U.S. Army Corps of Engineers
Mississippi Valley Division
New Orleans District

Review Plan for Louisiana Highway 1 T-Wall Construction, Larose to Golden Meadow Hurricane Protection Levee

Pursuant to 33 USC § 408

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Commanding

US Army Corps of Engineers

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1. Introduction

a. Purpose of This Review Plan

This Alteration-Specific Review Plan is intended to ensure quality of the review by the New Orleans District (MVN) for the request to alter a US Army Corps of Engineers (USACE) civil works project within the MVN's area of responsibility. This review plan was prepared in accordance with Engineer Circular (EC) 1165-2-216, "Policy and Procedural Guidance for Processing Requests to Alter US Army Corps of Engineers Civil Works Projects Pursuant to 33 USC 408" (reference paragraph 7.c.(4) in EC 1165-2-216) and Engineering Circular (EC) 1165-2-214, Civil Works Review Policy, 15 December 2012. This review plan provides the review guidelines associated with a specific alteration request pursuant to 33 USC 408 (Section 408).

b. Guidance and Policy References

- EC 1165-2-214, Civil Works Review Policy, 15 December 2012
- EC 1165-2-216 Policy and Procedural Guidance for Processing Requests to Alter US Army Corps of Engineers Civil Works Projects Pursuant to 33 USC 408, 31 July 2014
- ER 1110-1-12, Quality Management, 31 Mar 2011
- Hurricane Storm Damage Risk Reduction System Design Guidelines, March 2012
- EM 1110-2-2000, Standard Practice for Concrete for Civil Works Structures, Mar 01
- EM 1110-2-2102, Waterstops and Other Preformed Joint Materials for Civil
- Works Structures, Sep 95
- EM 1110-2-2104, Strength Design for Reinforced Concrete Hydraulic Structures, Jun 92 (Including Change 1, Aug 03)
- EM 1110-2-2502, Retaining and Flood Walls, Sep 89
- EM 1110-2-2906, Design of Pile Foundations, Jan 91
- EM 1110-2-2504, Design of Sheet Pile Walls, Mar 94
- EM 1110-2-1901, Seepage Analysis and Control for Dams, Apr 93
- EM 1110-2-1902, Slope Stability, Oct 03
- EM 1110-2-2100, Stability Analysis of Concrete Hydraulic Structures, Dec 05
- EM 1110-2-3400, Painting: New Construction and Maintenance, Apr 95
- ETL 1110-2-584, Design of Hydraulic Steel Structures, Jun 14
- ETL 1110-2-575, Evaluation of I-walls, Sep 11
- American Concrete Institute, Building Code and Commentary, ACI 318
- American Institute of Steel construction, Manual of Steel
- American Welding Society, AWS D1.1
- American Welding Society, AWS D1.5

- ASCE/SEI 7, Minimum Design Loads for Buildings and Other Structures

The products applicable to determination of impacts to the operation and maintenance of the flood risk reduction project will be reviewed against published guidance, including Engineering Regulations, Engineering Circulars, Engineering Manuals, Engineering Technical Letters, Engineering Construction Bulletins, Policy Guidance Letters, implementation guidance, project guidance memoranda, and other formal guidance memoranda issued by HQUSACE.

c. Description and Information

This Review Plan covers the proposed construction of approximately 400 linear feet of T-Wall, as part of the Louisiana Highway 1 (LA-1) Improvement Project. The proposed T-Wall will replace the existing earthen levee section under the proposed LA-1 Bridge crossing the Larose to Golden Meadow (LGM) Hurricane and Storm Damage Risk Reduction System (HSDRRS) at Golden Meadow, Louisiana. The proposed T-Wall will be installed between approximate levee stations 116+00 to 120+00, within the jurisdiction of the South Lafourche Levee District. Actual lengths of the levee stations will be determined during detailed design.

The purpose of the proposed T-Wall, underneath the new LA-1 Bridge, is to maintain and provide the required level of risk reduction associated with the LGM HSDRRS and to ease operations and maintenance requirements as well as provide potential 2085 protection and risk reduction to the 2% event of El 21.0.

The requestor, Louisiana Department of Transportation and Development (LaDOTD), has proposed the T-Wall to be supported on two rows of H-piles with a sheet pile cutoff wall. The existing levee will be degraded to elevation 11.0 NAVD88 (2004.65). The top of the wall base will be constructed to elevation 13.5 NAVD88 (2004.65) with a stem of 7.5 ft resulting in a top-of-wall elevation of 21.0 ft. The authorized hydraulic design elevation for this reach is 13.4 ft the still water level is 10.6 ft. By degrading the levee to 11.0 ft the levee will remain above the still water level. Since the proposed alteration degrades below the design elevation, should any of the work take place during hurricane season, a temporary flood protection plan will be required.

The proposed elevation of the floodwall is based on USACE evaluation of the LGM System and will provide a 2% level of risk reduction. Currently the LGM System is authorized to elevation 13.4 ft NAVD-88 (2004.65).

Federal Project Background:

The Larose to Golden Meadow (LGM) Hurricane and Storm Damage Risk Reduction System (HSDRRS) is located in Lafourche Parish, Louisiana, approximately 50 miles south of New Orleans, along Bayou Lafourche. The authorized project is a 48-mile ring levee system that includes levees and structures that have been constructed to provide risk reduction for the residents and economic interests in the leveed area. The earth levee was constructed in lifts of embankment material dredged from adjacent borrow locations on the land side of the levee that now make up the canals on the interior of the levee. The system also includes nine floodwall and gate structures that provide protection where levee construction has historically not been practical due to limited available rights-of-way and at transitions from levees to floodgates or utility crossings. The system consists of inverted T-type, single I-wall type, and A-frame braced sheet pile type floodwalls. There are two 56-foot wide canal sector gate floodgates, one at Larose and the other at Golden Meadow, for maintaining navigation on Bayou Lafourche. The system includes 9 pump stations, in conjunction with landside borrow pits and drainage canals that provide gravity drainage to the area within the system away from the banks of Bayou Lafourche to the low-lying marshes on either side of the waterway. Gravity drainage structures originally proposed in the GDM were not constructed; however, two gravity drainage culverts exist in the system near Hwy 24 and Hwy 657.

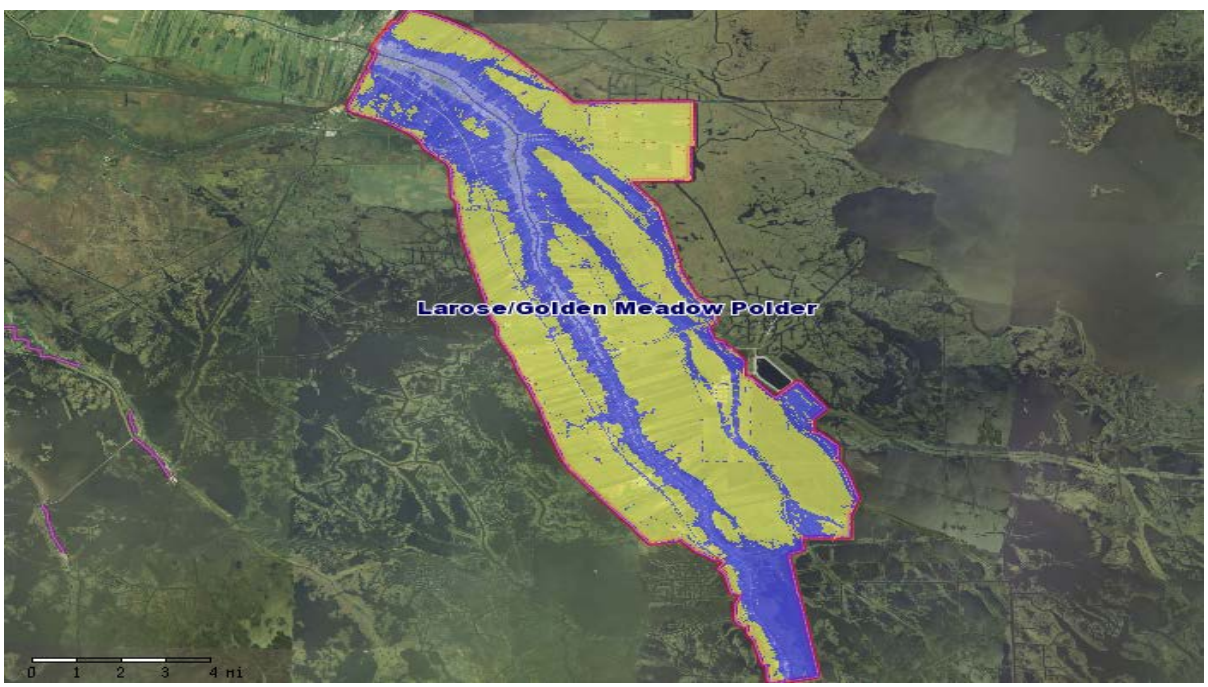

Figure 1 – Larose to Golden Meadow System

Figure 2 – Proposed T-Wall Location within the LGM System

Risk Characterization for the LGM HSDRRS

The following information is provided for information purposes only and is to be removed prior to posting on the District Web Site.

The MVN performed a screening level risk assessment of the system in September of 2015. The results of that screening follow. It should be noted that at this time, the screening results have not been reviewed by the Levee Senior Oversight Group (LSOG) and has not received a recommended Levee Safety Action Classification (LSAC), and LSAC rating is expected by the end of FY2016.

Table I: Overview of Flood Risk Management Project

Levee Information	
USACE District:	**MVN**
USACE Division:	MVD
NLD Segment ID#:	4404000518
NLD System ID#:	4405000513
Levee Screening ID#:	3628
Proposed LSAC:	
LSAC:	
Length (Miles):	48.24
Inspection Date:	JUL 2010
Inspection Rating:	U
Elevations (NAVD 88)	
Top of Levee Segment - Max:	18.57
Top of Levee Segment - Min:	5.3
Top of Levee System - Min:	5.3
Leveed Area Min Elev:	-18.5
Typical Section Height (ft.)	3.5 - 16.5
Annual Chance Exceedance (ACE)	
Toe:	1.00E+00
Authorized Capacity:	1.00E-02
Overtopping:	5.00E-02
Largest Historic Load (% of height):	75%
Flood Duration Characteristics	Short

Table II: LST Computed Consequences

Leveed Area Information	
Population (Day)	16137
Population (Night)	20690
# Structures	8860
Property Value (1000s)	$2,581,496
LST Computed Consequences	
% Area Inundated (> 2')	100
PAR (Day)	16136
PAR (Night)	20690
Evacuation Effectiveness (Prior)	83% (D) : 83% (N)
Loss of Life (Day)	22
Loss of Life (Night)	29
Weighted Fatality Rate (%)	0.82
Property Damages (1000s)	$1,152,827
# Structures Inundated	8860

Table III: Annualized Consequence

Annualized Consequence	Percent Rank
Life Loss - Prior to Overtopping	98
Life Loss - Overtopping	95
Property Damage - Prior	99
Property Damage - Overtopping	99
The percent rank for this levee is relative to all levees in the Corps portfolio that have been screened to date.	

Table IV: Contribution to Risk Prior to Overtopping

Contribution to Risk Prior to Overtopping Performance Type	API	AALL	AAPD
Embankment and Foundation Seepage and Piping	5.61%	7.43%	5.55%
Embankment Stability	4.88%	6.45%	4.82%
Embankment Erosion	8.04%	10.63%	7.95%
Closure Systems	27.87%	4.60%	28.70%
Floodwall Stability	6.41%	8.48%	6.34%
Floodwall Under seepage and Piping	47.19%	62.41%	46.65%

d. Review Management Organization (RMO) Coordination

The RMO is responsible for managing the overall peer review effort described in this Review Plan. The RMO for the peer review effort described in this Review Plan is the USACE Risk Management Center (RMC).

The products applicable to determination of impacts to the operation and maintenance of the flood risk reduction project will be reviewed against published guidance, including Engineering Regulations, Engineering Circulars, and Engineering Manuals, Engineering Technical Letters, Engineering Construction Bulletins, Policy Guidance Letters,

implementation guidance, project guidance memoranda and other formal guidance memoranda issued by HQUSACE.

2. Execution Plan and Review Requirements

a. Level of Review Required by the Requester

The MVN has carefully evaluated potential impacts to LGM HSDRRS and determined the following level of reviews are appropriate.

1) Quality Assurance and Quality Control (QA/QC) Review

The requester, or its agent or consultant, is responsible for its own internal design quality control, but quality control should minimally include review of the structural adequacy, geotechnical stability, suitability borrow material, and concurrence with all applicable USACE design regulations, guidance and practices for this type of work. The requester should provide USACE with documentation regarding the quality control/quality assurance procedures followed in the development of the project design. This documentation should be in the form of a report that identifies:

- Purpose and scope of the review;
- Description of the review team and a short statement on their qualifications
- Summary of the review performed during design;
- Lessons learned and major changes made during the review;
- All internal QC comments and resolutions; and,
- Supplemental studies or analyses performed during the design, e.g. geotechnical report.

2) Safety Assurance Review (SAR)

A Safety Assurance Review, also known as a Type II Independent External Peer Review (IEPR), shall be conducted on design and construction activities for flood risk management projects, as well as, other projects where potential hazards pose a significant threat to human life. External panels will review the design and construction activities prior to initiation of physical construction and periodically thereafter until construction activities are completed. The charges to the SAR panels complement the Agency Technical Review (ATR) process and do not duplicate it, the SAR will be accomplished by the requestor LaDOTD.

The SAR (Type II IEPR) panel will be selected and managed by the requestor LaDOTD. Selection of SAR panel members will be made up of independent, recognized experts

from outside of the USACE in the appropriate disciplines, representing a balance of expertise suitable for the review being conducted. Per EC 1165-2-214, selection of the SAR Panel members for IEPR efforts will adhere to the National Academy of Science Policy on Committee Composition and Balance and Conflicts of Interest, which set the standard for "independence" in review processes and complexity in a national context.

b. Decision-Level Determination for SAR

The requester's level of review was determined based on the guidance outlined in EC 1165-2-214, which evaluates the need for a SAR. The position of the MVN is based on a risk informed determination that carefully weighed the potential detriments of the proposed alteration. According to MVD's guidance published 27 May 2015 (Subject: Alterations to Federally Constructed Projects within the Mississippi Valley Division), a "yes" answer to either of the first two questions mandates the requirement for a SAR. A "yes" answer to the following three questions requires consideration SAR. Furthermore, EC 1165-2-214, Paragraph 13b, states in relevant part "When a non-Federal interest…requests permission to alter a Federal project, the non-Federal interest is required to undertake, at its own expense, any IEPR that the Government determines would have been required if the Government were doing the work."

c. Rationale for SAR Recommendation

1) Is this project justified by life safety?

Yes. The Larose to Golden Meadow project as originally authorized and constructed is a life safety project.

2) Would the project's failure pose a significant threat to human life?

Yes, failure of the project poses a significant threat to human life.

3) Does the project involve the use of innovative materials or techniques where the engineering is based on novel methods, presents complex challenges for interpretations, contains precedent setting methods or models, or presents conclusions that are likely to change prevailing practices?

No. The proposed alteration does not align itself with any item presented in this question. The proposed floodwall will be designed and built in accordance to USACE, Hurricane and Storm Damage Risk Reduction System Design Guidelines.

4) Does the project design require redundancy, resiliency, or robustness?

No. The section of the earth embankment will be replaced with a T-Wall that will be to a greater elevation of the current levee, as such the proposed alternation has the benefit of ensuring the level of risk reduction, intended by the project authorization will extend into future years.

5) Does the project have unique construction sequencing or a reduced or over lapping design construction schedule?

No, the construction will follow a traditional sequence consistent with any similar USACE floodwall and earth embankment projects.

Based on the responses to question 1, a SAR (Type II IEPR) is required for the proposed alternations. External panels will review the design and construction activities prior to initiation of physical construction and periodically thereafter until construction activities are completed. A site visit will be conducted by the SAR review panel.

d. Level of Review Required by the District

The review of this alteration request shall include a district-led Agency Technical Review (ATR), reference paragraph 7.c.(4) in EC 1165-2-216. Per EC 214 the District's Chief of Engineering has determined that a SAR will be required.

e. Decision-Level Determination

Per EC 1165-2-216, paragraph 6t, seven questions must be addressed to determine the required review and decision level. If the answer to any of the questions is "yes," and the District and Division recommend approval of the alterations, then the Section 408 request requires HQUSACE level review and decision. The questions, and MVN's responses, are provided below:

1) Does the proposed alteration require a Type II IEPR, reference EC 1165-2-214?

Yes. As described above a SAR, Type II IEPR will be conducted on the proposed alternations.

2) Does the proposed alteration require an Environmental Impact Statement (EIS) in which USACE is the lead agency?

No.

3) Does the proposed alteration change how the USACE project will meet its authorized purpose?

No.

4) Does the proposed alteration preclude or negatively impact alternatives for a current General Investigation (GI) or other study?

No.

5) Is the non-federal sponsor for a USACE project proposing to undertake the alteration as in-kind contributions eligible for credit under Section 221 of Flood Control Act of 1970, as amended?

No.

6) Is the proposed alteration for installation of hydropower facilities?

No.

7) Is there a desire for USACE to assume operations and maintenance responsibilities of the proposed navigation?

No.

The answer to question #1 above is yes. Therefore HQ USACE review and approval will be required.

f. District Review Purpose

The review of all work products will be in accordance with the guidelines established within this review plan. The ATR will serve as the District's review of the request. The purpose of this review is to ensure the proper application of established criteria, regulations, laws, codes, principles and professional practices.

For the purposes of Section 408, the ATR team will make the following determinations:

The review of all work products will be in accordance with the guidelines established within this review plan. The ATR will serve as the District's review of the request. The purpose of this review is to ensure the proper application of established criteria, regulations, laws, codes, principles and professional practices.

For the purposes of Section 408, the ATR team will make the following determinations:

1) Impair the Usefulness of the Project Determination. The objective of this determination is to ensure that the proposed alteration(s) will not limit the ability of the project to function as authorized and will not compromise or change any authorized project conditions, purposes or outputs.

2) Injurious to the Public Interest Determination. Proposed alteration(s) will be reviewed to determine the probable impacts, including cumulative impacts, on the public interest. The decision whether to approve an alteration(s) will be determined by the consideration of whether benefits are commensurate with risks.

3) Legal and Policy Compliance Determination. A determination will be made as to whether the proposed alteration(s) meet all legal and policy requirements.

3. District-led Agency Technical Review Team

The District-led Agency Technical Review (ATR) Team is comprised of reviewers with the appropriate independence and expertise to conduct a comprehensive review in a manner commensurate with the type of proposed alteration(s) described in Section 1.c of this Review Plan. The ATR team will be composed of the District Section 408 Coordinator and designated New Orleans District Division Chiefs; Division Chiefs and/or Branch Chiefs may assign qualified individuals to perform the review on their behalf. Reviewers will be assigned to each proposed alteration(s) at the time the Section 408 request and associated submittals are received. Reviewers may be assigned based on the location and nature of the proposed alteration(s), and the reviewer's expertise. If the Division Chief and/or Branch Chief delegates the review to a technical manager/staff member, comments will be require review by the Branch Chief, and the Division Chief will to sign the ATR report indicating concurrence with the review.

The MVN will conduct an ATR with a team comprised of senior USACE personnel and may be supplemented by outside experts as appropriate. If lacking the appropriate expertise, the MVN will supplement their staff through appropriate Communities of Practice, Centers of Expertise, or other offices.

For the project alteration(s), the ATR team will include personnel from the disciplines of geotechnical, hydraulics, civil, structural, real estate, counsel and environmental. Other disciplines may be ultimately added through the process if required, in which case the added personnel will have the appropriate expertise pertinent to the project.

a. Review Procedures

Reviews will be conducted in a fashion which promotes dialogue regarding the quality and adequacy of the required documentation.

1) Due to the nature of the specific alteration, the MVN has been engaged in coordination efforts with Requestor, LaDOTD to ensure the proper plans, specifications, design, and environmental documents are submitted to perform an adequate review in a timely manner. The District Section 408 Coordinator will determine if adequate information has

been provided to start a review. The requestor will be notified in writing if its proposal is missing documentation. Proposed alteration submittal packages may be submitted by the civil works project sponsor, its agent or consultant, or third party. Alteration proposals must be submitted via electronic format. A hard copy is recommended but not required. The proposal must address all applicable documentation as outlined in EC 1165-2-216. The Section 408 Coordinator will be the responsible party for tracking and coordinating the ATR.

2) The Section 408 Coordinator will consult with the ATR Team to determine the level of review required once a submittal is deemed complete. The ATR Team will formulate a risk informed recommendation to the Levee Safety Officer (LSO). A review plan will be developed and sent to the RMC for endorsement. Ultimately, the Mississippi Valley Division (MVD) Commander will approve the proposed review plan pending the resolution of any comments.

3) When there is not a consensus among the ATR team as to the appropriate authorization level, complexity, or uniqueness of an alteration(s) a Review Advisory Team meeting will be held. Members of this team may include the District Engineer, Chief of Engineering, Section Chiefs, Levee Safety Program Manager, Operations Chief, Flood Area Engineer, District Counsel and Section 408 Coordinator. To facilitate the meeting, the Section 408 Coordinator shall be responsible for providing the Review Advisory Team with an overview of the project and review comments. At the conclusion of this meeting the team should have made a determination as to the appropriate level of review or scope, and it shall be agreed to by the LSO. If no conclusion can be made at the end of the meeting, vertical coordination through the chain of command will be required.

4) The submittal will undergo a thorough New Orleans District ATR. Upon completion of the review, each reviewer will prepare an ATR memorandum with review comments and submit them to the District Section 408 Coordinator. If the Section Chief delegates the review to a staff member, the Section Chief will be required to review the comments and sign the ATR memorandum indicating concurrence with the staff member's review. Each review should address four key parts.

The four key parts of a review comment will normally include:

- The review concern: identify the deficiency or incorrect application of policy, guidance, or procedures.
- The basis for the concern: cite the appropriate law, policy, guidance, or procedure that has not been properly followed.

- The significance of the concern: indicate the importance of the concern with regard to its potential impact on the district's ability to make a decision as to whether to approve or deny the Section 408 request.

- The probable specific action needed to resolve the concern: identify the action(s) that the requester must take to resolve the concern.

In some situations, especially addressing incomplete or unclear information, comments may seek clarification in order to then assess whether further specific concerns may exist.

5) The ATR documentation will include the text of each ATR concern, the ATR team response, a brief summary of the pertinent points in any discussion, including any vertical team coordination (the vertical team includes the District, RMO, MSC, and HQUSACE), and the agreed upon resolution.

The report will document the following:

- The name and location of the proposed alteration that underwent review by the ATR team;

- The name, organization, qualifications, and relevant experience of each ATR team member;

- The charge of the reviewers including objective of the review, the specific technical questions, as well as the broad technical approach applied to the review;

- Description of the nature of the review, findings, conclusions, and/or recommendations;

- A brief summary of the pertinent points in any discussion, including any vertical team coordination (the vertical team includes the District, RMO, MSC, and HQUSACE), and the agreed upon resolution; and

- A verbatim copy of each reviewers comments, or a representation of the views of the ATR team as a whole, including any disparate and dissenting views;

Ultimately, the requestor will modify the submittals in accordance with USACE ATR report, and will resubmit them for verification until all issues are addressed and satisfied.

6) The ATR is complete when the ATR team is satisfied that the proposed alteration meets the following requirements:

- Will not be injurious to the public;
- Will not impair the usefulness of the project; and,
- Not in conflict with any known laws and/or regulations.

If the proposed alteration(s) does not adequately address the above statements then the ATR team should recommend the proposed alteration(s) be denied. Upon notification by the Section 408 Coordinator to the LSO that the ATR has been satisfactorily completed, the LSO or Chief of Engineering will perform a final review of all documents prior to issuing any recommendation of approval to MVD or denial.

7) The review requires the following information to determine whether the proposed alteration(s) will impair the usefulness of the project to be injurious to the public interest.

a) Technical Analysis and Design. A review of the technical analysis and design will be performed on plans and specifications that are at a 60% level of detail at a minimum. Supporting analysis for the proposed alternation should include at a minimum, the following information:

- Consistency with previous HSDRRS construction;
- Use of consistent datum and epoch information, including datum/epoch conversions, as appropriate;
- Proposed alternation will meet all applicable Greater New Orleans HSDRRS design procedures and factors of safety;
- Standard for placing construction materials
- Quality Control procedures; and,
- Proper review and approval by the contracting authority of contractor submittals.

b) Environmental Compliance. A decision on a Section 408 proposed alteration(s) request is a federal action and therefore subject to National Environmental Policy Act (NEPA) and other environmental compliance requirements. The requester is responsible

for providing all information that the District identifies as necessary to satisfy all applicable federal laws, executive orders, regulations, policies, and ordinances. Either MVN or the requestor will prepare an Environmental Assessment (EA) for the Section 408 proposed alteration if required.

c) Real Estate Requirements. The requestor should provide a list of all real property interests required to support the proposed work/alteration. This should be supported by a map which clearly depicts both the existing real estate rights and the additional real estate required (existing right-of-way and new right-of-way required, if any). This should include both permanent and temporary real property rights needed. Alternatively, if all work will be constructed within existing rights-of-way, the requestor may so state. If the project requires the acquisition of new right-of-way, USACE approved standard estates should be utilized for project purposes by the requestor. If the requestor should propose a non-standard estate, approval requirements as outlined in EC 405-1-11 and Chapter 12, ER 405-1-12 will be followed. All potential requestors for this levee lift work were so advised by letter dated 23 July 2015. No use of lands under the control of the Army/USACE is anticipated.

8) The District Counsel will be responsible for performing the legal and policy review in accordance with EC 1165-2-216. This review will be accomplished after the ATR is completed and the LSO has reviewed the alteration documents, but prior to the District Engineer's determination.

9) The LSO and Chief of Engineering will review the Summary of Findings (SOF) report and provide the documentation for the District Engineer. The District Engineer will recommend approval of the alteration(s) to the MVD Commander.

10) The Section 408 Coordinator will forward the District Engineer's transmittal letter, review package and SOF report to the MVD Support Team and to the RMC for review and concurrence with the District's review findings.

11) Following the review from MVD and the RMC, the requestor will address and correct review comments. If necessary, the District Section 408 Coordinator in conjunction with the ATR team will make the appropriate corrections to their technical, environmental and policy determinations. The process will be repeated until all comments have been resolved by the requestor and district.

12) After endorsement by MVD, the SOF will be forwarded to the HQUSACE Office of Water Project Review (CECW-PC) for a policy compliance review. The Regional Integration Team (RIT) will ensure participation of the appropriate reviewers, such as

personnel with expertise in engineering, navigation, levee safety, real estate and environmental. Additionally, the RIT will be coordinating with the District to address comments. The process will be repeated until all comments have been resolved by the requestor and District. The RIT will draft a decision memorandum for the Director of Civil Works signature as to whether the proposed alteration(s) is accepted or denied.

13) After endorsement by HQUSACE and the Director of Civil Works, a letter of permission will be sent to the District. The District Section 408 Coordinator will send the requestor a permission letter signed by the District Commander for acceptance or denial of the proposed alteration(s).

b. Products to Undergo ATR

The ATR team will review the following products:

- Written Request;
- Geotechnical Analysis and Report;
- Design Documentation Report/Design Calculations;
- Plans and Specifications;
- All NEPA documentation;
- As-built drawings and construction documentation; and,
- All Real Estate documentation deemed necessary.

c. Required ATR Team Expertise and Requirements

The following provides an estimate of the ATR members and the types of expertise that should be represented on the review panel.

ATR Lead: The ATR team lead will be the District Section 408 Coordinator. The District Section 408 Coordinator is an individual appointed by the District Engineer as having the appropriate expertise in EC 1165-2-216 comprehension and possesses the ability to adequately scale a review in accordance with paragraph 7.b of EC 1165-2-216. The ATR lead has extensive experience in reviewing Section 408 Alteration(s) and the skills necessary to lead a team through the ATR process.

Geotechnical Engineer: The Geotechnical Engineering team member should be a senior-level geotechnical engineer with experience in the field of geotechnical engineering, analysis, design, and construction of embankment levees. The team member will hold a degree in Civil Engineering, or Geotechnical Engineering. The team member should have knowledge and experience in evaluation of seepage, settlement, and slope stability problems associated with levee embankments. The team member should have experience in failure mode analysis, risk assessment of embankment levees, and evaluating risk reduction measures for levee safety assurance projects.

Hydraulic Engineer: The Hydraulic Engineering team member should be a senior-level team member and have experience with engineering analysis related to flood risk management and levee safety projects. The team member will hold a degree in Civil Engineering, or Hydrology and Hydraulics Engineering. Reviewer should have experience in analyzing levee hydraulics along with experience in the analysis and design using hydrology models.

Civil Engineer: The Civil Engineering team member should be a senior-level civil engineer with experience in design and construction of embankment levees with engineering analysis related to flood risk management and levee safety projects. The team member will hold a degree in Civil Engineering. The team member should have experience in the preparation of plans and specifications for the construction of earthen embankment levees.

Structural Engineer: The Structural Engineering team member should be a senior-level structural engineer with experience in the design and construction floodwalls with engineering analysis related to flood risk management and levee safety projects. The team member will be responsible for reviewing structural design, construction drawings and specifications to ensure the project meets applicable standards and criteria. The reviewer will have experience in the analysis and design of floodwalls, such as the ones found in the New Orleans HSDRRS projects. In addition the team member should have experience and knowledge of temporary flood protection systems, such as cofferdams.

Levee Safety: The reviewer will ensure that the proposed project meets Corps of Engineers standards for flood risk reduction and levee safety guidelines.

Construction Engineer: Reviewer should be a senior level, professionally registered engineer with extensive experience in the engineering construction field with particular emphasis on levee safety projects. The Construction reviewer should have a minimum of 15 years of experience.

Real Estate: The Real Estate team member should be a senior-level realty specialist with experience in identifying right-of-way requirements for project purposes, estates, process for obtaining approval of non-standard estate approval, validating real estate requirements for project purposes, basic requirements for management out grant and consent actions, experience in reviewing plans and specifications, and critical thinking skills.

Operations: The Operations Division team member should be a senior level civil engineer with experience in the operations & maintenance and inspection of all types flood damage risk reduction features. The team member will hold a degree in Civil Engineering. The team member will have knowledge and experience in operations and maintenance and inspection of these features and be proficient in the Inspection of Completed Works (ICW) programs, policies, and procedures. The team member may also be the 408 District coordinator.

Environmental: Responsible for reviewing NEPA and other environmental compliance documents prepared by the requester. Coordination with Corps of Engineers Regulatory personnel will be required to evaluate potential Section 10 or 404 actions.

Counsel: The reviewer will provide an opinion on the legal sufficiency of the reviews products. The Section 408 permission will not be recommended for approval until it has concurrence by the MVN Office of Counsel. The reviewer will have experience in analyzing regulatory, policy and federal action documents.

d. Completion and Certification of the ATR

At the conclusion of the ATR effort, the ATR team will prepare a Review Report summarizing the review. Review Reports will be considered an integral part of the ATR documentation and shall:

- Identify the document(s) reviewed and the purpose of the review;
- Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer;
- Include the charge to the reviewers;
- Describe the nature of their review and their findings and conclusions;
- Identify and summarize each unresolved issue (if any); and Include a verbatim copy of each reviewer's comments (either with or without specific attributions), or represent the views of the group as a whole, including any disparate and dissenting views.

ATR may be certified when all ATR concerns are either resolved or referred to the vertical team for resolution and the ATR documentation is complete. The ATR lead will prepare a completion of ATR and certification of ATR. It will certify that the issues raised by the ATR team have been resolved (or elevated to the vertical team). The completion and certification should be completed based on the work reviewed to date for the project. A sample Completion of ATR and Certification of ATR are included in Attachment 1.

The ATR team members will determine whether the proposed alteration(s) would impair the usefulness of the federal project, be injurious to the public interest, and meets legal and policy requirements. ATR team members will provide their comments to the District Section 408 Coordinator, who will use the comments to determine if the proposed alteration(s) can be approved in accordance with EC 1165-2-216. Conflicts in addressing ATR comments will be elevated to the functional chief and MVD for resolution if necessary. Following ATR, the District Section 408 Coordinator will compile a Summary of Findings in accordance with EC 1165-2-216 (with an appendix of ATR Comments and Resolution) and obtain the endorsement of the District Levee Safety Program Manager, the District Levee Safety Officer, the District Counsel, and other District leadership before recommending to the District Commander that the proposed alteration(s) be approved or denied.

4. Requester-led SAR

The SAR (Type II IEPR) panel will be selected and managed by the requestor LaDOTD. Selection of SAR panel members will be made up of independent, recognized experts from outside of the USACE in the appropriate disciplines, representing a balance of expertise suitable for the review being conducted. Per EC 1165-2-214, selection of the SAR Panel members for IEPR efforts will adhere to the National Academy of Science Policy on Committee Composition and Balance and Conflicts of Interest, which sets the standard for “independence” in review processes and complexity in a national context.

http://www.mvn.usace.army.mil/About/Offices/ProgramsProjectManagement/ProjectReviewPlans.aspx

a. Required SAR Panel Expertise

The following provides an estimate of the SAR panel members and the types of expertise that should be represented on the review panel. The SAR panel will take the form of a two member consultant panel, but the member is limited to reviewing and commenting on the work being done by others. The Consultant shall identify the expert for the required discipline and level to serve as the IEPR panel. The expert will also be referenced as an

expert reviewer. Selection will be based on availability, technical credentials, and absence of perceived or actual conflict of interest

A two member panel is required due to the limited the size and complexity of the project. The expert reviewer shall be an industry leader in their required field of review stated below and have experience in design and construction of projects similar in scope to LA-1 proposed alteration. Panel members should have an advanced degree and be professionally registered.

Geotechnical Engineer: The Geotechnical Engineer panel member shall have a minimum of 15 years of experience in the specific field of levee engineering in evaluating, designing, and constructing large levees embankments; and with a minimum MS degree or higher in engineering is preferred. Geotechnical panel member experience shall be in soil compaction and earthwork construction; soil mechanics; seepage and piping; landslide and slope stability evaluations; bearing capacity and settlement; and foundation inspection and assessment. The Geotechnical panel member shall have knowledge and experience in the forensic investigation of seepage, settlement, stability, and deformation problems associated with embankments constructed on foundations with soft soils. The Geotechnical panel member shall have familiarity with preparing plans and specifications for levee embankment and levee rehabilitation projects. The Geotechnical panel member shall also have knowledge of best practices regarding levee design and construction procedures and policies.

Structural Engineer: The Structural Engineer panel member shall have a minimum of 15 years of experience evaluating levee structural elements with emphasis on USACE design regulations; and with a minimum MS degree or higher in engineering is preferred.

b. Completion and Certification of the SAR

DrChecks review software may be used to document the SAR comments and aid in the preparation of the Review Report but is not required. Panel comments will be compiled into a letter to the requestor and should address the adequacy and acceptability of the engineering, models, and analyses used. SAR comments should generally include the same four key parts as described for ATR comments in Section 3a Review Procedures.

A suggested report outline is an introduction, the composition of the review team, a summary of the review during design, a summary of the review during construction, any lessons learned in both the process and/or design and construction, and appendices for conflict of disclosure forms, for comments to include any appendices for supporting analyses and assessments of the adequacy and acceptability of the methods, models, and analyses used. All comments in the report will be finalized by the panel prior to their release to USACE for each review plan milestone. Written responses to the IEPR Review

Report will be prepared to explain the agreement or disagreement with the views expressed in the report, the actions undertaken or to be undertaken in response to the report, and the reasons those actions are believed to satisfy the key concerns stated in the report (if applicable). The final report will be provided to the RMO and MVD. After the MSC Commander's approval, the District will make the report and responses available to the public on the District's website located at the following:

http://www.mvn.usace.army.mil/About/Offices/ProgramsProjectManagement/ProjectReviewPlans.aspx

5. Review Schedule

To the extent practical, reviews should not extend the design schedule but should be embedded in the design process. Reviewers should be involved at key decision points and are encouraged to provide timely over the shoulder comments.

Review schedules are commensurate with the scale and complexity of review. The District 408 Coordinator will work with the ATR team to achieve timely reviews and will maintain contact with the requestor and/or the non-Federal sponsor to keep them informed about the review time.

6. Review Cost

The initial review and pre-coordination for these 408 requests have been funded thru the ICW, O&M General project. Future review costs for these Section 408 requests will be requested and funded nationally thru the Section 408 O&M General account. However, if funds are denied, either the Section 408 requests could not be processed or the Requester(s) would have to request and initiate 214 agreements with USAGE.

It is estimate that the SAR will cost between $40,000 and $50,000.

7. Public Participation of Review Plan

As required by EC 1165-2-214, the approved Review Plan will be posted on the District public website:

http://www.mvn.usace.army.mil/About/Offices/ProgramsProjectManagement/ProjectReviewPlans.aspx.

The public will have 14 days to provide comments on the documents; after all comments have been submitted, the comments will be provided to the technical reviewers. This is

not a formal comment period and there is no set timeframe for the opportunity for public comment. If and when comments are received, the ATR Team will consider them and decide if revisions to the review plan are necessary. This engagement will ensure that the peer review approach is responsive to the wide array of stakeholders and customers, both within and outside the federal government.

8. Review Plan Points of Contact

Name/Title	Organization	Email
Amy Powell District Section 408 Coordinator	CEMVN-OD-W	Amy.e.powell@usace.army.mil
RMC Review Manager	CEIWR-RMC	304-399-5217 rmc.review@usace.army.mil

ATTACHMENT 1: COMPLETION OF AGENCY TECHNICAL REVIEW

The Agency Technical Review (ATR) has been completed for the *<short description of proposed alteration>* for *<project name and location>*. The ATR was conducted as defined in the Alteration-Specific Review Plan to comply with the requirements of EC 1165-2-216. During the ATR, compliance with established policy principles and procedures and legal requirements was verified. This included the determination whether the proposed alteration would impair the usefulness of the federal project or was injurious to the public interest. All comments resulting from the ATR have been resolved.

SIGNATURE _____ _____

Name, Chief Engineering Division Date
ATR Team Leader
CEMVN-ED

SIGNATURE _____ _____

Amy Powell Date
District Section 408 Coordinator
CEMVN-OD-W

SIGNATURE _____ _____

Nathan Snorteland Date
Director
CEIWR-RMC

For Official Use Only -To be Removed Prior to Posting on District Web Site

ATTACHMENT 2: DISTRICT TEAM ROSTERS

Agency Technical Review (ATR) Team

Name	Discipline/Role	Phone	E-Mail Address
Amy Powell	Operations, 408 Coordinator	504-862-2241	Amy.E.Powell@usace.army.mil
Richard Pinner	Levee Safety Officer/Geotech Engr	504-862-1033	Richard.B.Pinner@usace.army.mil
Daryl Glorioso	Office of Council	504-862-1941	Daryl.G.Glorioso@usace.army.mil
Julie LeBlanc	Hydrology and Hydraulics	504-862-1597	Julie.Z.LeBlanc@usace.army.mil
Sandy Stiles	NEPA Compliance	504-862-1583	Sandra.E.Stiles@usace.army.mil
Heath Jones	Emergency Management	504-862-2426	Heath.E.Jones@usace.army.mil
Jean Vossen	Civil Engineer	504-862-2404	Jean.Vossen@usace.army.mil
Dave Beck	Civil Engineer	504-862-2406	David.A.Beck@usace.army.mil
Christopher Dunn	Structural Engineer	504-862-1799	Christopher.L.Dunn@usace.army.mil
Mark Woodward	Geotechnical Engineer	504-862-1006	Mark.L.Woodward@usace.army.mil
Linda LaBure	Real Estate Specialist	504-862-1295	Linda.C.Labure@usace.army.mil
Mike Farabee	Regulatory	504-862-2292	Michael.V.Farabee@usace.army.mil
Pierre Hingle	Construction Engineer	504-862-2738	Pierre.M.Hingle@usace.army.mil

ATTACHMENT 3 – Safety Assurance Review (SAR) Plan

This plan serves to satisfy the Safety Assurance Review (SAR) requirements for the proposed Louisiana Highway 1 T-Wall Construction as required by Engineering Circular (EC) 1165-2-216, Policy and Procedural Guidance for Processing Requests to Alter US Army Corps of Engineers Civil Works Projects Pursuant to 33 USC 408, dated 31 July 2014.

The Louisiana Department of Transportation and Development (LaDOTD) is proposing construction of approximately 400 linear feet of T-Wall, as part of the Louisiana Highway 1 (LA-1) Improvement Project. The proposed T-Wall will replace the existing earthen levee section under the proposed LA-1 Bridge crossing the Larose to Golden Meadow (LGM) Hurricane and Storm Damage Risk Reduction System (HSDRRS) at Golden Meadow, Louisiana. The proposed T-Wall will be installed between approximate levee stations 116+00 to 120+00, within the jurisdiction of the South Lafourche Levee District. Actual lengths of the levee stations will be determined during detailed design.

The USACE New Orleans District is working with the LaDOTD, the local sponsor of the Louisiana Highway 1 (LA-1) Improvement Project, to ensure the SAR of the project meets the requirements of EC 1165-2-216. This document outlines how the SAR will be performed and identifies the independent consultants who will comprise the SAR Panel charged with executing an adequate review for the T-Wall portion of the Louisiana Highway 1 (LA-1) Improvement Project.

1. Project Background

This section of LA-1 is a major access route for residents and business in South Louisiana and provides direct access to the oil and gas industry at Port Fourchon. LA-1 is also the major hurricane evacuation route for communities in South Louisiana, including, Grand Isle, Leeville, Golden Meadow, Galliano, Cut Off, and Larose. The intent of this Section 408 is to elevate a portion of LA-1 over the LGM, A-West levee and replace the levee section under the roadway with a T-Wall and to show that the LA-1 project will not adversely impact the operation and maintenance of the LGM flood damage risk reduction project.

2. Purpose

This document outlines the SAR Plan for the LA-1 project. EC 1165-2-216 outlines the policy on review of decision documents, including with regard to SAR, which is also referred to as Type II IEPR. As discussed in more detail in the LGM/LA-1 Review Plan Section 3.c, an SAR is required.

The SAR Panel provides and impartial and independent review of the project. The review shall be on a regular schedule sufficient to inform the Chief of Engineers on the adequacy, appropriateness and acceptability of the design and construction activities for the purpose of assuring that good science, sound engineering and public health, safety and welfare are the most important factors that determine a project's fate.

Specifically, the SAR will address the following questions:

For the design phase of the project;

1. Has the analysis and design been complete in accordance with USACE Standards?
2. Are the steps (input data, assumptions, methods, analyses, etc.) for determining the stability and integrity of the proposed T-Wall appropriate?
3. Do the design assumptions made during the decision document phase or previous studies remain valid through the completion of design as additional knowledge is gained and the state-of-the-art evolves?
4. Do the project features and/or components effectively work as a system before and after the proposed alteration is performed?

For the construction phase of the project;

1. Do the assumptions made during design remain valid through construction as additional knowledge is gained and the state-of-the-art evolves?
2. Will the project monitoring adequately reveal any deviations from assumptions made for performance?

3. References

- EC 1165-2-214, Civil Works Review Policy, 15 December 2012
- EC 1165-2-216 Policy and Procedural Guidance for Processing Requests to Alter US Army Corps of Engineers Civil Works Projects Pursuant to 33 USC 408, 31 July 2014
- ER 1110-1-12, Quality Management, 31 Mar 2011
- Hurricane Storm Damage Risk Reduction System Design Guidelines, March 2012
- EM 1110-2-2000, Standard Practice for Concrete for Civil Works Structures, Mar 01
- EM 1110-2-2102, Waterstops and Other Preformed Joint Materials for Civil
- Works Structures, Sep 95
- EM 1110-2-2104, Strength Design for Reinforced Concrete Hydraulic Structures, Jun 92 (Including Change 1, Aug 03)
- EM 1110-2-2502, Retaining and Flood Walls, Sep 89
- EM 1110-2-2906, Design of Pile Foundations, Jan 91
- EM 1110-2-2504, Design of Sheet Pile Walls, Mar 94
- EM 1110-2-1901, Seepage Analysis and Control for Dams, Apr 93
- EM 1110-2-1902, Slope Stability, Oct 03
- EM 1110-2-2100, Stability Analysis of Concrete Hydraulic Structures, Dec 05
- EM 1110-2-3400, Painting: New Construction and Maintenance, Apr 95

- ETL 1110-2-584, Design of Hydraulic Steel Structures, Jun 14
- ETL 1110-2-575, Evaluation of I-walls, Sep 11
- American Concrete Institute, Building Code and Commentary, ACI 318
- American Institute of Steel construction, Manual of Steel
- American Welding Society, AWS D1.1
- American Welding Society, AWS D1.5
- ASCE/SEI 7, Minimum Design Loads for Buildings and Other Structures

4. SAR Review Expertise and Management

LaDOTD, as the project applicant, will identify and select two experts based on varied professional disciplines to serve on the SAR Panel. A two member panel is required due to the limited the size and complexity of the project.

The expert reviewer shall be an industry leader in their required field of review stated below and have experience in design and construction of projects similar in scope to LA-1: T-Wall project.

The panel members shall not have any financial or litigation association with the USACE; the DOTD or the Designer of Record; their engineering teams, sub-consultants or construction consultants. The panel member shall fully disclose any known or potential conflict of interest that may arise from the performance of the work. Areas of conflict may include current employment by the Federal or State governments, participation in developing the subject project, a publicly documented statement advocating for or against the subject project, current or future interests in subject project or future benefits from the project, and paid or unpaid participation in litigation against the USACE and/or DOTD or the Designer of Record.

The Geotechnical Engineer panel member shall serve as the panel lead and shall have a minimum of 15 years of experience in the specific field of levee engineering in evaluating, designing, and constructing large levees embankments; and with a minimum MS degree or higher in engineering is preferred. Geotechnical panel member experience shall be in soil compaction and earthwork construction; soil mechanics; seepage and piping; landslide and slope stability evaluations; bearing capacity and settlement; and foundation inspection and assessment. The Geotechnical panel member shall have knowledge and experience in the forensic investigation of seepage, settlement, stability, and deformation problems associated with embankments constructed on foundations with soft soils. The Geotechnical panel member shall have familiarity with preparing plans and specifications for levee embankment and levee rehabilitation projects. The Geotechnical panel member shall also have knowledge of best practices regarding levee design and construction procedures and policies.

The Geotechnical panel member shall have recent and relevant experience on multi-million dollar projects verifying the constructability of the proposed designs and then verifying that these projects were being constructed per the plans and specifications.

The Structural Engineer panel member shall have a minimum of 15 years of experience evaluating levee structural elements with emphasis on USACE design regulations; and with a minimum MS degree or higher in engineering is preferred.

The SAR Panel shall:

- Conduct the review in a timely manner in accordance with the project and SAR Plan schedule;
- Follow the "charge", but when deemed appropriate by the panel lead, feel free to request other products relevant to the project and purpose of the review;
- Receive from the USACE any public written and/or oral comments provided on the project;
- Provide timely written and oral comments throughout the development of the project as requested;
- Submit reports in accordance with the review plan milestones; and
- The panel lead shall be responsible for ensuring comments represent the group, be non- attributable to individuals and where there is lack of consensus and note the non-concurrence and reasoning.

5. SAR Review Panel Expertise

Per EC 1165-2-214, selection of expert reviewers for SAR efforts will adhere to the National Academy of Science (NAS) Policy on Committee Composition and Balance and Conflicts of Interest. Prior to submitting the SAR panel for approval, the LaDOTD shall obtain a statement from the panel members indicating willingness to participate and the absence of a conflict of interest (COI). LaDOTD will require the proposed panel members to submit the NAS COI form for the sole purpose of validating that there is no conflict of interest. If necessary, panel members will be replaced during a review if a conflict arises. All potential reviewers carry professional and personal biases, and it is important that these biases be disclosed when reviewers are considered and selected.

Panel members shall be registered professional engineers in the United States. The reviewers must have an engineering degree. A master's degree in engineering is preferred, but not required. Hands-on, relevant engineering experience in the listed disciplines is critical. The panel members shall have a minimum fifteen years' experience in each of their respective fields.

6. Comment Tracking

The SAR Panel will provide written comments and recommendations to the LaDOTD and design team for response. Based on a panel review of the design team responses, the issues raised will be closed for items resolved satisfactorily or remain open for unresolved items.

Upon completion of each stage of the review, the panel lead shall prepare a response detailing any actions undertaken or not taken in response to the comments.

Comments that lack consensus shall be clarified to explain the non-concurrence. All comments shall be addressed.

7. Schedule and Costs

The SAR team will be allowed approximately two (2) weeks to complete the Design Phase SAR, once team members have been selected and approved. Included in this time period, is a one (1) day workshop for the team to review the plans and ask questions of USACE, DOTD, and designer of record. The design of LA-1 T-Wall project is currently at or near 95% complete, and it is anticipated that once the review plan and the review team have been approved the SAR will begin shortly thereafter.

After completion of the Design Phase SAR, it is anticipated that the 50% construction review will begin within 18 months.

The SAR panel has the option to request additional review time warranted and reasonable. In advance of each review, LaDOTD and/or design team will prepare an agenda including important topics, questions for the panel, etc., as well as provide and supporting reports and/or project briefing materials.

The estimated cost of the SAR's is between $40,000 and $50,000.

8. Adequacy of the SAR

The information provided in this SAR Plan demonstrates LaDOTD's effort to ensure good science and sound engineering, as well as public health, safety and welfare are the most important considerations for the LA-1 T-Wall project. The planned actions outlined in this document satisfy the intent of EC 1165-2-216 and 33 USC 408. This SAR Plan is a living document and may be modified in the future as warranted.

9. Proposed SAR Panel Roster

The SAR Panel listed below is accurate for the initial submittal, but may be updated in the future when the project progresses to the next phase of review. Resumes for the SAR Panel members are included as part of this appendix.

SAR Panel Roster	
Role	**Name**
Geotechnical Engineer and Panel Lead	R. Jay Mazzoni, P.E.
Geotechnical Engineer	Alan F. Rauch, PhD., P.E.
Structural Engineer	Bob Tucker, P.E.

R. Jay Mazzoni PE

Senior Principal

Jay Mazzoni is a Senior Principal with over 34 years of geotechnical engineering experience. Designs, implements, and reviews geotechnical explorations for Federal clients in diverse geologic settings in Kentucky, Indiana, Louisiana, South Carolina, North Carolina, and Georgia. Experienced in design, analysis, and installation inspection of deep foundations including pressure injected footings, prestressed concrete piles, step-tapered piles, wood piles, auger cast piles, drilled piers, and shallow footing foundations in soil and rock. Oversees field inspection and testing of various construction activities and materials including soil compaction, subgrade stabilization, foundation installation, concrete placement, and hot-mix asphalt. Design experience includes projects using various military requirements such as US Army Technical Manuals and Engineer Manuals, as well as preferences expressed by local US Army Corps of Engineers' Districts and military installations. Familiar with the USACE Quality Management Program, and has performed Quality Control and Quality Assurance activities, including Independent Technical Reviews, on numerous Task Orders.

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EDUCATION

BS, Civil Engineering, University of Louisville, Louisville, Kentucky, 1979

MS, Civil Engineering, University of Louisville, Louisville, Kentucky, 1980

REGISTRATIONS

Professional Engineer #036484, State of Georgia

Professional Engineer #34936, State of Louisiana

Professional Engineer #15042, Commonwealth of Kentucky

Professional Engineer #10607332, State of Indiana

MEMBERSHIPS

Member, Kentucky Geotechnical Engineering Group

Member, Association of State Dam Safety Officials

Member, American Society of Civil Engineers

Member, National Society of Professional Engineers

Member Representative, Society of American Military Engineers, Kentuckiana Post

PROJECT EXPERIENCE

Geotechnical Engineering

Permanent Canal Closures & Pumps, New Orleans, Louisiana (Geotechnical Task Lead)

Jay served as Geotechnical Design Lead for this $615 million design-build project to construct permanent canal closures and pump stations at the mouths of the 17th Street, Orleans Avenue and London Avenue outfall canals. These three main outfall canals in New Orleans are a critical element of the flood control system, serving as drainage conduits into Lake Pontchartrain for much of the city. Oversees the geotechnical design efforts including subsurface exploration with soil test borings and Cone Penetration Testing (CPT), as well as laboratory testing. Manages and provides Quality Control of engineering services including axial and lateral analyses for driven pipe piles and H-piles, settlement, t-induced bending analyses, evaluation of pile load test data, seepage analyses, stability analyses, and levee design.

Civil Works Levee/Floodwall Design, Jefferson, Plaquemines, and St. Charles Parishes, Louisiana (Geotechnical Engineer)

Managed five fast-track New Orleans projects involving levee and floodwall evaluations and retrofit designs. Evaluated existing soil test boring and laboratory test data for soils along the levee/floodwall alignments, and seepage, stability, and settlement analyses for redesigned levee sections. These projects are complicated by the unique soft soils characteristics of southeast Louisiana. Conducted the stability evaluations using stability with uplift (Method of Planes) and Spencer's Method for both circular and non-circular failure surfaces. The design includes preparation of drawings of the new levee section and protected or flood-side stability berms. Evaluated the as-built cross sections of the existing levee to determine the placement of the newly designed sections within the available right-of-way.

R. Jay Mazzoni PE

Senior Principal

Geotechnical Design Report: Algiers Canal Levees, New Orleans, Louisiana (Project Manager)

Jay served as Project Manager for evaluation and retrofit design of over 9 miles of levees in Plaquemines Parish, LA. The projects include evaluation of existing soil test boring and laboratory test data for soils along the levee alignments, and seepage, stability, and settlement analyses for redesigned levee sections. The stability evaluations have been conducted using stability with uplift (Method of Planes) and Spencer's Method for both circular and non-circular failure surfaces. The design includes preparation of drawings of the new levee section and protected- or flood-side stability berms. The as-built cross sections of the existing levee have been evaluated to determine the placement of the newly designed sections within the available right-of-way.

Dover Dam Independent Technical Review, New Philadelphia, Ohio (Quality Control Officer)

Jay provided Independent Technical Review for the Quality Control Plan, Site-Specific Safety and Health Plan, Field Sampling and Analysis Plan and the Sampling and Analysis Report. The project consisted of a Phase II HTRW Investigation and involved sampling soil, groundwater, and sediment along the Tuscarawas River for the Huntington District of the U.S. Army Corps of Engineers.

USACE Levee Periodic Inspections, Various Locations, Kentucky and Indiana (Geotechnical Engineer)

Oversaw 200 miles of levee periodic inspections in Kentucky and Indiana. Managed inspection teams and oversaw quality control of project deliverables, providing regular communication and coordination with USACE personnel and local levee sponsors. Performed Independent Technical Review of pre-inspection packets, including hydraulic, geotechnical, structural, mechanical electrical, and survey datum design criteria reviews. The District used the results as the basis for initial risk assessment screenings of their levee inventory and provide recommendations for levee repairs/upgrades to local levee sponsors.

Watauga Hydroelectric Dam Slope Stability Evaluation, Carter County, Tennessee (Geotechnical Engineer)

Performed ITR of the field investigation and laboratory testing report for the existing earthen embankment to aid in the stability evaluation of the dam. The objective of the field investigation and laboratory testing was to obtain current and representative subsurface information relative to phreatic conditions and properties of materials comprising the dam structure, including the materials underlying the dam. Reviewed historical data, plans for geotechnical explorations, instrumentation installation, and laboratory testing. He evaluated the proposed investigation for conformance with established protocols and in light of historical information and site geology.

Military Infrastructure

Fort Campbell Training Support Center, Fort Campbell, Kentucky (Project Manager)

Jay served as Project Manager for a Full Geotechnical Characterization as part of a Design-Build solicitation. The services on the project included 13 soil test borings and laboratory testing consisting of index tests, California Bearing Ratio (CBR), Proctor moisture-density tests, and unconfined compressive strength tests.

Schriever Air Force Base 310th Wing Headquarters, Schriever Air Force Base, Colorado (Project Manager)

Jay served as Project Manager responsible for geotechnical engineering services for a new 31,000 square foot Headquarters Facility located approximately 20 miles east of Colorado Springs, Colorado. The new facility was to be located on a 5.6-acre, undeveloped site within the controlled perimeter fence but outside the highly restricted security area. The services on the project included soil test borings, laboratory testing, and geotechnical engineering recommendations for site development and the new building. The subsurface conditions included potentially collapsible soils. The geotechnical evaluation included research and specific site development and structural design recommendations to mitigate the effects on these potentially problematic soils.

** denotes projects completed with other firms*

R. Jay Mazzoni PE

Senior Principal

March Air Reserve Base Joint Deployment Facility, March Air Force Base, California (Project Manager)
Jay served as Project Manager responsible for geotechnical engineering services for a new, 41,300 square-foot Joint Regional Deployment facility located in Riverside County, California. The services on the project included soil test borings, laboratory testing, and geotechnical engineering recommendations for site development and the new building on the airside of the existing Base. The geotechnical evaluation included research on nearby geologic faults in the seismically active area and in-depth evaluation of seismic and liquefaction issues.

Fort Knox - Gaffey Hall, Fort Knox, Kentucky (Project Manager)
Jay served as Project Manager for a Full Geotechnical Characterization of the proposed improvements to Gaffey Hall. The project included reconstructing paved parking areas, installing an elevator shaft at Gaffey Hall, and paving an existing gravel parking area. The services on the project included soil test borings, laboratory testing, and geotechnical engineering recommendations for site development and the new buildings.

Fort Benning Armed Forces Reserve Center, Equipment Concentration Site and Tactical Equipment Maintenance Facility, Fort Benning, Georgia (Project Manager)
Jay served as Senior Geotechnical Engineer for a proposed 58,100 square-foot AFRC with a separate 13,400 s.f. Operations Maintenance Shop (OMS), and an Unheated Storage Building located on the east side of the Fort Benning post. The proposed Equipment Concentration Site (ECS) consisted of a 150,000 s.f. warehouse with administrative area and a 37,000 s.f. Tactical Equipment Maintenance Facility (TEMF). The services on the project included 68 soil test borings, laboratory testing, and geotechnical engineering recommendations for site development and the new buildings.

Las Vegas Armed Forces Reserve Center, Las Vegas, Nevada (Project Manager)
Jay served as Project Manager responsible for geotechnical engineering services for a new 79,618 square feet U.S. Armed Forces Reserve Training Center with a separate 16,540 square feet Vehicle Maintenance Shop, and an approximately 4,100 square feet Unheated Storage Building. The services on the project included soil test borings, laboratory testing, and geotechnical engineering recommendations for site development and the new building on a greenfield sites. The geotechnical evaluation included research on nearby geologic faults and in-depth evaluation of seismic and liquefaction issues.

Fort Sam Houston U.S. Army Reserve Training Facility, Fort Sam Houston, Texas (Project Manager)
Jay served as Project Manager responsible for geotechnical engineering services for a new, two story, 76,383 square-foot training facility. The services on the project included soil test borings, laboratory testing, and geotechnical engineering recommendations for site development and new buildings. The subsurface conditions included clay soils with high swell potential, and the geotechnical evaluation included specific recommendations to address these potentially problematic soils.

Hill Air Force Base Squad Ops/AMU Facility, Hill Air Force Base, Utah (Project Manager)
Jay serves as Project Manager responsible for geotechnical engineering and surveying services for a new 12,250 square feet Reserve Squad Operations / Aircraft Maintenance Unit (AMU) facility for the Air Force Reserve. The proposed site is located within the controlled perimeter of Hill Air Force Base in Davis County, Utah. The services on the project include surveying of existing site conditions, soil test borings, laboratory testing, and geotechnical engineering recommendations for site development and new buildings.

Fort Knox Replacement High School, Fort Knox, Kentucky (Project Manager)
Jay served as Project Manager for the geotechnical exploration and survey at the proposed new high school site. Jay designed the light duty and heavy duty pavement sections using PCASE and the requirements of the Department of the Army publication TM 5-822-5 entitled Pavement Design for Roads Streets, Walks and Open Areas. The Louisville District's preferred pavement section minimum thicknesses, crushed stone base material types and specifications for subgrade preparation and density were incorporated into the design.

** denotes projects completed with other firms*

Alan F. Rauch PhD, PE

Senior Geotechnical Engineer - Coal Combustion Byproduct Management

Dr. Alan Rauch specializes in geotechnical and dam engineering, with over 24 years of professional experience. He serves as the Discipline Lead for Stantec's U.S. Geotechnical practice, where his duties include advanced analyses, design development, project execution, and quality assurance. Prior to joining Stantec, he was a professor at the University of Texas at Austin.

Dr. Rauch's technical expertise and work experience includes the design and evaluation of dams and levees, stability of coal ash disposal facilities, liquefaction-induced ground deformations in earthquakes, seismic engineering, numerical analysis of geotechnical engineering problems, seepage and slope stability evaluations, and in situ ground improvement. Led the innovative development of a new engineering method for estimating embankment deformation when the underlying foundation soil liquefies in an earthquake, a tool implemented by USACE for the probabilistic assessment of risk at dams and levees nationwide. His laboratory and field experience includes testing of geotechnical structures, geotechnical materials, and in situ soil deposits. He has published and presented numerous technical papers. In 2012, Dr. Rauch was named a national Top 25 Newsmaker by ENR magazine for his role as the lead engineer for the seismic design of the re-built coal ash storage facility at TVA's Kingston Plant.

EDUCATION

PhD, Civil Engineering, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 1997

MS, Civil Engineering, Ohio University, Athens, Ohio, 1990

BS, Civil Engineering, Ohio University, Athens, Ohio, 1986

Unsaturated Soils in Engineering Practice, ASCE GeoInstitute, Denver, Colorado, 2000

Risk and Uncertainty Training, RAC Engineers and Economists, Louisville, Kentucky, 2008

Leadership Development Program, PSMJ Resources, Lexington, Kentucky, 2007

Project Management Training, PSMJ Resources, Lexington, Kentucky, 2006

Drilled Shaft Foundations and Anchored Geo-support, Association of Drilled Shaft Contractors, Fort Collins, Colorado, 2000

REGISTRATIONS

Professional Engineer #102989 (Inactive), Texas Board of Professional Engineers

Professional Engineer #113982, State of Tennessee

Professional Engineer #22874, State of Oklahoma

Professional Engineer #23934, Commonwealth of Kentucky

MEMBERSHIPS

Member Representative, Society of American Military Engineers, Huntington Post

Member, Kentucky Geotechnical Engineering Group

Member, Association of State Dam Safety Officials

Member, United States Society on Dams

Member, American Society of Civil Engineers

AWARDS

2012 Top 25 Newsmaker, Engineering News-Record Magazine

** denotes projects completed with other firms*

Alan F. Rauch PhD, PE

Senior Geotechnical Engineer - Coal Combustion Byproduct Management

2007 Fourth Outstanding Paper Award, "Seismic risks to the seepage cutoff wall at Clearwater Dam", United States Society on Dams, Philadelphia, Pennsylvania

2001 Faculty Services Award, Graduate Engineering Council, The University of Texas at Austin

2000 Engineering Foundation Young Faculty Award, College of Engineering, Then University of Texas at Austin

1992 Via Doctoral Fellowship, Department of Civil Engineering, Virginia Polytechnic Institute and State University

1986 Stocker Graduate Fellowship, College of Engineering, Ohio University

PROJECT EXPERIENCE

Geotechnical Engineering

Skiatook Dam Investigation Sloughing of Outlet Channel, Phase 1: Instrumentation Installation, Testing, Monitoring and Analysis, Skiatook Lake, Oklahoma (Technical Project Manager)

The concrete-lined spillway at Skiatook Dam was cut through a natural ridge on the right abutment of the dam. Significant surficial sloughing and retrogressive landslides have since developed in the overburden soils on both sides of the spillway. Together with a geotechnical exploration program, an array of fully grouted piezometers was installed with inclinometer casings in rock. The data collected over the subsequent six months was used to ascertain the sliding mechanisms and the hydrogeology of the site. Dr. Rauch was responsible for the technical oversight of the investigation and engineering analyses.

Seepage and Stability within the Abutment of Winfield Lock and Dam, Winfield, West Virginia (Senior Geotechnical Engineer)

Located on the Kanawha River, Winfield Dam is a gated navigation structure completed in 1937. A hydroelectric power plant is located on the left abutment of the dam. Significant seepage water exits the river bank downstream of the power plant, creating concern that erosive flows and high pore pressures could undermine the stability of the soil slope. A program of soil explorations, piezometer installation, and water testing was initiated to understand the source and path of this seepage water. Integration of this diverse field data with knowledge of the geologic setting was key to understanding the seepage mechanism and potential consequences. Concepts for remediating the riverbank seepage and stability conditions were developed. Dr. Rauch served as Project Manager and Technical Lead for this study.

Clearwater Dam Seismic Performance Assessment, Wayne County, Missouri (Senior Geotechnical Engineer)

Clearwater Dam is a 150-ft tall earth embankment dam located near the New Madrid seismic zone. A seismic evaluation of the dam was undertaken to support the design of a seepage cutoff wall. The dam is built on a gravelly alluvium that is prone to liquefy and difficult to characterize using conventional methods. Dr. Rauch evaluated the liquefaction potential of the foundation materials, assessed the stability of the dam following the design earthquake, and led the effort to comprehensively document the study results.

Development of a Simplified Tool for Assessing the Deformation of Embankment Dams and Levees on Liquefied Soils (Senior Geotechnical Engineer)

Dr. Rauch led the innovative development of a new engineering method for estimating the deformation of embankments when the underlying foundation soil liquefies in an earthquake. Using a custom-built FLAC model, thousands of parametric numerical simulations were completed to predict deformations in various cross sections with a range of soil strengths. Using regression techniques, simplified algebraic equations were then fit to the results. The resulting method implemented as a tool for the probabilistic assessment of risk at Corps of Engineers dams and levees nationwide.

** denotes projects completed with other firms*

Alan F. Rauch PhD, PE

Senior Geotechnical Engineer - Coal Combustion Byproduct Management

Canton Dam Safety Assurance Project, Canton, Oklahoma (Senior Geotechnical Engineer)

Seepage and seismic evaluations of the 2.7-mile long Canton Dam. The embankment has exhibited substantial underseepage since the project was completed in the 1940s. Seepage pressures drain through a line of relief wells along the toe of the embankment. Using data from the drainage system and finite element modeling, Dr. Rauch assessed the current conditions and the potential for soil piping, recommended pool restrictions related to target safety margins, and suggested specific actions to improve the safety of the dam. While seismic hazards in the region are low, the foundation soils under the dam are susceptible to liquefaction in the maximum credible earthquake scenario. With the goal of improving the dam's seismic performance, spoil from a new spillway excavation is being placed in a stabilizing berm along the downstream toe of this 2.7-mile long embankment dam. Dr. Rauch directed efforts to analyze the subsurface conditions, quantify the potential for soil liquefaction, and estimate the likely deformations of the embankment with the new toe berm in place.

Keystone Dam - Dam Safety Assurance Project (DSA), Sand Springs, Oklahoma (Senior Geotechnical Engineer)

Keystone Dam is a 120-ft high embankment dam, with a concrete gravity spillway section, located on the Arkansas River just upstream of Tulsa, Oklahoma. With high economic, environmental, and life risks downstream, dam safety investigations were initiated to better understand conditions deep within the embankment. A key focus was the potential for soil erosion due to high hydraulic gradients along and below the core trench, and through rock in the dam abutments. Dr. Rauch played a key role in planning and managing the soil boring program and piezometer installations, completed in three separate project phases. Data from the instruments were collected and analyzed to evaluate seepage conditions within the dam.

Zoar Levee and Diversion Dam Expert Elicitation, Tuscarawas County, Ohio (Senior Geotechnical Engineer)

Built to protect the historic village of Zoar from flooding, the levee and diversion dam have experienced uncontrolled seepage and soil piping during past high water events. Expert elicitation was used to quantify the annual failure risks to these earth embankment structures, due to seepage through fissures in the underlying bedrock. The results were used by the Corps of Engineers to make risk-informed decisions for rehabilitating Zoar levee and diversion dam. Dr. Rauch assembled key background information, organized the elicitation meetings, served as an expert on the panel charged with evaluating risks, and documented the project findings.

Seepage Mitigation at Douglas Saddle Dams, Sevier County, Tennessee (Principal)

TVA's Douglas Dam project includes ten saddle dams along the western rim of the reservoir. Each one is a homogeneous embankment dam underlain by steeply dipping, thinly laminated shale bedrock. Under flood pool conditions, seepage through the shale could cause soil heaving at the toe of the downstream slopes. The ten saddle dams were carefully evaluated for this potential failure mode. Weighted berms of graded stone were constructed to provide additional stability to four of the structures. At the tallest saddle dam, 14 deep relief wells were installed to address artesian pressure conditions. Asphalt paving and extensions to a concrete floodwall were also needed to raise the crest at three of the saddle dams. Dr. Rauch provided technical oversight for the analyses, developed seepage models and methods for quantifying the factor of safety for soil heaving, and lead the design effort for mitigations at five of the saddle dams. The analyses and design efforts were expedited to meet project requirements.

Kentucky River Lock and Dam No. 9 Engineering Services, Madison and Jessamine Counties, Kentucky (Senior Geotechnical Engineer)

Dr. Rauch was a lead designer for renovations to this 100-year old facility. A concrete-filled, cellular sheet pile structure was built adjacent to the existing lock and dam. The new dam and abutment structures were designed to permit construction without extensive dewatering of the work site. Other distinctive features include the use of massive precast concrete blocks for scour protection, a drilled shaft abutment structure, and a permanent three-pipe siphon.

** denotes projects completed with other firms*

Alan F. Rauch PhD, PE

Senior Geotechnical Engineer - Coal Combustion Byproduct Management

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Tennessee Valley Authority Hydroelectric Dam Evaluation Program, Various, Tennessee, Georgia, and Alabama (Principal)

A comprehensive review of embankment dam stability was completed for the Tennessee Valley Authority. Ten dams were evaluated over two years: Chatuge Dam, South Holston Dam, Nottely Dam, Douglas Dam, Watauga Dam, Tims Ford Dam, Nickajack Dam, Little Bear Creek Dam, Upper Bear Creek Dam, and Cedar Creek Dam. The study included field explorations, laboratory testing, seepage modeling, slope stability analyses, liquefaction assessments, and seismic analyses. Each structure was evaluated for normal operating conditions, flood pool loadings, rapid drawdown, and earthquake performance. Dr. Rauch planned and established methods of analysis, developed guidance documents for the engineering teams, resolved technical issues, and provided overall technical review of the project findings.

Kentucky River Dam No. 3 and Lock Nos. 3 and 4, Franklin and Owen Counties, Kentucky (Senior Geotechnical Engineer)

Dr. Rauch led efforts to characterize the existing conditions at these 170-year old timber, stone masonry, and concrete facilities. Extensive geotechnical explorations and testing of rock core was completed. He then led the design effort for a replacement dam, which will consist of a concrete-filled, cellular sheet pile structure, which can be constructed without extensive dewatering. Unique features of the design include a cast-in-place concrete connection between the new dam and the historic lock wall, and a steel master pile system with lightweight fill that forms a downstream training wall.

Portfolio Assessment of Seismic Risks at Coal Combustion Residual Storage Facilities, Various Locations, Kentucky, Tennessee and Alabama (Senior Geotechnical Engineer)

TVA operates coal-fired power plants at 11 sites in Tennessee, Kentucky, and Alabama. Combustion byproducts (typically fly ash) are currently stored in wet impoundments at each of these power plants. TVA is planning to close these storage facilities, but needs to understand the risks associated with the seismic hazards at each site. Dr. Rauch led the effort to develop an assessment methodology, evaluate each coal combustion product storage facility within TVA's portfolio, and quantify the seismic risks (probability and consequences of failure) after closure. TVA is using the study results to support key decisions regarding the need to mitigate seismic risks in the design for closure of each facility.

Centrifuge Model Tests of Embankments Built over Saturated Ash, Vicksburg, Mississippi (Principal)

When embankments are built across old deposits of saturated coal ash, the pore pressures induced in the ash can trigger a massive failure. The stability during construction will depend on how rapidly the embankment is built, how quickly the excess pore pressures can drain, and the undrained strength of the ash. To better understand the conditions that lead to failure, three scale models were built and tested in the world's most powerful geotechnical centrifuge, at the US Army Corps of Engineers Centrifuge Research Center. When spun to high accelerations, a small embankment is subjected to the same stress levels as a full scale embankment in the field. The scale models included a 6.5-inch tall sand embankment built over 6 inches of saturated ash. An air bladder on top of the sand was used to rapidly impose additional load. Instrumentation recorded deformations and pore pressure buildup in the ash. This research project was funded by the Electric Power Research Institute.

Kingston Fossil Plant, Dredge Cell Closure, Harriman, Tennessee (Senior Geotechnical Engineer)

Using slurry wall methods, a stabilized perimeter is being constructed around the two-mile circumference of the coal ash landfill at TVA's Kingston, Tennessee, facility. The landfill is being built within the footprint of the ash impoundment that experienced a catastrophic, static liquefaction failure in December 2008. When complete, the new capped facility will contain roughly 12 million cubic yards of coal ash produced by the power plant over the last six decades, including ash recovered from the 2008 failure. The closed facility is designed to meet current regulatory requirements, and must withstand a 2,500-year seismic event. The lower deposits of coal ash will remain saturated and, like the deeper alluvial sands beneath the site, will liquefy in the design earthquake. The stabilized perimeter, consisting of a grid of walls beneath a new perimeter berm, will buttress the ash embankment and retain the liquefied ash under dynamic loading. As the Engineer of Record for the design, Dr. Rauch led Stantec's efforts to characterize the soil and ash materials and then analyze the disposal facility for seismic performance. A sophisticated, dynamic numerical simulation of the facility was completed for the design earthquake event, in addition to conventional ground response, liquefaction, slope stability, and 3D structural analyses. To meet the challenging schedule of the five-year project, the design is being completed in segments concurrent with construction. Dr. Rauch is also responsible for verification of construction quality, delineation of unacceptable wall sections.

** denotes projects completed with other firms*

Alan F. Rauch PhD, PE

Senior Geotechnical Engineer - Coal Combustion Byproduct Management

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Savannah River Site Cone Penetrometer Testing Services*, Savannah River Site, South Carolina (Geotechnical Engineer)

In situ testing work to investigate the foundation soils beneath existing nuclear facilities, and for characterizing deep foundation conditions at the site of a planned, new nuclear reactor. In addition to conventional cone penetrometer test parameters, this investigation used down-hole shear wave testing to characterize the seismic response of the in situ soils. Test depths exceeded 150 ft, with one exploration pushed to 280 ft.

Cone Penetrometer Testing Services*, Nationwide (Geotechnical Engineer)

Geotechnical site characterization work using the cone penetrometer test at numerous project sites located across the U.S. Supervised fieldwork, analyzed test data, and prepared final project reports. Designed, manufactured, and tested a state-of-the-art cone penetrometer probe and a prototype, push-in ground penetrating radar antenna module.

** denotes projects completed with other firms*

Alan F. Rauch PhD, PE

Senior Geotechnical Engineer - Coal Combustion Byproduct Management

PUBLICATIONS

"Recovery at Kingston". *Power Engineering, Vol. 118, No. 2*, 2014.

"Seismic design of perimeter slurry walls for the Kingston coal ash pond closure". *Proceedings of the 33rd Annual United States Society on Dams Conference*, 2013.

"Closure of the failed ash dredge cell at Kingston – The engineering challenge". *Proceedings of the 2013 World of Coal Ash Conference*, 2013.

"Simplified Estimation of Seismic Deformation for Risk Analysis". *The Sustainability of Experience - Investing in the Human Factor, Proc., 28th Annual USSD Conf, United States Society on Dams*, 2008.

"Creep of compacted recycled asphalt pavement". *Canadian Geotech*, 2007.

"Liquefaction under dams and levees: Back-of-the-envelope predictions of deformation". *Proceedings of Dam Safety 2007 - ASDSO*, 2007.

"Embankment load tests on an active ash basin". *Proceedings of the World of Coal Ash 2007 Conference*, 2007.

"Seismic risks to the seepage cutoff wall at Clearwater Dam". *Modernization and Optimization of Existing Dams and Reservoirs, Proceedings of the 27th Annual United States Society on Dams Conference*, 2007.

"Liquefaction potential assessment of gravelly foundation soils at Clearwater Dam". *Dynamic Response and Soil Properties, Proceedings of Geo-Denver 2007*, 2007.

"Components of suction caisson capacity measured in axial pullout tests". *Ocean Engineering*, 2005.

"Creep behavior of recycled asphalt pavement backfill". *Proceedings of the 16th International Conference on Soil Mechanics and Geotechnical Engineering*, 2005.

"Compaction control of crushed concrete and recycled asphalt pavement using nuclear gauge". *Proceedings of the ASCE Geo-Institute Conference on Geotechnical Engineering for Transportation Projects*, 2004.

"Measured horizontal capacity of suction caissons". *Paper No. OTC 16161 Proceedings of 2004 Offshore Technology Conference*, 2004.

"A practical method for predicting expansive soil behavior". *Proceedings of the ASCE Geo-Institute Conference on Geotechnical Engineering for Transportation Projects*, 2004.

"Automated quality assessment of stone aggregates based on laser imaging and a neural network". *Journal of Computing in Civil Engineering*, 2004.

"Performance evaluation of automated machines for measuring gradation of aggregates". *Geotechnical Testing Journal*, 2003.

"Shear and interface strength of clay at very low effective stress". *Geotechnical Testing Journal*, 2003.

Alan F. Rauch PhD, PE

Senior Geotechnical Engineer - Coal Combustion Byproduct Management

"Components of suction caisson capacity measured in axial pullout tests". *Proceedings of OTRC 2003 International Symposium: Deep Water Moorings; Concepts, Design, Analysis and Materials*, 2003.

"Behavior of suction caissons measured in laboratory pullout tests". *Paper No. OMAE2003-37023, Proceedings of 22nd International Conference on Offshore Mechanics and Arctic Engineering*, 2003.

"Comparison of the dynamic properties and undrained shear strengths of offshore calcareous sand and artificially cemented sand". *Paper No. OMAE2003-37091, Proceedings of 22nd International Conference on Offshore Mechanics and Arctic Engineering*, 2003.

"Image texture based quality control of aggregate production". *Proceedings of 11th Annual Symposium, International Center for Aggregates Research*, 2003.

"Measured response during laboratory installation of suction caissons". *Proceedings of 13th International Offshore and Polar Engineering Conference*, 2003.

"Soil reconsolidation following the installation of suction caissons". *Paper No. OTC 15263, Proceedings of 2003 Offshore Technology Conference*, 2003.

"3D image segmentation of aggregates from laser profiling". *Computer-Aided Civil and Infrastructure Engineering*, 2003.

"Self-weight consolidation of large laboratory deposits of clay". *Proceedings of 12th Panamerican Conf. Soil Mechanics and Geotechnical Engineering*, 2003.

"Artificial intelligence based quality control of aggregate production". *Proceedings of 19th International Symposium on Automation and Robotics in Construction*, 2002.

"Wavelet-based 3D descriptors of aggregate particles". *Geomaterials 2002, Transportation Research Record No. 1787*, 2002.

"Dimensional ratios for stone aggregate from three-dimensional laser scans". *Journal of Computing in Civil Engineering*, 2002.

"Liquid soil stabilizers: Measured effects on engineering properties of clay". *Geomaterials 2002, Transportation Research Record No. 1787*, 2002.

"Hydraulic Conductivity and Drained Strength of Recycled Asphalt Pavement and Crushed Concrete". *Proceedings of the Texas Section ASCE Spring Meeting*, 2002.

"The laser-based aggregate scanning system: Current capabilities and potential developments". *Proceedings of 10th Annual Symposium, International Center for Aggregates Research, Baltimore, Maryland*, 2002.

"DEM study of wave propagation in weak sandstone". *3rd International Conference Discrete Element Methods*, 2002.

Alan F. Rauch PhD, PE

Senior Geotechnical Engineer - Coal Combustion Byproduct Management

"Predicting the maximum and distribution of displacements on liquefaction-induced lateral spreads". *Paper No. 4.18, Proceedings of the 4th International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics*, 2001.

A prototype laser scanner for characterizing size and shape parameters in aggregates". *Proceedings of the 9th Annual Symposium, International Center for Aggregates Research*, 2001.

"Innovative system for scanning construction aggregates using laser profiling". *Proceedings of the 17th International Symposium on Automation and Robotics in Construction*, 2001.

"A prototype laser scanner for characterizing size and shape parameters in aggregates". *Proceedings of 9th Annual Symposium, International Center for Aggregates Research, Austin, Texas*, 2001.

"Mechanisms of soil stabilization with a liquid ionic stabilizer". *Geomaterials 2001, Transportation Research Record No. 1757*, 2001.

"Toward the Design of New Technologies for Deep-Water Construction Aggregate".. *Proceedings of the 11th International Offshore and Polar Engineering Conference, ISOPE-2001*, 2001.

"Development of a laser-based system for testing construction aggregate". *Proceedings of the 18th International Symposium on Automation and Robotics in Construction*, 2001.

"A laboratory facility for testing model suction caissons". *Proceedings of the OTRC 2001 International Conference on Geotechnical, Geological and Geophysical Properties of Deepwater Sediments*, 2001.

"Comparison tests of automated equipment for analyzing aggregate gradation". *Proceedings of the 9th Annual Symposium, International Center for Aggregates Research*, 2001.

"EPOLLS model for predicting average displacements on lateral spreads.". *Journal of Geotechnical and Geoenvironmental Engineering*, 2000.

"Laboratory correlation of liquefaction resistance with shear wave velocity". *ASCE Geotechnical Special Publication No. 110, Computer Simulation of Earthquake Effects, Proceedings of Geo-Denver 2000*, 2000.

"Technical aspects of implementing rapid aggregate gradation". *Proceedings of the 8th Annual Symposium, International Center for Aggregates Research*, 2000.

"State of the art in aggregate classification: Review of aggregate gradation technologies". *Proceedings of 7th Annual Symposium, International Center for Aggregates Research, Austin, Texas*, 1999.

"EPOLLS prediction of permanent ground deformation resulting from laterial spreading". *Proceedings of 5th U.S. Conference on Lifeline Earthquake Engineering, Seattle, Washington*, 1999.

"Behavior of deeply corrugated steel plate in culvert". *Journal of Structural Engineering*, 1994.

"Performance of a deep-corrugated steel, box-type culvert". *Journal Geotechnical Engineering*, 1993.

"Undrained triaxial compression behavior of saturated Indiana Limestone". *Proceedings of the 3rd International Conference on Constitutive Laws for Engineering Materials: Theory and Applications*, 1991.

"Instrumentation of deep corrugated steel box culverts". *Modern Geotechnical Methods: Instrumentation and Vibratory Hammers, Transportation Research Record No. 1277*, 1990.

"Determination of hyperbolic soil model parameters for sand using a multiaxial device". *Proceedings of the 3rd International Symposium on Numerical Models in Geomechanics (NUMOG III), Elsevier Science Publishers, New York*, 1989.

Bob Tucker PE

Senior Structural Engineer

Robert "Bob" Tucker delivers more than 30 years of experience, the majority of which was with the U.S. Army Corps of Engineers, related to the assessment, planning, and design of structures. Areas of expertise include the investigation and design of the structural aspects of hydraulic structures, bridges, gravity pipe systems and culverts, and military structures. He has been directly involved with the design of enhancements, repairs, and upgrades of a variety of structures. His career has involved him as Senior Structural Engineer and Team Leader of several regional flood control and numerous municipal flood protection projects. Details of his project involvement include: the preparation of design and analysis calculations, the technical oversight of junior structural engineers, coordination with design team members of other disciplines, and liaison with cost-share sponsors, state departments of transportation and the FHWA, and municipal utility providers. Bob typically designs features that include gated hydraulic structures, pumping stations of various configurations and sizes, project service bridges, large and irregular culvert and pipe systems, and a variety of floodwalls and earth retaining structures types. He also conducts bridge inspection and load ratings, independent technical reviews, shop drawing review, and coordination with, and technical assistance to, field personnel during construction. Bob maintains a working proficiency with industry standard software programs such as Bentley MicroStation, RISA3D, and various USACE CASE programs.

EDUCATION

M.S. Structural Engineering, Mississippi State University, Starkville, Mississippi, 1998

B.S. Civil Engineering, University of South Florida, Tampa, Florida, 1983

CERTIFICATIONS & TRAINING

Certification, FHWA Certification for Safety Inspection of In-Service Highway Bridges, Deerfield Beach, Florida, 1998

Certification, Bridge Inspection Refresher Training, Seattle, Washington, 2007

Certification, INDOT Certified Bridge Inspection Team Leader, Atlanta, Georgia, 2014

REGISTRATIONS

Professional Engineer #25690, Commonwealth of Kentucky

Professional Engineer #11400206, State of Indiana

Professional Engineer #76853, State of Florida

Professional Engineer #29166, State of Colorado

AWARDS

2010 Dam Safety Team of the Year, Canton Dam Safety Assurance Project, U.S. Army Corps of Engineers

2005 Professional Engineer of the Year, Tulsa District, U.S. Army Corps of Engineers

PROJECT EXPERIENCE

Flood Control and Drainage Management

Metro Floodwall Relocation*, Louisville, Kentucky (Senior Structural Engineer)

This project involved the realignment design of a section of the downtown floodwall consisting of five concrete I-wall monoliths. Realignment was necessitated by bridge foundation construction in the area. The monoliths were replaced with a concrete clad sheetpile I-wall structure meeting USACE latest design and construction standards.

Duck Creek IVC Local Flood Protection Project*, Cincinnati, Ohio (Structural Team Leader)

Led the design for the structural aspects of this project including the main protection line concrete clad I-wall system, a 20' x 8' x 900 LF culvert system including inlet and outlet frame structures, the upper inlet structure U-frame and I-wall system, several concrete T-wall monoliths, and a variety of other miscellaneous structures. Achieved significant cost savings by incorporating closed-cell extruded polystyrene foam in the flutes of the sheetpile behind the cladding and thereby reducing the amount of shotcrete required.

** denotes projects completed with other firms*

Bob Tucker PE

Senior Structural Engineer

Duck Creek IVB Local Flood Protection Project*, Cincinnati, Ohio (Senior Structural Engineer)
Led structural engineering work during pre-bid continuing through construction completion. Made significant structural design changes and additions to the original project including the complete redesign of a large diameter elliptical RCP drainage system with a gated outlet structure incorporated into the T-wall floodwall system.

North Indianapolis IIIB White River Flood Protection Project*, Indiana (Structural Team Leader)
Lead Structural Designer for the structural aspects of the project including four sluice gate structures, four pumping stations, several large diameter (up to 11'-0" ID) RCP pipe systems, 4200 LF of concrete clad sheetpile I-walls, several T-wall monoliths, and a variety of other miscellaneous structures.

Anderson White River Flood Protection Project*, Indiana (Structural Team Leader)
Lead Structural Engineer on this local flood damage reduction project. Structures included 427 LF of concrete I-wall coupled with sheetpile and installed in problematic soil conditions and severely sloped locations, segmental block retaining walls, interface with existing bridge abutments, floodwall personnel egress gates, and gate valve structures.

Holes Creek Flood Protection Project*, West Carrollton, Ohio (Structural Team Leader)
Lead Structural Engineer for the design of the flood protection system for the city of West Carrollton, Ohio. Project included significant concrete clad sheetpile I-wall design including two auger-pile founded T-wall structures required for large diameter buried RCP penetration of the protection line.

Canton Lake Auxiliary Spillway*, Oklahoma (Structural Team Leader)
Due to an assessed hydraulic deficiency (the potential for PMF overtopping), a fuse-gated auxiliary spillway and channel was designed to increase the discharge capacity of Canton Lake, Oklahoma. Served as Structural Project Manager for the concept and early design phase through 2007 and, later, Structural Team Leader for the diaphragm wall remediation project, the highway bridge, and the wet well structure. Phase I construction of this project was completed in November 2014. When Phase 2 is completed in 2017, the Canton Lake Dam Auxiliary Spillway will be one of the largest fuse-gated spillway in the world.

Meadowbrook Flood Protection Project*, Lawton, Oklahoma (Structural Engineer)
Structural Engineer of Record for the design of the flood protection system for the city of Lawton, Oklahoma. Structural facets included a three barrel highway culvert, a large capacity inlet structure, various non-standard roadway drop inlets, and numerous ancillary structures.

Arkansas City Flood Protection Project*, Kansas (Senior Structural Engineer)
Senior Structural Engineer for the design of the flood protection system for the city of Arkansas City, Kansas. The project structural requirements included three sluice gated gravity drainage structures, a spillway, the refurbishment of a circa 1940 pumping station, an access bridge, and numerous secondary structures.

Augusta Flood Protection Project*, Kansas (Senior Structural Engineer)
Senior Structural Engineer for the design of the flood protection system for the city of Augusta, Kansas. Structural facets included a four sluice gate gravity drainage structure, a spillway, T-wall type floodwall monoliths, and three road closure structures.

50'-0" Stop Log Lift-Beam, Robert S. Kerr Lock & Dam Maintenance Area*, Oklahoma (Structural Engineer)
Structural Engineer for the design of the 50-foot stop log lift beam for use on the McClellan–Kerr Arkansas River Navigation System. The users had requested a design less prone to pickup actuation problems and permanent beam deformation due to racking in the stop log slots. The design provided eliminated or greatly reduced these issues.

Red River Basin Chloride Control Project*, Texas (Senior Structural Engineer)
This project was designed to control natural chloride brine emissions at ten major source areas to improve water quality for municipal, industrial, and agricultural use. Improvements included the design and construction of low flow dams, pump stations, and diversion pipelines to impoundment facilities. Served as Project Structural Engineer for phases 9 and 10 of this multi-phase project.

** denotes projects completed with other firms*

Bob Tucker PE

Senior Structural Engineer

Sicily Island Bayou Pumping Station Project*, Louisiana (Structural Engineer)
Primary Structural Engineer for the design of the pumping station portion of this $10 million project located in the Tensas Basin area of Louisiana. The twin-diesel operated 750-CFS pumping station included two 13,500 HP diesel engines, a service bridge, a 10-ton capacity bridge crane, a twin 48-inch diameter steel pipe system, and numerous ancillary features.

W.D. Mayo Lock and Dam Navigation Miter Gate Rehabilitation*, Oklahoma (Structural Engineer)
This project comprised a complete rehab of the downstream miter gates consisting of quoin and seal replacements, hundreds of weld repairs, replacement of dozens of secondary structural members, and sand blasting and painting of the entire structure. Much of the work was done during an abbreviated (12 day) de-watered timeframe required to limit the closure downtime of the navigation system. Structural Design Engineer who performed the in-depth condition investigation of the gate, recording (as to location, type, and extent) and photographing hundreds of deficiencies, designed the necessary repairs, coordinated with River transportation authority officials and the contractor to minimize the navigation project down-time, and provided technical support during construction.

Bayou Rapides Pumping Station*, Alexandria, Louisiana (Structural Engineer)
One of three Principal Structural Design Engineers of the combined pumping station and gravity drainage structure replacing an obsolete station located in downtown Alexandria, Louisiana. This structure, covered as the lead story of the October 7, 2002 issue of "Construction News," magazine, included several innovative types and methods of construction for this type of structure including a U-frame configuration and the use of soil-nailed tie-backs in soft soils for the braced excavation and permanent wing walls.

Swan Lake Environmental Management Program, Pool 26*, Calhoun County, Illinois (Project Team Leader)
Team Leader for the design of two combination bridge-gate structures that involved cellular sheet pile abutments, pre-stressed concrete plank bridge structures, precast gate sills for underwater construction, and a slide gate system integral with the bridge structure. The project also included two pumping stations and ancillary structures.

Columbia Lock & Dam, Ouachita River*, US 165 Columbia, Louisiana (Structural Engineer)
Assisted in the design of the heat straightening repair of the main strut and strut bracing of a tainter gate damaged as a result of a barge impact. Significant cost saving were realized as a result of utilizing this FHWA approved technique.

Arkansas City Hwy 77 Bypass Levee Sluice Gate Assessment*, Kansas (Senior Structural Engineer)
Provided the structural assessment of a 1930 era 84-inch diameter sluice gate structures which had been experiencing major serviceability issues in addition of exhibiting extensive structural distresses. As no record drawings were available, the assessment included a site investigation which included the development of detailed dimensioned drawings. The project further included an analysis of the capacity of the structure with regards to its diminished condition, a written report to the owner, and coordination with USACE and municipal officials to establish the basis for replacement funding.

Heyburn Dam Intake Structure*, Polecat Creek, Oklahoma (Project Engineer)
Project Engineer for the design of a maintenance slide gate for this intake structure constructed in 1948. Wrote the scope of work and provided QC on the 4' x 5' gate design and gate track system.

Road Bridges

Bridge 85138 Replacement*, Fort Carson, Colorado (Structural Engineer)
Designed a two span, 148 foot long, bridge comprised of four BT-42 prestressed girders per span on a spread footing founded hammerhead center pier and MSE wall abutments. Designed for HS-30 live load in order to accommodate military tactical vehicle traffic.

Bridge over V-ditch, Tank Trail B*, Fort Carson, Colorado (Structural Engineer)
Designed a 38-foot single span CIP portal frame with a two-foot thick flat slab superstructure on a drilled pier foundation. Designed for M-1E Main Battle Tank live load.

Sicily Island Area Levee Pumping Station Service Bridge*, Sicily Island, Louisiana (Structural Engineer)
Design of a four span, 160-foot long service bridge. Prestressed concrete girder superstructure on a prestressed pile bent substructure. Designed for HS-20 live load.

** denotes projects completed with other firms*

Bob Tucker PE

Senior Structural Engineer

Swan Lake Environmental Mitigation Project Bridges*, Swan Lake, Illinois (Structural Team Leader)
Design Team Leader for two 30-foot span, side-by-side box beam bridges on cellular sheet pile retained soil structures. The bridges also provided the upper frame supports for multiple slide gate systems. Designed for HS-20 live load and dead, live, stream flow, and water retaining conditions.

Meadowbrook Flood Control Project - 51st Street Bridge*, Lawton, Oklahoma (Senior Structural Engineer)
Design of a three span, 60 foot long bridge. Precast concrete deck planks on encased H-pile piers and pile founded breast wall abutments. Designed for HS-20 live load.

Lake Tenkiller Channel Bridge*, Oklahoma (Senior Structural Engineer)
Designed a four span, 360 foot long, bridge comprised of prestressed concrete girders on hammerhead piers founded on single drilled caissons supported in rock. Designed for HL-93 live load and a 16.5 fps stream velocity.

Bowie County Levee*, Red River, Texas (Senior Structural Engineer)
Provided the preliminary design of a six span, 360 foot long bridge. Prestressed concrete girder superstructure on a prestressed pile bent substructure. Designed for HL-93 live load.

Highway 58A Spillway Bridge*, Canton, Oklahoma (Structural Team Leader)
Design Team Leader for a six span, 540-foot long, bridge comprised of prestressed concrete girders on hammerhead piers founded on drilled caisson supported pier caps.

Detroit Arsenal - Bear Creek Bridge*, Warren, Michigan (Structural Team Leader)
Design Team Leader for a nonsymmetrical, splayed girder bridge, 61 foot single span, prestressed concrete girders with a trapezoidal 9 ½" reinforced concrete deck. Semi-integral abutment system on a drilled pier foundation. Designed for Michigan modified HL-93 + 20% and Heavy Equipment Transport w/M-1E Main Battle Tank controlling.

Training Area Range Road - Bridge 13*, Fort Campbell, Kentucky (Structural Team Leader)
Design Team Leader for a forty-foot long, single span bridge with a side-by-side box beam superstructure with a 5" CIP topping on an H-pile supported integral abutment substructure. Designed for a military tactical vehicle live load of W30/W42.

Ohio River Bridge Project - Bridge A003-1, Ramp 6*, Louisville- Jefferson County, Kentucky (Structural Team Leader)
Design Team Leader for a 95 foot, single span, integral end bent founded, prestressed concrete hybrid girder structure with a variable roadway width designed for HL-93 (+25%) live load. This bridge was part of the Louisville Metro Ohio River Bridges Project.

Cantonment Area Bridge Replacement Project*, Fort Carson, Colorado (Structural Team Leader)
Designed the replacement of three 1943 era multi-span, timber bridges with pre-cast concrete box culvert systems. Designed for HS-30 live load in order to accommodate tactical vehicle traffic.

** denotes projects completed with other firms*

Gulf Coast District
Quality Management Plan

Revised: Winter 2011/2012

QUALITY MANAGEMENT PLAN

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INTRODUCTION

The HNTB doctrine states – sustainability, profitable growth, best business practices and “4 for 4”. HNTB’s “4 for 4” is our performance standard for each and every project as stated below:

- Quality Work
- On Time
- On Budget
- To the Client’s Satisfaction

Quality is a key component of this doctrine and is expected in everything we do. HNTB has defined the standard of quality that is to be achieved in our *Manual of Professional Practice (MPP)* and has established general guidelines for achieving this goal and documenting the results.

The Gulf Coast Quality Management Plan (QMP) establishes planned and systematic processes necessary to provide adequate confidence that a project will conform to the established quality requirements. It consists of two key components, Quality Control and Quality Assurance.

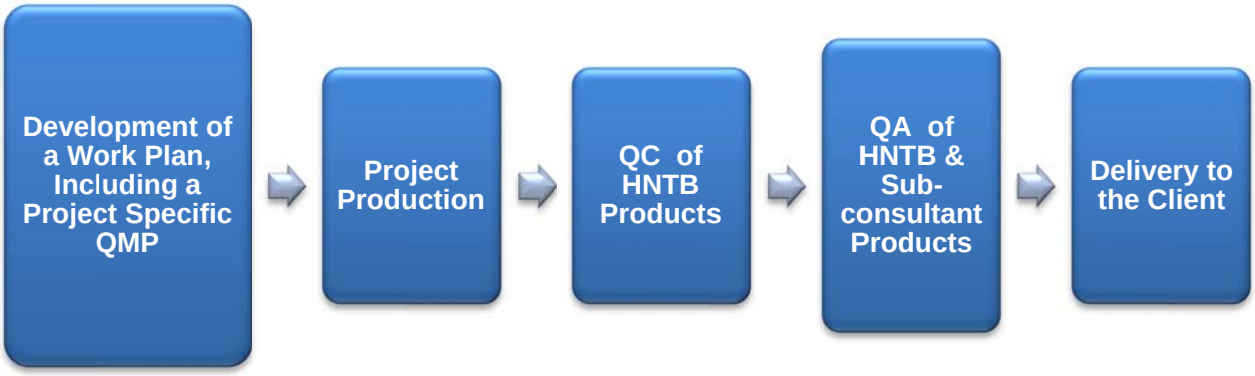
This QMP provides an understanding of basic quality processes set forth for the HNTB Gulf Coast offices and the procedures established for implementing those processes. The general procedures outlined herein are recommended for use on all tasks and projects, including the management of our sub-consultant’s work products. These procedures are intended to serve as guidelines, and are not intended to be a replacement for sound professional judgment. They have been developed to supplement the general guidelines of HNTB’s *MPP*, and other instructive documents such as Administrative Policy Memoranda and Service Group Standards, and are intended to become part of the detailed work plan developed for each project.

Adherence to good quality best practices is expected during all phases of the project life cycle, from client selection and marketing, to proposal preparation, to contracting and execution, to project closeout. Good quality best practices are conducive to effective control of all project types at HNTB.

1.0 WORK PLAN IMPLEMENTATION

Quality shall be planned into each project through an orderly process which includes procedures, actions, verification and identification of appropriate review personnel and budget. A project work plan is recognized as one of the most important planning tools available to the project management team. In accordance with the *MPP*, a quality plan is to be included as an element of the work plan to define the quality process, appropriate review milestones and required resources to accomplish the reviews. Typically, this Gulf Coast QMP can be referenced for use in the work plan, (see Appendix for example).

The following is a typical project quality work flow:



1.1 SUBCONSULTANTS

Any work being performed by a sub-consultant to HNTB, shall be held to the same quality standards as described herein for HNTB produced work. The subconsultant shall submit proof of quality control per the contract agreement. If the subconsultant does not have a QA/QC procedure, they shall be provided with the Gulf Coast Quality Management Plan for implementation. At a minimum, the subconsultant shall provide HNTB with a completed QUALITY CONTROL SIGN-OFF SHEET (Form 3.0), along with backup documentation (check prints, commentary, etc.).

2.0 QUALITY CONTROL PROCESS (QC)

QC is defined as the procedures and processes established to meet the project requirements for quality as stated in the Quality Management Plan and the accepted standard of care. It is our basic checking procedures for ensuring accuracy and completeness. The following are the standard checking formats for hard copy documents (such as hand calculations, maps and plans) and electronic documents (such as financial spreadsheets and input data) that should be implemented for all QC processes:

Hard Copy Documents

A check print of the original document is made for documentation of all review activities.

Review of the document for correctness and completeness is performed by the **Checker**.

- Changes are shown in red
- Correct items are yellowed
- Correct full paragraphs (or pages) marked with a yellow diagonal or check mark

A back-check of all comments/proposed changes is performed by the **Back-checker** (usually the **Originator**)

- Agreement shown with a green check mark
- Disagreement is discussed with **Checker** and noted with a green "STET" or "ok as is" upon concurrence with original value

All agreed upon changes are made to the original document by the **Updater**

- Items are circled or checked in blue to show that the change has been made

All updates to the document are verified for completeness and correctness by the **Verifier** (usually the **Checker**)

- Blue circles or checks are yellowed to show that updates were made

Electronic Documents

A review of the document for correctness and completeness is performed by the **Checker**.

- Changes are shown in an inserted comment box or using Track Changes (Word Document)
- Correct items are highlighted with yellow
- Correct full paragraphs (or pages) are highlighted in yellow

A back-check of all comments/proposed changes is performed by the **Back-checker** (usually the **Originator**)

- Agreement is shown by typing “concur” and initialing in comment box or Accepting Changes (Word Document)
- Disagreement is discussed with **Checker** and noted with a “STET” or “ok as is” in comment box with initials of both parties or by Rejecting Changes (Word Document) upon concurrence with original value

All agreed upon changes are made to the original document by the **Originator or Updater**

All updates to the original document are verified for completeness and correctness by the **Verifier** (usually the **Checker**)

- Type verified and initials in the comment box of the “check print”

A basic checking procedure is displayed below:

2.1 LEVELS OF REVIEW - There are two levels of review that are utilized within the QC process, as defined below. A given project task could receive a Level 1 or a Level 2 review, or both as deemed appropriate by the PM or PQM.

Level 1 - 100% checking of a produced document to include *drawings, calculations, spreadsheets, special provisions, tables within reports, graphic elements for reports or presentations, design programs, CADD modeling input.*

Level 1 - 100% Document Check

- Everything on a sheet is checked
- Use the appropriate standard checking format
- Checking procedures are documented on an attached check print sign off sheet or by check print stamp (see Appendix for examples)
- Original checked documents are copied and uploaded as color pdf files to the project "QC" directory, to await audit

Level 1 - 100% Input Check

- Checking is only for input data
- Use the appropriate standard checking format
- Verify that the software or spreadsheet used is appropriate
- HNTB developed Software does not require validation
- Non-HNTB Software only needs one project-wide validation
- Check the input only to pre-validated computer programs, individual and client provided spreadsheet templates
- Checking procedures are documented on an attached check print sign off sheet (see Appendix)
- Original checked documents are copied and uploaded as color pdf files to the project "QC" directory, to await audit

Level 2 - Peer Review of documents to include *drawings, calculations, report text, CADD documents, shop drawings and RFIs, presentation materials, quality assurance checklists*; Inter-disciplinary, Constructability and independent technical reviews; Review and oversight of *sub-consultant* submittals.

- Only specific items are checked or validated as determined by the PM or Task Leader
- Use the appropriate standard checking format
- Checking procedures are documented on an attached check print sign off sheet or by check print stamp (see Appendix for examples)
- Original checked documents are copied and uploaded as color pdf files to the project "QC" directory, to await audit

2.2 DELIVERABLE GROUPINGS – All common client deliverables produced within the Gulf Coast offices have been grouped by task similarity and required level of review. These groupings are located in the following Sections 2.3 through 2.7 along with specific quality procedures and documentation requirements for each group.

The individual responsible for performing the QC review of a particular deliverable should identify the appropriate grouping for that document and then follow the specific review procedures provided for that group.

GROUP A

Report Text
Report Narrative
Technical Specs
Special Provisions
Scope Narrative

2.3 Deliverable Group A

Scope

Level 2 Review of written documents using standard checking format. All drawings, tables, and calculations included in or appended to such documents are to be checked per their appropriate deliverable group.

Responsibilities

PM or Task Leader – Selects a *Checker,* determines scope of review and provides any pertinent checklist.

Originator – Provide hard copy of written documents.

Checker –Review of the written document with attention to:

- Content accuracy
- References
- Omissions
- Grammar

Project Quality Manager is responsible for verification that the QC is implemented in accordance with this procedure.

Procedures – Level 2

Originator prepares narrative package, fills in the project info portion of Form 3.0 – "Level 2 Review Memorandum", attaches the form to the package, places the package in the project "QC" folder, logs it into the PQM log and notifies the PM that it is ready for QC.

Checker completes review in accordance with standard checking procedures and Level 2 criteria, and records the review findings on Form 3.0.

Originator and *Checker* resolve comments, make corrections, and complete the records on Form 3.0; place the package in the project "QA" folder; log the review into the QMP log and notify the PM that it is ready for QA.

2.4 Deliverable Group B

GROUP B

Financial Spreadsheets
Input Data
Estimate Templates
Hand Calculations
Design Spreadsheets
Model Input
Fee Estimates

Scope

Level 1 Review of calculations using standard checking format.

Responsibilities

PM or Task Leader – Selection of a *Checker* with task related technical qualifications equal to those of the *Originator* and provides any pertinent checklist.

Originator – Provide all calculations and/or input data in a neat, logical, complete package conducive for checking,

Checker –100% check of the calculation or input data package with attention to:

- Accuracy
- Assumptions
- Mandated parameters
- References
- Given values and formulas
- Omissions
- Arithmetic

The *Checker* shall ask questions of the *Originator* in areas that are not clear or seek technical advice as required for any particular element of the calculation.

Project Quality Manager is responsible for verification that the QC is implemented in accordance with this procedure.

Procedures – Level 1

Originator prepares complete package of calculations or input data, fills in the project info portion of Form 2.0 – "Level 1 Check Print Signoff Sheet", attaches the form to the calc package, places the package in the project "QC" folder, logs it into the PQM log and notifies the PM that it is ready for QC.

Checker completes review in accordance with standard checking procedures and Level 1 criteria, and records the review on Form 2.0.

Originator and *Checker* complete the backcheck, correction and verification steps of the QC process; complete the records on Form 2.0; place the package in the project "QA" folder; log the review into the QMP log and notify the PM that it is ready for QA.

2.5 Deliverable Group C

GROUP C

Graphs
Charts
Exhibits
Report or Presentation Graphics
Model Graphics

Scope

Level 2 Review of graphic elements using standard checking format.

Responsibilities

PM or Task Leader – Selects a *Checker,* determines scope of review and provides any pertinent checklist.

Originator – Provide hard copy of graphic elements.

Checker –Review of the graphics with attention to:

- Content accuracy
- References
- Omissions
- Consistency within the document
- Model Input Data

Project Quality Manager is responsible for verification that the QC is implemented in accordance with this procedure.

Procedures – Level 2

Originator prepares graphic package, fills in the project info portion of Form 3.0 – "Level 2 Review Memorandum", attaches the form to the package, places the package in the project "QC" folder, logs it into the PQM log and notifies the PM that it is ready for QC.

Checker completes review in accordance with standard checking procedures and Level 2 criteria, and records the review findings on Form 3.0.

Originator and *Checker* resolve comments, make corrections, and complete the records on Form 3.0; place the package in the project "QA" folder; log the review into the QMP log and notify the PM that it is ready for QA.

2.6 Deliverable Group D

GROUP D

Cross-Check Data
Design Software Checklists

Scope

Level 2 Review or validation of design software, checklists cross-check data including *Independent Quality Reviews, Constructability Reviews, Inter-Disciplinary Reviews*, and other items requiring validation using standard checking format.

Responsibilities

PM or Task Leader – Selects a *Checker,* determines scope of review and provides any pertinent checklist. *PM* makes the final determination on the acceptability of the item being validated.

Originator – Provide hard copy of documentation package to be reviewed; or input, output and program description of software to be validated.

Checker –Review of the documents with attention to:

- Content accuracy
- References
- Omissions
- Consistency across all disciplines represented
- Software Output Accuracy (may require independent calculations)

Checker shall select an appropriate number of items to spot check for completeness.

Project Quality Manager is responsible for verification that the QC is implemented in accordance with this procedure.

Procedures – Level 2

Originator prepares documentation package, fills in the project info portion of Form 3.0 – "Level 2 Review Memorandum", attaches the form to the package, places the package in the project "QC" folder, logs it into the PQM log and notifies the PM that it is ready for QC.

Checker completes review in accordance with standard checking procedures and Level 2 criteria, and records the review findings on Form 3.0.

Originator and *Checker* resolve comments, make corrections, and complete the records on Form 3.0; place the package in the project "QA" folder; log the review into the QMP log and notify the PM that it is ready for QA.

2.7 Deliverable Group E

GROUP E

Plan Sheets
Check Prints
GIS Maps

Scope

Level 1 Review of drawings, construction documents and maps using standard checking format. Timely checking of drawings is important for efficient performance. A drawing used as a base by several disciplines should be checked and corrected before further additions are made; this will eliminate the need to check and correct the same items on subsequent drawings. Drawing files will be kept as per the project's document control system.

Responsibilities

PM or Task Leader – Selection of a *Checker* not directly responsible for the design and provides any pertinent checklist.

Originator – Provide all drawings or maps as hard copies in a neat, logical, complete check print package conducive for checking;

Checker –100% check of the calculation or input data package with attention to:

- Accuracy and Completeness
- Project CADD Standards
- Mandated parameters
- References
- Omissions

Project Quality Manager is responsible for verification that the QC is implemented in accordance with this procedure.

Procedures – Level 1

Originator prepares complete package of calculations or input data, fills in the project info portion of Form 2.0 – "Level 1 Check Print Signoff Sheet", attaches the form to the calc package, places the package in the project "QC" folder, logs it into the PQM log and notifies the PM that it is ready for QC.

Checker completes review in accordance with standard checking procedures and Level 1 criteria, and records the review on Form 2.0.

Originator and *Checker* complete the backcheck, correction and verification steps of the QC process; complete the records on Form 2.0; place the package in the project "QA" folder; log the review into the QMP log and notify the PM that it is ready for QA.

3.0 QUALITY ASSURANCE PROCESS (QA)

QA is defined as the systematic activities implemented to provide confidence that the QC processes are being followed in compliance with the Quality Management Plan. These are our audit processes for verifying that the appropriate checking procedures have been performed and documented, and our corrective action plans for addressing problems that have been identified within the processes. The keys to an effective quality program lie in the accountability, compliance and continual improvement of the program.

Once the quality control processes have been performed, a quality assurance process must be implemented to confirm that the quality control procedures were performed to the expectations documented in the work plan. The following procedures should be part of the assurance/ validation process.

3.1 Audits

All completed QC documents should be in the project "QA" folder awaiting audit. The *Project Quality Manager* will audit the *Quality Control Records* prior to each submission to confirm that all quality control procedures have been performed for each task of the deliverable, and record the findings on FORM 4.0 (see Appendix). Upon approval of the quality documents, the *Project Quality Manager* move each approved document into the project "Quality Records" folder and will inform the *Project Manager* that the submittal is ready for release to the client. The *Office Leader* will also receive a hard copy of that verification.

Additionally, the *Office Quality Manager* may choose a project or submittal for review at an executive level. An audit will be performed similar to the routine project audit, but will also include interviews with staff to determine if the quality management process is clearly understood and is being performed unbiased and independently of the design or production process.

The purpose of the audit is twofold:

1. Identify and correct a breakdown in quality or any instance of noncompliance to established HNTB best practice procedures through a defined corrective action plan.
2. Identify opportunities for implementation of preventive action, training and continual improvement processes to enhance quality, efficiency and value to our projects and clients.

All audit findings, including good and bad performances, should be documented as a part of the *Quality Records.*

3.2 Corrective Action and Preventive Action Plans

A corrective action plan is a strategy for correcting or eliminating a problem impacting project quality or performance that has already occurred or been identified. The focus of the

plan is to systematically review the root cause of the problem in an attempt to prevent the problem from recurring. The primary concepts of the plan are as follows:

- Task leads identify the problem and presents to PM or PQM
- Determine the cause of the problem or unintended result
- Identify action items or plan to correct to the problem

Preventive actions are implemented in response to the identification of a trend that would potentially impact quality and lead to a project issue or problem. Preventive action should be considered as a proactive undertaking. For example, if we anticipate a potential problem and take action to eliminate the causes and prevent the occurrence of that problem, this is considered to be preventive action.
If a problem or breakdown in quality is discovered during an audit, the *Project Manager* should be notified immediately. The *Project Manager* and *Project Quality Manager* should perform a root cause analysis to determine the extent of the problem and develop and a *Corrective Action Plan* for implementation. A follow-up meeting should be conducted with all responsible individuals to convey the CAP expectations. If a resolution cannot be reached, the *Office Leader* will be involved in the process.

3.3 After Action Review (AAR)

An after action review should be performed for every project that requires a CAP, to determine the effectiveness of the plan and to identify any “best practices” that should be implemented on future projects. AARs will typically be performed by the *Office Quality Manager* or a designee, and documented as part of the *Quality Control Records.* AARs may also be performed on large, multi-discipline projects, projects achieving outstanding “four for four” performance, and financially unsuccessful projects to develop office trends for future improvement. The AAR trends shall be developed and maintained by the *Office Quality Manager,* at the direction of the *Office Leader.*

3.4 Training

This Quality Management Plan is intended to be a living document. The *Office Quality Manager* will develop a training program to provide all employees with initial training on these procedures. Each employee will be expected to update their training on annual basis, or as deemed appropriate by the *Office Quality Manager.*

A *Project Quality Manager* may also choose to do supplemental or project specific training as deemed necessary for a project team.

4.0 QUALITY MANAGEMENT IMPLEMENTATION

For a quality program to be effective it must be a planned and implemented as part of the project work plan, and budgeted accordingly. A Quality Management Plan Log - FORM 1.0 (see Appendix) should be filled out by the *Project Manager* for every project, incorporated into the Project Work Plan and forwarded to the Project Quality Manager for execution.

Proper documentation of the process throughout is also key to successfully managing quality. The following file structure should be setup within the project directory for each project:

\\Batw00\Projects\#####\QMP\QC
“ “ “ “ \QA
“ “ “ “ \Quality Records

The **QMP** folder will contain the Quality Management Plan Log (Form 1.0) and all project specific quality requirements, checklists, etc.

The **QC** sub-folder will receive each task item or deliverable that has been produced and is ready for review. Each deliverable will be accompanied by either Form 2.0 or Form 3.0, as determined by the *PM* or *Task Leader*. All assigned *Checkers* will go here to get their assigned documents.

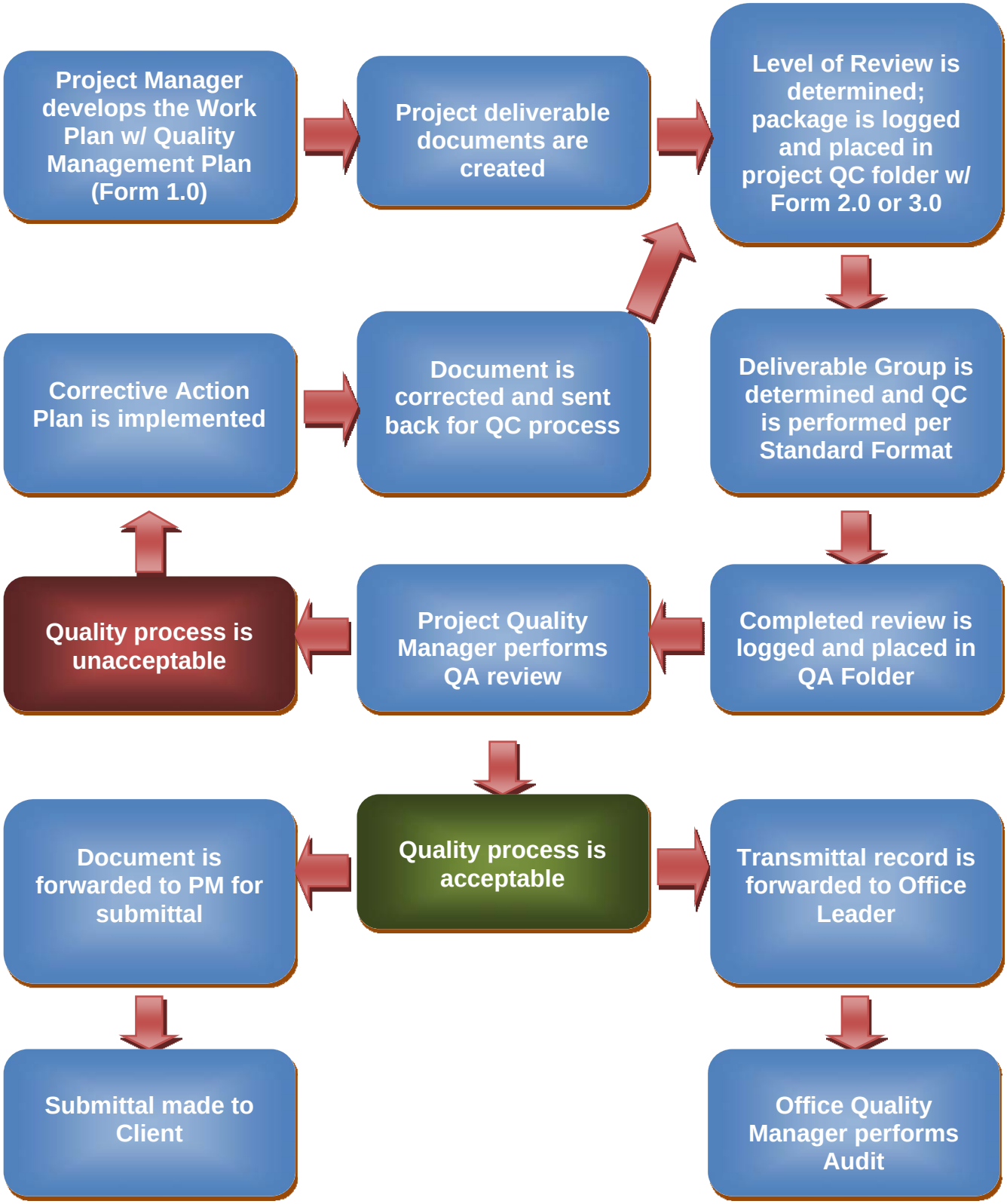
The **QA** sub-folder will receive each completed item or deliverable from the QC folder along with a completed Form 2.0 or Form 3.0. The *PQM* will go here to find all documents ready for QA.

The **Quality Records** sub-folder will receive all completed quality documentation that has been signed off by the *PQM* and the *PM*, all audit findings, CAP and AAR documentation.

4.1 QMP Process Diagram

The diagram below depicts all key activities and the work flow required for the Quality Management Process. This diagram is only intended as a guide and can be supplemented as required by the PM or PQM, based upon project complexity or client requirements.

Quality Process Diagram



5.0 APPENDIX

Key Roles

Definitions

FORM 1.0 - Quality Management Plan Log

FORM 2.0 - LEVEL 1 CHECK PRINT SIGN-OFF SHEET

FORM 3.0 – LEVEL 2 REVIEW MEMORANDUM

FORM 4.0 – QUALITY AUDIT CHECKLIST

FORM 5.0 – CORRECTIVE ACTION LOG/ PREVENTIVE ACTION LOG

Sample Check Print Stamps

Sample Quality Plan from Work Plan

KEY ROLES

The following defines key roles within a project work plan and the quality process:

Back-checker -- The individual (usually the Originator) who reviews the comments, suggested changes, additions, and corrections to design calculations, drawing or report made by the Checker. The Back-checker and the Checker must reach consensus on proposed changes or additions.

Checker -- The individual who reviews design calculations, analyses, plans, reports or graphics prepared by the Originator. The Checker must possess technical qualifications at least to the level of the Originator.

Office Leader (OL) -- The individual responsible for the overall operation and direction of an HNTB office, to include the quality and profitability of all work performed. The OL shall be copied on all quality audit documentation and shall be a part of all monthly project reviews, to include quality assurance documentation.

Office Quality Manager (OQM) -- The individual assigned by the Office Leader to oversee the quality management processes for the office, perform periodic reviews of project quality documentation and conduct quality training. The OQM or an appointed quality assurance manager is responsible for conducting project quality audits on a prescribed basis.

Originator -- The individual who prepares design calculations, construction documents, reports, studies, analyses or graphics.

Project Manager (PM) -- Individual responsible for overall design and plan production of the project in accordance with the project requirements, approved design criteria and the project work plan.

Project Quality Manager (PQM) -- Individual responsible for the implementation of the Quality Management Plan and for compliance monitoring through the duration of the design phase. The PQM reports to the Office Quality Manager.

Quality Assurance Managers -- Individuals identified by the Office Quality Manager, responsible for conducting office audits to verify compliance with quality procedures and processes.

Subconsultant -- A company performing specific tasks or defined responsibilities on the project under a subcontract to HNTB.

Task Leader – Individual responsible for a specific project task and associated budget. Task leaders are typically assigned for each discipline of a project.

Updater – Individual responsible for updating the document or product to reflect all agreed upon changes.

***Verifier* --** Individual (usually the Checker) responsible for verifying that all changes or additions to a drawing, calculation, report or graphic element have been accurately incorporated.

DEFINITIONS

The following definitions identify some key components of a project quality process:

Audit -- A systematic, independent and documented activity performed to verify that applicable elements of the QMP have been effectively implemented and documented in accordance with the specific requirements.

***Constructability Review* --** A design review performed by the Contractor or appropriate construction services personnel to assess the feasibility of the proposed design from a construction perspective.

***Design Criteria* --** A set of project-specific parameters that define the design requirements, specifications and functional classifications of the project.

Inter-Discipline Review -- A discipline specific design review of a design package by all applicable design disciplines.

Quality Records -- A completed document or recordkeeping evidence of successful implementation of any given aspect of the Quality System.

***Stet* –** No change required.

HNTB

FORM 1.0

Quality Management Plan Log

Project Description:	Job No. PM:
Project Fee:	QA/QC Budget:

Deliverable		QA/QC Budget	Review Level	Reviewer	Date	Completed

LEVEL 1 CHECK PRINT SIGN-OFF SHEET

Client Name: _____

Job Title: _____

Job Number: _____

Document Title: _____

Check Level (Mark One):

☐ 1 - 100% Document Check

☐ 1 - 100% Input Check (When Pre-Validated Software in Used)

		Name	Received Date	Completion Date
Originated By:	☐			
Checked By:	☐			
Backchecked By:	☐			
Verified By:	☐			

Comments:

LEVEL 2 REVIEW MEMORANDUM

Client Name: _____

Job Title: _____

Job Number: _____

Document Title: _____

Check Level (Mark One):

- ☐ Studies or Report Type Documents
- ☐ Documents Prepared by Others
- ☐ Checklist
- ☐ CADD QC Audit
- ☐ Other
  Specify below:

		Name	Received Date	Completion Date
Reviewed By:	☐			

Review Findings:

HNTB

FORM 4.0

QUALITY AUDIT CHECKLIST

AUDITED AREA:	**DATE(S) OF AUDIT:**
AUDITOR:	**AUDIT:**

AUDIT ITEM	**REFERENCE**	**METHOD OF VERIFICATION**	**CONFORMS**	
			YES	**NO**
1. Have computer programs utilized been validated?	QMP Group D	Review validation records.		
2. Are calculation check prints available?	QMP Group B	Review originals and check prints		
3. Were calculations checked prior to drawing checking?	QA Folder, QMP Log	Review check prints.		
4. Are drawing check prints available?	QMP Group E	Review record set and check prints.		
5. Are check prints of specifications available?	QMP Group A	Review record set and check prints.		
6. Is checking of input to computer programs being accomplished?	QMP Group B	Review originals and check prints		
7. Are check prints of studies or report-type documents available?	QMP Group A	Review check prints.		
8. Are procedures for marking up check prints being followed? Checker - Yellow/Red Backchecker - Green Updater - Blue Verifier - Yellow	QA Folder	Review check prints.		
10. Are check prints properly signed and dated?	QA Folder	Review check prints.		
11. Are plan reviews completed?	QMP Log	Review package to verify that comment sheets are available.		
12. Are the review comments incorporated into the final documents or disposed of as otherwise noted?	QA Folder	Review for verification that Design Reviews comments have been		

		incorporated. Review for verification that comments from prior Design Reviews have been incorporated.		
13. Are check prints of graphic elements available?	QMP Group C	Review check prints.		
14. Are all checklists validated?	QMP Group D	Review check prints.		

Corrective Action Log

Form 5.0

Office 003 - Quality Manager:

Project #	PM or PQM	Issue Summary	Corrective Action	Implemented
12345	Joe Smith	Subs delayed project submittal	Updated schedule for additional time for subs; weekly conference calls initiated	1/1/2012

Preventative Action Log

Office 003 - Quality Manager:

Project #	PM or PQM	Issue Summary	Preventative Action	Implemented
12345	Joe Smith	Task 50% complete - 65% spent	Weekly monitoring by PM	1/1/2012

Sample Check Print Stamps

CHECKING PRINT

Checked by_____ Date_____
Back Checked by_____ Date_____
Corrected by_____ Date_____
Tracing Signed by_____ Date_____

AUXILIARY
CHECKING PRINT NO._____

Checked by_____ Date_____
Back Checked by_____ Date_____
Corrected by_____ Date_____
Tracing Signed by_____ Date_____

PROJECT QUALITY PLAN:

Project: IH 35 – 3t2 (North of Troy to Woodlawn Road)

PM: Tom Diamond

Team: Bill Fleming, Jeremy Kraft, Ashley Jones, Erik Nelsen, Phil Elzeenni, Matt Gautreaux & Bridge Group

Fee: $5,552,832.37

QAQC Budget: Hours provided in budgets task lines.

QC Approach:

- Reference Dallas Office Quality Assurance Plan.
- Check and Backcheck all project deliverables by project team members
- Document checks
- Save all QC and QA check plans for future reference and for client if requested

Submittal QA: Independent QA for all milestone submittals to client

PM QA: QA for all submittals to client.

Project Quality Manager: Jeremy Kraft (Tom Diamond & Pat Ellis – support QA Team)

Define and Agree with Client to Project Criteria Early on the Project

Filing: Efiles: Hard files; Flat Files

1/5/2010

ATTACHMENT 4: REVIEW PLAN REVISIONS

Revision Date	Description of Change	Page / Paragraph Number