acquiring, compiling and evaluating water quality data
- Conducting load duration curve and SELECT modeling
- Managing and submitting data and results as part of the WPP document

Tasks covered under this QAPP:

- 2, 3, 4, and 6

Tasks NOT covered under this QAPP:

- 1 and 5

The Performing Party will assess the existing data and information to determine if it allows for determination of sources and quantities of pollution. If data gaps are identified, the Performing Party will work with stakeholders to determine how to address them. The data and information will be presented to stakeholders in appropriate formats including graphs, tables, and maps.

Subtask 3.2: DMR and SSO analysis — The Performing Party will acquire DMR and SSO data for the last five years for permitted wastewater entities in the Spring and Cypress Creek watersheds. The Performing Party will evaluate the data for trends in volume by year, volume by cause, number of events by year, and number of events by cause for each reporting permitted entry.

The data evaluations for Spring Creek will be used to update the Spring Creek Watershed Characterization Report, and the data evaluations for Cypress Creek will be used to inform stakeholders, evaluate wastewater as a potential pollutant source, and as inputs for revised SELECT modeling runs for the Cypress Creek WPP.

Subtask 3.3: Data Analysis Summary Report — The Performing Party will develop a report describing, detailing, and summarizing all data evaluations to be presented in the Cypress Creek WPP or the Spring Creek Watershed Characterization Report update. The Performing Party will document the data acquired, the evaluation methodologies, and the analyses, for inclusion in the WPP and Characterization Report.

Deliverables:

- Draft and Final Data Analysis Summary Report, including documentation of data compilation and review and documentation of DMR/SSO analysis

Task 4: Modeling

Objective: To update and revise preliminary modeling results for the Cypress Creek Watershed to identify extent, causes, and spatial distribution of bacterial contamination and reduction goals.

Subtask 4.1: Load Duration Curves — The Performing Party will update load duration curves as needed for indicator bacteria and DO levels in the Cypress Creek Watershed to further define conditions under which loading is occurring and to calculate the pollutant load reductions (or percent improvement for DO) needed to meet water quality standards, screening levels, or continue meeting standards in the Cypress Creek Watershed. The load duration curves developed as part of the Cypress Creek Characterization Report from a previous project, will be used as the starting point for subtask effort. This analysis will be used to satisfy Element B of EPA's nine-element criteria for WBPs.

Subtask 4.2: SELECT — The Performing Party will update the SELECT model for Cypress Creek to include the most current version of its data sources, and to revise findings based on stakeholder feedback. SELECT will be used in the WPP to identify the relative prominence of bacteria sources, their spatial distribution, and the total potential bacterial load to the watershed. Both current and future condition runs will be updated. This analysis will be used to satisfy Element A of EPA's nine-element criteria for WBPs.

Subtask 4.3: Modeling Report — The Performing Party will develop a report detailing activities conducted under this Task and summarize the results of the modeling for inclusion in the Final Modeling Report.

Deliverables:

- Updated load duration curves, included in Modeling Report
- Updated SELECT, included in Modeling Report
- Draft and Final Modeling Report

Subtask 5.6: Education and Outreach Events — The Performing Party will host a series of education and outreach events whose purpose is to engage stakeholders, raise general awareness of watershed issues, or address specific water quality concerns raised in the WPP development process. The Performing Party will provide all meeting presentations, notices, agendas, and meeting summaries to the TCEQ Project Manager, at least two weeks prior to public dissemination.

The Performing Party will hold at least three events, possibly including but not limited to: 1) an On-site Sewage Facility workshop for homeowners, 2) a school program highlighting water quality and personal actions for elementary school children, 3) outreach at a Trash Bash site in the watershed (and support for maintaining the site), and 4) a workshop on land management resources for agricultural producers.

The Performing Party will also seek to support and coordinate with events and meetings held by partners that are relevant to WPP goals (e.g. Texas Watershed Stewards, etc.). The Performing Party will attend at least two partner events in the watershed for the purpose of public outreach and education and provide brief summaries to the Project Manager.

Subtask 5.7: Stakeholder Outreach Task Report — The Performing Party will submit a report summarizing activities completed under this task.

Deliverables:

- Draft and Final PPP
- Stakeholder contact list, updated quarterly with QPRs
- Project website and website updates
- Documentation of communication with stakeholders
- Documentation of project stakeholder meetings, including meeting notices, materials, presentations, agendas, attendance lists, and summaries
- Documentation of other public meetings attended, including presentation material, notices, agendas, and dates with brief summaries of topics discussed and action needed
- Documentation of education and outreach events hosted, including press releases, agendas, and attendance lists
- Documentation of partner events attended, including dates with brief summaries
- Draft and Final Stakeholder Outreach Task Report

Task 6: Watershed Protection Plan Development

Objective: The Performing Party will facilitate the development of a WPP for Cypress Creek through a stakeholder driven process. The WPP will satisfy EPA's nine key elements for WBPs.

Subtask 6.1: WPP Development — The Performing Party, in collaboration with project partners, will develop a WPP for the Cypress Creek Watershed that satisfies EPA's *Nine Key Elements for WBPs* as described in the latest EPA document, *Nonpoint Source Program and Grants Guidelines for States and Territories*. The WPP will be based on decisions made by stakeholders through the watershed planning process and incorporate findings from project technical evaluations. The WPP will be designed to achieve the load reductions identified as needed by modeling results and approved by the stakeholders. The Performing Party will facilitate public review and stakeholder approval of the WPP.

Prior to drafting the WPP, a detailed timeline and outline will be developed by the Performing Party in consultation with the TCEQ Project Manager.

The Performing Party will work with stakeholders to identify information that satisfies EPA's nine key elements for WBPs. The WPP will:

Schedule of Deliverables

Task No.	Task Deliverable	Due Date
1 Project Administration		
1.2	QPRs	The 15th of the month following each state fiscal quarter
1.3	Reimbursement forms	See Special Terms and Conditions, Item 8
1.4	Post-Award orientation meeting and notes	Meeting within 30 days of Contract execution, meeting notes within two days of meeting
1.4	Conference call notes and action items	Quarterly, notes within seven days of meeting
1.5	EPA coordination meeting	Upon request
1.6	Annual Report article	Upon request
1.7	Contract Budget updates	Discussed quarterly and updated as needed
1.7	Annual Budget updates	Quarter 5
2 Quality Assurance		
2.1	QAPP planning meetings notes	Meeting within 30 days of Contract execution
2.2	Draft QAPP	At least 120 days prior to the scheduled initiation of environmental data operations
2.2	Final QAPP	30 days prior to the scheduled initiation of environmental data operations
2.3	QAPP Annual Reviews and Revisions	No less than 90 days prior to the QAPP approval anniversary
2.4	Draft QAPP Amendments	No less than 90 days prior to the scheduled initiation of changes or additions to activities listed in the current QAPP
2.4	Final QAPP Amendments	Within 30 days of receipt of TCEQ comments
3 Water Quality Data Acquisition and Evaluation		
3.1 – 3.3	Draft Data Analysis Summary Report, including documentation of data compilation and review and documentation of DMR/SSO analysis	Quarter 3

Task No.	Task Deliverable	Due Date
6.1	WPP Outline	Quarter 2
6.2	WPP document review plan	Quarter 1
6.2	Draft WPP to stakeholders and TCEQ	Quarter 7
6.2	Response to comments from stakeholders and TCEQ	Revisions to be completed 30 days after receipt of each set of comments from TCEQ
6.2	Documentation of stakeholder approval of the WPP	Quarter 8
6.2	Draft WPP to EPA	Following stakeholder approval of the TCEQ-approved revised WPP
6.2	Response to comments from EPA	30 days following receipt of comments from EPA
6.2	Final WPP to EPA	Quarter 8
6.3	Draft Executive Summary	Quarter 8
6.3	Final Executive Summary	30 days following receipt of comments from TCEQ on the Draft Executive Summary
6.3	Documentation of dissemination of WPP and Executive Summary	Within 30 days following acceptance by EPA, and approval by TCEQ
7 Final Report		
7.1	Final QPR as Final Report	The 15th of the month following the last fiscal quarter of the project

Appendix B - Corrective Action Plan Form

Nonconformance Report and Corrective Action Plan
QAPP Title: _____ **QAPP Contractor:** _____ **Issued by:** _____ **Date of Occurrence:** _____ **Report No.:** _____ **Date Issued:** _____
Description of deficiency
Root Cause of deficiency
Programmatic Impact of deficiency
Does the seriousness of the deficiency require immediate reporting to the TCEQ? If so, when was it reported?
Corrective Action to address the deficiency and prevent its recurrence
Proposed Completion Date for Each Action
Individual(s) Responsible for Each Action
Method of Verification
Date Corrective Action Plan Closed?

APPENDIX C. CORRECTIVE ACTION PLAN STATUS FORM

APPENDIX D. ADHERENCE LETTER

APPENDIX E. DATA MANAGEMENT PLAN

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Introduction

The Data Management Plan (The Plan) outlines the standard policies and procedures for data management within the Community and Environmental Planning (C&E) Department. The Plan covers the management of both tabular (non-geographic) and spatial (geographic) datasets. Its primary purpose is to ensure the efficient access and maintenance of these datasets within the C&E Geospatial/Geographic Information Systems (GIS) environment.

GIS technology provides a systematic means to capture, manipulate, analyze, store and display spatially referenced data. GIS supports a wide variety of applications ranging from site assessments, environmental planning, urban planning, and spatial analysis to support organizational strategies. In general, GIS supports the overall departmental goals of guiding regional planning, enhancing the quality of the region's natural environment, and public education through outreach programs. The C&E GIS team supports various programs within the C&E department through data development, spatial analysis, geospatial applications development, cartography in support of departmental goals.

The Plan is considered a dynamic working document which responds to changing technology, funding, staffing, and project requirements. Consequently, the Plan is reviewed on an annual basis and amended as necessary.

Geospatial Services

The following section explains the geospatial services provided by the H-GAC C&E GIS team as it relates to the sharing of data, development of geospatial applications, cartography, and underlying GIS resources. The C&E GIS team is responsible for the development of data and sharing of many publicly viable datasets, developing geospatial applications, cartography, and coordination of maintenance of underlying geospatial hardware and software for C&E.

The C&E GIS team maintains a centralized geospatial warehouse (C&E SDE), an online mapping platform for web-based geospatial applications (Mapping Server), and an FTP download site (Data Clearinghouse). The C&E SDE utilizes ESRI's ArcSDE software running on a Microsoft SQLServer RDBMS. The mapping server uses ESRI's ArcGIS Server platform running on .NET. The Data Clearinghouse is an FTP server that provides C&E with storage space where it can post publicly available datasets for downloading. The C&E SDE, Mapping Server, and Data Clearinghouse platforms are installed by the H-GAC Data Services department (Data Services), with Data Services maintaining only the lower-level technology components such as the physical hardware, software installation, and low-level server and RDBMS functions.

All upgrades and maintenance is coordinated by the C&E GIS Manager. All geospatial content stored in the C&E SDE, the Data Clearinghouse, and Mapping Server, are the responsibility of the C&E GIS staff, which resides within the C&E Socio-Economic Modeling program. A detailed schematic of the geospatial technical architecture and how the various systems are interconnected can be found in the *System Architecture* section below.

Data Sharing

The C&E SDE serves as the primary internal repository for geospatial data, metadata, and other information relevant to the activities and goals of the C&E department. All GIS users within

are including our map layers in their own mapping applications.

The third and final platform involves developing applications for mobile devices or tablets. The C&E department has developed both native (installed) applications for the Apple iOS platform, as well as server-side scripted applications which utilize the free ESRI ArcGIS for Mobile Devices viewer app, which runs on iOS, Android, or Windows phone devices. In both instances, map layers used in these applications are delivered from the C&E ArcServer platform.

Mapping and Cartographic Products

The C&E department produces a variety of static cartographic maps for the region as a result of project activities and for general usage. To facilitate the sharing of these maps in an electronic format, C&E has implemented a Map Book as part of their C&E GIS page. Maps can be downloaded in multiple formats. The C&E Map Book can be accessed via our C&E GIS page at http://www.h-gac.com/rds/map-book/Default.aspx.

System Resources

System Architecture

The C&E department uses an integrated architecture to support the development, analysis, and dissemination of spatial information. The diagram below illustrates this system architecture at a high level. The goal of the overall system is to allow for a streamlined workflow to develop/maintain data, optimize the data for use in online applications, and the consumption of applications via multiple platforms.

Currently the C&E GIS platform supports sharing of geospatial data via the ArcServer mapping server platform. This allows end users internally or externally to consume map layers and geoprocessing tools via GIS desktop, mobile, tablet, or 3rd part applications.
In some instances, applications are configured with public feedback and volunteer GIS workflows that allow the C&E GIS team to obtain information for the public on various geographic features in the region. This public feedback loop allows C&E to investigate feedback and verify its validity prior to incorporating the information into the data warehouse.

the C&E department. The C&E GIS staff maintains access privileges to the SDE datasets and assigns individual users to various SDE access groups to grant approved accessed to data in the SDE. The SDE is considered the central warehouse where GIS users can go to for geospatial data to use in their analysis or mapping projects.

The software products currently used to accomplish the department's data management objectives are listed in Appendix 4.

Programming Languages

Programming services will be provided on an as needed and resource available basis. All programming efforts will follow a standard procedure from needs assessment, program planning, development and testing, to refinement and documentation. The principal programming languages to be used in task automation and project customization will depend on the nature of the need and the current state of the technology. At this time, all web-based GIS applications are developed using the ESRI ArcGIS Server platform, and user interface components to that platform are developed using the ESRI JavaScript API. Automated data development and analysis workflows utilize the Python programming language and the SAS programming platform as needed.

Data

Department staff members will be consulted annually to determine priority needs for data management. Based on this consultation, specific data sets will be acquired or further developed for the various program areas represented in the department. The current list of department-specific data sets is shown in Appendix 5.

A separate database lists all datasets regularly obtained from external sources, contact information, as well as the frequency of the datasets availability, and its cost. This database is developed using Microsoft Access and is available to the C&E GIS team for tracking when updates to dataset may be available.

Personnel

The Data Management staff will be responsible for the maintenance and development of the C&E SDE, mapping server, geospatial applications, C&E GIS page, and Data Clearinghouse. These data management responsibilities cover a wide range from original data creation, acquisition and integration, data archiving and distribution. Additional responsibilities include enhancing the geographic extent, feature attributes, and metadata of the datasets.

The C&E GIS team is comprised of 3 full-time GIS professionals, one of which is the GIS Manager, and 2 full-time GIS Analysts. The C&E GIS team supports all programs within the C&E department, which include Clean Rivers/Water Quality, Sustainability, Economic Development, Solid Waste, Ped/Bike, Socio-Economic Modeling, and special project. The C&E GIS team is part of the Socio-Economic Modeling program within C&E.

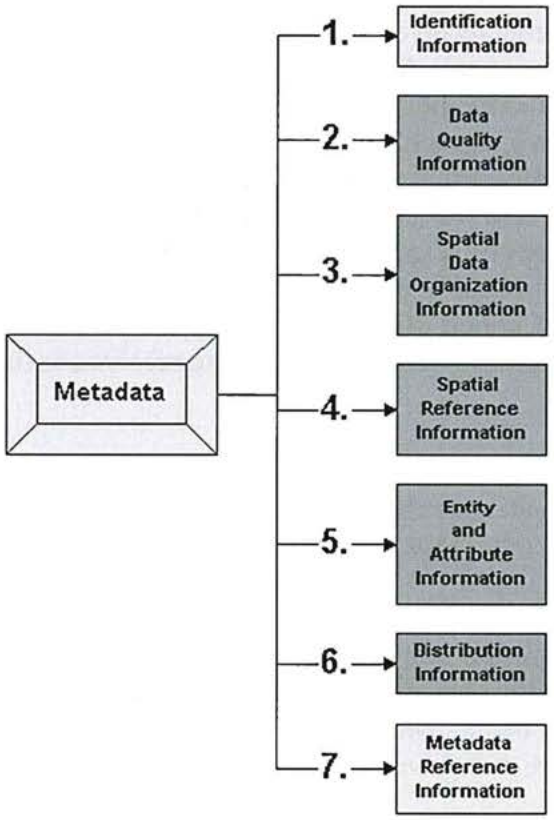
H-GAC's Data Services Department plays an indirect role in the implementation and maintenance of The Plan. The Data Services Department is responsible for managing the underlying hardware and network upon which C&E stores GIS data and implements GIS-based applications.

Training

Training for all users of the system is a critical part of The Plan. C&E staff directly responsible for data management will attend conferences, seminars, and software/hardware training courses

Data Dictionary
A list of all C&E data available in either the C&E SDE or other tabular formats can be found in Appendix 5.

Metadata
Metadata is data about the original source, quality, content, history, condition, and other characteristics of the geospatial data. All GIS datasets generated by H-GAC have been fully documented as per Federal Geographic Data Committee (FGDC) compliant metadata and follow Content Standards for Digital Geospatial Metadata (CSDGM) for all geospatial data. Similarly, data obtained from outside sources and used by H-GAC will include FGDC-compliant metadata from the source agency. Datasets without a known history and documented quality will be identified as provisional and used only when noted as such. The diagram below illustrates elements of the CSDGM standards. This standard is applied to all Point, Line, Polygon, Raster, and Tabular data that are stored in the C&E SDE. The C&E GIS data manager and/or point of contact (designee) has the authorized access to edit/change the metadata when a new dataset is created or updated in the SDE. Metadata for each dataset in the C&E SDE is stored with the datasets and can be viewed by GIS users via their GIS desktop software. Any data provided for public download via the Data Clearinghouse also has a metadata html page that can be viewed via internet browsers.



Data Conversion
Data to be imported into the C&E SDE from hard copy, digital or by manual data entry, will follow a uniform conversion protocol to comply with the structure of current data sets. The type of data being converted will determine the protocol. All data is stored in ESRI geodatabase format within the C&E SDE, and when posted to the Data Clearinghouse the data is stored in the ESRI File Geodatabase file format, unless there is a specific requirement to provide the data in

Data Security & Access

Data placed on the Data Clearinghouse will be available to those with Internet browsing and/or FTP capability. Data requests for non-public data from other agencies and the general public will be evaluated on an individual basis. When the data requests are received, a preliminary evaluation of the deliverable will be determined and a timeline and cost if applicable will be provided to the requesting agency or individual.

GIS and tabular data will be secure through directory permissions. H-GAC will employ Firewall or Proxy Server Technology to filter and severely restrict access to internal networks and database systems. Virus protection will be implemented to ensure system and data integrity.

Archives/Backup

Each week the C&E GIS team runs a schedule backup program to store a copy of all C&E SDE datasets on a portable hard drive with resides in a secure location within the H-GAC office. In addition, Data Services backs up and archives C&E SDE data and server configuration at regular intervals. A backup will be performed daily, and the tapes will be maintained for 8 weeks before they will be recycled. Every six month, a complete system backup will be performed, and the tapes will be archived and kept for five years off-site for security.

Disaster Recovery

In the event of a disaster, the C&E department will have access to all C&E SDE data which is stored on the portable hard drive. The C&E GIS team will restore or provide needed data to GIS users from this portable hard drive until such as time that Data Services can restore the C&E SDE onto either a new server or a temporary server.

Appendix 2 Data Log Sheet
Date received:

_____

Report Prepared by:

_____

Source Name and Phone:

_____

Format:

_____
_

Media:

_____
__

Check the following steps to determine the validity of the data:

1. What is the extent of the geographic area? _____
_____
_____

2. Structure (Circle One) Vector Raster

3. Scale?

_____
_

4. Projection and Datum?

_____

1. Do any of the key fields have missing values? If so which parameters have missing values?
Yes ___ No ___

_____
_____
_____
_____
_____
_____

2. Any known duplicate records? Yes ___ No ___

Lacie 300GB external hard drive (USB, Firewire)

Appendix 5 Data List

C&E Spatial Data Warehouse (SDE) Datasets

Dataset Name	Type
AustCAD_Parcels_Coverage_2005	Polygon
AustCAD_Parcels_Coverage_2005_pts	Point
AustCAD_Parcels_Coverage_2006	Polygon
AustCAD_Parcels_Coverage_2006_pts	Point
AustCAD_Parcels_Coverage_2007	Polygon
AustCAD_Parcels_Coverage_2007_pts	Point
AustCAD_Parcels_Coverage_2008	Polygon
AustCAD_Parcels_Coverage_2008_Pts	Point
Austin_County	Polygon
AUSTIN_COUNTY_PARCEL_INFO_2005	Table
AUSTIN_COUNTY_PARCEL_INFO_2006	Table
AUSTIN_COUNTY_PARCEL_INFO_2007	Table
Austin_County_Parcel_Info_2008	Table
Austin_County_Parcel_Values_2006	Table
Austin_County_Parcel_Values_2007	Table
Austin_County_Parcel_Values_2008	Table
BrazCAD_Parcels_Coverage_2005	Polygon
BrazCAD_Parcels_Coverage_2005_pts	Point
BrazCAD_Parcels_Coverage_2006	Polygon
BrazCAD_Parcels_Coverage_2006_pts	Point
BrazCAD_Parcels_Coverage_2007	Polygon
BrazCAD_Parcels_Coverage_2007_pts	Point
BrazCAD_Parcels_Coverage_2008	Polygon
BrazCAD_Parcels_Coverage_2008_Pts	Point
Brazoria_County	Polygon
BRAZORIA_COUNTY_PARCEL_INFO_2005	Table
BRAZORIA_COUNTY_PARCEL_INFO_2006	Table
BRAZORIA_COUNTY_PARCEL_INFO_2007	Table
Brazoria_County_Parcel_Info_2008	Table
Brazoria_County_Parcel_Values_2005	Table
Brazoria_County_Parcel_Values_2006	Table
Brazoria_County_Parcel_Values_2007	Table
Brazoria_County_Parcel_Values_2008	Table
Brazoria_County_Political	Polygon
Chambers_County	Polygon
Chambers_County_Political	Polygon
Clean_Rivers_Public_Feedback	Point
Clean_Rivers_Public_Feedback__ATTACH	Table
Colorado_County	Polygon
CRP_Project_Areas	Polygon
FBendCAD_Parcels_Coverage_2005	Polygon

Dataset Name	Type
Harris_County_Zones_58	Polygon
HCAD_Parcels_Coverage_2000	Polygon
HCAD_Parcels_Coverage_2000_pts	Point
HCAD_Parcels_Coverage_2003	Polygon
HCAD_Parcels_Coverage_2003_pts	Point
HCAD_Parcels_Coverage_2005	Polygon
HCAD_Parcels_Coverage_2005_pts	Point
HCAD_Parcels_Coverage_2006	Polygon
HCAD_Parcels_Coverage_2006_pts	Point
HCAD_Parcels_Coverage_2007	Polygon
HCAD_Parcels_Coverage_2007_Pts	Point
HCAD_Parcels_Coverage_2008	Polygon
HCAD_Parcels_Coverage_2008_Pts	Point
HGAC_13_County_Airports	Point
HGAC_13_County_Airports_ParcelIDs	Table
HGAC_13_County_BlockGroups_1990	Polygon
HGAC_13_County_BlockGroups_2000	Polygon
HGAC_13_County_BlockGroups_2010	Polygon
HGAC_13_County_Blocks_2000	Polygon
HGAC_13_County_Blocks_2010	Polygon
HGAC_13_County_Brownfield_Sites	Point
HGAC_13_County_Bus_Routes	Polyline
HGAC_13_County_Bus_Stops	Point
HGAC_13_County_Census_PL_Data_2010_Block_Groups	Table
HGAC_13_County_Census_PL_Data_2010_Blocks	Table
HGAC_13_County_Census_PL_Data_2010_Counties	Table
HGAC_13_County_Census_PL_Data_2010_Places	Table
HGAC_13_County_Census_PL_Data_2010_School_Districts	Table
HGAC_13_County_Census_PL_Data_2010_Tracts	Table
HGAC_13_County_Census_Places_2000	Polygon
HGAC_13_County_Census_Places_2000_Clipped	Polygon
HGAC_13_County_Census_Places_2000_Pts	Point
HGAC_13_County_Census_Places_2010	Polygon
HGAC_13_County_Census_Places_2010_Clipped	Polygon
HGAC_13_County_Census_Places_2010_Pts	Point
HGAC_13_County_Census_Urban_Areas_1990	Polygon
HGAC_13_County_Census_Urban_Areas_2000	Polygon
HGAC_13_County_Census_Urban_Areas_2009	Polygon
HGAC_13_County_Census_Urban_Areas_2010	Polygon
HGAC_13_County_Census_Zip_Codes_2010	Polygon
HGAC_13_County_City_Boundaries	Polygon
HGAC_13_County_City_Boundaries_Clipped	Polygon
HGAC_13_County_City_Ordinance_Areas	Polygon
HGAC_13_County_Closed_Landfill_Inventory	Point

Dataset Name	Type
HGAC_13_County_School_Districts_Census_2010	Polygon
HGAC_13_County_School_Districts_TEA_2010	Polygon
HGAC_13_County_Service_Area_Boundaries	Polygon
HGAC_13_County_Soils	Polygon
HGAC_13_County_State_Parks	Polygon
HGAC_13_County_Superfund_NPL_Sites	Polygon
HGAC_13_County_Superfund_NPL_Sites_Pts	Point
HGAC_13_County_TIRZs	Polygon
HGAC_13_County_Tracts_1990	Polygon
HGAC_13_County_Tracts_2000	Polygon
HGAC_13_County_Tracts_2010	Polygon
HGAC_13_County_Transit_Centers_Parks_and_Rides	Point
HGAC_13_County_Water	Polygon
HGAC_13_County_Water_Detailed	Polygon
HGAC_13_County_Watershed_Project_Monitoring_Sites	Point
HGAC_13_County_Zip_Codes_2000	Polygon
HGAC_13_County_Zip_Codes_2002	Polygon
HGAC_13_County_Zip_Codes_2005	Polygon
HGAC_15_County_Aquifer_Recharge_Zones	Polygon
HGAC_15_County_Basins	Polygon
HGAC_15_County_Bio_Monitoring_Sites	Point
HGAC_15_County_Census_Zip_Codes_2010	Polygon
HGAC_15_County_City_Boundaries	Polygon
HGAC_15_County_City_Boundaries_Clipped	Polygon
HGAC_15_County_Coastline	Polygon
HGAC_15_County_Coastline_Boundary	Polygon
HGAC_15_County_Contours_2_Feet	Polyline
HGAC_15_County_Contours_5_Feet	Polyline
HGAC_15_COUNTY_CRP_Impairments	Table
HGAC_15_County_CRP_Lakes	Polygon
HGAC_15_County_CRP_Stream_End_Points	Point
HGAC_15_County_CRP_Streams	Polyline
HGAC_15_County_DEM_10m	Raster
HGAC_15_County_Hillshade	Raster
HGAC_15_County_Major_Rivers	Polyline
HGAC_15_County_Major_Roads	Polyline
HGAC_15_County_Political	Polygon
HGAC_15_County_Political_Boundary	Polygon
HGAC_15_County_School_Districts_TEA_2010	Polygon
HGAC_15_County_Soils	Polygon
HGAC_15_County_Wastewater_Outfalls	Point
HGAC_15_County_Wastewater_Outfalls_Historical	Point
HGAC_15_County_Wastewater_Outfalls_Info	Table
HGAC_15_County_Water	Polygon

HGAC_8_County_Forecast_Region_v	Table
Dataset Name	**Type**
HGAC_8_County_Forecast_TAZ_h_2003	Table
HGAC_8_County_Forecast_TAZ_v_2003	Table
HGAC_8_County_Forecast_Tracts_h	Table
HGAC_8_County_Forecast_Tracts_v	Table
HGAC_8_County_Forecast_Zip_Codes_h	Table
HGAC_8_County_Forecast_Zip_Codes_v	Table
HGAC_8_County_G025M	Polygon
HGAC_8_County_G1	Polygon
HGAC_8_County_G10	Polygon
HGAC_8_County_G1M	Polygon
HGAC_8_County_Livable_Centers	Point
HGAC_8_County_Livable_Centers_Areas	Polygon
HGAC_8_County_Major_Rivers	Polyline
HGAC_8_County_Major_Roads	Polyline
HGAC_8_County_PedBike_Improvement_Areas	Polyline
HGAC_8_County_PedBike_Improvement_Locations	Polyline
HGAC_8_County_Pedestrian_Pathways	Polyline
HGAC_8_County_Political	Polygon
HGAC_8_County_Political_Boundary	Polygon
HGAC_8_County_Railroads	Polyline
HGAC_8_County_Raster_Extent	Polygon
HGAC_8_County_RAZ	Polygon
HGAC_8_County_School_Districts_TEA_2010	Polygon
HGAC_8_County_Soils	Polygon
HGAC_8_County_TAZ_2003	Polygon
HGAC_8_County_Tracts_1970	Polygon
HGAC_8_County_Tracts_1980	Polygon
HGAC_8_County_Tracts_2000	Polygon
HGAC_8_County_Tracts_2010	Polygon
HGAC_8_County_Water	Polygon
HGAC_8_County_Water_Detailed	Polygon
HGAC_8_County_Zip_Codes_2000	Polygon
HGAC_8_County_Zip_Codes_2002	Polygon
HGAC_8_County_Zip_Codes_2005	Polygon
HGAC_8_County_Zoning_2010_pts	Point
HGAC_Bastrop_Bayou_Sub_Watersheds	Polygon
HGAC_CRP_Watersheds	Polygon
HGAC_LAND_COVER_10_CLASS_2008	Polygon
HGAC_LAND_COVER_10_CLASS_ROADS_2008	Raster
HGAC_LAND_COVER_3X3_MODE_FILTERED_2008	Raster
HGAC_LAND_COVER_MERGED_6_CLASS_2008	Raster
HGAC_Other_CRP_Monitoring_Stations	Point

Model_Buildings_Rural	Point
Model_Buildings_Uses	Point
Dataset Name	**Type**
Model_Buildings_Uses_Rural	Table
Model_Parcels	Table
Model_Parcels_Acct_Nums	Polygon
Model_Parcels_Acct_Nums_Rural	Table
Model_Parcels_Addresses	Table
Model_Parcels_Addresses_Rural	Table
Model_Parcels_Features	Table
Model_Parcels_Features_Rural	Table
Model_Parcels_Forecast	Table
Model_Parcels_Removed_Merged	Table
Model_Parcels_Rural	Polygon
MontCAD_Parcels_Coverage_2005	Polygon
MontCAD_Parcels_Coverage_2005_pts	Point
MontCAD_Parcels_Coverage_2006	Polygon
MontCAD_Parcels_Coverage_2006_pts	Point
MontCAD_Parcels_Coverage_2007	Polygon
MontCAD_Parcels_Coverage_2007_pts	Point
MontCAD_Parcels_Coverage_2008	Polygon
MontCAD_Parcels_Coverage_2008_Pts	Point
Montgomery_County	Polygon
MONTGOMERY_COUNTY_PARCEL_INFO_2006	Table
MONTGOMERY_COUNTY_PARCEL_INFO_2007	Table
Montgomery_County_Parcel_Info_2008	Table
Montgomery_County_Parcel_Values_2006	Table
Montgomery_County_Parcel_Values_2007	Table
Montgomery_County_Parcel_Values_2008	Table
Montgomery_County_Zones_4	Polygon
NLCD_IMPERVIOUSNESS_2001	Raster
NLCD_IMPERVIOUSNESS_2006	Raster
NLCD_IMPERVIOUSNESS_CHANGE_2006	Raster
NLCD_TREE_CANOPY_2001	Raster
NOAA_Surge_MOM_Galveston_Bay	Polygon
NOAA_Surge_MOM_Matagorda_Bay	Polygon
San_Jacinto_County	Polygon
SEM_User_Input_Point	Point
SEM_User_Input_Polygon	Polygon
SEM_User_Input_Polyline	Polyline
Texas_113th_Congressional_Districts	Polygon
Texas_Census_BlockGroups_1990	Polygon
Texas_Census_BlockGroups_2000	Polygon
Texas_Census_BlockGroups_2010	Polygon

WalkCAD_Parcels_Coverage_2007	Polygon
WalkCAD_Parcels_Coverage_2007_pts	Point
WalkCAD_Parcels_Coverage_2008	Polygon
Dataset Name	**Type**
WalkCAD_Parcels_Coverage_2008_Pts	Point
Walker_County	Polygon
WALKER_COUNTY_PARCEL_INFO_2005	Table
WALKER_COUNTY_PARCEL_INFO_2006	Table
WALKER_COUNTY_PARCEL_INFO_2007	Table
Walker_County_Parcel_Info_2008	Table
Walker_County_Parcel_Values_2005	Table
Walker_County_Parcel_Values_2006	Table
Walker_County_Parcel_Values_2007	Table
Walker_County_Parcel_Values_2008	Table
WallCAD_Parcels_Coverage_2007	Polygon
WallCAD_Parcels_Coverage_2007_Pts	Point
WallCAD_Parcels_Coverage_2008	Polygon
WallCAD_Parcels_Coverage_2008_Pts	Point
Waller_County	Polygon
WALLER_COUNTY_PARCEL_INFO_2007	Table
Waller_County_Parcel_Info_2008	Table
Waller_County_Parcel_Values_2007	Table
Waller_County_Parcel_Values_2008	Table
Wharton_County	Polygon
World_Country_Boundaries	Polygon

C&E Non-Spatial Data
Ambient Surface Water Quality Monitoring
Wastewater Self-reporting Data
Parcel-Based Land Use, Attributes, and Valuation (9 counties)
Census Data

Projection
Geographic Projection:
Spheroid:
Zone:
Datum:
Units:
Fips Zone:
Quadrant:
X Shift:
Y Shift:
1st Standard Parallel:
2nd Standard Parallel:
Central Meridian:
Lat. of Projection Origin:
False Easting:
False Northing:

Additional Documentation
Quality Assurance Quality Control
Attribute Reports Available
Additional Documentation Available