January 25, 2024

Via E-Mail: Howard.Ashley@EPA.Gov

Ms. Ashley Howard
Remedial Project Manager, Superfund Emergency Management Division
United States Environmental Protection Agency, Region 6
1201 Elm Street, Suite 500
Dallas, Texas 75270

RE: San Jacinto Waste Pits Superfund Site, Channelview, Texas (Site)
Plan in Response (Plan) to the United States Environmental Protection Agency (EPA) January 5, 2024 Notification of Serious Deficiency (Notice) Pursuant to Paragraph 59 of Administrative Settlement Agreement and Order on Consent for Remedial Design (AOC), CERCLA Docket No. 06-02-18

Dear Ms. Howard:

International Paper Company (IPC) and McGinnes Industrial Maintenance Corporation (MIMC), collectively referred to as the Respondents, hereby submit this letter and the enclosed Plan in response to the above referenced Notice received from EPA on January 5, 2024.[1] The Notice alleges that Respondents' Northern Impoundment Pre-Final (90%) Remedial Design (90% RD) contains serious deficiencies, as outlined in an appended Grounds for Issuance of EPA Notification of Serious Deficiency. EPA provided Respondents 20 days to either remedy the deficiencies identified in the Notice, or submit a plan to EPA for remedying the deficiencies in an expedited timeframe and submitting the 100% RD in a timeframe acceptable to EPA.

As a threshold matter, Respondents' believe that EPA's Notice does not, in many respects, accurately characterize Respondents' 90% RD or the history of the parties' engagement, and Respondents dispute EPA's allegation that the 90% RD contains serious deficiencies. Specifically, Respondents dispute that the inclusion of uncertainties and unresolved technical challenges within the 90% RD renders it unimplementable. Not only is the inclusion of such elements at the pre-final stage of a remedial design common practice, but Respondents were explictly advised to include such uncertainties in the 90% RD by EPA Region 6 Administrator Nance in correspondence to Respondents, dated April 15, 2022, which stated that *"[t]o the extent there are uncertainties about design issues…or even the need for a partial re-design of parts of the best management practices in light of additional information, the EPA would expect these to be noted in the [90% RD] submittal."*

Notwithstanding these concerns, Respondents have worked expeditiously to prepare the attached Plan, which details the Respondents' plans to submit a revised 90% RD (Revised 90% RD) and addresses issues identified in the Notice. In preparing the Plan, the Respondents are providing to EPA drafts of several documents that will become part of the Revised 90% RD, including:

- An updated draft of the excavation surface;
- An Updated Hydraulic Heave Analysis;
- A technical memorandum describing the evaluation of scour on the outside of the cofferdam wall best management practice (BMP) and proposed scour protection measures; and

[1] The Respondents understand that reference to EPA comments in the Notice are not to be construed as a complete set of technical comments on the 90% RD, for purposes of submission of the Northern Impoundment (100%) Final RD or the deadline for submitting same pursuant to Section 6.2 of the Statement of Work attached to the AOC.

- A complete draft of the specifications, combining and supplementing the specifications from the two 90% RD submittals.

Also included is a proposed schedule for the submission of the Revised 90% RD within 130 days from EPA approval of the Plan.

The Notice also directed that the Respondents address plans for submittal of the Northern Impoundment (100%) Final RD (100% RD), as referenced in Section 6.2 of the AOC's Statement of Work. Section 6.2 requires the 100% RD to be submitted within 30 days of receipt of comments on the 90% RD design document (in this case, the Revised 90% RD). The Respondents are committed to moving forward expeditiously, following EPA approval of the Revised 90% RD, to submit the 100% RD.

It is Respondents' intent to work cooperatively with EPA and relevant stakeholders to address any elements of the Plan, that in EPA's view, may require further development. Respondents therefore look forward to the meeting with EPA that has been scheduled for February 9, 2024, as an opportunity to discuss the Plan.

As a final administrative note, Respondents' submittal of the attached Plan does not constitute an admission of EPA's allegations that Respondents' 90% RD contained serious deficiencies or that it was not compliant with the Order. The attached Plan is submitted without waiver of Respondents' right to challenge EPA's allegations contained in the Notice.

Should EPA wish to discuss any aspect of the Plan in advance of the February 9 meeting, we are available to do so.

Regards,

International Paper Company

By: Brent Sasser
_____
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Sr. Environmental/Remediation Manager

McGinnes Industrial Maintenance Corporation

By: Judy Armour
_____
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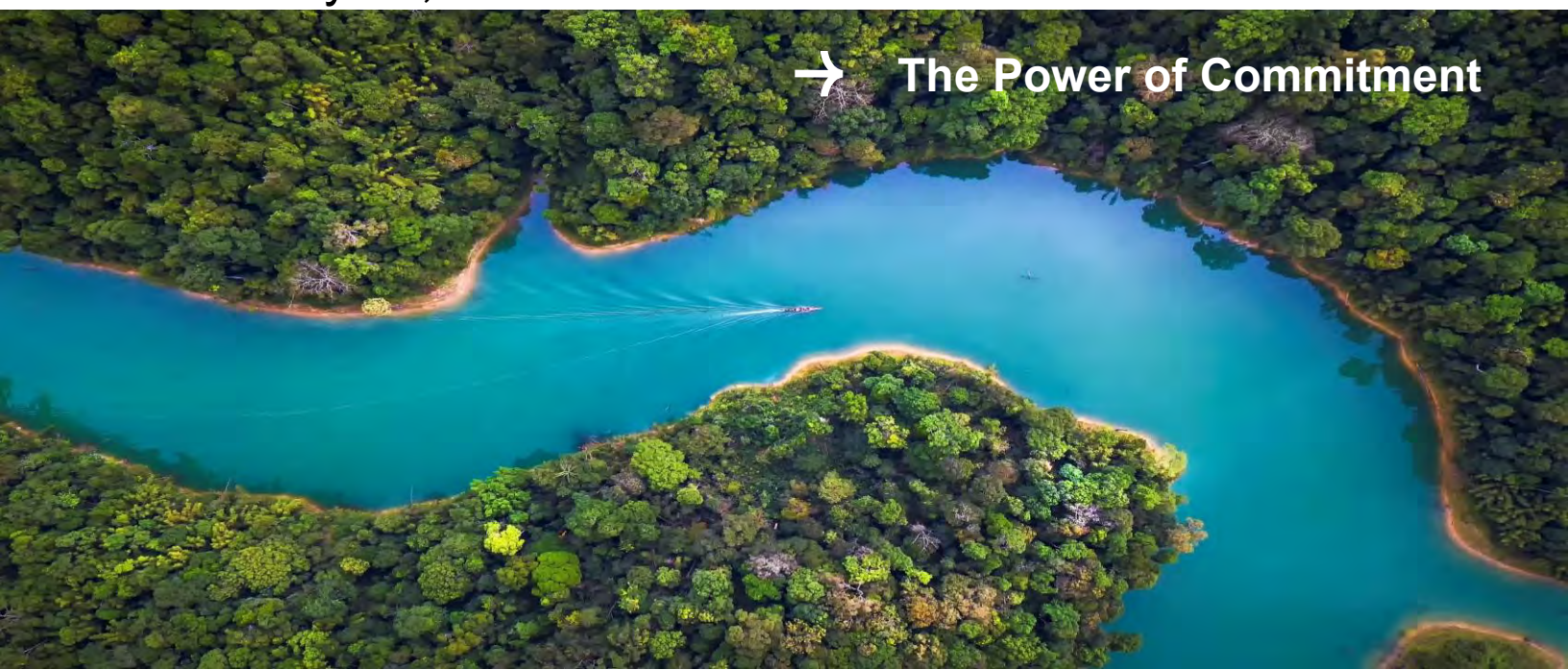
Plan in Response to EPA Comments to Pre-Final 90% Remedial Design - Northern Impoundment

International Paper Company and McGinnes Industrial Maintenance Corporation

January 25, 2024



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1. Introduction

GHD Services Inc. (GHD), on behalf of International Paper Company (IPC) and McGinnes Industrial Maintenance Corporation (MIMC; collectively referred to herein as the Respondents), submits to the United States Environmental Protection Agency (EPA) this *Plan in Response to EPA Comments*[1] *to Pre-Final 90% Remedial Design - Northern Impoundment* (Plan) for the San Jacinto River Waste Pits Superfund Site in Harris County, Texas (Site). In a letter dated January 5, 2024 (January 5 Letter), EPA issued a *Notification of Serious Deficiency* in response to the Pre-Final 90% Remedial Design - Northern Impoundment (90% RD) and the Respondents have prepared this Plan in response and to address the anticipated submission of a revised 90% RD (Revised 90% RD).

Respondents are submitting the Plan with the intent of addressing EPA's comments and providing a good faith approach to resolving the outstanding technical issues and completing the remedial design using best engineering practices and appropriately managing and mitigating risk, where practicable. As set forth in the cover letter transmitting the Plan, the Respondents do not agree with all of EPA's comments, including EPA's conclusions as to deficiencies in the 90% RD and with respect to delay associated with the project. Respondents undertook the 90% RD to design a safe, implementable engineering solution that met the Record of Decision (ROD) requirements and as part of that work identified technical uncertainties. Identifying uncertainties is customary for such submittals in the EPA RD process, and was in fact requested by EPA prior to Respondents' submittal of the 90% RD. Notwithstanding this disagreement, Respondents are submitting the Plan with the intent of addressing EPA's comments and providing a good faith approach to resolving the outstanding technical issues and completing the remedial design using best engineering practices and appropriately managing and mitigating risk, where practicable. In that regard, the Respondents have been working closely with EPA over a long period of time to resolve the challenging technical issues on the project. As such, Respondents have not sought to delay the project, but rather to develop sound engineering solutions to the uncertainties that have been identified during the design process.

This Plan is formatted chronologically to track EPA's comment letter by reciting a short summary of each specific EPA review comment, followed by corresponding responses setting forth the steps Respondents propose to take, including the planned approach to address any unresolved issues. It also includes a proposed schedule for submission of a Revised 90% RD, which Respondents propose to deliver within one hundred thirty (130) days of EPA's approval of this Plan. Drafts of the following documents are provided with this Plan:

- An updated draft of the excavation surface is provided in Appendix A that shows removal of all material above 30 nanograms per kilogram (ng/kg) Toxicity Equivalency Quotient (TEQ) dioxin on a point-by-point basis, in lieu of being based on surface-weighted average concentrations (SWAC).
- A draft Updated Hydraulic Heave Analysis is included in Appendix B.
- A technical memorandum describing the evaluation of scour on the outside of the cofferdam wall best management practice (BMP) and the scour protection measures that are proposed is included in Appendix C.
- A compete draft of the specifications, combining the specifications from the June 27, 2022 90% RD submittal (June 2022 90% RD Submittal) with the dredging specification from the November 8, 2022 90% RD Northwest Corner Component (NWC) submittal (NWC 90% RD Submittal) is provided in Appendix D.

The Plan takes into account progress in addressing several of the technical issues during the EPA review period, including proposed barge strike protection measures (described in Section 3.8.2) and further analysis of heave risk, as reflected in the Updated Hydraulic Heave Analysis (Appendix B).

[1] The Respondents understand that reference to EPA comments in the Notice are not to be construed as a complete set of technical comments on the 90% RD, for purposes of submission of the Northern Impoundment (100%) Final RD or the deadline for submitting same pursuant to Section 6.2 of the Statement of Work attached to the Administrative Settlement Agreement and Order on Consent for Remedial Design (AOC), effective April 11, 2018.

2. General Comments

2.1 The 90% RD is not Consistent with the ROD Requirements as Required by the Settlement

The comment specifically refers to the ROD requirement of excavation and removal of wastes above 30 ng/kg TEQ dioxin, and the added requirement that the remedy utilize BMPs sufficient to prevent releases in excess of the Texas Surface Water Quality Standards (TSWQS).

The excavation surface has been modified to include excavation and removal of all material above 30 ng/kg, on a point-by-point basis. The attached Drawing C-08 and Table 5-1 in Appendix A provide the revised excavation surface**.**

Discharge of water from within the BMP, particularly between excavation seasons, is a challenging technical issue due to the volume of water that would accumulate within the BMP during a potential overtopping event. Section 3.2.2 below provides a plan to add procedures and specifications to the Revised 90% RD to manage this water and Respondents believe that the planned approach is consistent with previous discussions with EPA and would be protective against releases to the river above the TSWQS.

2.2 The 90% RD is not Consistent with the Respondents' Obligation under the Settlement to Develop an Implementable Design of the ROD Remedy

This comment generally refers to the technical uncertainties that are described in the 90% RD and EPA's concern that they have not been adequately addressed in the design.

Several of the uncertainties have been further evaluated during the EPA review period. This document provides updated information and describes how each of the uncertainties will be addressed in the Revised 90% RD.

The updated information provided as part of this Plan includes a draft Updated Hydraulic Heave Analysis (Appendix B), showing the areas of heave potential (in the NWC and four areas within other portions of the Northern Impoundment). At this point, it is anticipated that heave potential in the NWC will be addressed with flooding the area and use of mechanical dredging and that the Revised 90% RD will provide a plan to address the other potential hydraulic heave areas with monitoring and prescribed mitigation procedures. Barge strike protection measures and scour protection measures will be added to the Revised 90% RD. Appendix C includes a description of the proposed scour protection measures.

This Plan also describes how the potential for overtopping of the BMP during the excavation season will be addressed through a comprehensive monitoring program and specific performance metrics and mitigation procedures. As stated in this Plan, these procedures will be added to the 90% RD as part of the supporting plans and Remedial Contractor specifications to provide clear direction to the Remedial Contractor during the Remedial Action (RA).

2.3 The 90% RD Lacks Complete Plans and Specifications as Required by the Settlement, and Also Lacks Complete Plans, Procedures and Performance Metrics for Critical Work as Required by EPA Guidance and the Settlement

Appendix D provides a complete draft of the specifications, combining the specifications from the June 2022 90% RD Submittal with the dredging specification from the NWC 90% RD Submittal. Appendix D includes the specifications that EPA indicated were not included in the prior submissions, including: 01 30 00 Administrative Requirements; 01 33 00 Submittal Procedures; 01 35 00 Temporary Traffic Controls; 01 35 29 Health and Safety Requirements; 01 40 00 Quality Requirements; 01 50 00 Temporary Facilities and Controls; and 01 57 13 Temporary Soil Erosion and Sediment Controls. As described throughout this Plan, the specifications will be updated in the Revised 90% RD to provide more prescribed procedures for addressing the uncertainties (specifically the potential for hydraulic heave, barge strike, scour, and flooding), with the objective of providing direction to the Remedial Contractor while maintaining an appropriate level of flexibility as to not dictate the Remedial Contractor's means and methods.

2.4 The 90% RD is Not Suitable for Procurement as Required by the Settlement and EPA Guidance

This Plan describes how the 90% RD will be revised to increase its specificity of procedures and specifications. The Revised 90% RD will incorporate the changes described in this Plan with respect to the excavation limits, hydraulic heave, barge strike protection and scour protection. It will include further revisions to the specifications (Appendix D) to be more prescriptive regarding the performance metrics and mitigation measures, while still maintaining an appropriate level of flexibility as to not dictate the means and methods of the Remedial Contractor. The Revised 90% RD will also contain more detailed mitigation plans and strategies to address the risks at the Northern Impoundment.

3. Specific Design Component Comments

3.1 Excavation Depths

3.1.1 EPA Comment

The 90% RD does not provide for removal of waste, regardless of depth, exceeding the cleanup level of 30 ng/kg TEQ dioxin as required by the ROD.

Summary of EPA Comments[2]

The Respondents' use of the surface area-based average concentration (SWAC) approach is not consistent with the ROD and it cannot be used to determine the excavation limits since it does not remove all material above 30 ng/kg. The excavation limits provided by the Respondent cites hydraulic heave as a reason to not remove waste above 30 ng/kg in select areas but does not evaluate alternative approaches to achieve the 30 ng/kg cleanup level, such as dredging through the water column.

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

The 90% RD claims to address this deficiency by stating that the excavation surfaces are only the initial step of the removal process, and that confirmation sampling will ensure the cleanup level is met. The proposed confirmation sampling procedures state that confirmation sampling would be collected from the top 4 to 6 inches of the excavation surface. This post-excavation confirmation sampling would not extend into areas where material exceeding the clean-up level is found more than 4 to 6 inches under the proposed SWAC excavation boundary. Therefore, the EPA does not agree that the excavation surfaces determined by the SWAC followed with confirmation sampling of a depth of 4 to 6 inches satisfies the 2017 ROD requirements for "removal of all waste material that exceeds the clean-up level of 30 ng/kg regardless of depth."

3.1.2 Respondents' Response

Respondents proposed a SWAC approach in the 90% RD in light of conversations with EPA during Technical Working Group (TWG) meetings and monthly project calls, as well as the widely accepted use of SWAC in EPA site remediation projects nationwide. Notwithstanding Respondents' understanding that SWAC would be an acceptable approach here, Respondents have modified their approach in light of EPA's comments. Accordingly, the excavation limits will be revised to show removal of all material above 30 ng/kg, on a point-by-point basis. A draft of Drawing C-08 showing the revised excavation limits and a draft of Table 5-1 showing a profile of the constituent concentrations, initial limits of excavation, and elevations of hydraulic heave risk are provided in Appendix A. Hydraulic heave is further addressed below in Section 3.4.

With the proposed excavation surface revisions, the confirmation sampling approach should be sufficient to determine if all material above 30 ng/kg has been removed.

3.2 Bulk Water Treatment

3.2.1 EPA Comment

The 90% RD does not provide for treatment of potentially contaminated pore water in the large volumes of water which will be within the cofferdam wall BMP after BMP installation, or provide for testing and/or treatment of potential bulk water used to intentionally flood the BMP between excavation seasons. This is inconsistent with the ROD requirement to prevent discharges to the San Jacinto River exceeding the TSWQS.

Summary of EPA Comments[2]

The Respondents did not provide for the treatment of potentially contaminated pore water within the cofferdam wall best management practice (BMP) after installation and at the beginning of each excavation season. EPA and Texas Commission on Environmental Quality (TCEQ) provided guidance on potential methods to achieve compliance with the Site Applicable or Relevant Appropriate Requirement (ARAR) for water discharges to the river, which is the Texas Surface Water Quality Standards (TSWQS).

In TWG meetings in December 2020 and February 2021, various methods of handling water contained within the BMP between excavation seasons were discussed, including floodgates, partial treatment of the water column, installing pumps, and intentional flooding within the BMP. EPA and TCEQ provided guidance that the bottom 2 feet of water in the water column, which may be in contact with contaminated pore water coming from the TCRA cap, could be impacted waste and should meet the water treatment standards in the ROD. This would apply to water naturally contained within the BMP between excavation seasons and intentional flooding of the BMP.

However, the June 2022 90% RD states that there will be no treatment of water trapped within the BMP either after BMP installation or prior to each excavation season. The 90% RD does not include floodgates in the BMP as

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

previously discussed, therefore the guidance provided by EPA and TCEQ regarding consideration of some water as river water when de-watering the BMP is inapplicable. The 90% RD has no consideration for pore water in the lower water column above the TCRA cap and covered wastes, which should require treatment. Specifications and procedures for identification and treatment of potentially contaminated water within the BMP should have been included in the June 2022 90% RD but were absent.

3.2.2 Respondents' Response

Dioxins were not present in the porewater samples collected as part of the 2016 TCRA Cap Porewater Field Sampling event, nor were they present in the 2016 Groundwater Sampling event. However, the Revised 90% RD will indicate that after installation of the BMP, prior to the initial work season, and between seasons, the water within the BMP will be pumped down, without treatment, to 2 feet (ft) at the lowest collection point(s). The remaining water below this two-foot level will be treated prior to discharge. The Revised 90% RD will provide specifications describing the water removal, monitoring and treatment procedures, and the metrics for when treatment is required, including metrics for scenarios in which the excavation area is intentionally flooded. The Revised 90% RD will also address procedures for complying with the TPDES General Permit.

A structural analysis conducted prior to submission of the 90% RD indicated that floodgates would compromise the BMP's structural integrity and could create a point of failure for the structure. Therefore, alternative measures to flood the BMP will be included in the Revised 90% RD. These measures will include detailed specifications for the Remedial Contractor describing metrics for when measures are required, and flood protection implementation procedures. In general, these measures will include intentionally flooding the BMP by pumping water in, as necessary, to increase the safety factor for the BMP's structural integrity and minimize potential scour through overtopping on the interior of the BMP.

3.3 Design of Remedy Not Selected in the ROD

3.3.1 EPA Comment

The November NWC 90% RD included a design for a remedial alternative not selected in the ROD, capping waste in place, which is not consistent with the ROD.

Summary of EPA Comments[2]

Respondents agreed to develop the RD consistent with the Site remedy selected in the ROD. The Northwest Corner (NWC) 90% RD included the evaluation and design of capping the waste in place in the NWC. This design alternative has been consistently rejected by the EPA as not being consistent with the ROD. The EPA has clarified that the two acceptable methodologies for removal of waste from the site are removal of waste in a de-watered state or removal of the waste through the water column by mechanical dredging within a BMP cofferdam wall.

3.3.2 Respondents' Response

Respondents note that consideration of partially capping a limited area in the Northwest Corner of the Site was merely one of the design alternatives proposed in the NWC 90% RD. Mechanical dredging was explicitly included in the NWC 90% RD as the other alternative. EPA did not acknowledge this fact in its comments, and instead elected to focus only on the capping proposal in generating its list of alleged deficiencies. Regardless, Respondents clearly understand that the capping alternative has been rejected by EPA and remain willing (as was specified in the 90% RD) to implement the mechanical dredging design alternative. As a result, references to the capping alternative will be removed from the Revised 90% RD.

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

3.4 Hydraulic Heave

3.4.1 EPA Comment

The 90% RD contains two contradictory hydraulic heave analyses. The 90% RD is not implementable, not complete, and not suitable for procurement or biddable because of the inconsistent heave analyses; the underlying concerns with the validity of the analyses; and Respondents' failure to address mitigation measures used for areas with hydraulic heave concerns.

Summary of EPA Comments[2]

The Respondents presented two different hydraulic heave analyses as part of the 90% RD, the first in the June 90% RD and the second in the November NWC 90% RD. The heave analysis from the November NWC 90% RD adopted a different methodology to calculate factors for hydraulic heave, potentially invalidating unknown portions of the June 90% RD. The November 90% RD alludes to a new heave evaluation using revised methodology for the majority of the Site, but has not provided this analysis to the EPA.

The United States Army Corps of Engineers (USACE) reviewed the initial heave analyses and commented on the Respondents' representations of the Site's stratigraphy, most notably about the depth of Beaumont clay layer and whether sand lenses were continuous and/or hydraulically connected. The USACE provided several alternatives in the December 2021 TWG: dredging through the water column, installing deeper sheet piles, and grouting the Beaumont sand. The USACE also suggested additional cross-sections, a top of Beaumont surface map, and a Beaumont thickness map.

The Respondents produced this information in response to the USACE but did not include a revised hydraulic heave analysis report with the new information. The USACE concluded that the lack of geologic cross-sections across the Site in the initial Site investigation program led to a conservative assumption that any sand was capable of moving fluid under full aquifer conditions.

Respondents provided a design for mechanical dredging in the NWC but did not provide consistent information. The safe water levels necessary to offset heave potential when dredging are inconsistent throughout the document; stating -9 ft North American Vertical Datum of 1988 (NAVD88) in the 90% RD Report, but in the NWC specifications states it is necessary to maintain a water level that does not go below -10.9 ft NAVD88. The EL -10.1 ft NAVD88 level is the calculated safe water level for the Extreme Case (flood level of 9+ ft NAVD88) in the Hydraulic Heave Evaluation/Geotechnical Engineering Report Addendum, while the Reasonable Maximum Case is calculated as EL -10.9 ft NAVD88. The safe water levels were calculated in the NWC heave analysis using a "dampening effect" calculation that is not adequately supported. The dampening effect calculation infers piezometric data from one part of the Site to another.

The Respondents did not include hydraulic heave mitigation measures other than dredging in part of the NWC with safe water levels. Respondents should provide adequate controls, best management practices, and protective measures and plans. Neither 90% RD contained these provisions for mitigation measures and safety procedures outside of the NWC.

3.4.2 Respondents' Response

Respondents continued to work on the hydraulic heave analysis during the EPA review period to combine the analysis for the NWC with that for the remainder of the site and provide a consistent basis for heave limits across the entire impoundment. A draft of the Updated Hydraulic Heave Analysis is provided in Appendix B. Measures to monitor and manage heave will be provided in the Revised 90% RD.

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

These measures are anticipated to include installation of piezometers to monitor hydraulic heads and heave potential prior to and during excavation and provide real-time data. The Revised 90% RD will include detailed procedures for installation and monitoring of these piezometers. The Revised 90% RD will also provide specifications for the Remedial Contactor to manage the heave in areas identified by the monitoring during excavation, including (1) limiting excavation activities in specific areas to periods considered safe from hydraulic heave based on the hydraulic head readings in the piezometers, and (2) utilizing mitigation measures during excavation to offset hydraulic head.

3.5 BMP Elevation

3.5.1 EPA Comment

Respondents' June and November 90% RD submittals document a likelihood that their selected BMP height could be overtopped by flooding during the excavation season and describe overtopping as a "technical uncertainty" for the implementation of the RD. The 90% RD fails to adequately address the potential safety and structural issues raised by the BMP's top elevation, either through re-design or adequately evaluated mitigation, protection and safety measures in the event of overtopping. Because of these issues with Respondents' selected top elevation of the BMP, the 90% RD is not complete and not suitable for procurement.

Summary of EPA Comments[2]

The Respondents have selected a BMP top elevation of +9 ft NAVD88 based on excavation activities only occurring during historically low river stage months. Historic water level data presented in the NWC 90% RD are inconsistent with the data provided in the 30% RD. In earlier submittals such as the May 28, 2020 30% RD, Respondents identified overtopping as an uncertainty and a challenge with design implementation. In the 90% RD, overtopping is presented as a "technical uncertainty", but did not provide and evaluate any mitigation and protection measures in the event of an overtopping event occurring during excavation season. Additionally, scour within the BMP is identified as a risk should overtopping occur, but no information regarding scour was provided in the 90% RD.

The 90% RD does not evaluate how overtopping during excavation might affect the design or the interior of the BMP. The June 90% RD does contain specifications and conceptual plans that might address the consequences of overtopping of the BMP during the excavation season, but they are not discussed in relation to their ability to address potential overtopping events. The Respondents have failed to adequately address any potential safety and structural issues raised by the BMP's top elevation nor properly evaluated mitigation, protection, and safety measures in the event of overtopping.

3.5.2 Respondents' Response

For purposes of the June 2022 90% RD Submittal, a BMP height of +9 ft NAVD88 was determined based on the hindcast model projecting that the on-site river stage had not exceeded this level during the excavation season. In an effort to continue to update and refine the hindcast model, additional river water level data that had been collected at the Site was incorporated into the model. The revised hindcast modeling included in the November 2022 NWC Submittal projected one event (November 1998) since 1994 where on-site river stage is modeled to have reached 9.78 ft during the excavation season. In light of the revised hindcast modeling, additional monitoring and mitigation procedures will be added to the Revised 90% RD in an attempt to address the potential effects of high water and BMP overtopping, to the extent practicable. In addition, the hindcast model will continue to be updated for purposes of the Revised 90% RD to include any additional on-site data that has been collected, which provides more confidence in the model. Based on this updated information, the BMP height will be evaluated for purposes of the Revised 90% RD.

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

In addition, a High-Water Preparedness Plan will be prepared that provides the procedures for monitoring the area rainfall and river elevations as a predictive tool to provide clear directions to the Remedial Contractor for managing the site during high water events. Remedial Contractor specifications will be added describing the limitations/requirements on open excavations and onsite backfill and the detailed procedures to secure the work and protect personnel and the equipment from a high-water event and minimize the risk of a release to the river. Remedial Contractor specifications will also be added for flooding the BMP with pumps to minimize the potential for scour of the material adjacent to the wall and to increase the factor of safety for the BMP structural integrity.

3.6 Inadequate Consideration of Trucking Alternatives

3.6.1 EPA Comment

The 90% RD presents limited road access along the TxDOT right-of-way (ROW) to the Site as a "technical uncertainty" for remedy implementation, but the 90% RD does not document adequate consideration of alternatives to using trucks for all materials handling. The 90% RD is not suitable for procurement because Respondents selected a design option identified by Respondents as a "technical uncertainty" potentially limiting or preventing implementation without sufficient evaluation of methods successfully used at other Superfund and sediment remediation sites for materials handling.

Summary of EPA Comments[2]

The 90% RD relies on continuing access to the Northern Impoundment via the Interstate Highway-10 (I-10) frontage road right of way (ROW) and an on-site logistical support area. The 90% RD discusses there is inadequate land at the Northern Impoundment for operations, truck staging and turnaround, and material laydown. The 90% RD also expresses concern regarding future Texas Department of Transportation (TxDOT) work on the I-10 bridge improvement project.

The 90% RD does not provide details as to how these issues can be addressed, leaving resolution to the Remedial Contractor. This is presented as a "technical uncertainty".

With sole reliance on trucks for material handling, the 90% RD should have evaluated alternatives to transport excavated material, such as barging and hydraulic pipelines. The 90% RD described the limited road access as a "technical uncertainty" but does not attempt to identify or evaluate alternative approaches used at other sediment remediation projects. The 90% RD leaves the issue of vehicle access to the Remedial Contractor.

3.6.2 Respondents' Response

Based on further evaluation since the submittal of the 90% RD, Respondents still believe trucking to be the safest and most effective transportation method. After submittal of the 90% RD, there were additional meetings (July 28, 2022, November 15, 2022, March 22, 2023, and August 16, 2023) between the Respondents, EPA, GHD, and TxDOT regarding access to the right-of-way. In those meetings, TxDOT stated that with proper planning, access could be provided to the TxDOT right-of-way for transporting the material by truck, including during periods when the I-10 bridge replacement project was underway. With respect to the I-10 project, TxDOT has specifically and publicly expressed concern regarding barge traffic in the area of the site, and the risk of barge strikes. Specific plans will need to be developed and commitments from TxDOT will need to be obtained as details regarding the I-10 bridge replacement project become known. Further, the work on the Southern Impoundment RA has demonstrated that trucking is a safe and effective way to move material from the Site to a landfill at production rates similar to those planned for the Northern Impoundment.

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

During the early phases of the RD, Respondents reviewed other transportation alternatives, including barging. A Remedial Action Objective for the Site, as stated in the ROD, is to "*Prevent releases of dioxins and furans above cleanup levels from the former waste impoundments to sediments and surface water of the San Jacinto River*." Barging significantly increases the risk of a potential release to the river as compared to trucking due to multiple handling operations from loading and offloading material over the water. Specifically, waste material would have to be lifted up and over the BMP and then placed in a barge moored in the river, directly adjacent to the BMP. With trucking, all loading operations would take place within the confined limits of the BMP. There is also the potential for a release while managing a barge that contains waste on the river, including releases during a flood event and during decontamination of the barge. A barging alternative also does not relieve the need for trucking as the evaluation determined that nearby landfills could not accommodate barge traffic directly. Barging would require an additional handling and transportation step by barging the waste material to a transfer station, offloading over the water into trucks, and then transporting waste material to a landfill by truck; consequentially increasing the impacts of greenhouse gas emissions.

Moreover, the local community of Channelview has long expressed concern and objection to increased barge traffic on both the north and south sides of the I-10 bridge, including hosting a public meeting on August 24, 2023 aimed at discussing how barge traffic "impacts and endangers our residents, neighborhoods, the waterways, the San Jacinto River Waste Pits Super Fund Site & remediation efforts, the San Jacinto Bridge and I-10 East."

With respect to the use of hydraulic pipelines, the removal method presented in the 90% RD is excavation in the dry for most of the impoundment and excavation through the water column by means of mechanical dredging in the NWC. Hydraulic pipelines are typically used in projects where hydraulic dredging is the removal method, not mechanical dredging. In order to move material via a hydraulic pipeline, the excavated material would have to be slurried by adding a significant amount of water. Once the material is transported via pipeline, the slurry would have to be dewatered prior to off-site disposal. This dewatering process would require significant property, would drastically increase the amount of contact water that would require treatment, would increase the chance of a release occurring should an overtopping event occur during dredging activities, and would likely extend the overall duration of the project. Therefore, hydraulic dredging is not considered a viable alternative for this project.

3.7 Intentional BMP Flooding

3.7.1 EPA Comment

The 90% RD does not decide whether the BMP will be intentionally flooded during the non-excavation season, despite its potential impact on the structural integrity of the wall in high-water events, and appears to leave this issue for resolution by the remedial contractor without a plan, performance metrics, or procedures to accomplish intentional flooding if it is deemed necessary. Respondents designed the wall without floodgates or alternate mechanisms to flood the BMP, impacting the ability to flood the BMP in a timely fashion in response to potential river flooding and also the ability to appropriately and timely treat water within the BMP for discharge prior to each excavation season. The 90% RD is seriously deficient because it is not complete due to this lack of procedures for critical work and is also not an implementable design of the selected remedy.

Summary of EPA Comments[2]

The 90% RD does not state whether the BMP will be intentionally flooded during the non-excavation season. The BMP was designed without floodgates, though no discussion was provided in the 90% RD as to why floodgates had

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

been omitted from the design of the BMP. This limits the ability to flood the BMP in a timely manner in response to potential river flooding.

The 90% RD also does not include procedures to appropriately and timely treat water within the BMP for discharge prior to each excavation season.

3.7.2 Respondents' Response

Intentional flooding of the BMP is not required to maintain the structural integrity of the BMP. The BMP is designed to withstand the differential pressures caused by the water level on the outside of the BMP at the top of the wall (+9 ft NAVD88) and the draft excavation surface shown on Drawing C-08 on the inside of the wall. The primary reason for intentionally flooding inside the BMP during offseason would be a mitigation measure to protect against scouring on the inside of the wall caused by potential overtopping of the BMP during a high-water event. The Revised 90% RD will provide specific procedures that will clearly define the requirements for monitoring the river levels and clear metrics, such as named tropical storm events, to define when mitigation measures are to be implemented.

As noted in Section 3.2.2, floodgates would compromise the BMP's structural integrity and could create a point of failure for the structure. The Revised 90% RD will therefore include measures, other than floodgates, that will not compromise the structural integrity of the BMP and that can adequately provide water within the BMP in a timely manner. Remedial Contractor specifications will be provided in the Revised 90% RD that describes the detailed procedures to be implemented during a potential high-water event and overtopping of the BMP, including controlled flooding of the BMP with pumps to manage the potential for scour on the inside of the BMP. Intentional flooding would also decrease differential pressures across the wall further increasing the factor of safety against compromising the BMP structural integrity. The Revised 90% RD will indicate that prior to the initial work and between seasons, the water within the BMP will be pumped down to 2 ft at the lowest collection point(s) without treatment and the remaining water below this two-foot level will be treated prior to discharge. This is discussed above in Section 3.2 - Bulk Water Treatment.

3.8 Barge Protection

3.8.1 EPA Comment

The 90% RD does not provide a plan for, or specifications or performance metrics related to, protection of the BMP from barge impacts, even though acknowledging the potential for damage to the BMP from barge strikes and describing potential barge strikes as a "technical uncertainty" in the implementation of the RD. The 90% RD leaves resolution of barge protection concerns to the remedial contractor, making the 90% RD not complete because of the lack of procedures for critical work.

Summary of EPA Comments[2]

The 90% RD describes a high potential that barges will strike the BMP over the course of the project. Respondents included an analysis to evaluate barge impact loads on the BMP and concluded that a strike could cause localized damage to the BMP. Modeling suggests a barge strike would not cause global failure. However, a strike could cause deformation of the wall necessitating repairs, soil shear strains, and potential work stoppages. Respondents concluded that additional protective measures were not required, but also that "the risk of barge strikes remains an uncertainty in the RD and a risk with respect to the safe implementation of the RA."

There are several mitigation measures which could be utilized, including staggered h-pile/mooring dolphin protection systems, rubber fenders on the exterior face of the BMP, and sacrificial monopile dolphins located away from the

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

BMP. The 90% RD does not include plans, specifications, or performance metrics for barge mitigation protections. General directions are provided for the Remedial Contractor.

The Respondents assertion that barge protection is not required is unsupported given there have been three notable barge strikes to either the TCRA cap or the nearby I-10 bridge since 2019. Additionally, the 90% RD did not model for extreme conditions, using 95th percentile velocities for San Jacinto River flow. The 90% RD also does not provide emergency response plans or protocols in the event of a barge strike, nor does it provide plans, specifications, and drawings for barge protection measures.

Preventing potential damage to the BMP is a “critical issue affecting safety, potential liability issues, and the structural integrity of the BMP.” Protection of the BMP is left to the Remedial Contractor, but this is insufficient and should be included in the RD.

3.8.2 Respondents’ Response

A preliminary evaluation has been performed of potential mitigation measures to address the uncertainties surrounding potential barge impacts and damage to the BMP. This preliminary evaluation included several barge strike protection measures, including rubber fenders, monopiles, fiber-reinforced polymer structures, and increased sized steel in the BMP. Barge strike protection measures will be included in the Revised 90% RD. Remedial Contractor specifications will be modified in the Revised 90% RD to specifically address the construction and management of these barge strike protection measures. Drawings will be included to provide the location and construction details of the planned protection measures.

The 90% RD included institutional and administrative controls to be present during the RA. The Respondents request EPA facilitate additional coordination with the US Coast Guard and other stakeholders responsible for managing the barge traffic on the river. For proper protection of the BMP, physical protections to be added as part of the Revised 90% RD should be implemented in conjunction with the appropriate institutional controls such as safety zones, signage stating to reduce speed and maintain distance, notice to mariners, and the establishment of controlled-access areas, which will require the engagement and cooperation of these stakeholders. Stakeholder discussions regarding this component of the project should continue beyond the submittal of the Revised 90% RD.

The Revised 90% RD will include further evaluation and design of barge protection systems that reflect the conditions of the BMP in the river. Unlike the supporting piers of the I-10 bridge, the BMP is not located directly in the navigational waterways. The BMP should not be in the direct path of a head-on impact if there is a loss of engine control during typical navigation. The barges can be expected to maintain sufficient distance from the BMP as they navigate through the area to prevent unintentional collision with the BMP. The 90% RD evaluated the impact of unintentional strike from one of the largest barges utilizing the 95th percentile velocity of the river water. It is assumed that if a barge loses engine control or disconnects from the mooring, it may drift toward the BMP with the river flow. Such a strike could cause localized damage to the BMP, but a global failure or collapse of the BMP is unlikely. This is a reasonable approach instead of compounding several parameters with a low probability of occurrence, e.g. largest barge in the vicinity of the BMP, higher velocity of flow, loss of engine control etc. to define the design criteria for the BMP. The extent and magnitude of localized damage and deformation of the wall will vary with the size of the barge, velocity of impact and water levels in the river. If a barge impact were to occur to the protective device and/or the BMP wall, a stoppage of work would be required until full assessment of the damage is undertaken and the necessary repairs are completed. The barge protection systems to be included in the Revised 90% RD will be designed as added protection from barge impacts and to minimize delays in resumption of project work following a barge impact event.

3.9 Scour on the BMP Exterior

3.9.1 EPA Comment

The 90% RD does not provide a plan for, or specifications or performance metrics related to, protection of the BMP from potential scour on the exterior of the BMP, while acknowledging the

potential for structural damage to the BMP from scour. The 90% RD leaves resolution of external scour concerns to the remedial contractor, making the 90% RD not complete because of the lack of procedures for critical work.

Summary of EPA Comments

Scour and riverbed erosion in areas adjacent to the Northern Impoundment after significant flooding metrics were documented in the ROD. In the June 90% RD, Respondents evaluated the potential for scour and concluded that scour protection measures may be required in the future. The Design Drawings in Appendix G do not show any riprap or scour protection along the exterior of the BMP. It is unknown if scour protection would be required for the entire length of the BMP or just as sections with high scour potential. There are no specifications for the size and quantity of the rock used for scour protection outside the BMP. The 90% RD should have specifications and drawings for scour protection on the exterior of the wall, since it is a critical issue relating to structural integrity of the BMP.

3.9.2 Respondents' Response

During the EPA review period, Respondents continued to evaluate mitigation measures for scour protection along the exterior of the BMP. A technical memorandum summarizing the evaluation is provided in Appendix C. The Revised 90% RD will include Remedial Contractor specifications for construction of the BMP scour protection measures through the placement of riprap along the exterior of the BMP and the design drawings will be updated showing the locations and construction details.

3.10 BMP Removal/Site Restoration

3.10.1 EPA Comment

The 90% RD is seriously deficient because it lacks complete plans, procedures, specifications and/or performance metrics for removal of the BMP and restoration of the Site upon completion of the project.

Summary of EPA Comments[2]

The 90% RD does not include complete plans or specifications for the removal of the BMP upon completion of remediation. Critical work is left to the Remedial Contractor, which may create uncertainty affecting biddability.

Several stakeholders have requirements related to the removal of the BMP and the end-state of the site, including but not limited to TxDOT, pipeline owners at the Site, and the Port of Houston Authority. The 90% RD provides insufficient supporting information about BMP removal and restoration of the Site, including how they will protect these nearby structures.

Respondents' Hydrodynamic Report did not consider shear stresses and velocities in the end-state condition in relation to the I-10 Bridge. Drawing C-22 shows the proposed restoration of the site with a soil embankment on the southern side and installation of erosion and scour protection to address comments raised by the Hydrodynamic Model. Respondents produced revised drawings to address a request by TxDOT for more information about the slope of the embankment but did not provide adequate support in the 90% RD that the proposed sloping would remain stable after the removal of the BMP, or if it would remain protective of the I-10 bridge and its protection structures for the long-term.

The 90% RD does not provide information regarding stability of adjacent properties, shore stability, impacts to pipelines, or nearby fleeting operations.

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

3.10.2 Respondents' Response

The Revised 90% RD will include Remedial Contractor specifications for removal of the BMP while still maintaining some flexibility as to not dictate the Remedial Contractor's means and methods.

Meetings were conducted after submittal of the 90% RD between the Respondents, EPA, GHD, and TxDOT regarding the BMP alignment and end state restoration. In those meetings, TxDOT stated the planned alignment of the BMP does not conflict with the current design of the I-10 bridge replacement project and the southern wall of the BMP (to be installed on the TxDOT ROW) could be left in place and cut below ground surface as a measure to maintain slope stability for the shoreline. The above will be reflected in the Revised 90% RD's specifications, subject to further confirmation from TxDOT (that any conflict between the two projects can be resolved, use of the TxDOT right-of-way will be available in implementing the RA, and that TxDOT will allow a portion of the southern wall of the BMP to be left in place).

In addition, as part of the meetings with TxDOT described above, Respondents provided additional restoration drawings to TxDOT detailing the proposed sloping after the removal of the BMP, based on the end state evaluation in the hydrodynamic model. This information will be provided in the Revised 90% RD. The Respondents have been in discussion with ExxonMobil Pipeline Company (Exxon) (and all other stakeholders) during the development of the RD. Exxon has provided information, including design drawings, on its assets that are located at the site along with initial feedback on the proposed BMP. Exxon has indicated that the BMP as submitted in the 90% RD, does not physically conflict with Exxon's known assets. Respondents will continue engagement with stakeholders to evaluate potential impacts to adjacent property owners. The Revised 90% RD will provide additional information on shoreline stability.

The Hydrodynamic Modeling Report did consider shear stress and velocities in the end-state condition. The end-state condition was simulated by a change in bathymetry in the model to account for removal of the BMP, the revised bathymetry based on the excavated area, and shoreline embankment as part of restoration. Erosion and scour protection will be added to the Revised 90% RD. The protection will be placed on the soil embankment along the southern edge of the impoundment based on that analysis.

3.11 Technical Uncertainties

3.11.1 EPA Comment

Respondents have labeled certain design, engineering or construction issues as "technical uncertainties" where i) Respondents' own selected design approach creates or exacerbates issues, and alternate design approaches and/or mitigation and protection strategies exist consistent with best engineering practices and consistent with the ROD which are not adequately explored or developed by Respondents; and ii) Respondents fail to provide plans or specifications to address critical work issues affecting the structural integrity of the BMP, creating uncertainty by leaving the issues for resolution by the future remedial contractor. The use of the term "technical uncertainty" for issues not addressed by Respondents makes the 90% RD not complete and not suitable for procurement.

Summary of EPA Comments[2]

Respondents have not addressed multiple "technical uncertainties" which they claim "could render the remedial alternative outlined in the ROD technically impracticable and not implementable." Remedies and mitigation approaches have not been adequately explored by the Respondents.

Remedies to addressing hydraulic heave, such as injecting grout into sand lenses or dewatering sand lenses, have only been provided an "initial review" without full evaluation. While the EPA stated that Respondents should note

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uncertainties about design issues in the 90% RD, these uncertainties were stated in place of technical evaluations, supporting documentation, and complete plans, specifications, and drawings required in a 90% RD.

The Respondents leave critical issues to be resolved by the future Remedial Contractor. The Respondents have focused on the risk of the project in a manner which could influence potential Remedial Contractors' perception of the project. This may impact the biddability of the project, resulting in high and/or fewer bids for remedial construction.

Respondents have failed to document that the ROD is not implementable. Respondents' claims that there are not acceptable design approaches consistent with the ROD are often unsupported. Remedial approaches consistent with the ROD have been suggested by EPA and have not been adequately evaluated and supported. The use of the term "technical uncertainty" for issues that were not adequately evaluated represents a serious deficiency in the 90% RD.

3.11.2 Respondents' Response

The discussion of technical uncertainties identified in the 90% RD was consistent with the direction in EPA's *Remedial Design / Remedial Action Handbook* that technical uncertainties should be identified in an RD submission. Any design that has to address the conditions at the Northern Impoundment will necessarily involve some uncertainties. The Revised 90% RD will narrow and better define the remaining uncertainties, provide potential mitigation strategies using best engineering practices, and provide clear direction to the Remedial Contractor in the specifications, plans, and other design documents that include metrics and procedures for implementation of the mitigation strategies.

The Respondents have been in discussion with Exxon (and other stakeholders), as discussed in Section 3.10.2, during the development of the RD. Discussions with stakeholder engagements will continue as the RD progresses.

3.12 Insufficient Supporting Information and Overall Lack of Detail

3.12.1 EPA Comment

The 90% RD does not provide sufficient detail, explanation, documentation, and support for some design decisions, conclusions and factual statements, and is generally overly conceptual and not adequately developed for a 90% design. This affects the EPA's ability to review the document, but inadequate supporting information also affects the biddability and constructability of the RD.

3.12.1.1 Vibration Analysis

Summary of EPA Comments[2]

Respondents provided a vibration study in the 30% RD, which was a single wall design. An updated vibration study was not included in the 90% RD, despite the significant change to a double sheet-pile cofferdam wall.

Respondents claim that an additional study was not required due to the new design "being terminated in the Beaumont Clay layer instead of driving into stiffer sand layers, thereby reducing the potential for vibrations significantly". Given the importance of this issue, additional support and explanation should have been provided for this conclusion, because: 1) the design of the 90% RD moved the BMP closer to I-10 than the previous design; 2) Respondents indicate that they may not have obtained structural information on the foundation of the current I-10 bridge; and 3) vibrations may impact pipelines, which has not been evaluated.

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

3.12.1.1.1 Respondents' Response

The vibration analysis report will be updated to reflect the new conditions for the BMP and the updated report will be included in the Revised 90% RD. The updated report will address the potential effects on the I-10 bridge and Exxon pipelines in the area.

3.12.1.2 Waste Volume Estimates

Summary of EPA Comments[2]

In their March 2022 letter and Appendix E of the June 90% RD, Respondents estimated the total excavated waste material for areas in the Northern Impoundment excluding the Northwest Corner, based on use of a SWAC approach for excavation contours, was 177,000 cubic yards. In the body of the 90% RD, the approximate volume of waste material in the Northern Impoundment (excluding the Northwest Corner) is estimated at 168,000 cubic yards. This number differs from the 177,000 cubic yards cited in Appendix E of the same document.

The 90% RD also contains conflicting information on 25,000 cubic yards of unimpacted material in the historic central and southern berms. It is presented as material to be excavated for potential reuse but is also included in the total waste volume estimate of 168,000 cubic yards.

Respondents claim that excavation using the proposed SWAC contours would save 46,000 cubic yards of material from being excavated as opposed to the excavation going sampling point by sampling point. No support is provided for this estimate, and the EPA review team was unable to reproduce corroborating numbers. The EPA is unable to determine which, if any, volumes stated in the 90% RD are correct.

3.12.1.2.1 Respondents' Response

The waste volumes will be updated for the entire site in the Revised 90% RD using the draft excavation surface provided in the attached Drawing C-08 (Appendix A).

3.12.1.3 Residuals Management and Overtopping in Dredge Area

Summary of EPA Comments[2]

The 90% RD did not provide sufficient detail regarding residuals management approaches for the EPA's review, nor the full evaluation discussed in the EPA's September 28, 2022 letter. A full evaluation of the residuals created during dredging operations in the NWC should have been included in the 90% RD, yet Respondents left details critical to success of this approach up to the Remedial Contractor. Respondents did not document evaluation of all approaches discussed in the EPA's September 28, 2022 letter, and did not consider contact water generated during dredging. The 90% RD did not update the specs for the water treatment system to include this contact water.

The 90% RD claims that there are no controls that could be implemented to prevent a release if uncontrolled overtopping of the BMP occurred. This conclusion is unsupported and does not evaluate several mitigation strategies such as an interior wall to separate the dredging operation from the rest of the site, dropping suspended sediments out of the water column, or an evaluation of flocculants, polymers, coagulants, and other additives or mixtures that could be used in an emergency situation.

The 90% RD does not include details, performance metrics, or specifications for a Chemical Additives Dosing Plan for dredging. The 90% RD also does not support Respondents' assertion that an overtopping event for areas being dredged would have more severe consequences, because releases from overtopping could be lessened due to water depth within the BMP, and the water may provide a buffer from the potential turbid effects of the impacted sediments.

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

3.12.1.3.1 Respondents' Response

A Residual Management Plan will be included in the Revised 90% RD. The Residual Management Plan will provide an evaluation of the estimated residuals to be generated during the dredging. The Residual Management Plan will also provide a description of the options that were considered, including those described in EPA's September 28, 2022 letter, and describe the advantages and disadvantages of each followed by a more detailed discussion of the option(s) selected.

Remedial Contractor specifications will be added to the Revised 90% RD for managing the residuals based on the Residual Management Plan. The revised specifications will detail the Remedial Contractor requirements including the performance metrics to be followed. Regarding the use of chemical additives for residuals management, there would likely be some further testing during the RA, the nature of which would be specified during the RD phase in the Revised 90% RD. The Remedial Contractor specifications will define the testing requirements and the success metrics. In addition, Remedial Contractor specifications will be added to the Revised 90% RD to define the measures to be implemented to address the spread of contact water and the residuals. This will include detailed Remedial Contractor requirements to address the potential for spread of residuals should an overtopping of the BMP or other high-water event occur. These specifications will follow the High-Water Preparedness Plan described in Section 3.5.2 and provide clear direction to the Remedial Contractor of the measures to be taken to secure the site based on the protocols provided in the Residual Management Plan. The intent will be to be more prescriptive in the specifications and require adherence to the Residual Management Plan but allow sufficient flexibility as to not dictate the means and methods of the Remedial Contractor.

The wastewater treatment system design in the Revised 90% RD will be modified, as necessary, to include additional clarification/filtration components and operations for treating the wastewater streams with potential high sediment loading that will be generated during dredging, residuals management, and placement of the residual management layer. Remedial Contractor specifications will be modified to specifically address the construction and operation of these additional clarification or filtration systems. Updated Design Drawings will be included in the Revised 90% RD that show the added treatment components.

3.12.1.4 Design Loads

Summary of EPA Comments[2]

Respondents stated that the 90% RD did not consider FEMA flood loads because excavation work is planned to be completed seasonally outside the period of which there is a greater risk of flooding events, and the structure will be flooded with river water during the non-excavation season. However, no decision has been presented in the 90% RD on how or if the BMP would be intentionally filled between excavation seasons.

In the NWC 90% RD, Respondents also presented historical data indicating the potential for flooding at the site during excavation season, when the BMP would be dewatered. Respondents did not consider FEMA flood loads during excavation season even though bulk water apparently could not be quickly added to the BMP if flooding did occur. Respondents do not provide any rationale as to why their load calculations are sufficient given this information.

3.12.1.4.1 Respondents' Response

As discussed in Section 3.7.2, the BMP is designed to withstand the differential pressures caused by the water level on the outside at the top of the wall and the excavation surface on the inside of the wall shown on draft Drawing C-08 (Appendix A). The primary reason for intentionally flooding the inside of the BMP would be as a mitigation measure to protect against scouring on the inside of the wall should overtopping during a high-water event occur. The Revised 90% RD will provide specific procedures that will clearly define the requirements for monitoring the river levels and specific metrics, such as named tropical storm events, to define when mitigation measures are to be implemented including controlled flooding of the BMP.

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

As discussed above in Section 3.5.2, a High-Water Preparedness Plan will be prepared that provides the procedures for monitoring the area rainfall and river elevations as a predictive tool to provide clear directions to the Remedial Contractor for managing the site during high water events (including such events during the excavation season). The Remedial Contractor specifications will be revised to describe the procedures to be implemented for securing the site including moving out equipment, removing contaminated materials and covering open excavation surfaces.

3.12.1.5 TCRA Cap and Historic Berm Reuse

Summary of EPA Comments[2]

Section 5.2 *Re-use of TCRA Armored Cap and Historic Berm Material* does not contain sufficient information to explain how the boundaries of the historical berm and cap rock reuse area were derived. EPA's review of the sampling procedures for the berm material is reliant on this information.

The proposed one sample per 1,000 cubic yards may not be sufficient, since it has not been established that the historic berm material is completely free of contamination exceeding the cleanup level. Additionally, the 90% RD did not provide details on how rock in the armored cap will be removed without destroying the underlying geotextile, potentially exposing the rock to contamination. Additional sampling of the stockpiled cap rock may be required before reuse.

The 90% RD does not include information on how the cap rock and berm material will be stockpiled while waiting for sampling.

3.12.1.5.1 Respondents' Response

The Revised 90% RD will include additional information on how the boundaries of the historical berm material and TCRA armored cap (cap) rock reuse area were developed. It will also provide additional plans and details of how the cap will be removed to prevent damaging the underlying geotextile and geomembrane in the process. Once the rock is removed, the additional plans will provide options to either reuse the rock around the site or dispose of the cap rock at an off-site landfill. These options will include information related to sampling and staging of cap rock on-site.

3.12.1.6 Sufficiency of Geotechnical Information for Revised Wall Alignment

Summary of EPA Comments[2]

No sampled borings have been drilled/sampled at the current BMP alignment; the only data at the current BMP location is based on CPTs. Respondents should explain why the geotechnical data present in the 90% RD is sufficient for the BMP final design.

3.12.1.6.1 Respondents' Response

The Respondents believe the geotechnical data present in the 90% RD is sufficient for the BMP design as sixteen (16) deep geotechnical drilled borings have been conducted across the site. These boreholes executed across the whole impoundment footprint were drilled down to the Beaumont Sand Formation. A large number of samples were retrieved from each of these boreholes and submitted for laboratory testing to characterize the clayey deposit appropriately (moisture content, sieve analyses, Atterberg limits and shear strength parameters assessment). In an effort to obtain data along the current proposed BMP alignment, cone penetrometer testing (CPT) combined with shear vane tests were performed to obtain necessary parameters for design. CPT was also performed in two deep locations inside the impoundment limits. In contrast to sampled drilled borings, CPTs provide data on continuous strength and soil behavior, while drilled borings are not continuous and testing is not continuous. The previously drilled, sampled borings in combination with the CPTs provided sufficient information for the design of the BMP. However, if EPA

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believes that additional data collection along the BMP alignment is needed, a workplan for this additional work can be developed.

3.12.1.7 Seasonal Excavation

Summary of EPA Comments[2]

In order to expedite the remedial action timeline, greater efforts should have been taken to evaluate what specific work could be completed outside of the seasonal excavation season and to maximize that work, as well as conducting a potential re-evaluation of the proposed limits of the seasonal excavation. The community and THEA do not agree with the prolonged proposed remediation schedule in comments on the 90% RD and believes that excavation should be completed throughout the entire year with best management practices in place for work during hurricane season. The cessation of work from early May to early November is inconsistent with EPA's Superfund work in the Houston area, and Respondents' own contracted work on the TCRA cap from July 2011.

Emergency and contingency procedures for high water events should exist throughout the year, whether it is in or out of the excavation season. Appendix H of the 90% RD Specifications requires the submission of a Flood Contingency Plan and a Hurricane and Severe Storm plan. It is the EPA's expectation that these and other contingency plans will have adequate controls, best management practices, and protective measures to address adverse events, but the 90% RD does not contain an evaluation of the sufficiency of the contingency plans mentioned in the specifications.

In the NWC 90% RD, the potential effects and contingency measures for overtopping in an area being excavated through the water column would be different than those for areas being excavated in the dry, but these changes are not addressed.

The 90% RD should have thoroughly evaluated the seasonal work approaches' risks, limitations, and effects on implementation, and documented the many considerations, including all of the pros and cons, of this approach. This could have led to re-consideration of the potential for excavation behind the BMP, both in the dry and through the water column, to be extended into some or all of the hurricane season, as long as appropriate plans are in place and precautions are taken.

3.12.1.7.1 Respondents' Response

The Respondents completed a detailed evaluation of the river levels and work schedules to define the approach to effectively complete the project while minimizing the potential for a release to the river should a BMP overtopping event occur. This evaluation took into account the need to minimize the infrastructure that is within the BMP footprint that would be difficult to quickly remove from the area and therefore be vulnerable to a high-water event. The excavation seasons and BMP wall heights were selected based on careful consideration of these factors.

Recognizing the importance of the remedial action timeline and maximizing efficiency during the excavation season, the Revised 90% RD will include thorough consideration and discussion of any work that can be completed outside of the excavation season while still effectively managing the potential for a release and also managing the infrastructure within the BMP. The intent is to perform work outside the excavation season, except for uncovering and excavating contaminated soils. At a minimum, these activities would include:

- BMP installation and removal
- Mobilization/demobilization of the water treatment system
- Bulk water treatment
- Construction of roads and access
- Ancillary site work

The Revised 90% RD will provide an evaluation of these and potentially other tasks that can be performed outside the excavation season while managing the risks of a potential high water or overtopping event. It is recognized that while

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

unlikely based on the current model, there is a potential for an overtopping event to occur even during the excavation season. As discussed in the response to Section 3.5.2, a High-Water Preparedness Plan will be included in the Revised 90% RD that provides the procedures for monitoring the area rainfall and river elevations as a predictive tool to provide clear directions to the Remedial Contractor for managing the site during high water events. The Remedial Contractor specifications will be modified in the Revised 90% RD to provide more direction regarding the requirements for the Flood Contingency Plan and a Hurricane and Severe Storm Plan. The specifications will include incorporating the information that is developed from the High-Water Preparedness Plan to define the metrics for when action is required and the requirements for contingency planning.

3.12.1.8 Hydrodynamic Model

Summary of EPA Comments[2]

The USACE found that the 90% RD lacked sufficient technical detail and information to support the assumptions used in the hydrodynamic model, therefore creating questions about its limitations and the use of its conclusions in the 90% RD. The model was used to evaluate the potential for river flow to create scour around the BMP, barge impact velocities in load calculations, the BMP's potential effects on the surrounding floodplain, shear stresses after remedial excavation was completed, and the BMP's effects, during and after remediation, on the TxDOT I-10 bridge.

The USACE was concerned about the effect of wind waves during simulated flood events on bed shear stresses, as well as on potential overtopping of the cofferdam. These were not simulated in the modeling study. The model only simulated current-induced bed shear stresses. Wind-induced bed stresses were not evaluated. The USACE required more information on why the effect of wind waves were not included in the modeling study in order to evaluate its validity. The USACE also questioned how high flow events with return periods of 2, 10, and 100 years were chosen. The USACE questioned whether storm surges were actually simulated along with high river flows.

Respondents' hydrodynamic model also failed to explain why the 95th percentile shear stresses were higher for both the site's existing conditions and with the BMP cofferdam for the 2-year storm than they were for the 10-year and 100-year storms.

The USACE also believed additional technical information should have been provided to explain why only a qualitative-based sedimentation study was conducted. A technical justification for why a complete sedimentation study was not performed should have been provided.

TxDOT requested that Respondents use the hydrodynamic model to evaluate the effect of the BMP structure on the velocity and shear stress of the river on the current system protecting bridge piers. The USACE believes the model grid used by the Respondents was inadequate to evaluate the impact of BMP shear stresses around the bridge.

3.12.1.8.1 Respondents' Response

The Hydrodynamic model is appropriate for its intended use. The model that was used is based on previous models developed by Anchor QEA and included changes based on USACE comments on that model. USACE Environmental Fluid Dynamics Code (EFDC) model code was also utilized, with a refined mesh in the site area and the offshore boundary was extended to Morgans Point at Trinity Bay. The hydrodynamic model was developed with the main objective of evaluating flooding changes in the floodplain that could potentially be attributed to the cofferdam construction. The model was also used to calculate shear stresses to inform armoring or reinforcement at the base of the cofferdam, and for end-state conditions. Per TxDOT's request, the changes in velocities and shear stresses due to the presence of the cofferdam were also evaluated. Further technical details can be discussed with reviewers to clarify assumptions and limitations, and such technical details can be included in the Revised 90% RD.

Potential wave effects on shear stresses and structure overtopping were analyzed as part of the BMP design. It was estimated that fetch is not long enough in any direction to generate any significant waves in the area. The shallow water depth also limits the generation of significant waves. Storm surge was included in the model in the open

[2] To provide context, EPA's specific comments are summarized in this document, using terminology and wording from the January 5 Letter. In providing such summaries, the Respondents are not acknowledging the validity of EPA's comments.

boundary condition by generating water surface boundary conditions that simulates the propagation of a surge wave from Biscayne Bay into the San Jacinto River area.

The 95th percentile and maximum values were considered to estimate extreme conditions, and both were taken into account for the BMP design. The 95th percentile values were deemed more appropriate for comparison between different modelled scenarios and conditions since they are more representative of a global effect rather than very localized areas as would result on the use of maximum values. The use of the 95th percentile was discussed with EPA and TxDOT in a call on April 5, 2022, and following that discussion, velocity and shear stress analyses were provided to EPA and TxDOT on April 11, 2022, both of which were prior to the submittal of the 90% RD.

The decline in shear stresses with river flow is attributed to the increase in water surface elevation and flooding areas due to higher flows and higher storm surges.

A complete sedimentation analysis using a sediment model was not performed since the main goal was not to estimate how much and how deep erosion would be but to estimate areas of potential erosion and the design of protective measures using riprap and other measures based on shear stresses calculated by the model.

The resolution was discussed with TxDOT and is deemed appropriate for the scope, with a resolution in the bridge area of 50 ft for a bridge length of 700 ft approximately, giving a good resolution both across channel and along channel direction in the approach area.

More detailed technical information, as well as assumptions and limitations will be provided in the Revised 90% RD.

4. Planned Schedule

The following schedule for completion of the Revised 90% RD was developed based on the Plan described above.

The specific tasks for completion of the Revised 90% RD are described below.

- Update Basis of Design Document
- Update Reports
    - Hydraulic Heave Analysis
    - Vibration Report
    - BMP Structural Design Report (if necessary)
- Update Design Drawings
    - Excavation surfaces and heave analysis
    - Barge strike protection
    - Scour protection
    - Water Treatment components for dredging
    - Update other Drawings affected by design changes
- Prepare/Update Supporting Deliverables
    - High-Water Preparedness Plan
    - Residual Management Plan
    - Health and Safety Plan
    - Field Sampling Plan
    - Quality Assurance Project Plan
    - Site-Wide Monitoring Plan
    - Construction Quality Assurance/Quality Control Plan

- Update Design Specifications
    - BMP flooding and mitigation measures
    - Monitoring and mitigation for hydraulic heave areas
    - Residual management during dredging
    - Any changes to BMP Design
    - Global update to be more prescriptive to Remedial Contractor
    - Update Design Specifications
- Review and Finalization

The planned schedule for preparation of the Revised 90% RD is shown below on Figure 4-1.

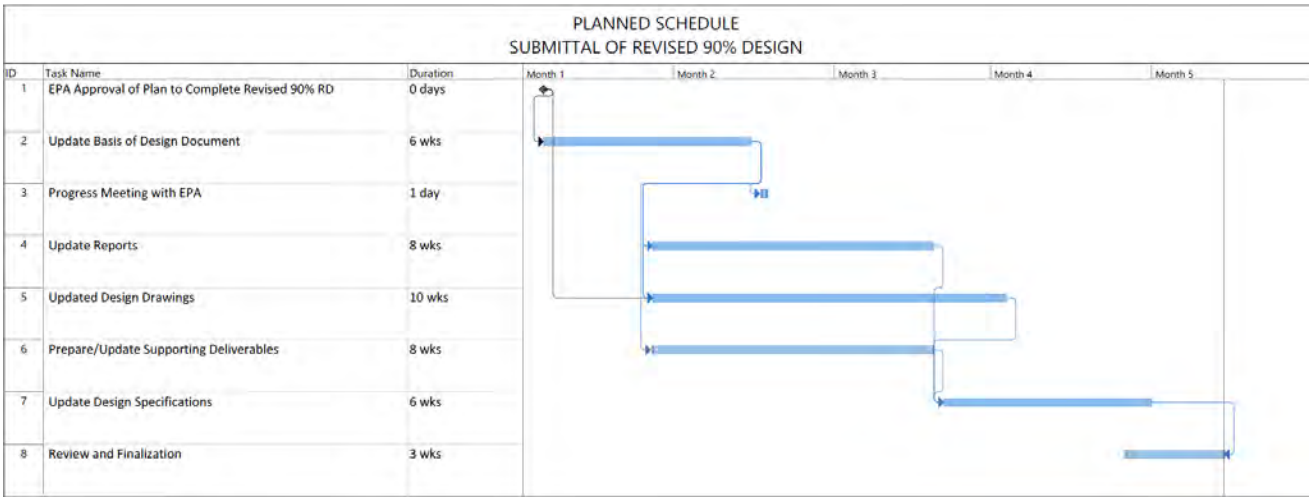

Figure 4.1 Planned Schedule for Submittal of Revised 90% RD

The schedule is based on completing the Revised 90% RD by addressing the comments in the manner described in this Plan. Based on the durations listed above, the Revised 90% RD would be submitted to EPA within 130 days of approval of this Plan. The schedule is based on the comments received in EPA's January 5 Letter and assumes a Progress Meeting with EPA during the 130-day period.

As such, the basis of design would be completed first. The reports, supporting deliverables and drawings would be worked on concurrently but would not be finalized until the design basis is complete. Work on the specifications would begin after the design basis and incorporate information from the drawings, reports and supporting deliverables, so completion of the specifications would follow the completion of these other design components.

Appendices

Appendix A

Draft Excavation Surface

SOURCE:

TOPOGRAPHIC, HYDROGRAPHIC, & MAGNETOMETER SURVEY OF SAN JACINTO RIVER WASTE PITS, HARRIS COUNTY, TEXAS, MORRISON SURVEYING INC., 190608, JULY 8, 2019 TO AUGUST 2, 2019
UPDATED BATHYMETRY DATA PROVIDED BY ANCHOR QEA OCTOBER 2021

NOTES:

1. ASSUMED TxDOT RIGHT OF WAY IS BASED ON INFORMATION PROVIDED BY THE HARRIS COUNTY TAX ASSESSOR'S OFFICE.
2. FINAL EXCAVATION CONTOURS ARE SUBJECT TO CHANGE.

GHD SERVICES INC.
JOB NO. 11215702 FILE NO. 001
GHD TEXAS FIRM REGISTRATION NO. 276

GHD
5551 Corporate Boulevard Suite 200
Baton Rouge Louisiana USA
T 225 292 9007 F 225 952 2978 W www.ghd.com

LEGEND

- ASSUMED TxDOT RIGHT OF WAY
- TCRA CAP PERIMETER
- EXISTING CONTOUR INTERVAL
- FENCELINE
- SHORELINE
- TOP OF BANK
- TOE OF SLOPE
- OVERHEAD ELECTRICAL
- GUARDRAIL
- PIPELINE
- SJSB002 BORING LOCATION
- MW MONITORING WELL
- P.P. POWER POLE
- L.P. LIGHT POLE
- WELL
- MATERIAL TO BE EXCAVATED
- EXISTING BERM TO EXCAVATED
- EXISTING BERM
- CONCRETE
- GRAVEL
- AZ26-700 PILE
- AZ40-700 PILE
- PLANNED IMPROVEMENTS FOR NORTHERN IMPOUNDMENT ACCESS
- RAISED BENCH

Client
SAN JACINTO RIVER WASTE PITS

Project
NORTHERN IMPOUNDMENT PRE-FINAL 90% REMEDIAL DESIGN HARRIS COUNTY, TEXAS

No.	Issue	Drawn	Approved	Date
2	30% EPA REVIEW	MW	RH	05/28/2020
1	30% CLIENT REVIEW	MW	RH	05/15/2020

Drawn	MW	Designer	RH
Drafting Check	-	Design Check	LL
Project Coordinator	CM	Date	Jan 24, 2024
This document shall not be used for construction unless signed and sealed for construction.		Scale	1" = 60'
Original Size	Arch D	Bar is one inch on original size drawing	0 — 1"

Project No. **11215702**

Title
EXCAVATION PLAN OVERALL

Sheet No.
C-08

Sheet - of -

Plot Date: 24 January 2024 - 12:34 PM Plotted By: Matt Wolfer Filename: N:\US\Baton Rouge\Projects\662\11215702\Digital_Design\ACAD 2019\Sheets\11215702-01-DWG-C-011.dwg

Table 5-1
Draft Excavation Elevations
Plan in Response to EPA Comments to 90% RD – Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

	SJSB073	SJSB058	SJSB101[1]	SJSB071[1]	SJSB037	SJSB070	SJSB099	SJGB013	SJSB100	SJSB098[1]	SJSB057[1]	SJSB103	SJSB097	SJSB056	SJSB056-C1	SJSB095	SJSB055-C1	SJSB055	SJSB096	SJGB014
Starting Elevation (Mud-line)	1.29	0.62	-0.15	-0.80	1.43	-1.17	-0.61	-8.04	-13.36	-14.36	-18.39	-15.36	-15.64	-12.40	-4.29	-2.07	-9.54	-4.90	-6.55	-1.22
ELEVATION (feet NAVD88)																				
+7																				
+6																				
+5																				
+4																				
+3																				
+2																				
+1	9.6	12			NA															
0	9.6	12	**63000**		NA															
-1	**31000**	**36100**	**63000**	**34700**	NA	**43900**	**53000**													**31625**
-2	**31000**	**36100**	**59000**	**34700**	NA	**43900**	**53000**									**35000**				**31625**
-3	**26000**	**48400**	**59000**	**45900**	**40400**	**68600**	**54000**									**35000**				**210.4**
-4	**26000**	**48400**	**25000**	**45900**	**40400**	**68600**	**54000**								0.79	**59**				**210.4**
-5	**68000**	**324**	**25000**	26.8	0.87	**45600**	**130**								0.79	**59**		1.36		**531.3**
-6	**68000**	**324**	18	26.8	0.87	**45600**	**130**								1.14	1.0		1.36		**531.3**
-7	**83000**	**1160**	18	2.24		**24300**	13								1.14	1.0		1.07	**87000**	**213.3**
-8	**83000**	**1160**	2.7	2.24		**24300**	13	**5100**							0.26	9.7		1.07	**87000**	**213.3**
-9	**41.0**	**376**	2.7	1.03	**618**	**16700**	15	**5100**							0.26	9.7		0.81	**22000**	18.6
-10	**41.0**	**376**	**230**	1.03	2.59	**16700**	15	**1740**							0.60	**1200**	**34.3**	0.81	**22000**	18.6
-11	5.2	**9890**	**230**	1.48	11.5	**1000**	**210**	**1740**							0.60	**1200**	**34.3**	1.28	**310**	1.29
-12	5.2	**9890**	0.62	1.48		**1000**	**210**	**338**						3.35	1.4	**57**	**31.1**	1.28	**310**	1.29
-13	15	**136**	0.62	0.52		**609**	1.9	**338**	**110**					3.35	1.4	**57**	**31.1**	2.53	4.9	
-14	15	**136**	0.27	0.52		**609**	1.9	**104**	**110**	**71**				1.65	1.33	6.0	1.34	2.53	4.9	
-15	5.6	**788**	0.27	**44.6**		6.9	26	**104**	3.7	**71**		2.2		1.65	1.33	6.0	1.34	0.89	**8500**	
-16	5.6	**788**	11	**44.6**		6.9	26	25.2	3.7	**1900**		2.2	5.2	0.80	0.60	**55**	0.70	0.89	**8500**	
-17		0.52	11	**45.4**		4.69	14	25.2	9.2	**1900**		1.1	5.2	0.80	0.60	**55**	0.70	1.09	**84.0**	
-18		0.52	3.2	**45.4**		4.69	14		9.2	**1800**	**24200**	1.1	1.2	0.78	0.62	0.60	1.07	1.09	**84.0**	
-19			3.2						0.81	**1800**	**24200**	14	1.2	0.78	0.62	0.60	1.07	1.42	5.2	
-20									0.81	**160**	**37600**	14	1.8	3.76	0.96		1.16	1.42	5.2	
-21									2.3	**160**	**37600**	4.8	1.8	3.76	0.96		1.16	0.92	1.9	
-22									2.3	**9600**	**3540**	4.8	1.4	0.93			0.67	0.92	1.9	
-23									0.58	**9600**	**3540**	3.9	1.4	0.93			0.67		13	
-24									0.58	**3900**	**372**	3.9	2.6	2.91			1.12		13	
-25									0.57	**3900**	**372**	0.49	2.6	2.91			1.12			
-26									0.57	**680**	7.6	0.49	0.77	4.44			5.49			
-27									0.51	**680**	7.6	0.46	0.77	4.44			5.49			
-28									0.51	11	2.93	0.46	1.4	0.46						
-29										11	2.93		1.4	0.46						
-30										0.16	15.9		0.29							
-31										0.16	15.9		0.29							
-32											1.59									
-33											1.59									
-34											1.5									
-35											1.5									
Calculated Exc. Elev.	**-10.71**	**-17.38**	**-17.65**	**-18.80**	**-9.57**	**-15.17**	**-12.61**	**-16.04**	**-15.36**	**-28.36**	**-26.39**	**-16.99**	**-15.64**	**-12.40**	**-21.92**	**-18.07**	**-13.54**	**-4.90**	**-18.55**	**-9.22**
Calculated Exc. Depth	**12**	**18**	**17.50**	**18**	**11**	**14**	**12**	**8**	**2**	**14**	**8**	**1.63**	**0**	**0**	**17.63**	**16**	**4**	**0**	**12**	**8**
Hydraulic Heave Elevation	**-20.00**	**-19.02**	**-18.38**	**-18.48**	**-20.02**	**-20.07**	**-22.07**	**-21.70**	**-20.41**	**-24.53**	**-15.65**	**-23.14**	**-26.20**	**-27.27**	**-28.54**	**-29.19**	**-31.84**	**-23.28**	**-28.55**	**-26.44**
Hydraulic Heave Depth	**21.29**	**19.64**	**18.23**	**17.68**	**21.45**	**18.90**	**21.46**	**13.66**	**7.05**	**10.17**	**-2.74**	**7.78**	**10.56**	**14.87**	**24.25**	**27.12**	**22.30**	**18.38**	**22.00**	**25.22**

Notes:

- Bold font indicates dioxins results >30 ng/kg TEQ.
- Yellow shading indicates material >30 ng/kg TEQ being removed.
- Green shading indicates material <30 ng/kg TEQ being removed.
- Red line indicates the elevation in each boring at which there is risk of hydraulic heave (Factor of Safety <1.25).
- Green line indicates the target removal elevation for each boring.
- Black line indicates the target removal and hydraulic heave elevations are essentially identical.
- Grey shading indicates soil borings in the northwest corner.

[1] Excavation to the deepest elevation of dioxins concentrations >30 ng/kg TEQ would be at risk of hydraulic heave.

Notes:

Table 5-1
Draft Excavation Elevations
Plan in Response to EPA Comments to 90% RD – Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

	SJSB053-C1	SJSB053	SJSB054	SJSB094	SJSB052-C1	SJSB052	SJSB051	SJSB092	SJSB093	SJSB038	SJGB016	SJSB104	SJSB088	SJSB090	SJGB015	SJSB050-C1	SJSB033	SJGB012	SJSB072[1]	SJSB074
Starting Elevation (Mud-line)	-7.40	-9.70	-7.40	-4.22	-2.20	-5.70	-2.70	-4.93	-1.53	-1.98	-2.07	-5.49	-2.12	-1.50	-5.94	-6.30	3.12	0.43	1.42	3.34
ELEVATION (feet NAVD88)																				
+7																				
+6																				
+5																				
+4																				
+3																	95.6			7800
+2																	95.6			7800
+1																	1050		NA	70000
0																	1050	4050.5	NA	70000
-1																	7120	4050.5	NA	30000
-2					9.22				41000	NA	3517.8		39000	62000			7120	25065.3	NA	30000
-3					9.22		3.02		41000	NA	3517.8		39000	62000			5740	25065.3	NA	87
-4				36000	1.2		3.02		42000	NA	75.3		43000	6600			5740	24424.6	NA	87
-5				36000	1.2		4.98	43000	42000	NA	75.3	15	43000	6600			1700	24424.6	NA	5.1
-6				39000	0.49	2.07	4.98	43000	640	NA	0.46	15	50000	930	1.22	2.27	1700	17740	NA	5.1
-7	0.806		16600	39000	0.49	2.07	2.48	28000	640	NA	0.46	2.8	50000	930	1.22	2.27	157	17740	12	3.1
-8	0.806		16600	41000	1.47	1.94	2.48	28000	0.68	NA	2.33	2.8	71000	6.4	0.64	1.97	157		12	3.1
-9	0.855		1550	41000	1.47	1.94	2.64	130	0.68	NA	2.33	11	71000	6.4	0.64	1.97	24		340	0.37
-10	0.855	1.79	1550	17000	2.32	1.99	2.64	130	1900	96700	6.15	11	51000	260	1.48	2.22	24		340	0.37
-11	1.34	1.79	6.43	17000	2.32	1.99	3.03	4.8	1900	364	6.15	2.6	51000	260	1.48	2.22	17.6		1.3	2.6
-12	1.34	0.92	6.43	5500	1.39	1.99	3.03	4.8	1500	152		2.6	5.3	5.3	1.51	3.1	17.6		1.3	2.6
-13	1.4	0.92	5.94	5500	1.39	1.99	1.71	27	1500	4.71		1.7	5.3	5.3	1.51	3.1	12.5		1.7	0.84
-14	1.4	1.44	5.94	32	1.71	2.01	1.71	27	430			1.7	0.68	9.1	0.85	1.31	12.5		1.7	0.84
-15	0.94	1.44	17.6	32	1.71	2.01	2.91	26	430			1.8	0.68	9.1	0.85	1.31			34	
-16	0.94	1.44	17.6	2.0	1.79	2.8	2.91	26	17			1.8	1.3	4.1		1.54			34	
-17	1.76	1.44	5.28	2.0	1.79	2.8	2.35	10000	17			0.53	1.3	4.1		1.54			0.52	
-18	1.76	1.28	5.28	3.2	2.08	2.24	2.35	10000	4.4			0.53	1800	2.3		3.38			0.52	
-19	1.15	1.28	369	3.2	2.08	2.24	2.48	11	4.4			0.25	1800	2.3		3.38			120	
-20	1.15	1.79	369	1.9		0.69	2.48	11				0.25	2.5			2.88			120	
-21	2.2	1.79	32.7	1.9		0.69		7.2				0.20	2.5			2.88			0.81	
-22	2.2	0.22	32.7			12.1		7.2				0.20	2.2			1.33			0.81	
-23		0.22	6.52			12.1							2.2			1.33				
-24		0.34	6.52										1.1							
-25		0.34											1.1							
-26		0.35																		
-27		0.35																		
-28																				
-29																				
-30																				
-31																				
-32																				
-33																				
-34																				
-35																				
Calculated Exc. Elev.	-11.93	-9.70	-23.40	-16.22	-16.91	-5.70	-2.70	-18.93	-15.53	-15.60	-14.16	-5.49	-20.12	-11.50	-9.57	-6.30	-8.88	-17.62	-20.58	-4.66
Calculated Exc. Depth	4.53	0	16	12	14.71	0	0	14	14	13.62	12.09	0	18	10	4	0	12	18.05	22	8
Hydraulic Heave Elevation	-24.37	-22.35	-23.73	-24.63	-24.11	-23.20	-22.01	-23.40	-22.91	-22.70	-22.84	-22.70	-21.98	-23.05	-22.82	-22.79	-18.68	-18.31	-18.35	-18.97
Hydraulic Heave Depth	16.97	12.65	16.33	20.41	21.91	17.50	19.31	18.47	21.38	20.72	20.77	17.21	19.86	21.55	16.88	16.49	21.80	18.74	19.77	22.31

Notes:
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[1] Excavation to the deepest elevation of dioxins concentrations >30 ng/kg TEQ would be at risk of hydraulic heave.

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Draft Excavation Elevations
Plan in Response to EPA Comments to 90% RD – Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

	SJSB076	SJSB075	SJSB036	SJGB011	SJSB032	SJSB077	SJGB010	SJSB078[1]	SJSB080	SJSB079	SJSB081	SJSB082	SJSB046-C1	SJSB083	SJSB102	SJSB028	SJSB045	SJSB045-C1	SJSB046	SJSB084
Starting Elevation (Mud-line)	2.26	2.28	2.25	0.41	1.71	1.42	0.88	1.82	1.77	1.05	-2.26	-1.75	-2.39	-2.93	-2.05	4.48	-2.10	-1.30	-2.00	-3.86
ELEVATION (feet NAVD88)																				
+7																				
+6																				
+5																				
+4																59.2				
+3																59.2				
+2	3000	NA	NA		3410			33000	23000							2.4				
+1	3000	NA	NA		3410	NA	4723.8	33000	23000	32000						2.4				
0	49000	NA	NA	12724.8	7660	NA	4723.8	47000	14000	32000						35.9				
-1	49000	NA	50500	12724.8	7660	NA	30873.4	47000	14000	52000						35.9		286		
-2	63000	55000	NA	22222.8	3170	NA	30873.4	86000	9200	52000	2300	15000	1550		1400	12.3	10.3	286	636	
-3	63000	55000	NA	22222.8	3170	NA	6354	86000	9200	28000	2300	15000	1550	46000	1400	12.3	10.3	190	636	
-4	210	NA	276	9427.6	6.19	NA	6354	140	3200	28000	47000	670	3350	46000	5.9	21.2	5.26	190	2660	12000
-5	210	NA	276	9427.6	6.19	63000	194	140	3200	50000	47000	670	3350	2200	5.9	21.2	5.26	286	2660	12000
-6	11	NA	NA	14768.5	85.8	63000	194	100	1500	50000	47000	2000	2820	2200	340	3.35	5.58	286	8610	3200
-7	11	NA	NA	14768.5	85.8	77000		100	1500	50000	47000	2000	2820	9.8	340	3.35	5.58	46.8	8610	3200
-8	150	270	519	8707.4	26.5	77000		110	12	50000	5.3	7.7	11700	9.8	24	2.59	4.88	46.8	28500	45
-9	150	270	19	8707.4	26.5	150		110	12	190	5.3	7.7	11700	14	24	2.59	4.88	54.6	28500	45
-10	21	0.88	189	3.37	15.9	150		16	1.5	190	19000	120	14900	14	5.6	2.39	3.25	54.6	6930	23
-11	21	0.88		3.37	15.9	24		16	1.5	3.1	19000	120	14900	15000	5.6	2.39	3.25	50.4	6930	23
-12	5.2	1.8			2.13	24		12	0.44	3.1	280	4.1	55.1	15000	2.5	1.19	0.72	50.4	111	6.1
-13	5.2	1.8			2.13	350		12	0.44	16	280	4.1	55.1	200	2.5	1.19	0.72	3.79	111	6.1
-14	3.7	6.7			12.7	350		140	13	16	2.8	1.1	2230	200	34		1.52	3.79	3420	7.8
-15	3.7	6.7			12.7	0.21		140	13	0.64	2.8	1.1	2230	24	34		1.52	22.4	3420	7.8
-16						0.21		2.7		0.64	1.7	3.7	205	24	1.4		2.36	22.4	1710	6.1
-17								2.7			1.7	3.7	205	9.0	1.4		2.36	5.81	1710	6.1
-18								260			0.87	0.99	5690	9.0	110		4.96	5.81	3400	3.7
-19								260			0.87	0.99	5690	0.72	110		4.96		3400	3.7
-20								0.42						0.72	8.9				4.82	3.9
-21								0.42						4.8	8.9				4.82	3.9
-22														4.8	3.9					
-23															3.9					
-24															4.0					
-25															4.0					
-26																				
-27																				
-28																				
-29																				
-30																				
-31																				
-32																				
-33																				
-34																				
-35																				
Calculated Exc. Elev.	-9.74	-9.82	-10.75	-9.59	-8.29	-14.58	-15.21	-20.18	-8.23	-10.95	-14.26	-11.75	-20.39	-19.07	-20.05	-1.52	-2.10	-13.30	-20.00	-9.86
Calculated Exc. Depth	12	12.10	13	10	10	16	16	22	10	12	12	10	18	16.14	18	6	0	12	18	6
Hydraulic Heave Elevation	-18.96	-18.52	-18.64	-19.19	-19.02	-18.76	-18.73	-18.72	-19.00	-19.16	-20.47	-20.49	-21.13	-21.25	-20.91	-19.48	-19.65	-20.37	-20.90	-21.10
Hydraulic Heave Depth	21.22	20.80	20.89	19.60	20.73	20.18	19.61	20.54	20.77	20.21	18.21	18.74	18.74	18.32	18.86	23.96	17.55	19.07	18.90	17.24

Notes:
- Bold font indicates dioxins results >30 ng/kg TEQ.
- Yellow shading indicates material >30 ng/kg TEQ being removed.
- Green shading indicates material <30 ng/kg TEQ being removed.
- Red line indicates the elevation in each boring at which there is risk of hydraulic heave (Factor of Safety <1.25).
- Green line indicates the target removal elevation for each boring.
- Black line indicates the target removal and hydraulic heave elevations are essentially identical.
- Grey shading indicates soil borings in the northwest corner.

[1] Excavation to the deepest elevation of dioxins concentrations >30 ng/kg TEQ would be at risk of hydraulic heave.

Table 5-1
Draft Excavation Elevations
Plan in Response to EPA Comments to 90% RD – Northern Impoundment
San Jacinto River Waste Pits Site
Harris County, Texas

	SJSB087	SJGB017	SJSB086	SJSB047-C1	SJSB047	SJSB085	SJSB048	SJSB048-C1[1]	SJSB049	SJSB089	SJSB050	SJSB105	SJSB106	SJSB091	SJSB029	SJSB030	SJSB031	SJSB034	SJSB035
Starting Elevation (Mud-line)	-3.01	-1.85	-2.72	-4.00	-2.10	-5.67	-2.40	-4.00	-5.10	-2.88	-3.40	-4.36	-3.10	-3.58	2.68	4.33	5.12	6.99	6.64
ELEVATION (feet NAVD88)																			
+7																		5.12	1.32
+6																		5.12	1.32
+5																	2.46	1.17	0.59
+4																5.54	2.46	1.17	0.59
+3															14.90	5.54	0.77	3.04	1.00
+2															14.9	1.9	0.77	3.04	1.00
+1															2.95	1.9	0.67	0.99	0.90
0															2.95	0.74	0.67	0.99	0.90
-1															2.12	0.74	0.72	0.98	0.64
-2		1.95			1.19		1.7								2.12	2.81	0.72	0.98	0.64
-3	**4600**	1.95	5.0		1.19		1.7			**820**	7.41		**39**		1.48	2.81	0.73	0.81	0.80
-4	**4600**	1.46	5.0	**7470**	1.35		1.02	**623**		**820**	7.41	**36000**	**39**	16	1.48	0.44	0.73	0.81	0.80
-5	**25000**	1.46	2.3	**7470**	1.35		1.02	**623**	**23600**	**53**	3.13	**36000**	3.6	16	1.35	0.44	0.97	0.59	1.26
-6	**25000**	0.91	2.3	**6310**	1.53	**42000**	1.72	**55.1**	**23600**	**53**	3.13	**48000**	3.6	6.7	1.35	0.82	0.97	0.59	1.26
-7	**2300**	0.91	1.3	**6310**	1.53	**42000**	1.72	**55.1**	**6640**	18	1.33	**48000**	9.4	6.7	2.45	0.82	0.33	1.5	0.96
-8	**2300**	0.85	1.3	**139**	2.73	**720**	2.46	**592**	**6640**	18	1.33	**240**	9.4	5.2	2.45	0.45	0.33	1.5	0.96
-9	10	0.85	1.2	**139**	2.73	**720**	2.46	**592**	**2350**	3.5	1.48	**240**	2.9	5.2	1.36	0.45	0.65	0.897	0.52
-10	10	0.18	1.2	29.4	2.03	27	2.52	4.95	**2350**	3.5	1.48	29	2.9	2.7	1.36	0.59	0.65	0.897	0.52
-11	**570**	0.18	2.2	29.4	2.03	27	2.52	4.95	**110**	**52**	3.38	29	3.4	2.7	0.77	0.59	0.36		
-12	**570**		2.2	**769**	1.41	**44**	1.77	**323**	**110**	**52**	3.38	13	3.4	2.1	0.77	0.98	0.36		
-13	3.5		2.3	**769**	1.41	**44**	1.77	**323**	**251**	**34**	2.71	13	2.6	2.1	9.13	0.98			
-14	3.5		2.3	**685**	1.69	25	2.03	6.35	**251**	**34**	2.71	17	2.6	2.4	9.13				
-15	**110**		3.2	**685**	1.69	25	2.03	6.35	**112**	2.00	1.81	17	2.6	2.4					
-16	**110**		3.2	**821**	1.98	4.3	1.66	**147**	**112**	2.00	1.81	**1400**	2.6	2.4					
-17	**1500**		2.9	**821**	1.98	4.3	1.66	**147**	**117**	2.30	1.77	**1400**	1.6	2.4					
-18	**1500**		2.9	**327**	1.67	7.0	2.56	**143**	**117**	2.30	1.77	**60**	1.6	2.2					
-19	3.0		1.6	**327**	1.67	7.0	2.56	**143**	28.1	0.40	0.351	**60**	3.4	2.2					
-20	3.0		1.6	7.35		11		**219**	28.1	0.40	0.351	7.7	3.4	2.7					
-21				7.35		11		**219**	5.87			7.7		2.7					
-22						7.8		11.8	5.87										
-23						7.8		11.8											
-24								1.07											
-25								1.07											
-26																			
-27																			
-28																			
-29																			
-30																			
-31																			
-32																			
-33																			
-34																			
-35																			
Calculated Exc. Elev.	**-19.01**	**-17.04**	**-13.09**	**-20.00**	**-4.28**	**-13.67**	**-3.20**	**-22.00**	**-19.10**	**-14.88**	**-3.40**	**-20.36**	**-15.38**	**-18.10**	**2.68**	**4.33**	**5.12**	**-9.55**	**-14.71**
Calculated Exc. Depth	**16**	**15.19**	**10.37**	**16**	**2.18**	**8**	**1**	**18**	**14**	**12**	**0**	**16**	**12.28**	**14.52**	**0**	**0**	**0**	**16.54**	**21.35**
Hydraulic Heave Elevation	**-21.16**	**-22.02**	**-21.65**	**-21.35**	**-16.76**	**-22.55**	**-19.70**	**-21.87**	**-22.86**	**-22.73**	**-20.58**	**-21.95**	**-23.14**	**-22.79**	**-19.65**	**-19.64**	**-18.90**	**-23.99**	**-20.54**
Hydraulic Heave Depth	**18.15**	**20.17**	**18.93**	**17.35**	**14.66**	**16.88**	**17.30**	**17.87**	**17.76**	**19.85**	**17.18**	**17.59**	**20.04**	**19.21**	**22.33**	**23.97**	**24.02**	**30.98**	**27.18**

Notes:
- Bold font indicates dioxins results >30 ng/kg TEQ.
- Yellow shading indicates material >30 ng/kg TEQ being removed.
- Green shading indicates material <30 ng/kg TEQ being removed.
- Red line indicates the elevation in each boring at which there is risk of hydraulic heave (Factor of Safety <1.25).
- Green line indicates the target removal elevation for each boring.
- Black line indicates the target removal and hydraulic heave elevations are essentially identical.
- Grey shading indicates soil borings in the northwest corner.

[1] Excavation to the deepest elevation of dioxins concentrations >30 ng/kg TEQ would be at risk of hydraulic heave.

Appendix B

Updated Hydraulic Heave Analysis

Updated Hydraulic Heave Analysis

Northern Impoundment
San Jacinto River Waste Pits Superfund Site
Harris County, Texas

International Paper Company and McGinnes Industrial Maintenance Corporation

January 25, 2024

→ The Power of Commitment

Contents

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Appendices

1. Introduction

GHD Services Inc. (GHD), on behalf of the International Paper Company and McGinnes Industrial Maintenance Corporation (collectively referred to as the Respondents), submits to the United States Environmental Protection Agency (EPA) this *Updated Hydraulic Heave Analysis* performed for the Northern Impoundment of the San Jacinto River Waste Pits Superfund Site in Harris County, Texas.

Following completion and receipt of data from the Supplemental Design Investigation (SDI) in September and October 2021, GHD performed a hydraulic heave analysis to evaluate the geological and geotechnical conditions of the Northern Impoundment with respect to the Northern Impoundment 90% Remedial Design (RD). The Northern Impoundment 90% RD is being developed based on the 2017 EPA Record of Decision (ROD) which specifies that the selected remedy for the Northern Impoundment is the full removal of all waste material in the dry that exceeds the clean-up level of 30 nanograms per kilogram (ng/kg) for dioxins/furans. Data from the SDI found impacts above the clean-up level at deeper elevations than had been previously understood, prompting concern around the risk of hydraulic heave associated with the resulting excavation work. The geological and geotechnical context, methodology, and results of this analysis are described hereafter in this report.

2. Brief Geological Conditions Description

The San Jacinto River Waste Pits Site is located in Harris County, Texas, east of the City of Houston. The Northern Impoundment is located immediately north of the Interstate Highway 10 (I-10) bridge over the San Jacinto River.

The geology in the vicinity of the Northern impoundment is somewhat variable given the natural meander of the San Jacinto River over time. Based on the Geologic Atlas of Texas, Houston (1982), the near surface of the western bank of the San Jacinto River is comprised predominantly by Holocene Alluvium, which is comprised of clay, silt, and sand, and can include organic matter. These alluvium deposits can be comprised of point-bar, natural levee, stream channel, back-swamp, and coastal marsh deposits. The near surface of the eastern bank of the San Jacinto River is comprised predominantly of the Pleistocene Beaumont Formation, which is made up of mostly clay, silt, and sand.

Historical topographic maps of the area from the United States Geological Survey (USGS) indicate that the near surface in the vicinity of the Northern Impoundment may have been comprised of backswamp and/or swamp deposits. It is unclear the extent to which these were scoured out and/or eroded over time, as well as how much was physically removed due to industrialization.

3. Geotechnical Conditions

3.1 Geotechnical Soundings

In order to define the geotechnical conditions of the Northern Impoundment, four geotechnical investigation events were carried out and are listed below:

– Remediation investigation (RI) in 2011.
– First Phase Pre-Design Investigation (PDI-1) in 2018.
– Second Phase Pre-Design Investigation (PDI-2) in 2019.
– SDI in 2021.

For these four investigations, a total of 43 geotechnical boreholes were drilled. During the most recent investigation (SDI), four piezometers were installed and cone penetration tests (CPT) were also performed at 13 locations in the Northern Impoundment. Figure 1 shows the locations of the geotechnical soundings.

Table 3.1 below, presents the list of the deepest geotechnical soundings in which the Beaumont sand formation was reached.

Table 3.1 Geotechnical Soundings Considered in the Hydraulic Heave Analysis

Geotechnical Investigation	Sounding Identification	Termination Depth (feet below ground surface [ft bgs])	Coordinates (NAD83)		Ground Surface Elevation (ft NAVD88)
			Easting	Northing	
RI (2011)	SJGB-001	60	3216751.14	13857514.92	3.50
	SJGB-002	59.5	3216860.61	13857743.81	0.75
	SJGB-003	119.5	3217161.01	13857865.43	-10.67
	SJGB-004	59.5	3217397.81	13857774.85	-3.25
	SJGB-005	61.5	3217542.37	13857614.08	-4.50
	SJGB-007	119.5	3217417.80	13857330.12	-3.25
	SJGB-008	59.5	3217332.71	13857191.39	-3.0
PDI-1 (2018)	SJGB-018	52	3216809.99	13857802.24	-13.43
	SJGB-019	59	3216887.24	13857986.27	-14.82
	SJGB-020	62	3217105.99	13858004.5	-8.17
	SJGB-021	56	3217609.93	13857456.24	-5.15
	SJGB-022	47	3217485.03	13857183.95	-9.39
	SJGB-023	60	3216651.13	13857586.97	-1.86
PDI-2 (2019)	SJGB-047	100	3217421.37	13857278.32	-3.40
	SJGB-053	100	3217301.20	13857799.52	-9.70
	SJGB-057	100	3216960.20	13857956.45	-17.1
SDI (2021)	SJMW-16	70	3216869.54	13857581.37	5.0
	SJMW-17	72	3217204.37	13857083.84	5.0
	SJCPT-11	76	3216891.12	13857566.47	3.0

3.2 Subsurface Conditions

According to information provided by the various geotechnical investigations, the general subsurface stratigraphy noted within the Northern Impoundment is as follows:

– ***Surficial Alluvium Sediments:*** heterogenous, consisting of silty sands, sands silts, lean clays, and sandy clays. When cohesive, the sediments are typically very soft to firm. When granular (cohesionless), these sediments are loose -to -compact.

– ***Beaumont Clay Formation:*** generally encountered at elevations ranging between -20 to -30 feet (ft) North American Vertical Datum of 1988 (NAVD88), this formation is composed of a stiff -to -very -stiff high plasticity clay (fat clay). Interspersed within this deposit are seams/lenses of sandy materials, as evidenced in the boring logs and photographs from three different borings, all in the vicinity of the northwest corner of the Northern Impoundment. The lateral extents of these particular features remain unknown.

– ***Beaumont Sand Formation:*** encountered at elevations globally ranging between -50 to -80 ft NAVD88, this formation is essentially composed of compact -to -dense silty sand to clayey sand.

Subsurface geological conditions are shown in two cross-sections included as Figures 2 and 3. The interpolated thickness of the Beaumont clay is shown on the attached Figure 4.

3.3 Hydraulic Conditions

During the SDI, piezometers were installed in boreholes SJMW-16 and SJMW-17 and the water levels were logged in these piezometers at regular time intervals. Figure 3.1 below, shows the variation of the piezometric level (red line) in

the piezometer (SJMW-16) installed in the Beaumont sand for the period between August 13 and September 13, 2021. The water level in the San Jacinto River (blue line) is also shown in this figure for the same period.

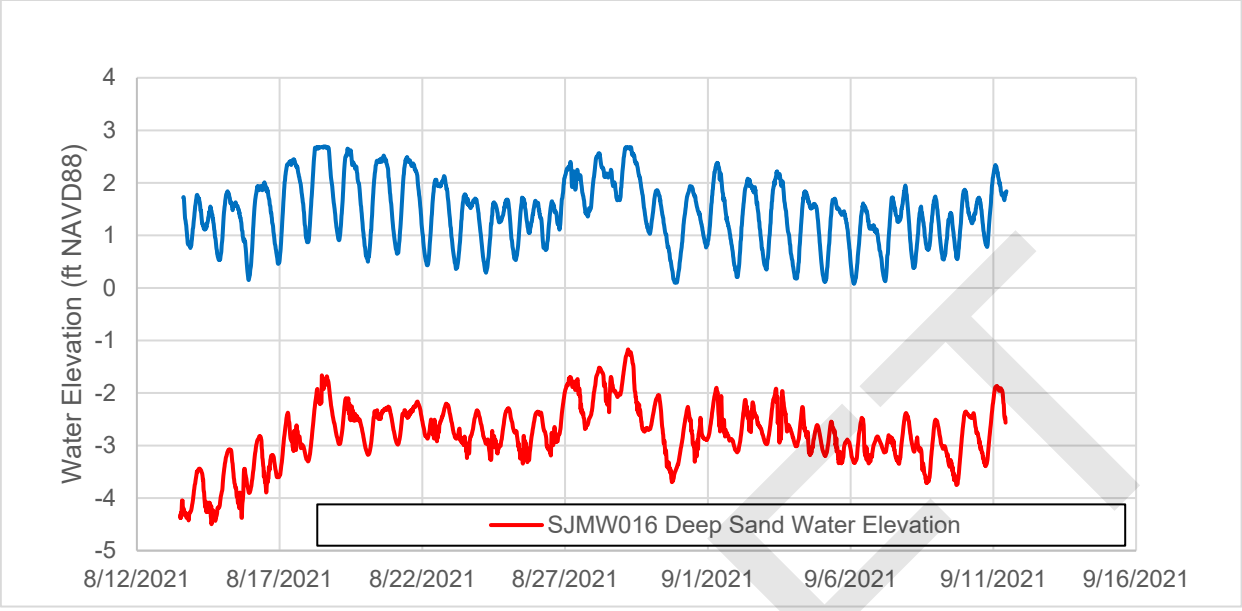


Figure 3.1 Variation of the Water Levels in the Beaumont Sand Formation and the San Jacinto River

Water level readings shown on Figure 3.1 suggest that:

– The water elevation in the river fluctuates with the tides between 0 to 3 ft NAVD88 (with an average elevation of 1.5 ft NAVD88).

– The piezometric level in the Beaumont sand fluctuates between -4 to -1 ft NAVD88 (with an average value of approximately -2.5 ft NAVD88) and seems to be tidally connected.[1]

Based on these data, it is estimated that the piezometric head in the Beaumont Sands is dampened in the overlaying clay. It is observed that the piezometric head is dampened by approximately 0.11 foot per feet (ft/ft) of the overlying clay. For the estimation of the uplift pressure, an average difference of 1.7 ft between the river stage and the piezometric head in the Beamont sand was conservatively assumed for the entire Northern Impoundment.

3.4 Stratigraphic Model

A stratigraphic model of the Northern impoundment area based on a triangulation process was developed using the information provided by both geotechnical (for sediments, Beaumont clay and sand deposits - see Table 3.1) and analytical (for sediments and Beaumont clay deposit) boreholes. The various formation thicknesses used in the hydraulic heave assessment were based on this model.

[1] The piezometer was removed from borehole SJMW-16 on September 13, 2021, at the direction of the EPA in advance of an approaching hurricane.

4. Required Excavation Depths

The compiled analytical results show the presence of exceedances of the clean-up level at various depths in the surficial alluvium in the Northern Impoundment. Based on these results, the deepest exceedances have been detected at elevations close to -28.4 ft NAVD88 within the northwest corner of the Northern Impoundment.

A complete removal of the impacted material, as specified in the ROD would thus require excavation down to elevations of -28.4 ft NAVD88, and potentially to lower elevations depending on the results of post-confirmation testing to be completed during excavation.

An assessment of the hydraulic heave risk assuming a complete removal of the impacted alluvions has been performed at an assumed high river stage of +5 ft NAVD88. The factor of safety (FS) used in this evaluation is discussed in Section 5.2.

5. Hydraulic Heave Assessment

5.1 Hydraulic Heave Mechanism

When an excavation is dug into a clay deposit underlain by a pervious stratum under artesian pressure, pressure and seepage may result, leading to instability of the excavation.

The above-mentioned conditions are illustrated for the Northern Impoundment case on Figure 5.1. The hydrostatic head in the deep Beaumont sand below the impervious Beaumont clay layer is higher than the bottom of the excavation. If the effective stress at point A approaches zero, the situation becomes unstable. Therefore, if the pore pressure at point A exceeds the total vertical stress at this point, heave may occur in the bottom of the excavation.

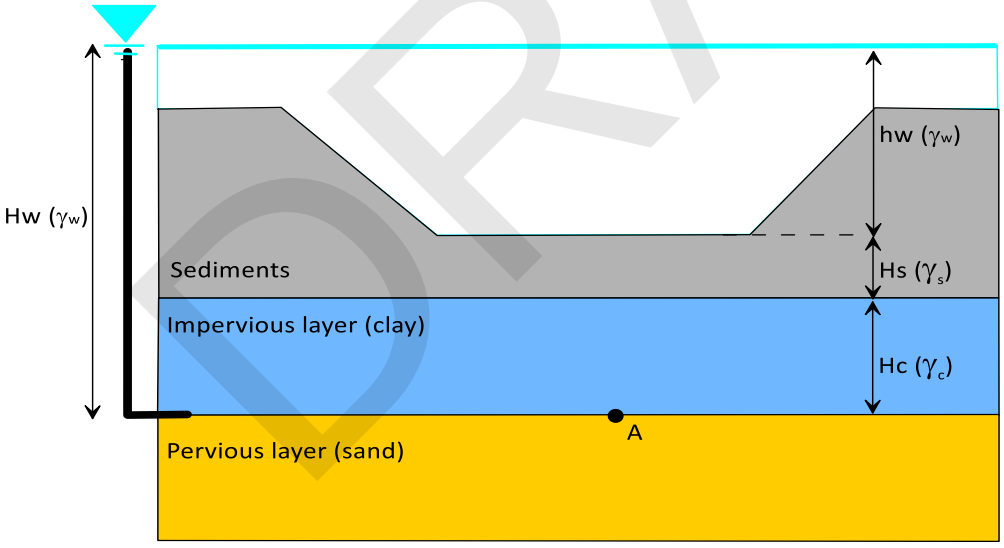


Figure 5.1 Artesian Groundwater Conditions Below Excavation

There are two methods to evaluate uplift pressures, which could result in a heave situation: the total stress approach and the effective stress approach. For the present hydraulic heave assessment, the total stress approach will govern the hydraulic heave assessment and only this approach was considered.

5.2 Safety Factor Evaluation

The hydraulic heave assessment is based on the ratio of total stresses and uplift pore pressures.

The FS value protective of hydraulic heave is expressed using the following equation:

$$FS = (Hs.\ \gamma_s + Hc.\ \gamma_c)/\ Hw.\ \gamma_w \quad [1]$$

In this equation, Hs and Hc are the thicknesses of the sediments and the clay layers, respectively and Hw is the water head in the pervious layer. γ_s and γ_c are the total unit weights of the sediments and the clay respectively. γ_w corresponds to the water unit weight. In order to prevent hydraulic heave with a sufficient security margin, pore pressure at point A should not exceed 80 percent of the total vertical stress at this point, corresponding to a FS value of 1.25.

5.3 Assessment Methodology

To assess the risk of hydraulic heave, the FS to protect against hydraulic heave was determined at the location of 85 boreholes (both geotechnical and analytical).

The evaluation of hydraulic heave FS using equation [1] requires the knowledge of (1) the thickness and unit weight of each stratigraphic units and (2) uplift pore pressures (water head) in the underlaying pervious sandy formation (Beaumont sand).

The methodology and the assumptions used for the determination of the required parameters are described in the following sections.

5.4 Stratigraphic Units (Depth and Thickness)

5.4.1 Surficial Sediments Layer

The sediment layer thickness was defined in all geotechnical and analytical boreholes. The actual measured thickness was thus considered for the hydraulic heave assessment.

5.4.2 Beaumont Clay

The total Beaumont clay thickness was only determined for the geotechnical boreholes listed in Table 3.1. The analytical boreholes terminated in the Beaumont clay deposit without reaching the underlaying Beaumont Sand. At these boreholes (analytical), the clay deposit thickness was estimated from the stratigraphic model described in Section 3.4.

5.4.3 Beaumont Sand

The Beaumont sand formation depth (where the hydraulic uplift pressure acts) was determined in all boreholes listed in Table 3.1. At the analytical borehole locations, the Beaumont sand depth was determined based on the stratigraphic model.

For the Northwest corner, sand seams/lenses ranging from a few inches to a few feet thick were encountered interspersed in the Beaumont clay layer at depths ranging between 35 to 60 ft corresponding to elevations globally ranging from -50 to -70 ft. These lenses were found in boreholes SJGB-018, SJGB-019, SJGB-020, and SJGB-057 all drilled in the northwest corner Photographs of these features are presented in Appendix A. The presence of such lenses has a major impact on the hydraulic heave assessment and is discussed in Section 5.3.

5.4.4 Geotechnical/Hydraulic Parameters

5.4.4.1 Unit Weights

The unit weights were evaluated based on the natural moisture content (w) and specific gravity (G) of samples recovered from the sediments and Beaumont clay deposit. Figure 5.2 shows the variation of unit weight values with the elevation for both deposits.

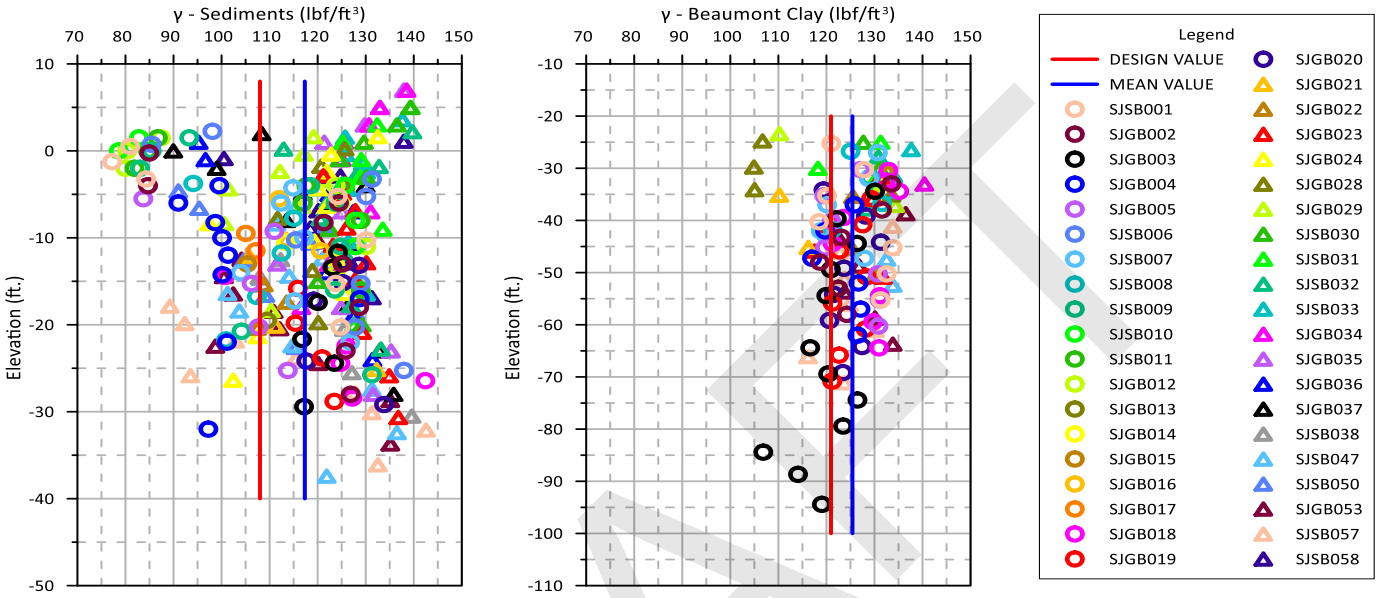


Figure 5.2 Variation of Unit Weights with Elevation

The unit weight values shown on Figure 5.2 are based on either direct measurements or estimated from the water content values. Table 5.1 below, summarizes the mean and design values considered for the hydraulic heave assessment (blue vertical line on Figure 5.2).

Table 5.1 Mean and Design Unit Weights

Stratigraphic Unit	Total Unit Weight, γ (pounds per cubic feet [pcf])
Surficial alluvium	118
Beaumont clay formation	125

5.4.5 Uplift Pore Pressures

As previously mentioned in Section 4, a river stage at elevation +5 ft was considered, corresponding to the high hydraulic conditions for the hydraulic heave assessment. Considering the average difference of 1.7 ft between the river stage and the piezometric head in the Beaumont sand, the uplift pore pressures were evaluated at an elevation of 3.3 ft NAVD88 (see Section 3.3).

It is important to note that the water conditions considered for the hydraulic heave assessment exclude water level variations induced by hurricane season, since excavation activities would not be conducted during that time.

5.5 Assessment Results

5.5.1 Complete Removal of Impacted Material

The FS values for excavation down to the elevations of impacted material are presented in the attached Table 1. Refer to Figure 5 for an isopach map showing hydraulic heave risk at various parts of the impoundment. The results are summarized below:

– Outside the limits of the Northwest corner, the FS values are generally larger than the target value (1.25) except for four locations (SJSB048-C1, SJSB071, SJSB072, and SJSB078) for which the FS values is slightly lower than the target value. Because the proposed excavation is just slightly lower than the safe depth for these locations, we are of the opinion that the complete removal of impacted material could be done safely for these locations if mitigation procedures are considered. These procedures are discussed in Section 6.
– In the Northwest corner area, where interspersed sand lenses were detected into the clayey deposit, FS values less than the target value are obtained at locations SJGB-057 and SJSB-098. It is worth mentioning that the presence of these sand lenses was considered at the location in which they were detected (SJGB-057).
– Even if the sand lenses were not detected in the shallow analytical boreholes drilled in the Northwest corner, the presence of such lenses is highly probable to exist, since they were detected at several locations at boreholes drilled in the Northwest corner area (SJGB-018, SJGB-019, and SJGB-020).
– Considering that the risk of hydraulic heave is assessed for location SJGB-057 and that risk of hydraulic heave potentially exists at other locations in this area, it is recommended that mitigation procedures be considered when removing all impacted materials to the targeted depth. These procedures are described in Section 6.

5.5.2 Safe Hydraulic Heave Excavation Surface

Safe surface excavation elevation for which a protective hydraulic heave FS value of 1.25 for the boreholes analyzed is presented in Table 1.

6. Conclusions and Mitigation

6.1 Conclusions

The hydraulic heave analysis indicates that there are areas of the Northern Impoundment in which excavation to the target elevations under a full removal scenario will result in a risk of hydraulic heave.

The presence of sand lenses is evident in logs and photographs from four geotechnical borings drilled in the northwest corner. This potential heave must be considered when developing a design that is sufficiently protective of hydraulic heave risks.

While there are some local areas across the Northern Impoundment that show FS values below the target value, the risk is most pronounced in the northwest corner area where FS values are less then/close to 1.0. In this area, approximately 12 ft of waste material could not be removed in the dry based upon the elevations calculated to be protective against hydraulic heave at the location of borehole SJGB-057, as shown in Table 1.

While the northwest corner presents the most pronounced risk of hydraulic heave, some locations in the rest of the Northern Impoundment are on the threshold of triggering the risk of hydraulic heave. This will need to be taken into consideration when developing excavation approach and post-confirmation sampling.

6.2 Mitigation Procedures

6.2.1 Outside the Northwest Corner

According to Table 1, the proposed excavation elevation at the location of boreholes SJSB048-C1, SJSB071, SJSB072, and SJSB078 are slightly lower than the elevation that provides a FS value of 1.25. Considering the limited depth required below the safe elevation, mitigation procedures to potentially allow excavation safely to reach the target depth exist. Examples of mitigation methods could include excavating in sequences of limited width, backfilling the excavated area before starting the excavation in another area, or excavation during a low river stage.

6.2.2 Northwest Corner

For the northwest corner, considering the amount of required excavation depths, the excavation sequencing procedure may not be applicable.

As a mitigation procedure, it is recommended to locally flood the area and remove the waste material under a column of water above the excavation floor to balance the weight of the excavated material and to counter the uplift pressures.

6.2.3 Geotechnical Instrumentation

It is recommended that piezometers be installed into the deep sand below the Beaumont Clay, as well as in the upper sand layers/seams prior to construction and to continuously monitor the pressure head in those strata during construction.

7. Scope and Limitations

The recommendations made in this report are in accordance with our present understanding of the project, the ground surface elevations and current conditions at the Northern Impoundment, and are based on the work scope described in the report. The services were performed in a manner consistent with that level of care and skill ordinarily exercised by members of geotechnical engineering professions currently practicing under similar conditions in the same locality.

All details of design and construction are rarely known at the time of completion of a geotechnical study. The recommendations and comments made in this report are based on our subsurface investigation and resulting understanding of the project, as defined at the time of the study. GHD will review our recommendations when the remedial design drawings and specifications are complete.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a Site and the comments included in this report are based on the results obtained at the test locations only. The subsurface conditions confirmed at the test locations may vary at other locations.

Table 1

Hydraulic Heave Safety Factors For Total Removal of Exceedances of Clean-Up Level
Hydraulic Heave Analysis
Northern Impoundment - San Jacinto River Waste Pits Superfund Site

Location	Northing (NAD83)	Easting (NAD83)	Surface/Riverbed Elevation	Aquifer Piezometric Elevation Normal Conditions Water Level 5 ft	BC Depth (ft)	BC Elevation (ft)	BS Depth (ft)	BS Elevation (ft)	Sediment Thickness (ft)	BC Thickness (ft)	Water Head (ft)	Uplift Porepressure (psf)	Total Vertical Stress Due to Clay Above Sand (psf)	Type of Excavated Soils	Elevation at Sounding Location for FS = 1.25 Normal Conditions	Proposed Deepest Excavation Surface Elevation (ft)	Downward Force Above BS (psf)	Factor of Safety for Proposed Excavation Surface	Status Against Hydraulic Heave
SJGB010	13857411.2	3216753.59	3.00	3.3	34.69	-31.69	60.23	-57.23	34.69	25.54	60.53	3777	3193	Sediments only	-18.73	-15.21	5137.14	1.36	OK
SJGB011	13857474.59	3216925.73	3.00	3.3	34.49	-31.49	61.35	-58.35	34.49	26.86	61.65	3847	3358	Sediments only	-19.19	-9.59	5941.70	1.54	OK
SJGB012	13857611.31	3216819.46	3.00	3.3	35.33	-32.33	59.27	-56.27	35.33	23.94	59.57	3717	2993	Sediments only	-18.31	-17.62	4728.28	1.27	OK
SJSB013	13857852.44	3216918.90	-12.4	3.3	20.15	-32.55	52.40	-64.80	20.15	32.25	68.1	4249	4031	Sediments only	-21.70	-16.04	5979.43	1.41	OK
SJGB014	13857716.96	3217158.78	-1.50	3.3	23.44	-24.940	74.29	-75.79	23.44	50.85	79.09	4935	6356	Sediments and clay	-26.44	-9.22	8321.25	1.69	OK
SJGB015	13857549.79	3217384.37	-4.00	3.3	18.61	-22.61	62.17	-66.17	18.61	43.56	69.47	4335	5445	Sediments and clay	-22.82	-9.57	7075.00	1.63	OK
SJGB016	13857551.03	3217162.51	-0.50	3.3	32.28	-32.78	67.20	-67.70	32.28	34.92	71	4430	4365	Sediments only	-22.84	-14.16	6562.16	1.48	OK
SJGB017	13857352.16	3217191.72	-1.85	3.3	22.37	-24.22	62.51	-64.36	22.37	40.14	67.66	4222	5018	Sediments only	-22.02	-17.04	5864.74	1.39	OK
SJSB028	13857067.13	3217256.40	4.48	3.3	36.48	-32	63.64	-59.16	36.48	27.16	62.46	3898	3395	Sediments only	-19.48	-1.52	6991.64	1.79	OK
SJSB029	13857119.31	3217153.09	2.68	3.3	34.40	-31.72	62.98	-60.30	34.40	28.58	63.6	3969	3573	Sediments only	-19.95	2.68	7631.70	1.92	OK
SJSB030	13857220.52	3216971.01	4.33	3.3	37.79	-33.46	64.11	-59.78	37.79	26.32	63.08	3936	3290	Sediments only	-19.64	4.33	7749.22	1.97	OK
SJSB031	13857295.05	3216774.91	5.12	3.3	39.45	-34.33	63.15	-58.03	39.45	23.7	61.33	3827	2963	Sediments only	-18.90	5.12	7617.60	1.99	OK
SJSB032	13857444.8	3216651.50	1.71	3.3	37.72	-36.01	60.30	-58.59	37.72	22.58	61.89	3862	2823	Sediments only	-19.02	-8.29	6093.46	1.58	OK
SJSB033	13857624.83	3216746.67	3.12	3.3	37.12	-34	60.55	-57.43	37.12	23.43	60.73	3790	2929	Sediments only	-18.68	-8.88	5892.91	1.56	OK
SJSB034	13857689.49	3217045.98	6.99	3.3	40.55	-33.56	77.70	-70.71	40.55	37.15	74.01	4618	4644	Sediments only	-23.99	-9.55	7476.93	1.62	OK
SJSB035	13857460.9	3217021.62	6.64	3.3	38.41	-31.77	68.42	-61.78	38.41	30.01	65.08	4061	3751	Sediments only	-20.54	-14.71	5764.33	1.42	OK
SJSB036	13857475.11	3216859.93	2.00	3.3	32.00	-30	58.74	-56.74	32.00	26.74	60.04	3746	3343	Sediments only	-18.64	-10.75	5614.00	1.50	OK
SJSB037	13857687.4	3216908.32	1.43	3.3	36.43	-35	62.37	-60.94	36.43	25.94	64.24	4009	3243	Sediments only	-20.02	-9.57	6243.24	1.56	OK
SJSB038	13857563.08	3217138.46	-1.98	3.3	33.02	-35	65.70	-67.68	33.02	32.68	70.98	4429	4085	Sediments only	-22.70	-15.60	6374.20	1.44	OK
SJSB045	13857135.81	3217343.07	-2.10	3.3	26.51	-28.61	56.97	-59.07	26.51	30.46	62.37	3892	3808	Sediments only	-19.65	-2.10	6935.68	1.78	OK
SJSB045-C1	13857149.35	3217285.35	-1.30	3.3	25.55	-26.85	59.32	-60.62	25.55	33.77	63.92	3989	4221	Sediments only	-20.37	-13.30	5820.15	1.46	OK
SJSB046	13857183.75	3217236.02	-2.00	3.3	21.93	-23.93	59.52	-61.52	21.93	37.59	64.82	4045	4699	Sediments only	-20.90	-20.00	5162.49	1.28	OK
SJSB046-C1	13857229	3217174.00	-2.39	3.3	21.60	-23.99	59.70	-62.09	21.60	38.1	65.39	4080	4763	Sediments only	-21.13	-20.39	5187.30	1.27	OK
SJSB047	13857278.32	3217421.37	-3.40	3.3	22.43	-25.83	48.00	-51.40	22.43	25.57	54.7	3413	3196	Sediments only	-16.76	-4.28	5739.15	1.68	OK
SJSB047-C1	13857302.55	3217340.99	-4.00	3.3	20.58	-24.58	58.73	-62.73	20.58	38.15	66.03	4120	4769	Sediments only	-21.35	-20.00	5309.19	1.29	OK
SJSB048	13857396.53	3217503.37	-2.40	3.3	24.77	-27.17	56.58	-58.98	24.77	31.81	62.28	3886	3976	Sediments only	-19.70	-3.20	6804.71	1.75	OK
SJSB048-C1	13857398.78	3217445.30	-4.00	3.3	21.53	-25.53	60.19	-64.19	21.53	38.66	67.49	4211	4833	Sediments only	-21.87	-22.00	5249.04	1.25	Risk of heave
SJSB049	13857406.39	3217395.26	-5.10	3.3	19.33	-24.43	61.42	-66.52	19.33	42.09	69.82	4357	5261	Sediments only	-22.86	-19.10	5890.19	1.35	OK
SJSB050	13857546.33	3217527.88	-3.40	3.3	24.78	-28.18	57.95	-61.35	24.78	33.17	64.65	4034	4146	Sediments only	-20.58	-3.40	7070.29	1.75	OK
SJSB050-C1	13857558.16	3217389.12	-6.30	3.3	16.22	-22.52	59.79	-66.09	16.22	43.57	69.39	4330	5446	Sediments and clay	-22.79	-6.30	7473.75	1.73	OK
SJSB051	13857682.02	3217424.68	-2.70	3.3	23.44	-26.14	61.94	-64.64	23.44	38.5	67.94	4239	4813	Sediments only	-22.01	-2.70	7578.42	1.79	OK
SJSB052	13857661.47	3217319.77	-5.70	3.3	17.64	-23.34	61.51	-67.21	17.64	43.87	70.51	4400	5484	Sediments only	-23.20	-5.70	7565.27	1.72	OK
SJSB052-C1	13857626.75	3217222.47	-2.20	3.3	23.36	-25.56	67.61	-69.81	23.36	44.25	73.11	4562	5531	Sediments only	-24.11	-16.91	6551.95	1.44	OK
SJSB053	13857799.52	3217301.20	-9.70	3.3	17.94	-27.64	56.00	-65.70	17.94	38.06	69	4306	4758	Sediments only	-22.35	-9.70	6874.42	1.60	OK
SJSB053-C1	13857775.27	3217268.41	-7.40	3.3	17.89	-25.29	63.03	-70.43	17.89	45.14	73.73	4601	5643	Sediments only	-24.37	-11.93	7218.98	1.57	OK
SJSB054	13857745.96	3217282.89	-7.40	3.3	17.00	-24.4	61.28	-68.68	17.00	44.28	71.98	4492	5535	Sediments only	-23.73	-23.40	5653.00	1.26	OK
SJSB055	13857915.36	3217183.42	-4.90	3.3	26.96	-31.86	63.78	-68.68	26.96	36.82	71.98	4492	4603	Sediments only	-23.28	-4.90	7783.78	1.73	OK
SJSB055-C1	13857843.36	3217150.48	-9.54	3.3	20.78	-30.32	80.61	-90.15	20.78	59.83	93.45	5831	7479	Sediments and clay	-31.84	-13.54	9576.25	1.64	OK
SJSB056	13857942.46	3217077.15	-12.40	3.3	16.52	-28.92	65.84	-78.24	16.52	49.32	81.54	5088	6165	Sediments only	-27.27	-12.40	8114.36	1.59	OK
SJSB056-C1	13857851.61	3217058.12	-4.29	3.3	28.14	-32.43	76.92	-81.21	28.14	48.78	84.51	5273	6098	Sediments only	-28.24	-21.92	7337.68	1.39	OK
SJGB057	13857956.45	3216960.20	-17.00	3.3	17.00	-34.00	32.82	-49.82	17.00	15.82	53.12	3315	1978	Sediments only	-15.65	-26.39	2875.48	0.87	Risk of heave
SJSB058	13857700.16	3216855.51	0.62	3.3	34.20	-33.58	58.86	-58.24	34.20	24.66	61.54	3840	3083	Sediments only	-19.02	-17.38	4994.10	1.30	OK
SJSB070	13857778.07	3216886.19	-1.17	3.3	31.44	-32.61	59.54	-60.71	31.44	28.1	64.01	3994	3513	Sediments only	-20.07	-15.17	5570.42	1.39	OK
SJSB071	13857719.19	3216821.13	-0.8	3.3	31.93	-32.73	55.95	-56.75	31.93	24.02	60.05	3747	3003	Sediments only	-18.48	-18.80	4646.24	1.24	Risk of heave
SJSB072	13857614.25	3216842.65	1.42	3.3	33.84	-32.42	57.80	-56.38	33.84	23.96	59.68	3724	2995	Sediments only	-18.35	-20.58	4392.12	1.18	Risk of heave
SJSB073	13857593.16	3216960.04	1.29	3.3	35.30	-34.01	62.04	-60.75	35.30	26.74	64.05	3997	3343	Sediments only	-20.00	-10.71	6091.90	1.52	OK
SJSB074	13857543.71	3216728.11	3.34	3.3	32.34	-29.00	60.77	-57.43	32.34	28.43	60.73	3790	3554	Sediments only	-18.97	-4.66	6425.87	1.70	OK
SJSB075	13857486.82	3216843.80	2.28	3.3	31.82	-29.54	58.65	-56.37	31.82	26.83	59.67	3723	3354	Sediments only	-18.52	-9.82	5680.71	1.53	OK
SJSB076	13857508.77	3216910.81	2.26	3.3	33.82	-31.56	59.79	-57.53	33.82	25.97	60.83	3796	3246	Sediments only	-18.86	-9.74	5821.01	1.53	OK
SJSB077	13857411.88	3216736.67	1.42	3.3	33.64	-32.22	58.79	-57.37	33.64	25.15	60.67	3786	3144	Sediments only	-18.76	-14.58	5225.27	1.38	OK
SJSB078	13857430.03	3216823.14	1.82	3.3	32.13	-30.31	58.80	-56.98	32.13	26.67	60.28	3761	3334	Sediments only	-18.72	-20.18	4529.09	1.20	Risk of heave
SJSB079	13857381.90	3216888.27	1.05	3.3	32.56	-31.51	59.33	-58.28	32.56	26.77	61.58	3843	3346	Sediments only	-19.16	-10.95	5772.33	1.50	OK
SJSB080	13857320.22	3216827.05	1.77	3.3	34.89	-33.12	59.87	-58.10	34.89	24.98	61.40	3831	3123	Sediments only	-19.00	-8.23	6059.52	1.58	OK
SJSB081	13857276.46	3217054.34	-2.26	3.3	27.11	-29.37	58.98	-61.24	27.11	31.87	64.54	4027	3984	Sediments only	-20.47	-14.26	5766.73	1.43	OK
SJSB082	13857216.12	3217091.82	-1.75	3.3	26.73	-28.48	59.41	-61.16	26.73	32.68	64.46	4022	4085	Sediments only	-20.49	-11.75	6059.14	1.51	OK
SJSB083	13857242.26	3217187.50	-2.93	3.3	21.00	-23.93	59.46	-62.39	21.00	38.46	65.69	4099	4808	Sediments only	-21.25	-19.07	5380.98	1.31	OK
SJSB084	13857243.09	3217292.26	-3.86	3.3	20.13	-23.99	58.16	-62.02	20.13	38.03	65.32	4076	4754	Sediments only	-21.10	-9.86	6421.09	1.58	OK
SJSB085	13857350.67	3217370.89	-5.67	3.3	22.05	-27.72	60.56	-66.23	22.05	38.51	69.53	4339	4814	Sediments only	-22.55	-13.67	6471.65	1.49	OK
SJSB086	13857292.63	3217249.90	-2.72	3.3	22.28	-25.00	60.83	-63.55	22.28	38.55	66.85	4171	4819	Sediments only	-21.65	-9.16	6687.87	1.60	OK
SJSB087	13857311.47	3217114.94	-3.01	3.3	23.75	-26.76	59.57	-62.58	23.75	35.82	65.88	4111	4478	Sediments only	-21.16	-19.01	5392.00	1.31	OK
SJSB088	13857488.39	3217119.28	-2.12	3.3	28.94	-31.06	63.17	-65.29	28.94	34.23	68.59	4280	4279	Sediments only	-21.98	-20.12	5569.67	1.30	OK
SJSB089	13857426.02	3217214.58	-2.88	3.3	19.12	-22.00	63.06	-65.94	19.12	43.94	69.24	4321	5493	Sediments and clay	-22.73	-14.88	6382.50	1.48	OK
SJSB090	13857506.13	3217218.41	-1.50	3.3	24.71	-26.21	65.74	-67.24	24.71	41.03	70.54	4402	5129	Sediments only	-23.05	-11.50	6864.53	1.56	OK
SJSB091	13857487.24	3217383.27	-3.58	3.3	19.83	-23.41	62.59	-66.17	19.83	42.76	69.47	4335	5345	Sediments only	-22.79	-18.10	5971.58	1.38	OK
SJSB092	13857618.60	3217303.61	-4.93	3.3	18.81	-23.74	62.84	-67.77	18.81	44.03	71.07	4435	5504	Sediments only	-23.40	-18.93	6071.33	1.37	OK
SJSB093	13857582.78	3217129.48	-1.53	3.3	33.27	-34.80	66.66	-68.19	33.27	33.39	71.49	4461	4174	Sediments only	-22.91	-15.53	6447.61	1.45	OK
SJSB094	13857691.55	3217241.22	-4.22	3.3	16.78	-21.00	66.76	-70.98	16.78	49.98	74.28	4635	6248	Sediments and clay	-24.63	-16.22	6845.00	1.48	OK
SJSB095	13857790.23	3217133.85	-2.07	3.3	21.91	-23.98	81.03	-83.10	21.91	59.12	86.40	5391	7390	Sediments and clay	-29.19	-18.07	8128.75	1.51	OK
SJSB096	13857798.66	3217196.29	-6.55	3.3	18.17	-24.72	74.85	-81.40	18.17	56.68	84.70	5285	7085	Sediments and clay	-28.55	-18.55	7856.25	1.49	OK
SJSB097	13857955.96	3217030.74	-15.64	3.3	10.36	-26.00	59.51	-75.15	10.36	49.15	78.45	4895	6144	Sediments and clay	-26.20	-15.64	7438.75	1.52	OK
SJSB098	13857874.76	3216977.36	-14.36	3.3	24.64	-39.00	58.50	-72.86	24.64	33.86	76.16	4752	4233	Sediments only	-24.53	-28.36	5488.02	1.15	Risk of heave

Table 1

Hydraulic Heave Safety Factors For Total Removal of Exceedances of Clean-Up Level
Hydraulic Heave Analysis
Northern Impoundment - San Jacinto River Waste Pits Superfund Site

Location	Northing (NAD83)	Easting (NAD83)	Surface/Riverbed Elevation	Aquifer Piezometric Elevation Normal Conditions Water Level 5 ft	BC Depth (ft)	BC Elevation (ft)	BS Depth (ft)	BS Elevation (ft)	Sediment Thickness (ft)	BC Thickness (ft)	Water Head (ft)	Uplift Porepressure (psf)	Total Vertical Stress Due to Clay Above Sand (psf)	Type of Excavated Soils	Elevation at Sounding Location for FS = 1.25 Normal Conditions	Proposed Deepest Excavation Surface Elevation (ft)	Downward Force Above BS (psf)	Factor of Safety for Proposed Excavation Surface	Status Against Hydraulic Heave
SJSB099	13857764.25	3216947.21	-0.61	3.3	33.45	-34.06	65.85	-66.46	33.45	32.40	69.76	4353	4050	Sediments only	-22.27	-12.61	6581.10	1.51	OK
SJSB100	13857919.31	3216899.69	-13.36	3.3	11.64	-25.00	47.09	-60.45	11.64	35.45	63.75	3978	4431	Sediments only	-20.41	-15.36	5568.77	1.40	OK
SJSB101	13857709.58	3216809.88	-0.15	3.3	32.77	-32.92	56.38	-56.53	32.77	23.61	59.83	3733	2951	Sediments only	-18.38	-17.65	4753.11	1.27	OK
SJSB102	13857180.23	3217192.14	-2.05	3.3	20.95	-23.00	59.35	-61.40	20.95	38.40	64.70	4037	4800	Sediments only	-20.91	-20.05	5148.10	1.28	OK
SJSB103	13857998.43	3216974.84	-15.36	3.3	12.62	-27.98	52.37	-67.73	12.62	39.75	71.03	4432	4969	Sediments only	-23.14	-16.04	6377.67	1.44	OK
SJSB104	13857613.24	3217397.90	-5.49	3.3	16.51	-22.00	60.37	-65.86	16.51	43.86	69.16	4316	5483	Sediments and clay	-22.70	-5.49	7546.25	1.75	OK
SJSB105	13857485.55	3217440.44	-4.36	3.3	19.52	-23.88	59.78	-64.14	19.52	40.26	67.44	4208	5033	Sediments only	-21.95	-20.36	5447.86	1.29	OK
SJSB106	13857469.99	3217311.02	-3.10	3.3	19.91	-23.01	63.91	-67.01	19.91	44.00	70.31	4387	5500	Sediments and clay	-23.14	-15.38	6453.75	1.47	OK

Total Beaumont clay Unit Weight (pcf)	125.0
Total Beaumont sand Unit Weight (pcf)	130.0
Total Sediment Unit Weight (pcf)	118.0
Water Unit Weight (pcf)	62.4
Target FS (Normal River Elevation = 5 ft)	1.25

Notes:

ft = feet
NAD83 = North American Datum of 1983
piezo = piezometer
BC = Beaumont Clay
BS = Beaumont Sand
psf = pounds per square foot
pcf = pounds per cubic foot
FS = Factor of Safety
BS = Beaumont Sand
psf = pounds per square foot
kN/m^3 = kilonewtons per cubic meter
pcf = pounds per cubic foot
FS = Factor of Safety

Legend

- SDI CPT Boring Location
- CPT Calibration Boring
- Shear Vane Testing
- SDI Shallow Piezometer Location
- SDI Intermediate Piezometer Location
- SDI Deep Piezometer Location
- SDI Deep Piezometer with SPT and Shelby Tubes Location
- RI Geotechnical Core with Primary and Secondary COPCs
- RI Geotechnical Core
- PDI-1 Geotechnical Boring Location
- PDI-1 Analytical and Geotechnical Boring Location
- PDI-2 Analytical Geotechnical Boring Location
- PDI-2 Geotechnical Boring Location
- SDI Geotechnical Stratigraphy Borings
- Conceptual BMP Alignment
- Non-impacted Berm Area
- TCRA Cap Perimeter
- Extent of ACBM

Paper Size ANSI B

0 30 60 90 120

Feet

N

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

GHD

SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

SITE LOCATIONS PLAN - SOUNDING LOCATIONS

Project No. **11215702**
Revision No. **-**
Date **Dec 7, 2021**

FIGURE 1

I:\GIS\GIS\Projects\11180000s\11187072\Layouts\MISC001\11187072-00(MISC001)GIS-BR073.mxd
Print date: 07 Dec 2021 - 08:39

Data source: Imagery - Google, 2019.

A
NORTH

A'
SOUTH

SJSCPT-04
RIVER
CROSS POINT WITH SECTION B-B'
SJSB 103
SJSB 057
SJSB 098
SJSB 037
SJSCPT-11
SJSB 036
SJGB 030
SJMW 17

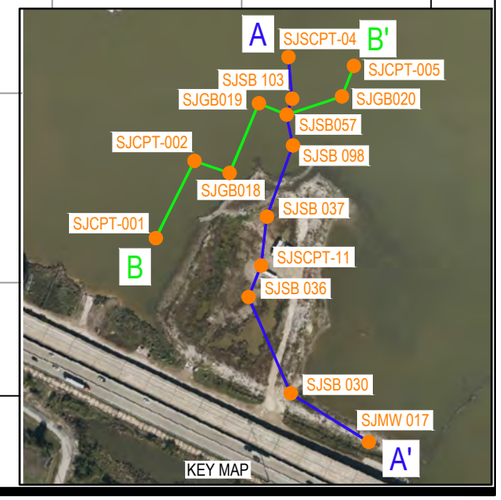
0
-25
-50
-75
-100
-125

ELEVATION (FT)

EOB = 14'
EOB = 32'
EOB = 24'
EOB = 37'
EOB = 35'
EOB = 40'
EOB = 75'
EOB = 75'
EOB = 100'

0
100
200
300
400
500
600
700
800
900

DISTANCE ALONG BASELINE (FT)



SJSB
— WELL ID
— GROUND
— WELL
EOB = END OF BORING

SILTY CLAY TO CLAYEY SILT, SOFT (CL-ML)
SILTY SAND WITH CLAY (SM)
BEAUMONT CLAY (CH)
SANDY TO SILTY CLAY (CL)
CLAYEY SILTY SAND (SC-SM)
GRAVELLY SAND (SW)
GRAY CLAY (CH)

HORIZONTAL
1" = 80 ft
0 40 80Ft
0 10 20Ft
1" = 20 ft
VERTICAL

GHD

SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

GEOLOGIC CROSS-SECTION A-A'

Project No. **11215702**
Date **December 2021**

FIGURE 2

Filename: N:\US\Baton Rouge\Projects\562\11215702\Digital_Design\ACAD 2019\Figures\MISC-001\11215702-GHD-0000-MISC-0101_DE-001.dwg
Plot Date: 07 December 2021 9:52 AM

B

WEST

B'

EAST

SJSCPT-01 SJSCPT-02 SJGB018 SJGB019 SJSB 057 SJGB020 SJSCPT-05

CROSS POINT WITH SECTION A-A'

EOB = 33'

EOB = 52'

EOB = 64'

EOB = 57'

EOB = 62'

EOB = 39'

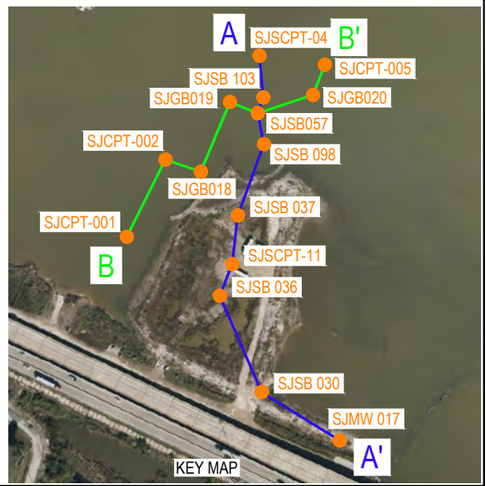
EOB = 100'

ELEVATION (FT)

0 -25 -50 -75 -100 -125

0 100 200 300 400 500 600 700 800

DISTANCE ALONG BASELINE (FT)



SJSB — WELL ID

— GROUND

— WELL

EOB = END OF BORING

SILTY CLAY TO CLAYEY SILT, SOFT (CL-ML)

SILTY SAND WITH CLAY (SM)

BEAUMONT CLAY (CH)

SANDY TO SILTY CLAY (CL)

CLAYEY SILTY SAND (SC-SM)

GRAVELLY SAND (SW)

GRAY CLAY (CH)

HORIZONTAL
1" = 80 ft

0 40 80Ft

0 10 20Ft

1" = 20 ft
VERTICAL

GHD

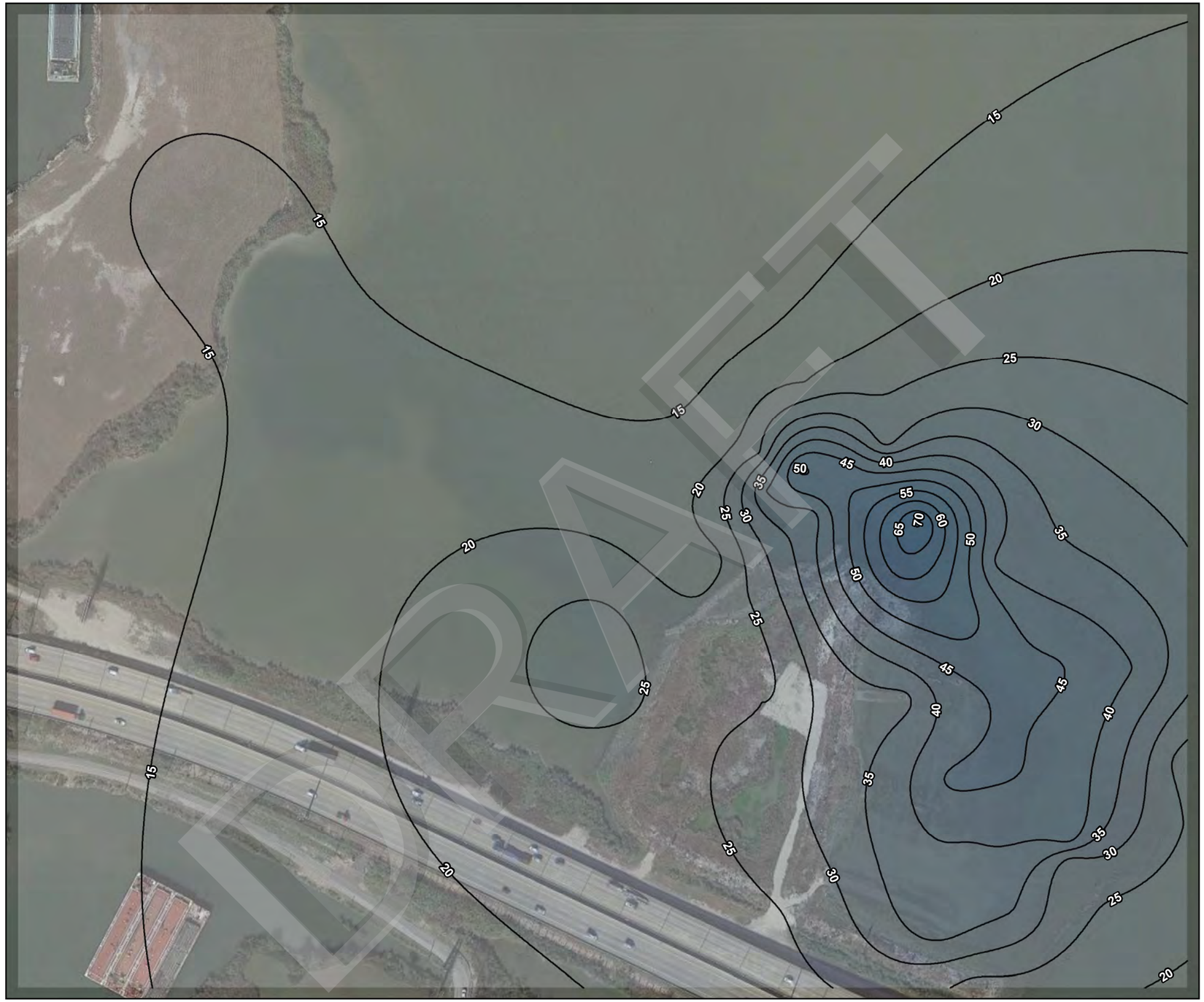
SAN JACINTO RIVER WASTE PITS SITE
HARRIS COUNTY, TEXAS

GEOLOGIC CROSS-SECTION B-B'

Project No. 11215702
Date December 2021

FIGURE 3

Filename: N:\US\Baton Rouge\Projects\562\11215702\Digital_Design\ACAD 2019\Figures\MISC-001\11215702-GHD-0000-MISC-0101_DE-001.dwg
Plot Date: 07 December 2021 9:53 AM



Legend

20 Contour

Thickness (ft)

- 0 - 15
- 15 - 20
- 20 - 25
- 25 - 30
- 30 - 35
- 35 - 40
- 40 - 45
- 45 - 50
- 50 - 55
- 55 - 60
- 60 - 65
- 65 - 70
- 70 - 75

Paper Size ANSI B

0 50 100 150 200

Feet

Map Projection: Lambert Conformal Conic
Horizontal Datum: North American 1983
Grid: NAD 1983 StatePlane Texas South Central FIPS 4204 Feet

N

GHD

SAN JACINTO RIVER WASTE PITS
CHANNELVIEW, HARRIS COUNTY, TEXAS

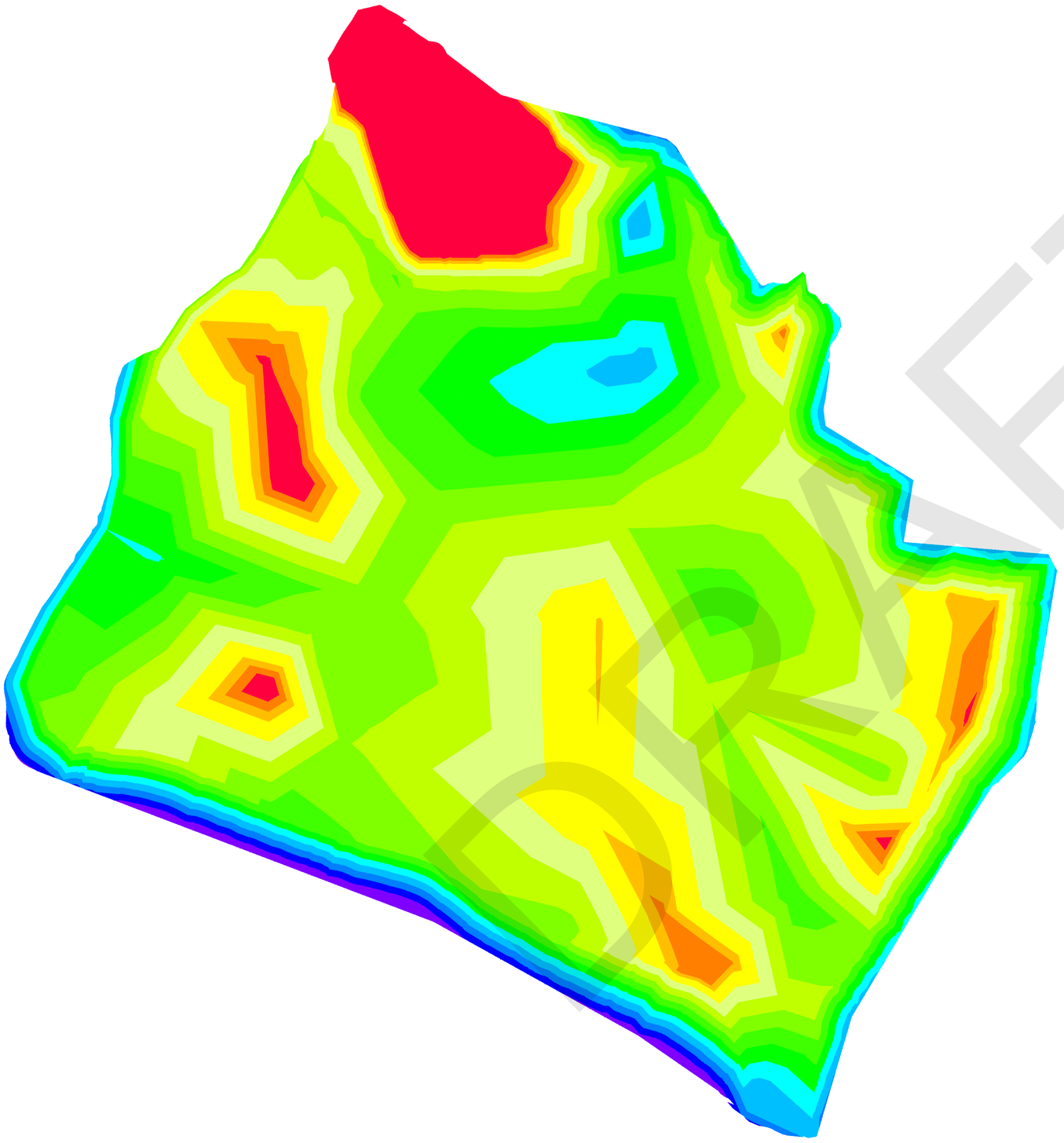
BEAUMONT CLAY
THICKNESS CONTOUR

Project No. **11215702**
Revision No. **-**
Date **Dec 6, 2021**

FIGURE 4

Q:\GIS\PROJECTS\11215000s\11215702\Beaumont Clay\11215702_202111_BeaumontClay_GIS004.mxd

Data source: Google Earth, Imagery Date 11/16/2020



Elevations			
Number	Min Thickness	Max Thickness	Color
1	−26	−22	
2	−22	−20	
3	−20	−18	
4	−18	−16	
5	−16	−14	
6	−14	−12	
7	−12	−10	
8	−10	−8	
9	−8	−6	
10	−6	−4	
11	−4	−2	
12	−2	−1	
13	−1	0	
14	0	15	

GHD
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Baton Rouge Louisiana USA
T 225 292 9007 F 225 952 2978 W www.ghd.com

Client
SAN JACINTO RIVER WASTE PITS

Project
UPDATED HYDRAULIC HEAVE REPORT

No.	Issue	Drawn	Approved	Date

Drawn -	Designer -
Drafting Check -	Design Check -
Project Coordinator CM	Date Jan 24, 2024
This document shall not be used for construction unless signed and sealed for construction.	Scale 1" = 50'
Original Size Arch D	Bar is one inch on original size drawing 0 1"

Project No. **11215702**

Title
HYDRAULIC HEAVE RISK POTENTIAL

Sheet No.
FIGURE 5

Sheet - of -

Plot Date: 24 January 2024 - 6:52 PM Plotted By: Matt Wolfer Filename: N:\US\Baton Rouge\Projects\562\11215702\Digital_Design\ACAD 2019\Figures\11215702-01-DWG-G-082.dwg

Appendices

Appendix A

Beaumont Clay Sample Photographs

Site Photographs

Photo 1 *Figure D.1: Sample G11 (40 to 42 feet (ft) deep in borehole SJGB-018).*

Photo 2 *Figure D.2: Sample G07 (30 to 32 ft deep in borehole SLGB-019).*

Photo 3 *Figure D.3: Sample G14 (40 to 42 ft deep) in borehole SJGB-020.*

GHD.com

→ The Power of Commitment

Appendix C

BMP Scour Protection

Technical Memorandum

DRAFT

January 25, 2024

To	Satish Chilka, PE	**Contact No.**	
Copy to		**Email**	
From	Aaron Holloway, PE	**GHD Project No.**	11215702
Project Name	San Jacinto River Waste Pits Site		
Subject	BMP Scour Protection		

GHD has prepared this memorandum to describe the countermeasures developed to mitigate potential scour along the proposed cofferdam (BMP). The need for scour protection was established through numerical modeling of various scenarios related to the Remedial Design (RD) and its effects on floodplain hydraulics summarized in the Hydrodynamic Modeling Report (GHD, 2022) provided as Attachment F in the Pre-Final 90% RD - Northern Impoundment. This study identified the potential for scour and/or sediment deposition along the outside perimeter of the BMP. The modeling results indicate that concentration of overbank flow around the BMP could generate shear stresses higher than the critical shear stress value (0.15 Pa) as shown in Figure 1, resulting in potential for scour to develop around the northern perimeter of the BMP during storm events. The shear stress values shown at the southwest corner are an artifact of the model bathymetry which doesn't capture the access road which will prevent conveyance of overbank flow through this area, reducing potential for scour at this location.

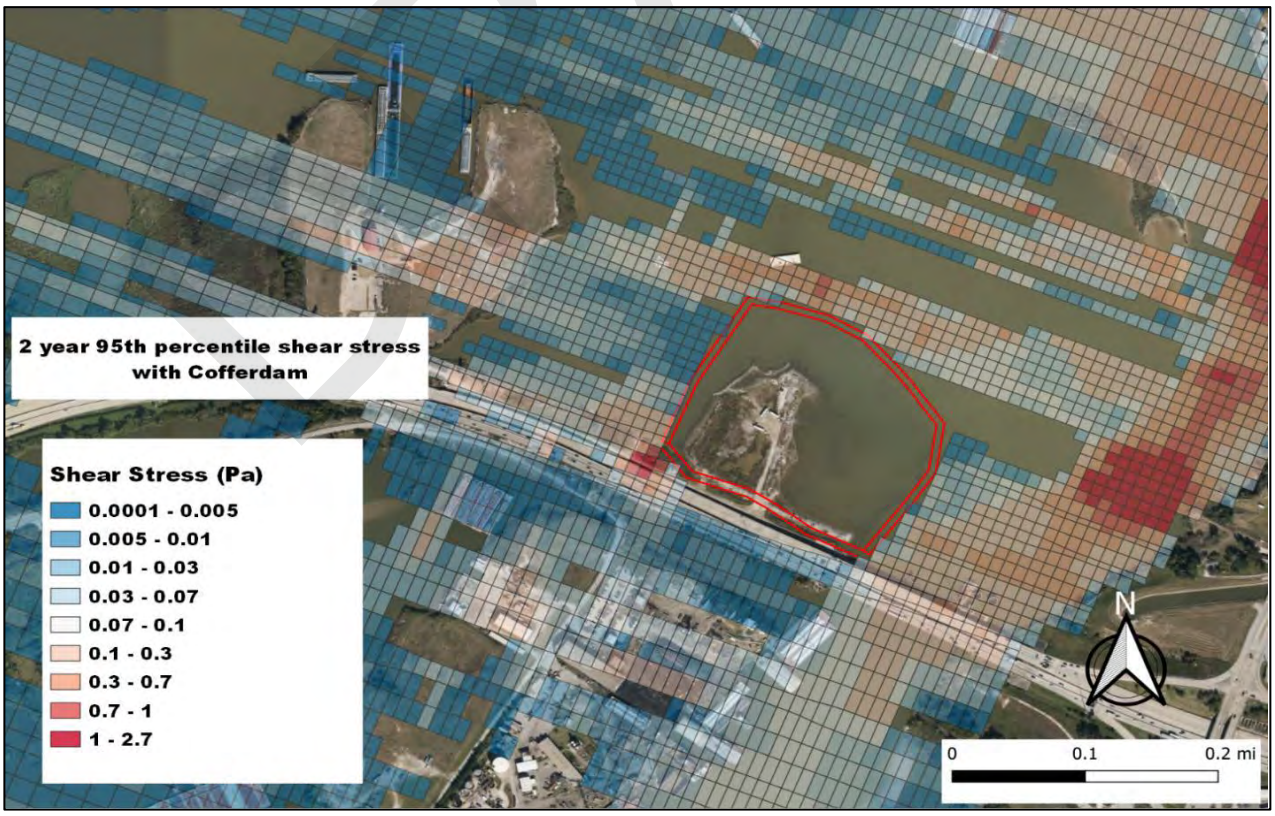

Figure 1 *95th% Shear Stresses "With Cofferdam" for the 2-year Storm*

Scour Protection - Riprap Scour Apron

Scour protection countermeasures were developed based on Federal Highway Administration (FHWA) guidance provided in Hydraulic Engineering Circular No. 23 (HEC-23), Bridge Scour and Stream Instability Countermeasures (Publication No. FHWA-NHI-09-111, September 2009). This document provides design guidelines for use of rock riprap to mitigate scour at bridge abutments. Although the BMP is not a bridge abutment, its influence on floodplain hydraulics is similar in that overbank flows are concentrated through a narrower section of the river resulting in localized increase in shear stress.

Design Guideline 14 was applied to the design of the rock riprap scour protection concepts. The median stone diameter for riprap scour protection is calculated based on depth, velocity and abutment geometry using the Isbash equation. Velocities around the abutment were evaluated using the 2D hydrodynamic model and compared against HEC-RAS, USGS gage data, and observations during Tropical Storm Imelda. These sources indicate maximum peak velocities would be in the 4-5 ft/s range. To account for uncertainties related to complex hydrodynamics and potential for localized flow accelerations along the BMP we applied a safety factor to the predicted maximum velocity and designed the median rock size for a velocity of 6 ft/s.

Based on this approach, the riprap scour protection apron should consist of a median stone diameter of 10 inches and an overall layer thickness of 1.5 feet. An apron width of 25 feet was selected to provide sufficient stability along the exterior perimeter of the BMP. A plan view illustrating the footprint of this scour apron is shown on Figure 2 and a typical section is shown on Figure 3.

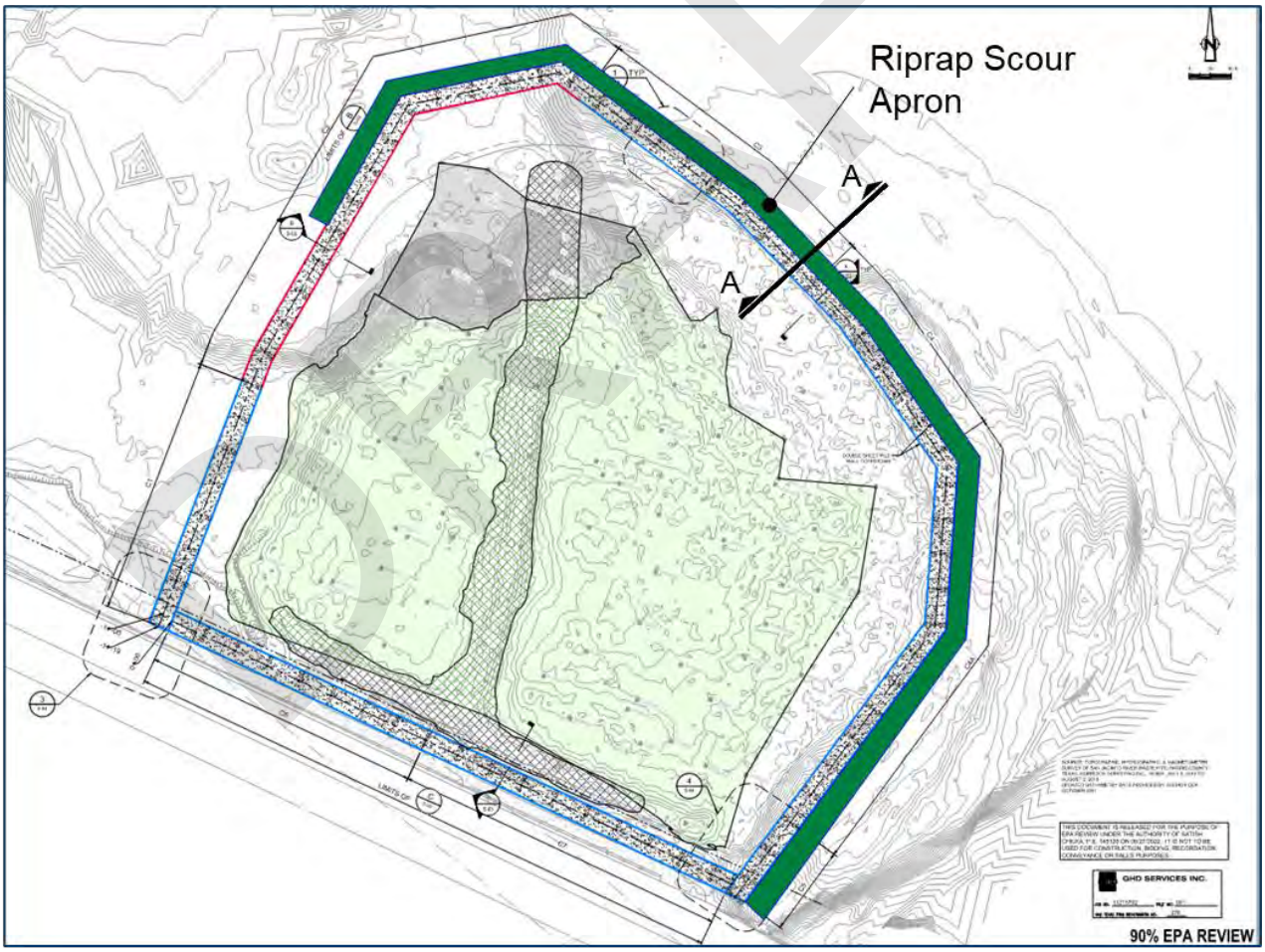

Figure 2 *Plan View of Riprap Scour Apron*

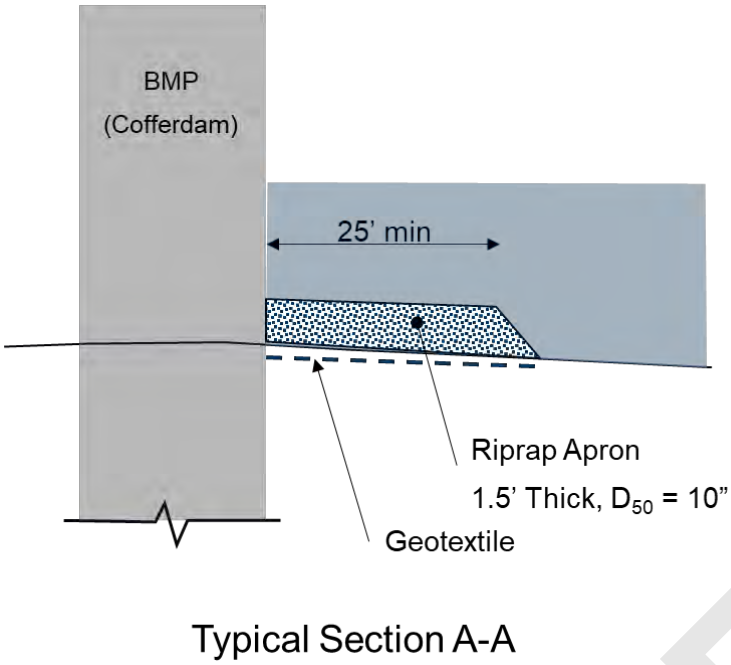

Figure 3 *Typical Section of Riprap Scour Apron*

Additional Considerations

We recommend use of a geotextile or engineered filter layer beneath the riprap layer to prevent the loss (erosion) of finer material beneath the riprap scour apron. In-water placement of geotextile can be challenging depending on depth and flow velocity during construction. Alternatives to geotextile may include an engineered filter layer (i.e. coarse sand/gravel or quarry run material). In addition, the use of a gabion mattress product which can be lined with geotextile prior to being filled with rock and lowered into place, could be an alternative for placement of geotextile and rip rap.

Appendix D

Design Specifications

SECTION 00 01 10

TABLE OF CONTENTS

END OF SECTION

DOCUMENT 00 01 20

SEALS

Consultant for Civil:

Consultant for Structural:

Consultant for Process:

END OF SECTION

SECTION 01 10 00

SUMMARY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. References.
2. Description of Project.
3. Location.
4. Access to the Work Site.
5. Scope of work.
6. Description of work.
7. Sequence of work.
8. Drawings.
9. CONTRACTOR use of the Work Site.
10. Work restrictions.

1.2 REFERENCES

A. Abbreviations and Acronyms:
1. NAVD88 – North American Vertical Datum of 1988.
2. USEPA -- United States Environmental Protection Agency.

1.3 DESCRIPTION OF PROJECT

A. The project is the Remedial Action (RA) for the Northern Impoundment of the San Jacinto River Waste Pits Superfund Site in Harris County, Texas, as described in the approved Final 100% Remedial Design for the Northern Impoundment (Northern Impoundment RD). The Northern Impoundment and associated locations at which the project will take place are referred to in these Specifications as the “Work Site.”

1.4 ACCESS TO THE WORK SITE

A. The Work Site is located directly north of the Interstate Highway 10 (I-10) bridge over the San Jacinto River. Access to the Work Site is available via Exit 786 off Highway I-10 (west of the I-10 bridge crossing), then heading east along the East Freeway Service Road which runs along the north side of I-10.

B. Make all necessary arrangements with the authorities having jurisdiction for the movement of CONTRACTOR material and equipment to and from the Work Site over public roadways.

1.5 SCOPE OF WORK

A. The Works to be performed consists of the RA, other than those elements of the RA that are expressly excluded.

1.6 DESCRIPTION OF WORK

A. The Works includes but is not limited to the following:
   1. Project startup.
   2. Development, implementation, and maintenance of required project plans, which may include plans included in the approved Northern Impoundment RD and/or the following:
      a. Temporary Traffic Control Plan (Section 01 35 00).
      b. Site-specific Health and Safety Plan (Section 01 35 29).
      c. Fall Protection and Prevention Plan (Section 01 35 29).
      d. Contingency and Emergency Response Plans (Section 01 35 29).
      e. Soil Erosion and Sediment Control Plan (Section 01 57 13).
      f. Dust Control Plan (Section 01 35 29).
      g. Storm Water Pollution Prevention Plan (Section 01 57 19).
      h. Flood Contingency Plan (Section 01 57 19).
      i. Hurricane and Severe Storm Plan (Section 01 57 19).
      j. Water Quality Control Plan (Section 01 57 19).
      k. Water Quality Monitoring Plan (Section 01 57 19).
      l. Water Treatment Plan (Section 46 07 01).
      m. Excavation Plan (Section 31 23 16).
      n. Material Handling and On-Site Transportation Plan (Section 02 61 14).
      o. Transportation Emergency Response Plan (Section 02 61 16).
   3. Mobilization to the Work Site.
   4. Installation and maintenance of temporary facilities and controls, including:
      a. Temporary access roads.
      b. Soil erosion and sediment controls.
      c. Staging pads.
      d. Temporary equipment decontamination pad.
      e. Water Treatment System (WTS).
   5. Work Site clearing, including removal, salvage, and storage of existing fence.
   6. Installation of a double steel sheet-pile wall approximately 3,300 feet in length around the entire perimeter of the Work Site, with a large portion of the sheet pile wall installed within the San Jacinto River. For that portion within the San Jacinto River, a turbidity curtain and oil boom will be installed only during installation and removal of the sheet pile wall.
   7. Removal of rock cover and geomembrane and/or geotextile.
   8. Excavation of impacted material.
   9. Excavation dewatering and conveying contact water from excavation(s) to the WTS for treatment and discharge to the river.
   10. Management of wet impacted material to remove free liquid (material must pass paint filter test prior to loading)
   11. Loading impacted material that passes the paint filter test for transportation and off-site disposal.
   12. Management of stockpiled materials awaiting off-site disposal.
   13. Reconstruction and restoration along shoreline.

14. Closeout including cleanup and demobilization; storage of materials; removal of equipment and material; and shutdown of WTS.
15. Restoration of work areas at the end of the Project.
16. Project closeout.

1.7 SEQUENCE OF WORK

A. Perform Works in an orderly and safe manner such that the movement and handling of materials, and potential exposure of personnel to Work Site-related contaminants and physical hazards are minimized.

1.8 CONTRACT TIMES

A. Perform the Works according to the following Contract Times:
   1. The Works at the Work Site shall be commenced after the date of notification from the OWNER to CONTRACTOR to proceed with the Works (Notice to Proceed).
   2. The Works shall be Substantially Completed on or before <_____>.
   3. The Works shall be fully completed and ready for final payment on or before <_____>.

1.9 DRAWINGS

A. Drawings issued with and forming part of the Contract Documents are provided under separate cover.

B. Perform the Works in accordance with the Drawings issued "Issued for Construction" (IFC) by ENGINEER. Such Drawings will be issued to CONTRACTOR with the Notice to Proceed and will consist of bid Drawings revised as required by ENGINEER and additional Drawings if required by ENGINEER.

C. Revised IFC Drawings may be issued from time to time by ENGINEER and such Drawings will supersede previous revisions.

1.10 CONTRACTOR USE OF THE WORK SITE

A. Limit use of the Work Site to allow:
   1. OWNER occupancy.

B. Construction Operations: Limited to areas noted on the Drawings.

C. Hours of Operation: Limit on-site hours of operation to the hours of 7 a.m. to 7 p.m. or as otherwise permitted under applicable access agreement(s), unless otherwise approved by ENGINEER.

D. CONTRACTOR employees working on the Work Site may be required to have a Transportation Worker Identification Credential (TWIC) issued by the United States Government. Any fees associated with obtaining and maintaining either certification card shall be borne by CONTRACTOR and not due reimbursement by OWNER. TWIC requires renewal every five (5) years.

E. When unfavorable weather or other unsuitable construction conditions exist, continue operations which will not be adversely affected by such conditions. Do not construct or cause to be constructed any portion of the Works under conditions which would adversely affect the quality of the Works, unless special means or precautions are taken to perform the Works in a proper and satisfactory manner.

1.11 WORK RESTRICTIONS

A. Monitor river levels daily. All work must be performed in compliance with the Health and Safety Plan.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Mobilization and startup.
2. Coordination.
3. Pre-construction meeting.
4. Progress meetings.
5. Pre-installation meetings.

1.2 DEFINITIONS

A. OWNER is the entity(ies) implementing the Remedial Action (RA).

B. ENGINEER is the representative of OWNER with responsibility to ensure that that all remedial construction activities are completed in accordance with the Drawings and these Specifications and who will provide field management of Construction Quality Control/Construction Quality Assurance (CQA/CQC) activities.

C. CONTRACTOR (including Subcontractors) shall carry out the remedial construction activities for the RA to the Drawings and these Specifications and implement the CQC requirements specified in these Specifications.

1.3 MOBILIZATION AND STARTUP

A. Do not mobilize to the Work Site without ENGINEER's prior written authorization.

B. Perform planning and scheduling activities as necessary for the performance of the Works.

C. Purchase materials and mobilize equipment, supplies, and incidentals to the Work Site.

D. Use the existing access roads at the Work Site to the designated work areas during mobilization. Complete improvements to roads as necessary for the performance of the Works.

E. Confine equipment, storage of materials and equipment, and the operations of workers to the Work Site and land and areas identified in and permitted by the Contract Documents and other land and areas permitted by laws and regulations, rights-of-way, permits, and easements. Do not unreasonably encumber the Work Site with construction equipment or other materials or equipment.

1.4 COORDINATION

A. Do not deliver material or equipment of any kind to the Work Site until approval in writing has been applied for and obtained by CONTRACTOR from ENGINEER.

B. Coordinate delivery of material and equipment to the Work Site with work sequence; schedule deliveries to limit requirement for storage at the Work Site to the practical minimum; limit on-site storage of materials to areas approved by ENGINEER.

1.5 PRE-CONSTRUCTION MEETING

A. ENGINEER will schedule and administer a pre-construction meeting at the Work Site after the date of the Notice to Proceed and prior to start of construction at the Work Site.

B. ENGINEER will make arrangements for meeting, prepare agenda with copies for participants, and preside at the meeting. Provide data required to ENGINEER and be prepared to discuss all items on the agenda.

C. Minimum Attendance Required: CONTRACTOR’s superintendent, CONTRACTOR's Health and Safety Officer, and major Subcontractors.

D. Agenda may include, but not necessarily be limited to, the following:
1. Designation of responsible personnel.
2. Lines of authority and communication.
3. Health and safety.
4. Use of the Work Site for storage, vehicle parking, access routes, and other Work Site requirements.
5. OWNER's requirements.
6. Coordination with Other Contractors and OWNER.
7. Temporary facilities and controls provided by CONTRACTOR.
8. Temporary utilities and services provided by OWNER.
9. Field offices.
10. Survey and Work Site layout.
11. Security and housekeeping procedures.
12. Procedures for processing field decisions, submittals, substitutions, applications for payments, proposal requests, Field Orders, Work Change Directives, Change Orders, and closeout procedures.
13. Progress schedules.
14. Procedures for testing and inspection.
15. Procedures for maintaining Project record documents.

E. ENGINEER will record minutes and distribute copies to participants and those affected by decisions made.

1.6 PROGRESS MEETINGS

A. ENGINEER will schedule and administer progress meetings at the Work Site throughout the progress of the Works as required.

B. ENGINEER will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings. Provide data required to ENGINEER and be prepared to discuss all items on the agenda.

C. Attendance Required: CONTRACTOR's Health and Safety Officer, CONTRACTOR's superintendent, major subcontractors and suppliers, as appropriate to agenda topics for each meeting.

D. Agenda may include, but not necessarily be limited to, the following:
1. Review of minutes of previous meetings.
2. Review of work progress since last meeting.
3. Field observations, problems, and decisions.
4. Identification of problems which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site material fabrication/processing and delivery schedules.
7. Review of health and safety concerns and issues including air monitoring results.
8. Maintenance of progress schedule.
9. Corrective measures to regain projected schedules.
10. Planned progress during succeeding work period.
11. Coordination of projected progress.
12. Maintenance of quality and work standards.
13. Effect of proposed changes on progress schedule and coordination.
14. Change Orders.
15. Applications for Payment.
16. Other business relating to the Works.

E. ENGINEER will record minutes and distribute copies to participants and those affected by decisions made. All communication to Subcontractors, Suppliers, or others that CONTRACTOR is responsible for will be made through CONTRACTOR.

1.7 PRE-INSTALLATION MEETINGS

A. When required in individual Sections, convene a pre-installation meeting at the Work Site prior to commencing work of the Section.

B. Require attendance of parties directly affecting, or affected by, work of the specific Section.

C. Prepare agenda and preside at meeting:
1. Review conditions of installation, preparation, and installation procedures.
2. Review coordination with related work.

D. ENGINEER will record minutes and distribute copies to participants and those affected by decisions made.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Submittal procedures.
2. Progress schedules.
3. Monthly progress reports.
4. Construction quality control reports.
5. Proposed products list.
6. Shop Drawings.
7. Product data.
8. Samples.
9. Manufacturer installation instructions.
10. Manufacturer certificates.
11. Project organization.
12. Submittals for progress meetings.
13. Work Site layout.
14. Submittals schedule.

1.2 SUBMITTAL PROCEDURES

A. Unless directed otherwise, transmit submittals to ENGINEER.

B. Transmit each submittal with a letter of transmittal and the correct number of copies.

C. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

D. Identify the Project, CONTRACTOR, Subcontractor, or Supplier; pertinent Drawing and detail number and Section number, as appropriate.

E. Apply CONTRACTOR's approval stamp prior to initial submission to ENGINEER, signed and dated, certifying that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contract Documents including but not limited to review and approval, verification of products required, field dimensions, adjacent construction work, and coordination of information with respect to CONTRACTOR's review and approval of that submittal. Unstamped or unsigned submittals will be returned by ENGINEER without action.

F. Schedule submittals according to specified scheduling. Coordinate submission of related items.

G. Identify product or system limitations which may be detrimental to successful performance of the completed Works.

H. Provide space for ENGINEER review stamp and comments on submittals.

I. Make corrections to each submittal required by ENGINEER. Promptly revise and resubmit the required number of corrected copies of each submittal and submit new submittals required by such correction; identify changes made since previous submission and changes other than those requested by ENGINEER.

J. Promptly distribute copies of reviewed submittals to Subcontractors, Suppliers, and other concerned parties as appropriate. Instruct parties to promptly report any inability to comply with provisions.

K. Submittals not requested will not be recognized or processed. Submittals received directly from Subcontractors, Suppliers, vendors, or other Representatives or without CONTRACTOR stamp will be returned by ENGINEER without action.

L. It is the responsibility of CONTRACTOR to review submittals made by Suppliers and Subcontractors before transmitting them to ENGINEER to assure proper coordination of the Works and to determine that each submittal is according to CONTRACTOR's desires and that there is sufficient information about materials and equipment for ENGINEER to determine compliance with the Drawings and Specifications. Incomplete or inadequate submittals will be returned for revision without review.

M. Unless specified otherwise submit three copies of submittals.

N. Requirements of this article (SUBMITTAL PROCEDURES) shall apply to all required submittals.

1.3 PROGRESS SCHEDULES

A. Prior to commencing work at the Work Site, submit initial detailed progress schedule in duplicate, and one electronic copy in Microsoft Project Gantt Chart format. Submit updated progress schedules at each progress meeting, identifying changes since previous version and estimated percentage of completion for each item of the Works. If a schedule remains unchanged from one period to the next, submit a written notice to that effect.

B. Show complete sequence of construction by activity, identifying work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.

C. Provide sub-schedules to define critical activities which dictate the rate of progress.

D. Show accumulated percentage of completion of each item, and total percentage of the Works completed, as of the first day of each month.

E. Provide separate schedule of submittal dates for Shop Drawings, product data, Samples, factory and field testing dates, and product delivery dates, including those furnished by OWNER, and dates reviewed submittals will be required from ENGINEER. Indicate decision dates for selection of finishes.

F. If during performance of the Works CONTRACTOR believes it necessary or advantageous to change sequence of activities shown on CONTRACTOR's progress schedule, submit proposed revisions to ENGINEER for approval prior to changing the sequence of work. No change shall be made in the order in which work activities are being performed until ENGINEER's written approval for the revised schedule has been obtained. The schedule will be acceptable to ENGINEER as providing an orderly progression of the Works to completion within any specified dates, but such acceptance will neither impose on ENGINEER responsibility for the sequencing, scheduling, or progress of the Works nor interfere with or relieve CONTRACTOR from CONTRACTOR's full responsibility therefor.

G. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes. Provide narrative report to define problem areas causing delay, anticipated delays and length, and impact on schedule. Report corrective action taken, or proposed, and its effect including the effect of changes on schedules of other contractors.

H. Distribute copies of reviewed schedules to Subcontractors, Suppliers, and other concerned parties. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

1.4 MONTHLY PROGRESS REPORTS

A. Submit monthly progress report in a form acceptable to ENGINEER indicating work accomplished, problems encountered, problems resolved, requests for changes to the Works, a comparison of the schedule submitted as part of the Contract Documents versus the current status, and work scheduled for the next month.

B. Submit progress schedule in the form of a Gantt chart with highlighted critical path tasks. The schedule shall show the original schedule and the actual schedule.

1.5 CONSTRUCTION QUALITY CONTROL REPORTS

A. Record daily Construction Quality Control activities in CONTRACTOR's Work Site log book.

B. Each work day submit a Construction Quality Control report for the previous work day.

1.6 PROPOSED PRODUCTS LIST

A. Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards or description, give name of manufacturer, trade name, model or catalog designation, and reference standards.

C. For products requiring special handling procedures, submit a Safety Data Sheet (SDS) prior to product's arrival on the Work Site.

1.7 SHOP DRAWINGS

A. When specified in individual Sections, prepare detailed drawings of material and structures to be supplied by CONTRACTOR from typical details shown on "Approved for Construction" Drawings and/or from specified requirements.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Indicate materials, methods of construction, attachment or anchorage, erection diagrams, connections, explanatory notes, and other information necessary for completion of the Works.

D. Where articles or equipment attach or connect to other articles or equipment, indicate that such work has been coordinated, regardless of the Section under which the adjacent items will be supplied and installed.

E. Confirm dimensions shown on CONTRACTOR's drawings with actual measurements of existing and/or completed associated structures and affected adjacent work at the Work Site.

F. Submit three hard copies and one digital copy of CONTRACTOR's drawings on USB memory stick or electronic file transfer or Compact Disc (CD) compatible for use with Windows 10 and AutoCad 2019.

G. After ENGINEER completes its review, Shop Drawings will be stamped with one of the following notations:
   1. Reviewed.
   2. Reviewed as Noted.
   3. Not Subject to Review.
   4. Revise and Resubmit.

H. If a Shop Drawing is acceptable, it will be marked “Reviewed" or "Reviewed as Noted". Two hard copies of the Shop Drawing will be returned to CONTRACTOR.

I. Upon return of a Shop Drawing marked "Reviewed" or "Reviewed as Noted", CONTRACTOR may order, ship, or fabricate the materials included on the Shop Drawing, provided it is according to the corrections indicated. Upon receipt of Shop Drawings stamped "Reviewed" or “Reviewed as Noted", produce copies and distribute according to PART 1, SUBMITTAL PROCEDURES and for Project record document purposes as described in Section 01 70 00.

J. If a Shop Drawing marked "Reviewed as Noted" has extensive corrections or corrections affecting other drawings or Works, ENGINEER may require that CONTRACTOR make the corrections indicated thereon and resubmit the Shop Drawings for Project record document purposes.

K. Shop Drawings that are for information only will be marked "Not Subject to Review" and one copy will be returned to CONTRACTOR.

L. If a Shop Drawing is unacceptable, two copies will be returned to CONTRACTOR marked "Revise and Resubmit".

M. Upon return of a Shop Drawing marked "Revise and Resubmit", CONTRACTOR shall make the corrections indicated and repeat the initial approval procedure.

N. Shop Drawings lacking adequate details or information to allow ENGINEER to determine whether or not the Shop Drawing meets the requirements of the Contract Documents will also be marked "Revise and Resubmit" and returned without further comment.

O. Shop Drawings not bearing ENGINEER's "Approved" or "Approved as Noted" notation shall not be issued to Subcontractors nor utilized for construction purposes. No work requiring submission and approval of Shop Drawings shall be performed or equipment requiring submission and approval of Shop Drawings installed without Shop Drawings bearing one of these notations.

P. Submit Shop Drawings well in advance of the need for the material or equipment for construction and with ample allowance for time required to make delivery of material or equipment after data covering such is approved. CONTRACTOR shall assume the risk for all materials or equipment which are fabricated or delivered prior to the approval of Shop Drawings. No materials or equipment shall be incorporated into the Works nor included in progress payments until approval thereof has been obtained in the specified manner.

Q. ENGINEER will review and process all Shop Drawings promptly, but a reasonable time should be allowed for this, for Shop Drawings being revised and resubmitted, and for time required to return the approved Shop Drawings to CONTRACTOR.

R. Approval of Shop Drawings shall not relieve CONTRACTOR from the responsibility of furnishing materials and equipment of proper dimension, size, quality, quantity, and all performance characteristics to efficiently perform the requirements and intent of the Contract Documents. Approval shall not relieve CONTRACTOR from responsibility for errors of any sort on Shop Drawings. Approval is intended only to assure conformance with the design concept of the Project and compliance with the information given in the Contract Documents. CONTRACTOR is responsible for information that pertains solely to the fabrication processes, to the technique of construction, and for the coordination of the work of all trades.

S. CONTRACTOR shall not be relieved of any part of its responsibilities for correctness of its drawings or adequacy of its design bearing ENGINEER's "Approved" or "Approved as Noted" notation. ENGINEER's approval is for the sole purpose of ascertaining conformance with general design concepts, and in no way constitutes approval of the detail design inherent in CONTRACTOR's drawings, responsibility for which remains solely with CONTRACTOR. Drawings prepared by CONTRACTOR's representatives including Subcontractors, Suppliers, vendors, or other Representatives shall be considered CONTRACTOR's drawings.

1.8 PRODUCT DATA

A. Submit the number of copies which CONTRACTOR requires, plus two copies which will be retained by ENGINEER.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to the Project.

C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

D. After review, distribute according to PART 1, SUBMITTAL PROCEDURES and provide copies for Project record documents as described in Section 01 70 00.

1.9 MANUFACTURER INSTALLATION INSTRUCTIONS

A. When specified in individual Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to ENGINEER in quantities specified for product data in PART 1, PROPOSED PRODUCTS LIST.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

C. Whenever the Specifications refer to manufacturer's instructions, such reference shall mean written instructions of the manufacturer.

1.10 MANUFACTURER CERTIFICATES

A. When specified in individual Sections, or when required by reference standards, submit certification and/or test results by manufacturer, in quantities specified for product data in PART 1, PROPOSED PRODUCTS LIST.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications, as appropriate.

C. Certificates may be recent or previous test results on material or product but must be acceptable to ENGINEER.

1.11 CONSTRUCTION PHOTOGRAPHS

A. Submit daily photographs to ENGINEER weekly, at a minimum.

B. Photographs: One digital copy; color.

C. Take Work Site photographs from differing directions indicating the relative progress of the Works.

D. ENGINEER will advise CONTRACTOR in writing, describing Project locations and subjects to be photographed, which will not be limited to work performed under the Contract.

E. Each photograph shall contain at least one person or other easily identifiable object properly located to effectively illustrate dimensional scale of work being photographed.

F. Camera equipment used shall be type best suited to produce enlargement prints that are sharp and show details clearly.

G. Identify photographs with date, time, orientation, Project identification, and description provided by ENGINEER.

H. Permission for CONTRACTOR to use progress photographs will be subject to approval of ENGINEER.

I. Deliver copies to OWNER with Project record documents. Catalog and index electronic photos in chronological sequence; provide typed table of contents.

1.12 PROJECT ORGANIZATION

A. Submit a Project organization chart identifying major positions and names of persons assigned to these positions, including project manager, superintendent, and Work Site health and safety officer. Resumes of each person in these positions shall be submitted and approved by OWNER. A list of testing labs and Subcontractors shall also be submitted for review.

1.13 SUBMITTALS FOR PROGRESS MEETINGS

A. Prior to scheduled progress meetings submit the following:
   1. Updated progress schedule detailing all activities. Include review of progress with respect to previously established dates for starting and stopping the various stages of the Works, major problems and action taken, injury reports, equipment breakdown, and material removal.
   2. Copies of air sampling and analytical results conducted by CONTRACTOR.
   3. Copies of transport manifests, trip tickets, and disposal receipts for waste materials removed from the work area.
   4. Weekly copies of the Work Site entry and work area logbooks with information on worker and visitor access.
   5. Any other information required by ENGINEER or relevant to the agenda for the upcoming progress meeting.

1.14 WORK SITE LAYOUT

A. Submit Work Site layout drawings showing existing conditions, facilities, proposed construction facilities, and temporary controls to be provided by CONTRACTOR which may include, but are not limited to, the following:
   1. Existing property lines, structures, roads, utilities, and other existing Work Site feature or facility.
   2. Temporary access roads and utilities to be constructed.
   3. Field offices and sheds.
   4. Equipment and personnel decontamination areas.
   5. The means of ingress and egress and temporary traffic control facilities.
   6. Proposed location of Work Site access.
   7. Equipment and material staging areas.
   8. Soil stockpile areas.
   9. Exclusion Zones, Contaminant Reduction Zones, and other zones specified in CONTRACTOR's Work Site-specific Health and Safety Plan.
   10. Grading, including contours, required to construct temporary construction facilities.
   11. Water storage areas.
   12. Any other data deemed pertinent by CONTRACTOR or required by ENGINEER.

1.15 SUBMITTALS SCHEDULE

A. The submittals schedule shall be in tabular form listing all submittals required by the Contract Documents and the date on which CONTRACTOR will make each submittal. As a minimum, the submittals schedule shall consist of the following columns:
   1. Submittal Number: Number consecutively.
   2. Section Number: Section number or description of location in the Contract Documents where submittal is requested.
   3. Page Number: Page number of the Section in the Contract Documents where submittals is requested.
   4. Item: Description of item or items to which submittals pertain.
   5. Submittal Type: A letter code indicating what type of submittal was requested. The type key shall be as follows:
      a. Test Results and/or Certificates
      b. Manufacturers' Literature or Data (Informative only)
      c. Shop Drawings
      d. Operation and Maintenance Instructions
      e. Samples
      f. Alternative Product Supporting Data
      g. Administrative such as schedules, etc.
   6. Deficiencies: Manner in which submittal or proposed alternative product does not meet the requirements of the Contract Documents.
   7. Anticipated Submittal Date: Date on which CONTRACTOR anticipates submittal to be delivered to ENGINEER.
   8. Response Required: Indicate "yes" if CONTRACTOR anticipates response from ENGINEER and "no" if no response is anticipated.

B. The submittals schedule will be reviewed by ENGINEER and ENGINEER will respond in writing listing deficiencies. Do not list submittals not called for in the Contract Documents. The schedule shall include all items for which CONTRACTOR proposes to use substitute or "or-equal" products. Correct deficiencies and resubmit the submittals schedule prior to beginning any work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 35 00

TEMPORARY TRAFFIC CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. References.
2. Pre-Installation meetings
3. Submittals.
4. Information and Warning Devices.
5. Signs and Equipment.
6. Barricades and Lights.
7. Vehicular Traffic.
8. Control of Public Traffic.
9. Field Quality Control.

B. Related Requirements:
1. Section 01 50 00 – Temporary Facilities and Controls.
2. Section 02 61 14 – Material Handling and Transportation.

1.2 REFERENCES

A. Reference Standards:
1. US Department of Transportation Federal Highway Administration (FHWA).
a. Manual on Uniform Traffic Control Devices (MUTCD).
2. Texas Department of Transportation (TxDOT).

1.3 PRE-INSTALLATION MEETINGS

A. Meet with ENGINEER prior to the commencement of the Works in order to prepare a list of signs and other devices required for the project. If a condition on the Work Site changes, revise the list to the approval of ENGINEER.

1.4 SUBMITTALS

A. Submit Temporary Traffic Control Plan complying with MUTCD and TxDOT requirements.
1. Comply with all applicable local municipal and OWNER traffic regulations and by laws and requirements contained in applicable access agreement(s).
2. Develop and submit a detailed traffic control plan and coordinate a meeting with ENGINEER and OWNER in order to discuss the proposed traffic control plan, including any temporary traffic signals. CONTRACTOR shall be responsible for developing and implementing the Temporary Traffic Control Plan consistent with the Transportation and Off-Site Disposal Plan (TODP).

3. Show sequences of construction affecting the use of roadways, temporary access roads, and board mats, the amount of time required for each phase of the Works, and phasing of operations to provide necessary access, and plans for signing, barricading, and striping in order to provide safe passages for pedestrians and vehicles.
4. All traffic control measures (signs, barriers, control devices, etc.) during construction, if subject to MUTCD, shall be in accordance with MUTCD.
5. Stabilized construction entrance and or temporary vehicle washing facility to prevent the release of miscellaneous debris onto TxDOT access road.

B. Include copies of permits and approvals for construction as required by any applicable laws and regulations and governing agencies.

PART 2 PRODUCTS

2.2 INFORMATIONAL AND WARNING DEVICES

A. Provide and maintain signs, warning lights and other devices as may be required in order to provide adequate notification of construction activities or other temporary and unusual conditions resulting from the Works which may require road user response.

B. Supply and erect signs, delineators, barricades, and any miscellaneous warning devices as may be required by or specified in MUTCD and TxDOT.

C. Place signs and other devices as needed.

2.3 SIGNS AND EQUIPMENT

A. Conform to the requirements of MUTCD and TxDOT, if applicable.

B. Provide traffic controls to delineate traffic lanes and to guide and separate traffic movements.

C. Provide at obstructions, such as material piles and equipment.

D. Illuminate barricades and obstructions with warning lights from sunset to sunrise.

E. Use signs to alert the general public of construction hazards, including if applicable any surface irregularities, unramped walkways, grade changes, and trenches or excavations in roadways and in other public access areas.

2.4 BARRICADES AND LIGHTS

A. Provide barricades and lights in accordance with the requirements of MUTCD and TxDOT, if applicable, in sufficient quantity to safeguard the public and the Works.

B. Provide barricades and lights to meet regulations and in sufficient quantity to safeguard the public and the Works.

PART 3 EXECUTION

3.1 VEHICULAR TRAFFIC

A. Ingress and egress from the Work Site in accordance with the Drawings or as directed by ENGINEER.

B. Comply with the Temporary Traffic Control Plan and the Transportation and Off-Site Disposal Plan.

C. Confirm that designated route is available and adequate before coming to the Work Site.

D. Confirm height restrictions on all access and haul routes.

E. Confine construction traffic to haul routes approved by ENGINEER.

F. Comply with applicable laws and regulations regarding closing or restricting the use of public streets or highways and provisions of applicable access agreement(s).

G. Conduct the Works in a way that minimizes interference with public travel.

H. When traffic control persons are required by regulation or when deemed necessary in order to ensure public safety, furnish them with approved apparel and other traffic control devices as required.

I. Coordinate traffic routing with that of other contractors working in the same or in adjacent areas.

3.2 PROTECTION OF PUBLIC TRAFFIC

A. Comply with the requirements of all applicable acts, regulations and by-laws in force for the regulation of traffic or the use of roadways upon or over which it is necessary to carry out the Works or haul materials or equipment.

B. Do not close any lanes of road without the prior approval of TxDOT for any road under TxDOT jurisdiction. Before re-routing traffic, erect suitable signs and devices in accordance with MUTCD.

3.3 FIELD QUALITY CONTROL

A. Continually maintain the traffic control devices in use by:
   1. Checking all signs daily for legibility, damage, suitability and location. Clean, repair or replace the signs to maintain their clarity and reflectivity.
   2. Removing or covering signs which do not apply to existing conditions of that day.

END OF SECTION

SECTION 01 35 29

HEALTH AND SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. References.
2. General requirements.
3. Basis of program.
4. Work Site characterization.
5. Submittals.
6. Health and Safety Officer and Corporate Safety and Health Manager.
7. Personnel health, safety, and hygiene.
8. Air monitoring.
9. Contingency and Emergency Response Plans.
10. Site control.

1.2 REFERENCES

A. Abbreviations and Acronyms:
1. AIHA: American Industrial Hygiene Association.
2. CPR: Cardiopulmonary resuscitation.
3. FPAP Plan: Fall Protection and Prevention Plan.
4. HASP: Work Site-specific Health and Safety Plan.
5. HSO: Health and Safety Officer
6. JSA: Job Safety Analysis form.
7. NIOSH: National Institute for Occupational Safety and Health.
8. NRC: National Response Center.
9. OSHA: Occupational Safety and Health Administration.
10. PFD: Personal flotation device.
11. PID: Photoionization device.
12. PPE: Personal protective equipment.
13. SDS: Safety Data Sheet.
14. TCEQ: Texas Commission on Environmental Quality.
15. USACE: US Army Corps of Engineers.
16. USEPA: United States Environmental Protection Agency.
17. VOC: Volatile Organic Compound.

B. Reference Standards:
1. Section 01 40 00 - Quality Requirements: Requirements for references.
2. Occupational Safety and Health Administration, an agency of the United States Department of Labor, Occupational Safety and Health Standards and Safety and Health Regulations - Code of Federal Regulations:
a. 29 CFR 1910 - Subpart I - Personal Protective Equipment.
b. 29 CFR 1910.134 – Subpart I – Personal Protective Equipment - Respiratory Protection.

c. 29 CFR 1910 - Subpart Z - Toxic and Hazardous Substances.
d. 29 CFR 1910.120 – Subpart H Hazardous Materials - Hazardous Waste Operations and Emergency Response.
e. 29 CFR 1910.146 – Subpart J – General Environmental Controls - Permit-required Confined Spaces.
f. 29 CFR 1910.147 – Subpart J – The Control of Hazardous Energy Sources.
g. 29 CFR 1910.1200 - Subpart Z - Toxic and Hazardous Substances - Hazard Communication.
h. 29 CFR 1926 - Subpart O - Motor Vehicles, Mechanized Equipment, and Marine Operations.
i. 29 CFR 1926 - Subpart P - Excavations.
j. 29 CFR 1926.65 - Subpart D – Occupational Health and Environmental Controls - Hazardous Waste Operations and Emergency Response.
k. 29 CFR 1926.502 - Subpart M - Fall Protection - Fall Protection Systems Criteria and Practices.
l. 49 CFR 171, Subpart B - Incident Reporting, Notification, BOE Approvals and Authorization.
m. 49 CFR 172, Subpart G - Emergency Response Information.
n. 49 CFR 390.15, Subpart E - Hazardous Materials Safety Permits.

3. US Army Corps of Engineers:
   a. EM 385-1-1 - Safety and Health Requirements Manual.

1.3 GENERAL REQUIREMENTS

A. Develop a written Work Site-specific Health and Safety Plan (HASP) which complies with 29 CFR 1910.120 and 29 CFR 1926.65 prior to commencing mobilization to the Work Site and continue to implement, maintain, and enforce the HASP until final demobilization from the Work Site. The development, implementation, and maintenance of the HASP are CONTRACTOR's sole responsibility. The CONTRACTOR shall follow all requirements in the HASP and Emergency Response Plans that are provided with these Contract Documents and add any additional requirements to it that may be necessary and/or are specified in this Section.

B. The health and safety guidelines contained herein are minimal requirements intended to provide for a safe and minimal risk working environment for on-site personnel and to minimize the impact of activities involving contact with hazardous materials or hazardous wastes on the general public and the surrounding environment.

C. Should CONTRACTOR seek relief from, or substitution for, any portion or provision of the health and safety requirements specified herein, or the HASP reviewed by ENGINEER, such relief or substitution shall be requested from CONTRACTOR in writing, and if accepted by ENGINEER, will be authorized in writing.

D. Responsibility: Be responsible for the safety of persons and property on the Work Site and for the protection of persons off the Work Site and the environment to the extent that they may be affected by the performance of the Works. Comply with, and enforce compliance by employees of CONTRACTOR and Representatives, safety requirements of the Contract Documents, laws and regulations, and the HASP. CONTRACTOR acknowledges that safety and environment protection obligations are of paramount importance regarding all of the work to be performed under the Contract Documents.

E. Hazard Communication Requirements:

1. Comply with the requirements of 29 CFR 1910.1200. Obtain information on any hazardous chemical or harmful physical agent to which personnel of CONTRACTOR and Representatives and visitors have potential exposure while on the Work Site.
2. Provide ENGINEER with SDS documentation on "hazardous" chemicals that CONTRACTOR or Representatives plan to bring onto the Work Site. In addition, CONTRACTOR shall be responsible for meeting container warning label requirements of 29 CFR 1910.1200.
3. Comply with OWNER's health and safety requirements.
4. In the event of conflicting or overlapping health and safety requirements, comply with the most stringent requirements.

F. Work Stoppage: Give precedence to the safety and health of the public, plant personnel, and on-site personnel and the protection of the environment over cost and schedule considerations for all of the work to be performed under the Contract Documents. All CONTRACTOR personnel shall have the authority to stop Works should a health or safety concern arise. Any stop work action should be communicated to the CONTRACTOR HSO immediately who will evaluate the situation and implement any necessary mitigation actions. The HSO, along with ENGINEER, will determine when it is safe to commence Works again. ENGINEER and OWNER will also have the right to stop the Works for health and safety considerations.

G. Unforeseen Hazards: Should any unforeseen or Work Site-peculiar safety-related factor, hazard, or condition become evident during performance of the Works, bring such to the attention of ENGINEER verbally and in writing as quickly as possible, for resolution. In the interim, take prudent action to establish and maintain safe working conditions and to safeguard employees of CONTRACTOR and Representatives, the public, OWNER, ENGINEER, and the environment.

1.4 BASIS OF PROGRAM

A. OSHA standards and regulations contained in 29 CFR 1910 and 1926 provide the basis for the Work Site health and safety program. The program also reflects the position of the USEPA and NIOSH regarding procedures recommended or required to ensure safe operations at sites containing hazardous or toxic materials.

1.5 WORK SITE CHARACTERIZATION

A. Work at the Work Site may involve contact with soils, sediments, and water impacted by the Work Site constituents including dioxins and furans. The constituents at the Work Site are discussed further in the design documents included with these Specifications.

1.6 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. HASP:
1. Prior to mobilization to the Work Site, submit a HASP which complies with 29 CFR 1910.120, and 29 CFR 1926.65. As a minimum, the HASP shall include the following:
   a. A safety and health risk or hazard analysis for each work task and operation.
   b. Personnel training assignments in accordance with 29 CFR 1910.120 (e) and 29 CFR 1926.65 (e).

c. PPE to be used by personnel on the Work Site for each work task and operation being conducted in accordance with 29 CFR 1910.120 (g) (5) and 29 CFR 1926.65 (g) (5) and Plant health and safety requirements.
d. US Coast Guard approved PFD to be used by personnel on the Work Site for each work task and operation being conducted where drowning hazard exist as determined in accordance with USACE EM 385-1-1.
e. Medical surveillance requirements in accordance with 29 CFR 1910.120 (f), 29 CFR 1910.134, and 29 CFR 1926.65 (f).
f. Air monitoring program in accordance with 29 CFR 1920 (h) and 29 CFR 1926.65 (h), including frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.
g. The Work Site control measures in accordance with 29 CFR 1910.120 (d) and 29 CFR 1926.65 (d).
h. Decontamination procedures in accordance with 29 CFR 1910.120 (k) and 29 CFR 1926.65 (k).
i. Contingency and Emergency Response Plans meeting the requirements of 29 CFR 1910.120 (l) and 29 CFR 1926.65 (l) for safe and effective responses to emergencies, including necessary PPE and other equipment. CONTRACTOR shall start with the Emergency Response Plan that has been provided with these Specifications and add any additional requirements that may be necessary as determined by CONTRACTOR.
j. Provisions for first aid and bloodborne pathogens.
k. Communication systems.
l. A detailed description of the planned movement of labor, equipment, and materials from and between work areas as work progresses, including measures to be employed to prevent recontamination of previously cleaned areas and impacts to areas that do not now contain hazardous materials.
m. A written respiratory protection program for work activities.
n. Dust Control Plan.
o. Procedures dealing with heat stress.
p. Confined space entry procedures.
q. Control of hazardous energy in accordance with 29 CFR 1910.147.
r. A spill containment program meeting the requirements of 29 CFR 1910.120 (j) and 29 CFR 1926.65 (j) if drummed waste material is generated, excavated, stored, or managed at the Work Site.
s. A detailed description of the personnel decontamination facilities to be employed including the planned phasing of decontamination facilities between work areas as work progresses and the methods to be used to collect, store, treat, and ultimately dispose of personnel decontamination waters and wastes.
t. A detailed description of the wash down area for decontamination of vehicles and equipment and the methods to be used to collect, store, treat, and ultimately dispose of wash down decontamination waters and sediments.

2. ENGINEER will review the HASP and provide comments. Revise the HASP as appropriate and resubmit the HASP to ENGINEER.

C. Proof of OSHA Training: Prior to mobilization to the Work Site, submit a list of all personnel who will be employed at the Work Site. For each of the listed personnel, provide proof of training as required under 29 CFR 1910.120 and 29 CFR 1926.65 (40-Hour Hazardous Waste Operations and Emergency Response training). Submit proof of training for any additional personnel as they are sent to the Work Site.

D. Medical Surveillance:
   1. Prior to mobilization to the Work Site, submit certification of medical surveillance for all Site personnel.
   2. Submit additional certification of medical surveillance as personnel are sent to the Work Site.

E. Respirator Fit Test: Prior to mobilization to the Work Site, submit proof of respirator fit testing for on-site personnel that potentially could wear a respirator on the project.

F. Fall Protection and Prevention Plan (FPAP) Plan:
   1. As applicable, a qualified person for fall protection shall prepare and sign the FPAP Plan which complies with 29 CFR 1926.502. The FPAP Plan shall be Work Site specific and address all fall hazards on Work Site and during different phases of the Works. The FPAP Plan shall address:
      a. How to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 6 feet.
      b. Fall protection and prevention systems, equipment and methods employed for every phase of the Works, responsibilities, assisted rescue, self-rescue, and evacuation procedures, training requirements, and monitoring methods.
   2. Revise the FPAP Plan, as needed, reflecting any changes during the performance of the Works due to changes in personnel, equipment, systems, or work habits. The accepted FPAP Plan shall be kept and maintained at the Work Site for the duration of the Works.

G. Air Monitoring Reporting: Submit real-time air monitoring results daily on a separate CONTRACTOR designated form.

H. Physical Hazard Control Records: Maintain records of the activities undertaken to control physical hazards on the Work Site. This may include the following:
   1. Heart rate measurements and/or oral temperatures for heat stress monitoring.
   2. Results of heavy equipment inspections.
   3. Training and experience records of heavy equipment operators.
   4. Lockout/tagout records.
   5. Results of documented work area inspections.
   6. Results of documented excavation inspections.
   7. Activities on the equipment decontamination pad, dewatering and stabilization pad, and staging pads.

1.7 HEALTH AND SAFETY OFFICER AND CORPORATE SAFETY AND HEALTH MANAGER

A. Employ and assign to the Works a full-time competent and authorized representative, herein referred to as "Health and Safety Officer" (HSO). The HSO shall be dedicated to monitoring and administering the CONTRACTOR health and safety program at the Site and shall not split time/duties with other non-health and safety tasks.

B. Health and Safety Officer Qualifications:
   1. Minimum of 5 years site related working experience as a HSO specific to remedial construction activities at hazardous waste sites.
   2. Basic working knowledge of state and federal occupational safety and health regulations.
   3. Formal education and/or training in occupational safety and health.
   4. OSHA 30-hour Construction Training

5. OSHA Competent Person for Trenching and Excavation
6. OSHA Competent Person for Fall Protection

C. Health and Safety Officer Responsibilities:
   1. Obligated to stop or start the work when it is necessary or advisable for reasons of health or safety.
   2. Conduct health and safety training sessions and ensuring that personnel not successfully completing the required training are not permitted to enter the Work Site to perform work in the Exclusion Zone or Contaminant Reduction Zone.
   3. Implementation and daily enforcement and monitoring of the HASP.
   4. Be on the Work Site during the execution of work at the Work Site and be under the direction of CONTRACTOR's Corporate Safety and Health Manager.
   5. Verify that all on-site personnel are made aware of the provisions of the HASP and have been informed of the nature of physical and/or chemical hazards associated with the Work Site's activities.
   6. Ensure that JSA forms have been developed for all Project tasks and that Project personnel have been trained in all JSAs.
   7. Maintain a daily log of all significant health and safety activities and incidents.
   8. Verify that on-site personnel and visitors have received the required training, including instructions for safety equipment and PPE use.
   9. Suspend work if health and/or safety-related concerns arise.
   10. Provide on-site technical assistance.
   11. Conduct the Work Site and personal air monitoring program, including all required real-time air monitoring and equipment maintenance and calibration. Submit collected samples to an AIHA accredited laboratory.
   12. Issue/obtain required work permits.
   13. Conduct Work Site safety orientation training and daily safety meetings.
   14. Maintain the Exclusion Zones, Contaminant Reduction Zone, and Support Zones.
   15. Coordinate emergency procedures.
   16. Conduct on-site personnel safety indoctrination sessions for potential hazards, personal hygiene principles, confined space entry procedures, all other standard operating procedures, safety equipment usage, emergency procedures, and location of first aid kits and identification of personnel trained in first aid and CPR.
   17. Supervise and inspect equipment cleaning.
   18. Maintain the on-site Hazard Communication Program including copies of all SDS.
   19. Verify that on-site personnel have received the required physical examinations and medical certifications.
   20. Review Work Site activities with respect to the adequacy of the HASP.
   21. Maintain required health and safety documents and records on the Work Site.

D. Employ and assign to the Works a competent and authorized representative, herein referred to as the "Corporate Safety and Health Manager".

E. Corporate Safety and Health Manager Responsibilities:
   1. Oversee operations as necessary to ensure the Works is performed in accordance with the HASP.
   2. Oversee and be present during health and safety training sessions and, as a minimum, complete qualitative respirator fit testing.
   3. Oversee the HSO's activities on a part-time basis.
   4. Be available on an as-needed basis for emergency situations.

1.8 PERSONNEL HEALTH, SAFETY, AND HYGIENE

A. Medical Surveillance: Conduct medical surveillance of personnel as required by 29 CFR 1910.120, 29 CFR 1926.65, and 29 CFR 1910.134.

B. Training: Furnish personnel assigned to or entering the Work Site who have successfully completed training required by the applicable OSHA Standards in 29 CFR 1910 and 29 CFR 1926 and specifically with 29 CFR 1910.120 and 1926.65.

C. Levels of Protection: Establish actual levels of protection for each work area based on planned activity and location of activity. The anticipated levels of personal protection based on work activity are as follows:

Work Activity	*Anticipated Level of Personal Protection*
Mobilization and demobilization to and from the Work Site, including Work Site preparation/setup and Work Site restoration	Level D
Work Site clearing	Level D
Construction of access roads	Level D
Installation of temporary facilities and controls	Level D
Operation and Maintenance of Water Treatment Facility	Level D
Construction of Dewatering System	Level D, Modified Level D
Dewatering and water handling	Modified Level D
Excavation and stockpiling excavated materials	Level D and Modified Level D
Excavation and on-site transportation of excavated materials	Level C and Modified Level D
Solidification of excavated materials	Level C, Modified Level D
Collection, storage, and disposal of water from excavations and the decontamination area	Level C, Modified Level D
Backfilling	Level D, Modified Level D
Equipment decontamination	Level C, Modified Level D
Restoration of work areas	Level D, Modified Level D

D. PPE:
   1. Furnish on-site CONTRACTOR personnel with appropriate PPE. Clean and maintain safety equipment and protective clothing. As a minimum, each worker on the Work Site shall wear a hard hat, safety glasses with side shields, safety boots with steel toes and shank, and full-length pants.
   2. Develop PPE usage procedures and enforce strict compliance with such procedures by on-site personnel. Include the following procedures as a minimum:
      a. Do not permit prescription eyeglasses to be worn that are not safety glasses. Do not permit contact lenses to be worn within the Exclusion Zone or Contaminant Reduction Zone.
      b. Change respirator cartridges/filters daily during periods of respirator usage or prior to breakthrough, whichever occurs first.

3. Do not permit footwear to be worn that is not safety-toed shoes or boots.
4. Dispose of or decontaminate PPE worn on the Work Site at break time and at the end of the work day.
5. Decontaminate reusable PPE before reissuing.
6. If air monitoring indicates respirator use is required, do not permit on-site personnel who have not passed a respirator fit test to enter the Exclusion Zone or Contaminant Reduction Zone. Do not permit personnel to wear a respirator if they have facial hair that interferes with a proper fit of the respirator.

E. Respiratory Protection:
1. Furnish on-site personnel with extensive training in the usage and limitations of, and qualitative fit testing for, air purifying and supplied-air respirators in accordance with 29 CFR 1910.134 for confined space entry, or any work requiring Level C or higher protection.
2. Develop, implement, and maintain a written respiratory program in accordance with 29 CFR 1910.134.
3. Monitor, evaluate, and provide respiratory protection for on-site personnel.
4. Immediately notify ENGINEER when level of respiratory protection required increases from Level D to Level C or from Level C to Level B.
5. Be responsible for appropriate respiratory protection during work activities. Do not allow persons to enter the Exclusion Zone or Contaminant Reduction Zone without appropriate respiratory protection.
6. Be responsible for assessing the ability for on-site personnel to wear respiratory protection. Cardiopulmonary system examination and pulmonary function testing are minimum requirements for personnel wearing respiratory protection.
7. Do not permit on-site personnel unable to pass a respirator fit test to wear respiratory protection and to enter the Exclusion Zone or Contaminant Reduction Zone.
8. The following respiratory action levels have been established to be measured within the breathing zone:

Action Level	*Action Taken*
No Visible Dust	Initiate/continue work
Visible Dust	Notify ENGINEER and implement additional engineering controls, as needed
Lower Explosive Limit (LEL) ≥10 percent	Shutdown activities, move to a safe area, notify ENGINEER. Do not continue working until conditions are constantly below 10 percent LEL
<19.5 percent or >23.5 percent LEL	When oxygen levels are outside this range, percent LEL readings are not reliable. Shutdown activities, move to a safe area, notify ENGINEER. Do not continue working until oxygen levels are between 19.5 and 23.5 percent LEL

F. Heat Stress: Implement a heat stress monitoring program as applicable and include CONTRACTOR's Work Site-specific program in the HASP.

G. Personnel Hygiene and Personnel Decontamination Procedures:
   1. Provide, as a minimum, the following:
      a. Suitable disposable and reusable PPE on a daily basis for the use of CONTRACTOR's on-site personnel.
      b. Suitable containers for storage and disposal of used disposable PPE.
      c. Potable water and a suitable sanitation facility.

H. Emergency and First aid Equipment:
   1. Locate and maintain emergency and first aid equipment in appropriate on-site location, including:
      a. First aid kit containing medications appropriate for the initial treatment of burns, abrasions, fractures, and ingestion or dermal contact with on-site hazardous waste. Size first aid kit in accordance with the potential maximum number of on-site personnel.
      b. Portable emergency eye wash and shower capable of providing adequate irrigation for 15 uninterrupted minutes.
      c. Two 20-pound ABC type dry chemical fire extinguishers.
      d. Blankets and towels.
      e. Stretcher.
      f. One hand-held emergency siren (air horn) for each work area.
      g. A windsock(s) visible from all work areas.
   2. As a minimum, provide one certified first aid and CPR technician on the Work Site at all times that on-site work activities are in progress. This technician may perform other duties but shall be immediately available to render first aid when needed.

I. Work Site Communications:
   1. Post emergency numbers in office trailer.
   2. Ensure that personnel work under the use of a "buddy" system and develop a hand signal system appropriate for the Work Site activities.
   3. Provide an employee alarm system to notify employees of on-site emergency situations or to stop work activities if necessary.
   4. Furnish selected personnel with two-way radios.

J. Work Site-specific Training: Prior to commencement of Works, conduct an initial training session for all personnel who will be employed at the Work Site. Provide instructions on topics that may include the following:
   1. Operational Discipline.
   2. Hazard Identification Tool usage.
   3. Stop Work Authority.
   4. Operational Excellence Processes.
   5. Personnel responsibilities.
   6. Content and implementation of the HASP.
   7. Work Site hazards and controls.
   8. Work Site-specific hazardous procedures.
   9. Training requirements.
   10. PPE requirements.
   11. Emergency information, including local emergency response team phone numbers, route to nearest hospital, incident reporting procedures, and emergency response procedures.
   12. Instruction in the completion of required inspections and forms.
   13. Location of safety equipment, such as portable eyewash, first aid kit, fire extinguishers.

K. Behavioral Based Safety (BBS) Training: Provide BBS training for each employee on their

specific tasks or duties.

L. Tailgate Safety Meetings: Conduct mandatory daily tailgate safety meetings for on-site personnel in the morning to discuss safety issues recapped from the day before, review of JSAs for the work activities for the current day as well as health and safety issues for the current day, to address questions that may have arisen in the workforce, and additionally as required by special or work-related conditions. Include refresher training for existing equipment and protocols, review ongoing safety issues and protocols, and examine new Work Site conditions as they are encountered. Hold additional safety meetings on an as needed basis.

1.9 AIR MONITORING

A. Develop an air monitoring program meeting the requirements of 29 CFR 1910.120 (h) and 29 CFR 1926.65 (h). Implement all aspects of the air monitoring program that is presented in the HASP that has been provided.

B. Provide the required instruments for air monitoring including, as a minimum:
   1. PID equipped with a 10.6 eV lamp.
   2. MIE PDM DataRam, or equivalent.
   3. MiniRae capable of monitoring oxygen, combustible gas, and carbon monoxide.

C. Calibrate air monitoring equipment on a daily basis in accordance with manufacturer's guidelines. Record calibrations in the Work Site daily logbook.

D. Furnish a wind speed and direction indicator capable of providing a permanent record, placed at an unobstructed on-site location above the elevation of the work area, clearly visible to affected workers.

E. Dust Suppression Program:
   1. Implement dust suppression program at the Work Site during ground invasive activities or during other activities which may potentially create an airborne hazard.
   2. If excessive dust is observed leaving the work area, as determined by ENGINEER, implement additional dust suppression techniques.

F. Reporting:
   1. Report the results of air monitoring programs to ENGINEER daily. Include the following information as applicable:
      a. Work Site location and date.
      b. Work process and operation name.
      c. Temperature, wind speed, and wind direction.
      d. Area sampling location diagram.
      e. Field notes, including the following:
         1) Description of operations and complaints and symptoms.
         2) Chemicals, materials, and equipment in use.
         3) Engineering and administration controls in effect.
         4) PPE in use.
         5) Sampling observations and comments.
   2. Record all daily air monitoring activities in a hard cover log book which shall be maintained on the Work Site at all times by the HSO.

1.10 CONTINGENCY AND EMERGENCY RESPONSE PLANS

A. Comply with 29 CFR 1910.120 (l) and 20 CFR 1926.65 (l).

B. Include and address the following emergency situations and responses, as a minimum:
   1. In the event of injury to on-site personnel or contact with hazardous materials requiring immediate medical attention, implement the following protocol:
      a. Notify ENGINEER and the HSO.
      b. Phone the hospital previously identified to be closest to the Work Site and describe the injury.
      c. Decontaminate personnel and administer appropriate first aid.
      d. Transport personnel to the specified hospital along the most direct route which shall be predefined prior to commencing work on the Work Site.
   2. In the event that a release of a hazardous waste occurs on the Work Site beyond the limit of working areas, implement the protocols presented in the HASP. As a minimum, the response action shall consist of:
      a. Notifying TCEQ and, if the release qualifies under 40 CFR Part 302 (Designation, Reportable Quantities and Notification), the NRC.
      b. Performing material containment actions.
      c. Performing air monitoring, as appropriate.
      d. Performing required decontamination and/or disposal activities.
      e. Creating an Incident Report, which will, as a minimum, discuss the incident and the response actions taken, present the findings from the investigation of the incident, and present protocols to prevent a reoccurrence of the situation.
   3. In the event that excessive gases or vapors are detected at a work area, take the following actions:
      a. Evacuate workers to an area upwind of the affected area.
      b. Identify the contaminant and monitor contaminant concentrations to determine the type of respiratory protection and/or engineering controls required before workers re-enter the area.
   4. In the event of a fire at a work area, quickly use fire extinguishers and/or earth moving equipment to smother the fire if possible and, if the presence of noxious gases or degree of hazard prohibits this, employ proper evacuation procedures. Notify the appropriate public safety authorities, whose representatives will assume responsibility for coordinating with ENGINEER and the HSO for the proper emergency response strategy upon arrival.
   5. In the highly unlikely event of a major leak of toxic gas, evacuate on-site personnel to a safe distance, and notify the appropriate public safety authorities and local hospital if deemed necessary by ENGINEER and the HSO, and representatives of such public safety authorities will assume responsibility for coordinating with ENGINEER and the HSO for the proper emergency response strategy upon arrival.

C. Off-Site Contingency and Emergency Response Plan:
   1. Prior to commencing work involving the off-site transportation of soils and waste materials, CONTRACTOR shall develop a written emergency response plan that identifies the emergency response actions that will be implemented involving a spill or release of waste material (i.e., vehicle rollover, equipment failure or leakage) from a truck that is in transit to a disposal facility. The Contractor's Emergency Response Plan will identify the designated truck routes that will be used for driving to the disposal facility, a requirement to communicate these designated truck routes to all drivers to ensure that they stay on the designated routes and will also identify the name of the firm(s) and phone number(s) who have been contracted with to provide emergency response services. CONTRACTOR shall have agreements in place with these firms

that will require them to respond to the scene of any emergency within a 4-hour time frame.

2. The plan will address actions to be taken if a release of material from a transport vehicle occurs while in transit, which may include:
   a. Immediately notify CONTRACTOR, who will in turn notify ENGINEER and ENGINEER will notify applicable authorities.
   b. Take immediate measures within the capabilities of the transport driver to control the release, if necessary.
   c. Contain and eliminate the release, if possible.
   d. The driver must remain within a safe distance of the vehicle, and will keep unnecessary people away, isolate the area of the release, and deny entry to unauthorized personnel.
   e. Stay upwind, keeping out of low areas, and do not allow contact with the related material.
   f. Contact the appropriate local authorities (police, fire department, traffic control) and local hazardous materials response units.
   g. Other actions, as advised by the spill response team.
3. In the event of an accident involving transport vehicles, follow the procedures outlined in CONTRACTOR's Emergency Response Plan and comply with the requirements of 49 CFR 171 Subpart B, 49 CFR 172, Subpart G, and 49 CFR 390.15 Subpart E.

1.11 WORK SITE CONTROL

A. Comply with 29 CFR 1910.120 (d) and 20 CFR 1926.65 (d).

B. Slip, Trip, and Fall Hazards: Maintain good housekeeping at the Work Site for the duration of the Works. Remove, mark, or guard trip hazards. Use extreme caution when working on or around slippery surfaces. Take necessary precautions to protect personnel from injuries caused by slick surfaces.

C. Fall Protection: Using guard rail systems or personal fall arrest systems to protect walking or working horizontal and vertical surfaces at the Work Site with an unprotected side or edge that is 6 feet or more above a lower level such as found at the edge of excavations. Comply with 29 CFR 1926.502.

D. Confined Space Entry Program: Comply with 29 CFR 1910.146. Confined space workers and attendants shall wear and use fall arrest equipment according to manufacturer's instructions when there is a risk of falling:
   1. Six feet.
   2. Into operating machinery.
   3. Into water or another liquid.
   4. Onto a hazardous substance or object.
   5. Through an opening on a work surface.

E. Work Areas: Clearly layout and identify work areas in the field and limit equipment, operations, and personnel in the areas as defined below. Establish work areas as temporary or permanent, depending on the work activity and the sequence in which it is performed. These areas are:
   1. Exclusion Zone: Includes areas where hazardous or potentially impacted soils, debris, and other materials are being excavated contacted, disturbed, or handled (e.g., soil stabilization) and areas where contaminated equipment or personnel travel. Establish temporary Exclusion Zones around remote work areas beyond the limits of

the Exclusion Zone; clearly delineate temporary Exclusion Zones with temporary fencing and warning signs.

2. Contaminant Reduction Zone: Occurs at the interface of the Exclusion Zone and Clean Zone and provides for the prevailing upwind transfer of construction materials from the Clean Zone to the Work Site-dedicated equipment, the decontamination of equipment and vehicles prior to entering the Clean Zone from the Exclusion Zone, the decontamination of personnel and clothing prior to entering the Clean Zone from the Exclusion Zone, and the physical segregation of Clean and Exclusion Zones. An additional Contaminant Reduction Zone will be located on the decontamination wash pad.
3. Clean Zone: Defined as a clearly delineated predominantly upwind area outside the Exclusion Zone(s) and Contaminant Reduction Zone(s), which functions include:
    a. An entry area for personnel, material, and equipment to the Contaminant Reduction Zone.
    b. An exit area for decontaminated personnel, material, and equipment from the Contaminant Reduction Zone.
    c. A storage area for clean safety and work equipment.

F. Particulate Emission Control Program: Prior to commencing the Works, submit a Particulate Emission Control Program for approval. During work activities, implement and enforce this program to minimize the generation and migration of dust, fly ash, cement kiln dust and/or lime on and off the Work Site from waste material solidification operations. The Particulate Emission Control Program is in addition to the Dust Suppression Program.

G. Contaminant Migration Control: Take appropriate measures to prevent contaminant tracking on and off the Work Site. Decontaminate all vehicles including transport vehicles, equipment, and workers leaving areas of potential contamination prior to entry into Clean Zones. Locate decontamination facilities and sequence work activities to prevent contaminant tracking.

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. References
2. Quality control.
3. Tolerances.
4. Requirements for references.
5. Inspecting and testing services.
6. Manufacturers' field services and reports.

1.2 REFERENCES

A. Reference Standards:
1. Section 01 40 00 - Quality Requirements: Requirements for references.
2. ASTM International:
a. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
b. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
c. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing.

1.3 QUALITY CONTROL

A. Monitor quality control over Suppliers, products, services, the Work Site conditions, and workmanship, to produce Works of specified quality.

B. Comply with manufacturers' instructions, including each step-in sequence.

C. Should manufacturers' instructions conflict with the Contract Documents, request clarification from ENGINEER before proceeding.

D. Comply with specified standards as minimum quality for the Works except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform work by persons qualified to produce workmanship of specified quality. Use persons licensed to perform the Works where required by these Specifications or laws and regulations.

F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

G. Materials furnished and finished, or intermediate stages of the Works shall be sampled, tested, and inspected as specified in individual Sections and as required by reference standards.

1.4 TOLERANCES

A. Monitor tolerance control of installed products to produce acceptable Works. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with the Contract Documents, request clarification from ENGINEER before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.5 REQUIREMENTS FOR REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified by an individual Section or are required by applicable laws and regulations.

B. Conform to reference standard by date of issue current as of bid closing date, except where a specific date is established by Laws or Regulations or by an individual Section.

C. Specific provisions of laws or regulations may be referenced in these Specifications to assist CONTRACTOR and identify options selected by ENGINEER. Such references do not relieve CONTRACTOR from compliance with other applicable provisions of Laws or Regulations not specifically referenced.

D. No inference or provision of any reference document including, but not limited to any standard specification, manual, or code shall be effective to change the relationships, duties, and responsibilities of PERFORMING PARTIES, CONTRACTOR, or ENGINEER from those set forth in the Contract Documents, nor shall it be effective to assign to PERFORMING PARTIES or ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Works or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract.

E. Publications referred to in these Specifications form part of the Specifications to the extent specified in individual Sections.

F. In case of conflict or discrepancy between a reference standard and the Project Specifications or with another reference standard, the more stringent requirements shall apply.

G. Should specified reference standards conflict with the Contract Documents, request clarification from ENGINEER before proceeding.

1.6 INSPECTING AND TESTING SERVICES

A. CONTRACTOR shall employ and pay for services of an independent testing laboratory to perform inspecting and testing services as specified in individual Sections.

B. Employment of testing laboratory and services performed by such testing laboratory in no way relieves CONTRACTOR of obligation to perform the Works in accordance with requirements of the Contract Documents.

C. Quality Assurance:
   1. Comply with requirements of the reference standards listed in PART 1, References.
   2. Comply with agencies listed in individual Sections.
   3. Inspecting Company and Testing Laboratory: Authorized to operate in the state in which the Work Site is located.
   4. Inspecting Company and Testing Laboratory Staff: Maintain a full-time specialist on staff to review services.
   5. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to either the National Institute of Standards or Technology or accepted values of natural physical constants.

D. CONTRACTOR Submittals:
   1. Prior to start of the Works, submit independent testing laboratory name(s), address, and telephone number, and names of full-time specialist and responsible officer at the laboratory.
   2. Submit copy of report of testing laboratory facilities inspection made by the Materials Reference Laboratory of the National Institute of Standards and Technology during most recent inspection, with memorandum of remedies of deficiencies reported by the inspection.

E. Testing Laboratory Responsibilities:
   1. Test samples of mixes and materials submitted by CONTRACTOR.
   2. Provide qualified personnel at the Work Site. Cooperate with ENGINEER and CONTRACTOR in performance of services.
   3. Perform specified inspecting, sampling, and testing of products and methods of construction in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of the Contract Documents.
   5. Promptly notify ENGINEER and CONTRACTOR of observed irregularities, deficiencies, or non-conformance of products.
   6. Perform additional inspection and tests required by ENGINEER.
   7. Attend pre-construction meetings and progress meetings, as required.

F. Testing Laboratory Reports:
   1. After each inspection and test promptly submit two copies of reports to ENGINEER and CONTRACTOR. Submit draft on-site inspection report prior to leaving the Work Site.
   2. As a minimum, reports shall include:
      a. Date issued.
      b. Project title and number.
      c. Name and address of testing laboratory.
      d. Name of inspector.
      e. Date and time of sampling or inspection.
      f. Identification of product and related specification Section.
      g. Location in the Project.

h. Record of temperature and weather.
i. Type of inspection or test.
j. Date of test.
k. Results of tests and observations.
l. Conformance with the Contract Documents.

3. When requested by ENGINEER, provide interpretation of test results.

G. Limits on Testing Laboratory Authority:
1. Testing laboratory may not release, revoke, alter, or enlarge upon requirements of the Contract Documents.
2. Testing laboratory may not approve or accept any portion of the Works.
3. Testing laboratory may not assume or perform any duties of CONTRACTOR.
4. Testing laboratory has no authority to stop the Works.

H. CONTRACTOR Responsibilities:
1. Deliver to testing laboratory at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs for concrete, and other material mixes that require testing.
2. Cooperate with personnel of independent testing laboratory and provide safe access to the Works and to manufacturer's operations.
3. Provide incidental labor and facilities:
a. To provide access to the Works to be tested.
b. To obtain and handle samples at the Work Site or at source of products to be tested.
c. To facilitate tests and inspections.
d. For testing laboratory's exclusive use for storage and curing of test samples.
e. Forms for preparing concrete test beams and cylinders.
4. Notify ENGINEER and testing laboratory 24 hours prior to expected time for operations requiring inspecting and testing services to allow for assignment of personnel and scheduling of tests.
5. Furnish copies of product test reports.
6. Promptly notify ENGINEER of all observed irregularities or non-conformance of the Works.
7. Retesting required because of CONTRACTOR negligence or non-conformance to specified requirements shall be performed by the same testing laboratory on instructions by ENGINEER at CONTRACTOR's expense and at no additional cost to PERFORMING PARTIES.
8. If defects or deficiencies are revealed during testing or inspecting, correct such defects and deficiencies and retest affected portions of the Works.

1.7 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual Sections, require Suppliers to provide qualified personnel to observe the Work Site conditions, conditions of surfaces and installation, quality of workmanship, and to initiate instructions when necessary.

B. Submit qualifications of observer to ENGINEER.

C. Report observations and the Work Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

D. Submit report on same day as the Work Site visit to ENGINEER for information.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Temporary Utilities:
a. Electricity.
b. Water service.
c. Telephone service.
d. Internet service.
e. Portable radios.
f. Construction lighting.
g. Temporary cooling.
h. Fire protection.
2. Construction Facilities:
a. ENGINEER's field office.
b. Agencies field office.
c. CONTRACTOR's field office and sheds.
d. Equipment Decontamination Facility.
e. Personnel Hygiene/Decontamination Facility.
f. Emergency First-aid Facility.
g. Sanitary facilities.
h. Storage/stockpiling facilities.
i. Staging and stabilization pads.
j. Water storage tanks.
3. Vehicular Access and Parking:
a. Access roads.
b. Parking.
c. Traffic regulation.
4. Temporary Barriers and Enclosures:
a. Barriers.
b. Fencing.
c. Security.
5. Temporary Controls:
a. Water control.
b. Dewatering.
c. Erosion and sediment control.
d. Equipment decontamination.
e. Oil boom.
6. Project identification.
7. Removal of temporary facilities and controls.

1.2 REFERENCES

A. Reference Standards:

1. Section 01 40 00 - Quality Requirements: Requirements for references.
2. ASTM International:
   a. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   b. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
3. National Fire Protection Association:
   a. NFPA 10 - Standard for Portable Fire Extinguishers.
   b. NFPA 70 - National Electrical Code.
4. Occupational Safety and Health Administration, an agency of the United States Department of Labor, Occupational Safety and Health Standards and Safety and Health Regulations - Code of Federal Regulations:
   a. 29 CFR 1910.141 - Sanitation.
   b. 29 CFR 1910.157 - Portable Fire Extinguishers.
   c. 40 CFR 761.79 - Decontamination standards and procedures.

1.3 TEMPORARY UTILITIES

A. Electricity:
   1. Provide, maintain, and pay for power service required for performance of the Works.
   2. Provide power outlets for construction operations, with branch wiring and distribution boxes located as necessary. Provide flexible power cords as necessary.
   3. Provide main service disconnect and overcurrent protection at convenient locations.
   4. Route temporary utility lines along alignments approved by ENGINEER. Take necessary precautions to prevent service interruptions due to accidental breakage of utility lines. Coordinate installation with local utility company and comply with laws and regulations and NFPA 70.

B. Water Service:
   1. Provide, maintain, and pay for suitable quality water service required for performance of the Works.
   2. Extend branch piping with outlets located so that water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.
   3. Provide and maintain on the Work Site a potable water storage tank(s) with a minimum live capacity of 5,000 gallons and all pipes, hoses, and fittings to adapt to the water supply and to transfer water to work locations. Protect equipment from freezing. Provide an operating flow control valve in-line near work locations to reduce waste of potable water.
   4. Do not use water storage tanks to store or haul potable water.
   5. Potable water tanks shall be clean and contaminant free inside and outside.

C. Telephone Service:
   1. Provide, maintain, and pay for telephone service and equipment including a minimum of one telephone unit and answering service to CONTRACTOR's field office at time of mobilization to the Work Site.
   2. Provide, maintain, and pay for separate telephone service and equipment including one telephone unit and one answering machine to agencies field office at time of mobilization to the Work Site. Agencies will pay for own long-distance charges.
   3. Post emergency numbers including police, fire, ambulance, hospital, poison control center, and appropriate regulatory agencies in prominent location near each telephone.

D. Internet Service:
   1. Provide, maintain, and pay for Internet service for ENGINEER's field office, agencies field office, and CONTRACTOR's field office.

E. Portable Radios:
   1. Provide and maintain for ENGINEER's exclusive use, three two-way portable radios for Work Site communications, capable of clearly transmitting and receiving communications over a radius at time of mobilization to the Work Site.
   2. Radio Frequencies: Same as those set for radios used by CONTRACTOR.
   3. Equip at least the following key CONTRACTOR personnel with two-way portable radios:
      a. Superintendent.
      b. Health and Safety Officer.
      c. Security personnel.
      d. Each crew foreman.

F. Construction Lighting:
   1. Provide and maintain lighting for construction operations for any work done after daylight hours.
   2. Provide and maintain a minimum of 1 watt/sq ft lighting to exterior staging and storage areas exterior office area exterior decontamination areas after dark for security purposes.
   3. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as necessary.
   4. Maintain lighting and make routine repairs.

G. Fire Protection:
   1. Take precautions to prevent fires. Provide and maintain temporary fire protection equipment of a type appropriate to the hazard anticipated in accordance with applicable laws and regulations and to the satisfaction of ENGINEER and insurance authorities.
   2. Bulk storage of flammable liquids and other hazardous materials is not allowed on Work Site. Handle flammable liquids in approved containers.
   3. Open burning of rubbish is not permitted on Work Site.
   4. Deliver, use, and dispose of flammable materials as required by authorities having jurisdiction.
   5. Designate an area on Work Site where smoking is permitted.
   6. Establish a fire watch for cutting and welding and other hazardous operations capable of starting fires. Maintain the fire watch before, during, and for a minimum of 30 minutes after hazardous operations or until threat of fire does not exist, whichever is longer.
   7. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A-60B; C UL rating.
   8. Provide a minimum of one fire extinguisher in every construction trailer and storage shed.
   9. Use fireproofed tarpaulins.
   10. Include on-site fire protection specified in CONTRACTOR's Work Site-specific Health and Safety Plan.

1.4 CONSTRUCTION FACILITIES

A. ENGINEER's Field Office:
   1. Following issuance of the Notice to Proceed, provide structurally sound, completely weathertight and insulated office trailer acceptable to ENGINEER, which is specifically designed for this type of use and conforms to the requirements specified; minimum floor

area 200 sq ft, minimum 10 feet wide, complete with minimum 50 percent opening windows with minimum total area of 10 percent floor area per room with operable sash and screen, interior lighting of 50-foot candles at desktop height and exterior light at entrances, electrical wall outlets that are accessible from 6 feet along any point, 1 lockable door with new lock and two keys and screens, heating and cooling equipment to maintain ambient temperature of 68 to 72 degrees F, new interior finish, resilient floor covering in first class condition, and exterior finish, all acceptable to ENGINEER. Provide 4 feet minimum width clean gravel or boardwalk landings and sidewalks for complete access to field office.

2. Minimum Furnishings: five-drawer desk, shelf, three-drawer lockable filing cabinet, one coat rack, one swivel armchair, three side chairs, one waste basket, one tack board, two-door storage cabinet, one bookcase with shelving minimum 48 inches by 48 inches, drafting table with built-in drawer, drafting stool and light, and minimum one 20-pound ABC type dry chemical fire extinguishers, one five-person first aid kit.
3. Provide and maintain suitable bottled chilled drinking water service.
4. Provide and maintain a photocopier. ENGINEER will supply own paper.
5. Provide and maintain telephone and Internet service as specified in PART 1, TEMPORARY UTILITIES.
6. Provide and maintain private washroom facilities adjacent to the field office complete with flush or chemical type toilet, lavatory, and mirror.
7. Locate the field office where shown on the Drawings or as directed by ENGINEER.
8. Maintain the office and services continuously. Clean not less than once per week. Provide soap, paper towels, cleansers, and janitorial service and implements.
9. Repair immediately any damage, leaks, or defective service.
10. Exchange walk-off mats weekly at all entrances.

B. CONTRACTOR's Field Office and Sheds:
   1. Provide CONTRACTOR's field office with the minimum facilities specified. Provide all required storage and work sheds.
   2. Field Office and Furnishings:
      a. As required by CONTRACTOR and with sufficient room for Project meetings.
      b. Include conference table and chairs sufficient for 12 persons.
      c. Telephone service.
      d. Light and temperature as specified under ENGINEER's field office.
      e. Six hard hats for visitors' use.
      f. Exterior identifying sign.
      g. Other furnishings at CONTRACTOR's option.
   3. Remove field office and sheds upon completion unless otherwise approved by ENGINEER.

C. Equipment Decontamination Facility:
   1. Prior to commencing work involving equipment contact with potentially impacted materials, construct an equipment decontamination pad in accordance with the details shown on the Drawings.
   2. Provide, operate, and maintain suitable portable, high-pressure, low-volume decontamination wash unit(s) equipped with self-contained water storage tank and pressurizing system and capable of heating and maintaining wash waters to 180 degrees F and providing a nozzle pressure of 150 psi.
   3. Provide, operate, and maintain necessary equipment, pumps, and piping required to collect and contain equipment decontamination water and sediment and transfer same to approved storage facilities.

D. Emergency First-aid Facility: Comply with Section 01 35 29.

E. Sanitary Facilities:
   1. Provide and maintain required temporary sanitary facilities.
   2. Remove and dispose of sanitary wastes off site on a periodic basis as required and in accordance with applicable laws and regulations.
   3. Provide portable toilets in compliance with 29 CFR 1926.51(c) at a minimum.

F. Storage/Stockpiling Facilities:
   1. Provide, maintain, and operate storage/stockpiling facilities to details shown on the Drawings.

G. Staging and Solidification Pads:
   1. Provide, maintain, and operate staging and solidification pads to details shown on the Drawings.
   2. Provide and maintain facility approved by ENGINEER to store and protect solidification additives.
      a. Equip the facility with tarps capable of covering the stockpiled material before and after solidification
      b. Implement procedures to mitigate any hazards/risk of explosion from explosive dust.
      c. Do not deliver or store solidification additives without obtaining prior approval.

H. Drums:
   1. Storage of Liquid Waste: DOT-approved 55-gallon steel drums, closable lids, complete with labels for marking contents and date filled.
   2. Storage of Solid Waste: DOT-approved 55-gallon steel drums, closable lids, complete with labels for marking contents and date filled.

I. Temporary Water Treatment System: Comply with Section 46 07 01.

1.5 VEHICULAR ACCESS AND PARKING

A. Access Roads:
   1. Existing Roads: Reasonable use of existing on-site roads for construction traffic is permitted subject to the following conditions:
      a. Improve existing roads as CONTRACTOR may require for performance of the Works.
      b. Comply with weight and load size restrictions where applicable and as shown on the Drawings.
      c. Tracked vehicles are not allowed on paved areas.
   2. Perimeter and interior roads shall be maintained to allow use by emergency vehicles in accordance with the Emergency Contingency Plan and as required by local, state, and federal emergency response officials.
   3. Temporary Roads:
      a. Obtain prior approval for location and extent of temporary roads.
      b. Construct temporary all-weather access roads from Work Site roadways to serve construction area of a width and load bearing capacity to provide unimpeded traffic for construction purposes as CONTRACTOR requires for performance of the Works.
      c. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.

d. Materials:
   1) Temporary Construction: CONTRACTOR's option.
e. Preparation: Clear areas, provide surface and storm drainage of road and adjacent areas.
f. Extend and relocate temporary roads as work progress requires. Provide detours as necessary for unimpeded traffic flow.
g. Provide unimpeded access for emergency vehicles. Maintain sufficient width and turning space.

4. Maintenance and Use:
   a. Maintain temporary access roads in a sound condition, properly graded, and free of ruts, washboard, potholes, ponding, ice, snow, mud, soft material, excavated material, construction equipment, and products. Maintain access roads throughout the construction period to ensure unimpeded access for passenger automobiles as well as construction vehicles.
   b. Remove mud from vehicle wheels before entering public roads.
   c. Prevent contamination of access roads. Immediately scrape up debris or material on access roads; transport and bring back to the Work Site. Clean access roads at least once per shift.
   d. ENGINEER may collect soil samples for chemical analyses from the traveling surfaces of constructed and existing access routes prior to, during, and upon completion of the Works. Excavate and dispose of soil impacted by CONTRACTOR's activities, and supply and place clean replacement soil materials, all at no additional cost to OWNER.
5. Removal and Repair:
   a. Remove temporary materials and construction at Substantial Completion.
   b. Remove underground work and compacted materials to full depth and grade the Work Site as specified.

B. Parking:
1. Construct temporary gravel surface parking areas to accommodate use of CONTRACTOR, OWNER, ENGINEER, Agencies, and visitors.
2. When Work Site space is not adequate, provide additional off-site parking.
3. Locate parking areas as shown on the Drawings or as directed by ENGINEER.
4. Do not allow tracked vehicles on pavement.
5. Maintain separate parking area for construction equipment.

1.6 TEMPORARY BARRIERS AND ENCLOSURES

A. Barriers:
1. Provide barriers to prevent unauthorized entry to construction, Work Site office, and on-site parking areas, and to protect adjacent properties from damage from CONTRACTOR's operations.
2. Provide protection for plant life and wetland areas designated to remain. Replace damaged plant life.
3. Protect vehicular traffic, stored materials, the Work Site, and structures from damage.

B. Fencing:
1. Construction: CONTRACTOR's option.
2. Enforce and require that workers and visitors observe and respect the limits marked with temporary fencing.

C. Security:
1. Initiate security program at time of mobilization to the Work Site.
2. Maintain security program throughout the construction period until demobilization from the Work Site.
3. Provide security and facilities to protect the Works and the Work Site from unauthorized entry, vandalism, and theft.
4. Restrict entrance of persons and vehicles into the Work Site.
5. Allow entrance only to authorized persons with proper identification.
6. Maintain log of workers and visitors and make available to ENGINEER on request. Include date, name, address, company employed by, company/person visited, time in and time out for each person, and record of deliveries and security incidents.
7. Do not allow cameras on the Work Site or photographs to be taken except by prior written approval of OWNER or ENGINEER.
8. If unauthorized personnel are observed on the Work Site, notify ENGINEER or OWNER and, if so directed, call upon the appropriate law enforcement officials for proper legal actions.
9. Require visitors to complete training in accordance with the Work Site-specific Health and Safety Plan prior to gaining access to the secured areas.
10. Check that the perimeter fencing and warning signs are secure and intact on a daily basis; if deterioration of Work Site security fence is observed, or if warning signs are found to be removed, bring the situation to the attention of ENGINEER and immediately rectify.
11. Keep access gate to the Work Site closed except for passage of authorized personnel and vehicles.
12. Provide competent individuals to respond to an emergency on the Work Site during non-working hours.

1.7 TEMPORARY CONTROLS

A. Water Control:
1. Maintain excavations free of water as necessary to perform the Works.
2. Protect the Work Site from puddling or running water. Grade the Work Site to drain by constructing shallow drainage swales in approved locations. Provide water barriers as necessary to protect the Work Site from soil erosion.
3. Prevent surface water runoff from leaving work areas. Run-on from non-impacted areas shall be diverted around active work areas using berms and ditches.
4. Do not discharge decontamination water, or surface water runoff, which may have come in contact with potentially impacted material off-site.
5. Prevent precipitation from infiltrating or from directly running off stockpiled waste materials. Cover stockpiled waste materials with an impermeable liner during periods of work stoppage including at the end of each working day and as directed by ENGINEER.
6. Install and maintain appropriate BMPs around the stockpile(s) of excavated material.
7. Direct surface waters that have not contacted potentially impacted materials to existing or new surface drainage systems.
8. Provide, operate, and maintain necessary equipment appropriately sized to keep excavations, stockpile, staging pads, and other work areas free from water.
9. Contain water from stockpiled waste materials. Transfer potentially impacted surface waters to water treatment system.
10. Have on hand sufficient pumping equipment, machinery, and tankage in good working condition for ordinary emergencies, including power outage, and competent workers for the operation of the pumping equipment.
11. Contain and collect water and transfer such collected water to the water treatment

system.

12. Wash water containing oils, grease, or other hazardous materials resulting from wash down of equipment or working areas shall not be discharged into the river or existing drainage features. All wash water must be transferred to the water treatment system for treatment.
13. Treat water in accordance with Section 46 07 01.

B. Dewatering:
1. Dewater the various parts of the Works including, without limitation, open excavations and work areas.

2. Employ construction methods, plant, procedures, and precautions that will ensure the Works, including excavations, are stable, free from disturbance, and dewatered to an extent to allow inspection and verification of excavation bottom.
3. Dewatering Methods: Includes sheeting and shoring; water control systems; surface or free water control systems employing ditches, diversions, drains, pipes and/or pumps; and any other measures necessary to enable the whole of the Works to be carried out in the dry.
4. Provide sufficient and appropriate labor, plant, and equipment necessary to keep the Works free of water including standby equipment necessary to ensure continuous operation of dewatering system.
5. Take precautions necessary to prevent uplift of any structure and protect excavations from flooding and damage due to surface runoff.
6. Comply with Section 31 23 19.

C. Erosion and Sediment Control:
1. CONTRACTOR is responsible for taking the appropriate preventative erosion control measures to ensure compliance with the Project regulatory permits and approvals.
2. Plan and execute construction by methods to control surface drainage from cuts and fills, from stockpiles, staging areas, and other work areas. Prevent erosion and sedimentation.
3. Minimize the amount of bare soil exposed at one time. Stabilize disturbed soils as quickly as practical. Strip vegetation, regrade, or otherwise develop in such a way as to minimize erosion. Remove accumulated sediment resulting from construction activity from adjoining surfaces, drainage systems, and water courses, and repair damage caused by soil erosion and sedimentation as directed by ENGINEER.
4. Provide and maintain temporary measures which may include, but are not limited to, silt fences, ditches, geotextiles, drains, berms, terracing, riprap, vegetative cover, and any other construction required to prevent erosion and migration of silt, mud, sediment, and other debris off the Work Site or to other areas of the Work Site where damage might result, or that might otherwise be required by applicable laws and regulations. Make sediment control measures available during construction. Place silt fences and/or hay or straw bales in ditches to prevent sediments from escaping from the ditch terminations.
5. Plan construction procedures to avoid damage to, or work or equipment encroachment onto water bodies or drainage ditch banks. In the event of damage, promptly take action to mitigate the effects of such damage. Restore affected bank or water body to its existing condition.
6. Construct fill areas by selective placement to avoid erosive surface silts or clays.
7. Do not disturb existing embankments or embankment protection except as shown on the Drawings.
8. Take all necessary measures to minimize the alteration or disturbance of existing vegetation outside defined work areas and access roads.

9. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
10. If soil and debris from the Work Site accumulate in low areas, roadways, ditches, or other areas where in ENGINEER's determination it is undesirable, remove the accumulation and restore the area to its original condition.
11. Comply with Section 01 57 13.

D. Equipment Decontamination:
1. Do not commence work involving equipment contact with potentially impacted material until the Equipment Decontamination Facility is operational.
2. Decontaminate equipment after working in potentially impacted work areas and prior to subsequent work or travel on clean areas.
3. Perform equipment decontamination on CONTRACTOR-constructed equipment decontamination pad.
4. As a minimum, perform the following steps during equipment decontamination for equipment that is being moved from impacted work areas to clean areas:
   a. Mechanically remove packed dirt, grit, and debris by scraping and brushing without the use of steam or high-pressure water to reduce the amount of water needed and to reduce the amount of impacted rinsate generated.
   b. Use high-pressure, low-volume, supplemented by detergents as appropriate and as approved by ENGINEER.
   c. Pay particular attention to tire treads, equipment tracks, springs, joints, sprockets, and undercarriages.
   d. Scrub surfaces with long handle scrub brushes and a cleaning agent.
   e. Rinse off and collect cleaning agent.
   f. Air dry equipment in the Clean Zone before removing from the Work Site or travel on clean areas.
   g. Perform an assessment as directed by ENGINEER to determine the effectiveness of the decontamination.
5. Any excavation and waste handling equipment that has contacted impacted soils and leaves the Work Site will initially be cleaned on a decontamination pad by mechanical means (e.g., scraped, brushed, and/or wiped) to remove gross contamination (e.g., packed dirt, grit, and/or debris). All equipment will require to be inspected prior to leaving an exclusion zone or the Work Site.
6. Maintain an inspection record on the Work Site which includes:
   a. Equipment descriptions with identification numbers or license plates.
   b. Time and date entering the decontamination facility.
   c. Time and date exiting the decontamination facility.
   d. Name of the inspector with comment stating that decontamination was performed and completed.
7. Each piece of equipment will be inspected after decontamination and prior to removal from the Work Site and/or travel on clean areas. ENGINEER will have right to require additional decontamination to be completed if deemed necessary.
8. Take appropriate measures necessary to minimize the drift of mist and spray during decontamination including the provision of wind screens.
9. Collect decontamination water and sediments which accumulate on the equipment decontamination pad. Transfer water to designated water treatment system.
10. Transfer sediments to waste staging area or drums as appropriate.
11. Furnish and equip personnel engaged in equipment decontamination with protective equipment including suitable disposable clothing, respiratory protection, and face shields.
12. Have on hand sufficient pumping equipment, of adequate pumping capacity and associated machinery and piping in good working condition for ordinary emergencies,

including power outage, and competent workers for the operation of the pumping equipment. Maintain piping and connections in good condition and leak-free.

E. Oil boom.
   1. Install non-absorbent oil boom outside double sheet pile wall cofferdam during installation and removal, as shown on Drawing C-04 and associated detail.

1.8 PROJECT IDENTIFICATION

A. Provide and install a Project identification sign.
   1. Project name.
   2. CONTRACTOR.

B. No other signs, except for those currently existing, are allowed without OWNER's prior written permission except those required by law.

1.9 REMOVAL OF TEMPORARY FACILITIES AND CONTROLS

A. Remove temporary utilities, equipment, facilities, and materials prior to Substantial Completion inspection.

B. Remove underground installations to full depth. Grade the Work Site as shown on the Drawings.

C. Clean and repair damage caused by installation of or use for temporary work.

D. Restore existing facilities used during construction to original and functional condition.

END OF SECTION

SECTION 01 57 13

TEMPORARY SOIL EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. References.

B. Sequencing and scheduling.

C. Pre-installation meeting.

D. Coordination

E. Quality assurance.

F. Progress submittals.

G. Qualifications.

H. Delivery, storage, and handling.

I. Temporary drainage swale.

J. Silt fence.

K. Examination.

L. Preparation.

M. Installation, monitoring, and maintenance.

N. Field quality control.

O. Protection.

P. Cleaning.

1.2 REFERENCES

A. Section 01 40 00 - Quality Requirements: Requirements for references.

B. ASTM International (ASTM):
   1. D6461 - Standard Specification for Silt Fence Materials.
   2. D6462 - Standard Practice for Silt Fence Installation.

C. Texas Department of Transportation (TxDOT) Standard Specification for Construction and Maintenance of Highways, Streets, and Bridges: Item 506 – Temporary Erosion, Sedimentation, and Environmental Controls, including appropriate requirements of the

Storm Water Pollution Prevention Plan (SWP3) and Texas Pollutant Discharge Elimination System (TPDES) General Permit TXR150000.

1.3 SEQUENCING AND SCHEDULING

A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.

B. Temporary erosion control measures as identified in the approved Soil Erosion and Sediment Control Plan shall be in place and functional prior to initiation of earth work activities.

1.4 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene prior to commencing work of this Section.

1.5 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Maintain soil erosion and sediment control features during and after installation.

1.6 QUALITY ASSURANCE

A. Perform work of this Section in accordance with the Storm Water Pollution Prevention Plan (SWP3).

B. CONTRACTOR shall be responsible for the design of any temporary measures required to by-pass the water flow around the work area. CONTRACTOR shall assess the risks of any high water flow events (storms, floods) that may affect the Works and assume the appropriate level of risk. CONTRACTOR is responsible to prepare and implement a contingency plan should any surface water enter and overwhelm the work area. At a minimum, during high water events CONTRACTOR shall remove all equipment from the work area and temporarily protect all exposed soil areas.

1.7 PROGRESS SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit product data for all manufactured products and materials.

C. Soil Erosion and Sediment Control Plan: Submit Soil Erosion and Sediment Control Plan indicating locations, design, and product names of design features.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Protect materials from chemicals, physical damage, direct sunlight, or other conditions or substances which may degrade the product.

C. When transported to the Work Site, handle material by appropriate means so that no damage is caused, as recommended by manufacturer.

D. Take adequate measures to keep material away from possible deteriorating sources (i.e., vandalism, theft).

E. Use appropriate handling equipment when moving material from one place to another.

F. Notify ENGINEER 3 days in advance of material delivery to the Work Site. Perform joint inspection with ENGINEER upon delivery. Defects or damage from shipping and handling will be grounds for rejection of a portion or the entire material at the discretion of ENGINEER.

PART 2 PRODUCTS

2.1 TEMPORARY DRAINAGE SWALE

A. Temporary drainage channel to direct runoff water.

2.2 SILT FENCE

A. An assembled, ready to install unit consisting of geotextile attached to drivable posts.

B. Geotextile: Uniform in texture and appearance with no defects, flaws, or tears that would affect its physical properties. Contain sufficient ultraviolet ray inhibitor and stabilizers to provide a minimum 2-year service life from outdoor exposure.

C. Net Backing: An industrial polypropylene mesh which is joined to the geotextile at both top and bottom with double stitching of heavy-duty cord

D. Width of Netting: Minimum of 2.5 feet.

E. Posts: Sharpened hard wood 1 inch square and protrude below the bottom of geotextile to allow a minimum of 2-foot embedment.

F. Post Spacing: Not to exceed 8 feet.

G. Securely fasten each post to the geotextile and net backing by staples suitable for such purpose.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify surface water drainage pattern to ensure proper locating of soil erosion and sediment control features.

C. Verify that surfaces and the Work Site conditions are ready to receive work.

3.2 PREPARATION

A. Preserve salient natural features, keep cut and fill operations to a minimum, and ensure conformity with topography so as to create the least erosion and to adequately handle the volume and velocity of surface water runoff.

B. Whenever feasible, retain, protect, and supplement natural vegetation.

C. Do not damage, degrade, or in any way cause harm to existing above-ground structure or appurtenance, below ground utility, pipe, conduit, cable, conductor, or structure.

D. Performance of temporary erosion control work does not relieve CONTRACTOR of his responsibility for preventing or minimizing the potential for erosion or siltation.

E. Clear and grub areas where soil erosion and sediment control features are to be placed.

3.3 INSTALLATION, MONITORING AND MAINTENANCE

A. Construct temporary erosion control items in reasonably close conformity with the typical sections and elevation controls shown on the Drawings and in accordance with Soil Erosion and Sediment Control Plan. Actual alignment and/or location of the various items as directed by ENGINEER. Install silt fence in accordance with ASTM D6462.

B. Do not construct temporary erosion control items in flowing streams or in swales where there is the possibility of a washout.

C. Check erosion and sediment control measures at frequency defined in the SWPPP and at minimum daily and immediately after each rainfall.

D. Temporary erosion control items may be removed at the beginning of the work day but replaced at the end of the work day.

E. Whenever sedimentation is caused by stripping vegetation, regrading, or other development,

remove it from all adjoining surfaces, drainage systems, and watercourses, and repair damage as quickly as possible.

F. Prior to or during construction, ENGINEER may require the installation or construction of improvements to prevent or correct temporary conditions on-site. Improvements may include berms, mulching, sediment traps, detention and retention basins, grading, planting, retaining walls, culverts, pipes guardrails, temporary roads, and other measures appropriate to the specific condition. All temporary improvements shall remain in place and in operation until otherwise directed by ENGINEER.

G. If fence fabric tears, starts to decompose, or in any way becomes ineffective, replace the affected portion immediately.

H. Unless otherwise shown on the Drawings, or directed by ENGINEER, remove all items upon completion of the Works once vegetation has stabilized. Spread accumulated sediments to form a suitable surface for seeding or dispose of, and shape the area to permit natural drainage; all to the satisfaction of ENGINEER. All materials once removed become the property of CONTRACTOR.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. ENGINEER will inspect all temporary erosion control items for proper placement and maintenance. All erosion control items shall be maintained in good working order. If any maintenance or repairs are to be made to any erosion control item, the work shall be initiated within 24 hours of inspection.

C. Inspect erosion control items as follows:
   1. Silt Fence: Depth of embedment, tears or holes, erosion around or under the fence, sagging or collapse.

D. Repairs ordered by ENGINEER caused by circumstances not under CONTRACTOR's control after acceptance will be compensated for at Contract rates or as extra work in the absence of comparable items of work. Material used in restoring any original temporary erosion control installation, after the original installations were accepted, will be measured, and added to the quantities originally installed.

E. If soil disturbance activities have been temporarily suspended (e.g., winter shut down) and temporary stabilization measures have been applied to all disturbed areas, the maintenance inspection activities will be temporarily stopped. Maintenance inspections will begin as soon as soil disturbance activities resume.

3.5 PROTECTION

A. Section 01 00 00 - General Requirements: Requirements for protection of installed work.

B. Check erosion and sediment control items for damage on a weekly basis. Repair any damage and restore the erosion and sediment control items functionality to the satisfaction of ENGINEER.

3.6 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean sediment and erosion control items of excessive sediment accumulation when necessary.

C. Remove sediment deposits when the level of deposition reaches approximately one-half the height of the barrier.

END OF SECTION

SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. References.
   2. Submittals.
   3. Regulatory requirements.
   4. Temporary Controls:
      a. Water quality monitoring.
      b. Dust and organic vapor control.
      c. Pollution control.
      d. Oil spill prevention and control.
   5. Construction equipment.
   6. Removal of temporary facilities and controls.

B. Related Requirements:
   1. Section 01 50 00 – Temporary Facilities and Controls.

1.2 REFERENCES

A. Abbreviations and Acronyms:
   1. BMPs: Best Management Practices.
   2. NOAA: National Oceanic and Atmospheric Administration.
   3. SDS: Safety Data Sheets.

B. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.
   2. EPA SWPPP Guide: Developing Your Stormwater Pollution Prevention Plan for Construction, EPA-833-R-06-004 May 2007.
   3. Texas Commission on Environmental Quality (TCEQ) Construction General Permit.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Submit a Storm Water Pollution Prevention Plan in accordance with EPA-833-R-06-004 and TCEQ SWPPP requirements. The plan shall be approved by ENGINEER and implemented prior to commencement of the Works.

C. Submit a Flood Contingency Plan.
   1. Include all necessary data related to actions to be taken in case of river elevation equals or exceeds 10 feet above NAVD88 at the San Jacinto River Gage in

Sheldon, Texas and the proposed measures to protect active work areas, remove stockpiled material from the flood area or backfill to stabilize open excavations, remove equipment and personnel from the flood area.
2. Identify material and equipment to be used to activate the plan.
3. Addresses emergency backfill capabilities such as availability of adequate fill material, type and availability of backfill equipment, and when emergency backfilling operations would be initiated during a high water period.

D. Submit a Hurricane and Severe Storm Plan. The Plan shall include, but not be limited to, the following:
1. What type of actions will be taken before storm strikes at the Work Site.
2. What weather conditions will require shutdown of the Works and removal of equipment and personnel.
3. Notes from continuous monitoring of NOAA marine weather broadcasts and other local commercial weather forecasts.
4. Equipment list with details on their ability to handle adverse weather conditions.
5. Methods which will be used to secure equipment left on-site during adverse weather conditions.
6. Evacuation or immediate reaction plans to be taken by personnel for sudden storm occurrences.
7. Operations procedures which will be used to secure critical equipment during adverse weather conditions.
8. Communications protocol with local law enforcement and fire and rescue agencies.

E. Submit a Water Quality Control Plan. At a minimum, the plan shall include the following information:
1. Methods and procedures of excavation and fill placement.
2. A description of contingency measures that will be implemented in the event water quality compliance criteria are exceeded during the performance of such activities.
3. A description of BMPs that will be implemented during shoreline construction activities to prevent adverse effects to water quality and to satisfy permit requirements and meet the Project goals.
   a. BMPs shall include a Work Site-specific Spill Prevention and Counter Measure or Pollution Control Plan that provides a Work Site plan; a spill containment plan; and measures to contain hazardous and non-hazardous materials.
   b. The spill containment control plan shall include the following information: notification procedures, specific cleanup and disposal instruction for different products, quick response containment and cleanup measures, proposed methods of disposal of spilled materials and employee training on spill containment.
4. The plan must be reviewed and approved by ENGINEER prior to the start of construction activity.

F. Submit a Water Quality Monitoring Plan in conformance with applicable requirements.

1.4 REGULATORY REQUIREMENTS

A. CONTRACTOR shall be fully familiar and comply with all applicable environmental acts, regulations and laws.

B. CONTRACTOR shall be responsible for water quality monitoring and environmental controls at the Work Site to ensure compliance with applicable Project requirements.

1.5 TEMPORARY CONTROLS

A. Water Quality Monitoring:
   1. CONTRACTOR is responsible for conducting water quality monitoring and for achieving water quality criteria throughout all construction activities as defined in the Field Sampling Plan (FSP), and applicable local, state and federal standards.
   2. If the results of the monitoring show that the water quality standards or Project performance standards are not being met, additional monitoring and mitigation action shall be taken.
   3. Any changes to the monitoring requirements must be approved in writing by ENGINEER.
   4. Excavation, stockpiling and filling activities shall be performed in a manner that does not adversely impact water quality.

B. Dust and Organic Vapor Control:
   1. Execute the Works by methods to minimize raising dust, odor, and organic vapor from construction operations.
   2. Implement and maintain dust, odor, and organic vapor control measures immediately during construction and in accordance with the State of Texas regulations and the action levels specified in the Air Monitoring Plan. Conduct and control activities to meet Work Site dust, odor, and organic vapor control limits as specified in the Air Monitoring Plan.
   3. Provide positive means to prevent airborne dust from dispersing into atmosphere. Use water from a source approved by ENGINEER for a water misting system for dust control.
   4. Do not use chemical means for a water misting system for dust control without ENGINEER's prior written approval.
   5. Do not apply vapor suppressing foam for odor and/or organic vapor control without ENGINEER's prior approval.
   6. As a minimum, use appropriate covers on trucks hauling fine, dusty, or vaporous material and use watertight vehicles to haul wet materials.
   7. Prevent dust and odor from becoming a nuisance to adjacent property owners or occupants.
   8. ENGINEER may stop work at any time when CONTRACTOR's control of dusts, odors, and organic vapor is inadequate for the wind conditions present at the Work Site, or when the air quality monitoring indicates that the release of fugitive dusts, odors, or organic vapor into the atmosphere equals or exceeds the specified levels.
   9. In the event that CONTRACTOR's dust, odors, or organic vapor control is not sufficient for controlling dusts, odor, or organic vapor into the atmosphere, work shall be discontinued, and a meeting held between ENGINEER and CONTRACTOR to discuss the procedures that CONTRACTOR proposes to resolve the problem. Make all necessary changes to operations prior to resuming any excavation, handling, processing, or any other work that may cause a release of dusts or organic vapors.
   10. Maintain and adjust odor and air emission control efforts as necessary to limit visible dust, dust above control limits of 5 mg/m3 in the work zone and 150 $\mu g/m^3$ at the Work Site perimeter, complaints of odors, or as directed by ENGINEER.

C. Pollution Control:
   1. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of pollutants produced by construction

operations.

2. Be prepared to intercept, clean up, and dispose of spills or releases that may occur, whether on land or water. Maintain materials and equipment required for cleanup of spills or releases readily accessible on Work Site.
3. Promptly report spills and releases to ENGINEER and OWNER. Examine SDS and contact the manufacturer of the pollutant, if known, and ascertain the hazards involved, precautions required, and best measures to be used in any cleanup or mitigating action.
4. Take immediate action using available resources to contain and mitigate the effects on the environment and persons from any spill or release.

D. Oil Spill Prevention and Control:
   1. CONTRACTOR shall be responsible for prevention, containment, and cleanup of spilling of oil, fuel and other petroleum products used in CONTRACTOR's operations. All such prevention, containment and cleanup costs shall be borne by CONTRACTOR and shall be conducted in accordance with applicable regulations.
   2. CONTRACTOR is advised that discharge of oil from equipment or facilities is not permitted.
   3. CONTRACTOR shall, at a minimum, take the following measures regarding oil spill prevention, containment and cleanup:
      a. Fuel hoses, lubrication equipment, hydraulically operated equipment, oil drums, and other equipment and facilities shall be inspected regularly for drips, leaks, or signs of damage, and shall be maintained and stored properly to prevent spills. Proper security shall be maintained to discourage vandalism.
      b. Land-based oil and products storage tanks shall be diked or located so as to prevent spills from escaping. Diking and subsoils shall be lined with impervious material to prevent oil from seeping through the ground and dikes.
   4. Maintain on the Work Site the following materials, as a minimum:
      a. Oil-absorbent pads or bulk material.
      b. Oil-skimming system.
      c. Hay bales.
      d. Oil dri-all gloves and plastic bags.

1.6 CONSTRUCTION EQUIPMENT

A. When heavy equipment is used, the equipment selected shall have the least adverse effects on the environment, e.g., minimally sized, low ground pressure.

B. The equipment operating with hydraulic fluid shall use only those fluids certified as non-toxic to aquatic organisms.

C. The equipment shall be free of external petroleum-based products.

D. Accumulation of soils or debris shall be removed from the drive mechanisms (wheels, tires, tracks, etc.) and undercarriage of equipment prior to its use. Check the equipment daily for leaks and complete any necessary repairs prior to commencing work activities near the water.

E. All stationary power equipment such as generators, cranes, or other stationary equipment, operated within 150 feet of any waterbody shall be diapered to prevent leaks unless suitable containment is provided to prevent potential spills for entering the water.

F. Refueling areas shall employ standard mitigations (e.g., a gently sloping area with compacted soils and three- sided containment berm) operator training, emergency response planning and equipment maintenance.

G. A refueling station shall be set up within the designated area so that any accidental leaks of petroleum products during equipment fueling and maintenance will be contained and managed within the refueling area. This station should have a liner/spill containment control features (e.g., collection systems, berms).

1.7 REMOVAL OF TEMPORARY FACILITIES AND CONTROLS

A. Comply with Section 01 50 00.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Basic product requirements.
2. Product options.
3. Product substitutions.
4. Product delivery and handling requirements.
5. Product storage and handling requirements.

1.2 BASIC PRODUCT REQUIREMENTS

A. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

B. Provide interchangeable components of the same manufacturer for components being replaced.

1.3 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any approved product meeting those standards or descriptions.

B. Products Specified by Naming One or More Manufacturers With a Provision Not Prohibiting Substitutions: Products of manufacturers named and meeting specifications. Submit a request for substitution for any manufacturer not named in accordance with the following article.

C. Products Specified by Naming One or More Manufacturers With a Provision Prohibiting Substitutions: Products of manufacturers named and meeting specifications, no options or substitutions allowed.

1.4 PRODUCT SUBSTITUTIONS

A. Document each request with complete data substantiating compliance of proposed substitution with the Contract Documents.

B. A request for substitution constitutes a representation that CONTRACTOR:
1. Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.

3. Will coordinate installation and make changes to other Works which may be required for the Works to be complete at CONTRACTOR's expense and at no additional cost to OWNER.
4. Waives claims for additional costs or time extension which may subsequently become apparent.

C. Substitutions will not be considered when they are shown or implied on Shop Drawings or product data submittals without separate written request.

D. Substitution Submittal Procedure after the Notice to Proceed:
1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
2. Submit Shop Drawings, product data, and certified test results and other data as required by ENGINEER attesting to the proposed product equivalence. Burden of proof is on CONTRACTOR.
3. ENGINEER will notify CONTRACTOR in writing of decision to accept or reject request.
4. ENGINEER will be sole judge as to the acceptance or rejection of CONTRACTOR's request.
5. In the event CONTRACTOR obtains ENGINEER's approval for the use of products other than that shown or specified, CONTRACTOR shall, at CONTRACTOR's own expense and using methods approved by ENGINEER, make all changes to the Works, including structures, piping, electrical, equipment, and controls, that may be necessary to accommodate this product.

1.5 PRODUCT DELIVERY AND HANDLING REQUIREMENTS

A. Make all arrangements for transportation, delivery, and handling of products required for prosecution and completion of the Works.

B. Arrange delivery of products to the Work Site in accordance with work sequence and in ample time to facilitate inspection prior to installation. Schedule deliveries to limit requirement for storage at the Work Site to the practical minimum.

C. Do not have products delivered to the Work Site until related Shop Drawings or Samples have been approved by ENGINEER.

D. Do not have products delivered to the Work Site until required storage facilities have been provided.

E. Transport and handle products in accordance with manufacturers' instructions.

F. Immediately on delivery, inspect shipments to ensure that products comply with requirements of the Contract Documents and reviewed submittals, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.6 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Limit on-site storage of products to areas shown on the Drawings or otherwise approved by ENGINEER.

B. Make all arrangements and provisions necessary for storage of materials and equipment.

C. Place all excavated materials, construction equipment, and materials and equipment to be incorporated into the Works so as not to injure any part of the Works or existing facilities and so that free access can be had at all times to all parts of the Works and to all utility service company installations in the vicinity of the Works.

D. Store and protect products in accordance with manufacturers' recommendations and instructions and requirements of Specifications, with seals and labels intact and legible.

E. Store sensitive products in weathertight, climate-controlled enclosures. Protect products subject to ultraviolet degradation from direct exposure to sunlight.

F. For exterior storage of fabricated products, place on sloped supports, above ground.

G. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of product.

H. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

I. Furnish equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

J. Arrange storage of products to permit easy access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

K. Store materials and equipment neatly and compactly, and in locations that will cause a minimum of inconvenience to Other Contractors, public travel, adjoining owners, tenants, and occupants.

L. Protect delivered products from contamination or damage.

M. Do not use lawns, grass plots, or other private property for storage purposes without written permission of OWNER or other person in possession or control of such premises.

N. CONTRACTOR shall be fully responsible for loss or damage to stored products, materials, and equipment.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Examination.
2. Field surveying.
3. Restoration.
4. Progress cleaning.
5. Final cleaning.
6. Final decontamination.
7. Removal and disposal.
8. Protection.
9. Closeout procedures.
10. Project record documents.
11. Warranties.

1.2 EXAMINATION

A. Prior to commencement of work at the Work Site, inspect the Work Site with ENGINEER to review and establish the condition of surface features including existing roads, parking areas, monitoring wells, trees and other plants, grassed areas, fencing and gates, service poles, wires, paving, and survey benchmarks or monuments on or adjacent to the Work Site which may be affected by the Works.

B. Photograph roads and immediate adjacent areas; submit copies to ENGINEER. This inventory shall be mutually agreed between ENGINEER and CONTRACTOR and shall not thereafter be subject to dispute. Such inventory as may be amended, from time to time, will be used by ENGINEER to check compliance by CONTRACTOR with the requirements of the Contract Documents.

C. Provide ongoing review, inspection, and attendance during performance of the Works to properly document conditions. Promptly inform ENGINEER of any existing condition at the Work Site affected by the Works which may require restoration, repair, or replacement. Do not cover up any of the Works without prior approval from ENGINEER.

D. Maintain and protect existing structures and facilities at the Work Site from damage which may be affected by the Works while work is in progress. Repair or replace damage resulting from the Works to ENGINEER's approval.

E. Examine and verify specific conditions described in individual Sections.

F. Verify that utility services are available, of the correct characteristics, and in the correct location.

1.3 FIELD SURVEYING

A. Quality Assurance:
1. Employ a land surveyor registered in the State of Texas and acceptable to ENGINEER to perform survey work of this Article. CONTRACTOR's registered land surveyor shall complete pre-construction, in-progress, final grade, and as-built topographic surveys, sheet pile monitoring survey, and other survey activities necessary for design verification, and quantity calculations. If initial and subsequent surveys are in whole or in part performed by means of GPS-equipped construction equipment, perform supplemental control surveys approved by ENGINEER.
2. Notify ENGINEER in advance of commencing work on any part of the construction to enable ENGINEER to establish benchmarks and base lines.
3. Unless otherwise specified, ENGINEER will establish and provide to CONTRACTOR reference benchmarks and base lines adjacent to the Works. CONTRACTOR shall be responsible for laying out the Works from established reference points.
4. ENGINEER may, at any time, check CONTRACTOR's survey and layout work but this shall not relieve CONTRACTOR of any of its responsibilities to carry out the Works to the lines and grades set out according to the Drawings and Project Specifications or as otherwise necessary for performance of the Works according to the Contract Documents.

B. Submittals:
1. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
2. Submit paper and digital copies of registered drawing(s) of the Work Site and certificate signed by the land surveyor engaged by CONTRACTOR that the elevations and locations of the Works are in conformance with Project documents. Information shall include surface (XML) files, point files, CAD drawings and PDF figures. Provide digital copy, on USB memory stick or electronic file transfer or Compact Disc (CD) compatible for use with Windows 10, 64-bit and AutoCAD 3-D Civil (2019).
3. On request, submit documentation verifying accuracy of survey work.

C. Survey Reference Points:
1. Locate, preserve, and protect survey control and reference points.
2. Control datum for survey is that shown on the Drawings.
3. Promptly report to ENGINEER the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
4. Make good any errors entering into the Works through CONTRACTOR failure to notify ENGINEER concerning lack of preservation of such survey reference points.
5. Accurately replace or relocate disturbed survey control points based on original survey control. Make no changes without prior written notice to and approval from ENGINEER.

D. Examination:
1. Verify locations of survey control points prior to starting work.
2. Verify set-backs, easements, and clearances, confirm Drawing dimensions and elevations.
3. Promptly notify ENGINEER of any discrepancies discovered.

E. Survey Requirements:
1. Utilize recognized engineering survey practices. Locate and lay out the Works using properly calibrated instrumentation.
2. Establish elevations, lines, and levels and mark out work zone.
3. Periodically verify layouts by same means and methods.
4. Establish a minimum of four temporary benchmarks on the Work Site, referenced to established control points. Record locations, with horizontal and vertical data, on Project record documents.

5. Provide reasonable and necessary opportunities and facilities for setting points and making measurements during construction.
6. Confirm and document locations of all utilities.
7. Develop and make such additional detailed surveys as are needed for construction, such as benchmarks, slope stakes, batterboards, stakes for establishing the design elevations of excavations and final grades, as-builts, and other working points, lines, and elevations. Maintain benchmarks and base lines established by ENGINEER, existing property boundaries, lines and grade hubs, and other references and construction or survey points.
8. Record sheet pile locations.
9. Monitor sheet pile deflection at designated locations.

F. Record Documents:
1. Maintain a complete and accurate log of control and survey work as it progresses.

1.4 RESTORATION

A. As a minimum, restoration shall mean replacement, repairs, or reconstruction to a condition at least as good as or better than the condition prior to commencement of the Works.

B. Except where specifically required otherwise by other Sections, restore areas of the Works and areas affected by the performance of the Works to conditions that existed prior to commencement of the Works and to match condition of similar adjacent, undisturbed areas.

C. Ensure that restored areas match existing grade and surface drainage characteristics, except as otherwise specified, and ensure a smooth transition from restored surfaces to existing surfaces.

D. Do not alter original conditions without prior written approval from ENGINEER.

E. Without limiting the generality of the foregoing or other requirements of the Contract Documents, preserve and protect existing features encountered at the Work Site during performance of the Works including, but not limited to buildings, wells, structures, curbs and gutters, fences, pavement, manholes and catch basins, utilities, railroad sidings, roads, streets, walks, grassed areas, and other graded or improved areas.

F. Utilize construction methods and procedures during performance of the Works which keeps disturbance and damage of whatever nature to existing conditions to the practical minimum. Where work necessitates root or branch cutting, do not proceed without ENGINEER's prior approval.

G. Ensure that quality, grades, elevations, and the extent of bedding, cover, and other backfill materials including subgrades, finish grades, and thickness of pavements for roadways and parking areas are properly documented during their removal to ensure reconstruction to at least their original and functional condition.

H. Restoration Material: New, except as otherwise specified, not damaged or defective, and of the best quality for the purpose intended. Furnish evidence as to type, source, and quality of materials or products furnished when requested by ENGINEER or specified in other Sections.

I. Should any dispute arise as to the quality or fitness of materials, whether obtained on or off the Work Site, whether previously inspected by ENGINEER prior to use or not, the decision to use any material or product in the finished Works will rest solely with ENGINEER.

J. Remove from the Work Site clean material not approved for reuse.

K. Handle and store products and materials in a manner to prevent damage, adulteration, deterioration, and soiling and according to manufacturers' instructions when applicable.

L. Prior to commencement of restoration work, inform ENGINEER of proposed material, methods, and procedures to repair, replace, or reconstruct disturbed, damaged, or suspected damage to the Works.

M. Perform cutting, fitting, remedial, and coordination work to make the several parts of the Works fit together.

N. Except as specified otherwise, dismantle and salvage materials for reuse where practicable. Exercise due care when removing material for salvage. Repair or replace materials damaged through improper handling or through loss after removal.

O. Store and protect removed material approved for reuse in approved locations. Beginning of restoration work means acceptance of existing conditions.

P. Unless otherwise specified, restore pavement by:
1. Removing and replacing the entire portions between joints or scores.
2. Saw cutting surfaces, curbs and gutters, and similar structures or surfaces.
3. Protecting adjacent joints and load transfer devices and underlying granular materials.

1.5 PROGRESS CLEANING

A. Execute cleaning during progress of the Works.

B. Requirements of Regulatory Agencies:
1. In addition to the requirements herein, maintain the cleanliness of the Works and surrounding premises within the Works limits to comply with federal, state, and local fire and safety laws, ordinances, codes, and regulations.
2. Comply with all federal, state, and local anti-pollution laws, ordinances, codes, and regulations when disposing of waste materials, debris, and rubbish.

C. Coordinate cleaning operations with disposal operations to prevent accumulation of dust, dirt, debris, rubbish, and waste materials on or within the Works or on the premises surrounding the Works.

1.6 FINAL CLEANING

A. Execute final cleaning prior to Substantial Completion of the Works.

B. Clean debris from drainage systems.

C. Clean the Work Site; sweep paved areas and rake clean landscaped surfaces.

D. Repair pavement, roads, sod, and all other areas affected by construction operations and restore them to original condition or to minimum condition specified.

E. Maintain cleaning until acceptance by OWNER.

1.7 FINAL DECONTAMINATION

A. Perform final decontamination of construction facilities, equipment, and materials which may have come in contact with potentially impacted materials prior to removal from the Work Site.

B. Perform decontamination as specified in Section 01 50 00 to the satisfaction of ENGINEER. ENGINEER will have the right to direct CONTRACTOR to perform additional decontamination if required.

1.8 REMOVAL AND DISPOSAL

A. Remove surplus materials and temporary facilities and controls from the Work Site.

B. Dispose of all waste materials, litter, debris, and rubbish off the Work Site.

C. Do not burn or bury rubbish and waste materials on the Work Site.

D. Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.

E. Do not discharge wastes into streams or waterways.

F. Dispose of the following materials at an appropriate off-site facility approved by OWNER:
   1. Debris including excess construction material, litter, and rubbish.
   2. Spent Tyvek and other disposable personal protective equipment worn during final cleaning.
   3. Water removed from water storage tank, water generated from final decontamination operations including water storage tank cleaning.
   4. Lumber from the decontamination pads.

G. Dispose of materials according to Section 02 61 16.

1.9 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Protect installed work and provide special protection where specified in individual Sections.

C. Provide temporary and removable protection for installed products. Control activity in the immediate work area to prevent damage.

D. Prohibit traffic on landscaped areas.

E. Maintenance of Flow: Maintain the flow of water in existing sewers, drains, and watercourses. In the event that any emergency or situation should arise which requires interruption of normal operation of any existing systems, restore normal operation as soon as possible even though permission for such planned shutdown was obtained.

F. Flotation: Take necessary precautions against the flotation of any structures during construction. Make good any damage caused by flotation.

1.10 CLOSEOUT PROCEDURES

A. Submit written certification that the Contract Documents have been reviewed, the Works has been inspected, and that the Works is complete according to the Contract Documents and in compliance with applicable laws and regulations including, but not limited to, the provision of all applicable federal, state, and local health, safety, and environmental laws and regulations, including OSHA, and ready for ENGINEER's review.

B. Complete and furnish submittals to ENGINEER that are required by the Contract Documents.

1.11 PROJECT RECORD DOCUMENTS

A. Maintain one set of the following Project record documents on-site; record actual revisions to the Works to include:
   1. Drawings.
   2. Specifications.
   3. Reviewed Shop Drawings, product data, and Samples.
   4. Manufacturer's instruction for assembly, installation, and adjusting.
   5. Decontamination records.
   6. Erosion and Sediment Control inspections.
   7. Transportation and Disposal records.

B. Ensure entries are complete and accurate, enabling future reference by OWNER.

C. Store Project record documents separate from documents used for construction.

D. Retain all documents relating to the Project on-site including, but not limited to, emails, paper, sketches, testing results, and communications.

E. Record information concurrent with construction progress.

F. Specifications: Legibly mark and record a description of actual products installed.

G. Project Record Documents and Drawings: Legibly mark each item to record actual construction including:

1. Field changes of dimension and detail.
2. Details not on original Drawings.
3. Provide AutoCAD 3-D Civil (2019) files of as-built drawings on USB memory stick or electronic file transfer or Compact Disc (CD) compatible for use with Windows 10, 64 bit.

H. Remove ENGINEER title block and seal from all documents generated by CONTRACTOR.

I. Submit documents to ENGINEER.

J. Work Site Records: CONTRACTOR shall keep a complete, current, and permanent record at the Work Site of all data required to be maintained by the Contract Documents, including, but not limited to, the dates of commencement and completion of all aspects of the Works, daily records of the number of workers, the number and type of equipment engaged on the Works and on each division of the Works, survey information, and test results, and make such data available to ENGINEER upon request.

1.12 PRODUCT WARRANTIES

A. Obtain product warranties executed in duplicate by responsible Suppliers and manufacturers upon completion of the applicable item of the Works. Except for products put into use with OWNER's permission, leave date of beginning of time of warranty open until the date of Substantial Completion is determined.

B. Fill out original warranty forms in OWNER's name and register with manufacturers. Include coverage for specified performance requirements. Verify that documents are in proper form, contain full information, and are notarized.

C. Execute any special warranties and guarantees as required by the Contract Documents and laws or regulations.

D. Retain warranties until time specified for submittal.

E. Ensure that documentation regarding the terms of applicable warranties and all technical specifications, owners' manuals, operating instructions, or other information relating to materials or equipment that are covered by warranties are compiled.

F. For equipment or component parts of equipment put into service during construction with OWNER’s permission, submit documents after acceptance.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

END OF SECTION

SECTION 01 91 00

WATER TREATMENT CONSUMABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water Treatment Chemical Requirements.

B. Related Requirements:
   1. Section 46 07 01 – Water Treatment System.

1.2 REFERENCES

A. DEFINITIONS
   1. IBC Tote: Intermediate bulk container, a reusable container for transportation and storage of bulk liquid and granular materials.
   2. WTS: Water Treatment System.

1.3 PROGRESS SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Provide product data sheets and SDS for all provided chemicals.

1.4 SYSTEM DESCRIPTION

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Final treatment chemical selection and dosage shall be confirmed by CONTRACTOR during execution of jar testing on the Work Site.

C. Maintain sufficient quantity of consumables to ensure uninterrupted excavation operation and operation of the WTS.

D. Water Treatment System: The WTS processes shall require the following (or equivalent chemicals) to facilitate successful water treatment:
   1. Coagulant (Ferric Chloride or approved equal).
   2. Polymer for WTS.
   3. Polymer for sludge thickening (provisional)
   4. Organosulfide
   5. Sand Filter Media.
   6. Anthracite filter media.
   7. Absolute filters
   8. Granular Activated Carbon Media.
   9. Bag filters.

E. Health and Safety:
   1. Provide SDSs for all chemical used on the Work Site.
   2. Follow manufacturer's instructions for safe handling and use.
   3. Document proper procedures for storing and handling all chemicals in the Project Health and Safety Plan (HASP).
   4. Provide storage and secondary containment accessories/provisions per manufacturer recommendations.

PART 2 PRODUCTS

2.1 WATER TREATMENT SYSTEM CHEMICALS

A. Consumable chemicals are estimated based on anticipated 29 million gallons of contact water. This includes precipitation, mounded water, and existing water in excavation cells.

B. Coagulant:
   1. Service: Coagulation of suspended particles in the impacted water.
   2. Storage Container: IBC Tote or approved equal.
   3. Chemical Product: Poly aluminum chloride (PAC) or approved equal.
   4. Estimated Total Quantities: 24,200 lbs.
   5. Other Requirements: Provide secondary containment for chemical as per supplier recommendations.

C. Polymer for WTS:
   1. Service: Flocculation of Dredged Sediment/Sludge.
   2. Storage Container: Bulk or IBC tote or approved equal.
   3. Chemical Product: Nalco Polymer 7194 or equal approved by ENGINEER
   4. Estimated Total Quantities: 6,100 lbs.
   5. Other Requirements: Provide secondary containment for drums and provide all necessary equipment per supplier recommendations for preparation/activation and dosing of chemical. Polymer shall be activated/diluted prior to dosing into sediment/sludge.

D. Polymer for sludge thickening (provisional):
   1. Service: Flocculation of sludge coming from the bottom of the clarifier.
   2. Storage Container: Bulk or IBC tote or approved equal.
   3. Chemical Product: Nalco Polymer 7194 or equal approved by ENGINEER
   4. Estimated Total Quantities: TBD
   5. Other Requirements: Provide secondary containment for drum and provide all necessary equipment per supplier recommendations for preparation/activation and dosing of chemical. Polymer shall be activated/diluted prior to dosing into sediment/sludge.

E. .Acid or Caustic (provisional):
   1. Service: pH adjustment of WTS.
   2. Storage Container: 55 gallons drum or IBC Tote or approved equal.
   3. Chemical Product: Sulfuric acid, 93 percent (generic), 50% sodium hydroxide or approval equal.
   4. Estimated Total Quantities: TBD
   5. Other Requirements: Provide secondary containment for acid or caustic storage.

F. Organosulfide (provisional):
   1. Service: Metals precipitation in the impacted water. Organosulfide may be added depending on influent soluble metals concentrations.
   2. Storage Container: IBC Tote or approved equal.
   3. Estimated Total Quantities: TBD
   4. Other Requirements: Provide secondary containment for chemical as per supplier recommendations.

G. Filter Media:
   1. Service: Removal of particulates following coagulation/flocculation.
   2. Storage Container: 23 kg bags or 500 kg super sacs or approved equal.
   3. Chemical Product: Liquid phase sand (0.45-0.55 UC)/anthracite (0.8 x 1.2 mm) filter media.
   4. Estimated Total Quantities: Assume one media filter change out per month of operation of the water treatment system per vessel. However, media change out will depend on quality of the effluent or differential pressure of each vessel.
   5. Other Requirements: CONTRACTOR shall be fully responsible for media filter vessel loading and removal/disposal of spent filter media.

H. Bag/Cartridge Filters:
   1. Service: removal of suspended particles larger than 1 micron. Bag or cartridge filters (10 micron and 1 micron, both with minimum 95% removal efficiency) will be configured downstream of the multimedia filters. As the filters are fouled (with captured solids), they will need to be removed and replaced.
   2. Estimated Daily Quantities: Will depend on clarification efficiency. It is expected that filters will need to be replaced on a weekly basis.
   3. Other Requirements: CONTRACTOR shall be fully responsible for filter change out and removal/disposal of spent filters.

I. Granular Activated Carbon (GAC) Media:
   1. Service: Removal of remaining chemicals of concern.
   2. Storage Container: 20,000 lbs
   3. Chemical Product: Virgin coconut shell GAC media, 8 x 30 mesh.
   4. Estimated Daily Quantities: CONTRACTOR should assume a minimum of one GAC media change out every 2 months of operation of the water treatment system per vessel. However, media change out will depend on quality of the effluent or differential pressure of each vessel.
   5. Other Requirements: CONTRACTOR shall be fully responsible for GAC vessel loading and removal/disposal of spent GAC media.

J. Summary Table of estimated chemical quantities:

Chemicals	Estimate Dosage (mg/L)	Estimated Quantity (lbs)
Coagulant	100	24,200
Polymer for WTS	25	6,100
Organosulfide	TBD	TBD
Polymer for sludge thickening	TBD	TBD
Acid/Base	TBD	TBD

PART 3 EXECUTION – Not Used

END OF SECTION

SECTION 01 91 20

FACILITY TESTING AND COMMISSIONING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. References.
2. Submittals.
3. CONTRACTOR's testing and startup representative.
4. Equipment testing.
5. Facility startup and performance evaluation.

1.2 REFERENCES

A. Definitions
1. Facility: The entire Works, or an agreed upon acceptable portion, including all of its unit processes.
2. Field Quality Control: Term, as used in individual Specification Sections, which refers to the specified on-site functional and performance testing of equipment.
3. Functional Test: Test or tests performed in the presence of ENGINEER and OWNER to demonstrate that the installed equipment meets the manufacturer's installation, calibration, and adjustment requirements and any other requirements as specified in the Contract Documents.
4. Performance Test: A test performed in the presence of ENGINEER and after any required functional tests have been completed, to demonstrate and confirm that the individual equipment meets the performance requirements specified in the individual Specification Sections.
5. Source Quality Control: Term, as used in individual Specification Sections, which refers to the specified testing performed on specified equipment at the manufacturer's facility prior to shipment.
6. Unit Process: As used in this Section, a unit process is a portion of the facility that performs a specific process function.

1.3 SUBMITTALS

A. Section 01 30 00 - Administrative Requirements: Requirements for submittals.

B. Completed Manufacturer's Certificate of Proper Installation as required by any individual Specification Sections. Submit prior to beginning any facility startup procedures.

C. Equipment Test Report Form: Provide a written test report form for each item of equipment to be tested, to include the following information, at a minimum:
1. Project Name.
2. Equipment or item tested.
3. Date and time of test.

4. Type of test performed (functional or performance).
5. Test conditions.
6. Test results.
7. Signature space.

D. Testing Plan:
   1. Functional and performance test schedules, test plan, procedures, and log format.
   2. Facility Startup and Performance Evaluation Plan: Submit prior to the commencement of startup.

E. Certification of calibration for testing equipment.

1.4 CONTRACTOR'S TESTING AND STARTUP REPRESENTATIVE

A. Designate and provide one or more of CONTRACTOR's personnel to coordinate and expedite testing and facility startup. Such person or persons shall be present during all equipment testing and facility startup meetings and shall be available, at all times, during the testing and the facility startup and the performance evaluation period.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 EQUIPMENT TESTING

A. Preparation:
   1. General:
      a. Complete the installation of each unit and related processes before testing, including all related manufacturer's representative services.
      b. Provide qualified manufacturer's representatives, when required by individual Specification Sections, to assist in testing.
      c. Obtain, from the equipment manufacturer's representative, the manufacturer's certificate of proper installation, when required by individual Specification Sections.
      d. Schedule equipment testing and facility startup meetings to discuss the test schedule, plan of test, materials, chemicals and liquids required.
      e. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required in order to conduct testing.
      f. Unless otherwise indicated in the Contract Documents, provide water, power and chemicals as required for all testing and facility startup.
   2. Cleaning and Checking: Prior to beginning functional testing:
      a. Calibrate all testing equipment in accordance with the manufacturer's instructions.
      b. Inspect and clean all equipment, devices, connected piping, and structures to ensure that they are free of foreign material.
      c. Lubricate equipment in accordance with the manufacturer's instructions.
      d. Turn rotating equipment by hand when possible in order to confirm that the equipment is not bound.
      e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.

f. Check the power supply to electric powered equipment for the correct voltage.
g. Adjust clearances and torque.
h. Test piping for leaks.

3. The “ready to test” determination will be made by ENGINEER based on completion of the following, at a minimum:
   a. Notification by CONTRACTOR of the equipment’s readiness for testing.
   b. Acceptable testing plan.
   c. Acceptable Operation and Maintenance Manuals.
   d. Receipt of the Manufacturer’s Certificate of Proper Installation, if so specified in the Contract Documents.
   e. Adequate completion of the Works adjacent to, or interfacing with, the equipment to be tested.
   f. Availability and acceptability of the manufacturer’s representative, when specified in the Contract Documents, to assist in testing of the respective equipment.
   g. Fulfillment of all other manufacturers’ responsibilities as specified in the Contract Documents to the satisfaction of ENGINEER.
   h. Completion of the equipment and electrical tagging.
   i. Delivery of all spare parts and special tools.

B. Functional Testing:
   1. Conduct as specified in individual Specification Sections.
   2. Notify ENGINEER and the manufacturer’s representative in writing prior to the scheduled date of testing.
   3. When, in ENGINEER’s opinion, the equipment meets the functional requirements specified in the Contract Documents, such equipment will be accepted for the purpose of advancing to the performance testing phase, if so required by individual Specification Sections.

C. Performance Testing:
   1. Conduct as specified in individual Specification Sections.
   2. Notify ENGINEER prior to the scheduled date of the test.
   3. Performance testing shall not commence until the equipment has been approved by ENGINEER as having satisfied the functional test requirements specified in the Contract Documents.
   4. Follow the testing plan approved by ENGINEER and detailed procedures specified in the Contract Documents.
   5. Unless otherwise indicated in the Contract Documents, furnish all labor, materials, and supplies required for conducting the test and taking all samples and performance measurements.
   6. Prepare a performance test report summarizing the test method and results.
   7. When, in ENGINEER’s opinion, the equipment meets the performance requirements specified in the Contract Documents, such equipment will be accepted as conforming to the Contract requirements. Such acceptance will be evidenced by ENGINEER’s signature on the Equipment Test Report.

3.2 FACILITY STARTUP AND PERFORMANCE EVALUATION

A. General:
   1. Equipment shall be accepted by ENGINEER as having met the requirements for functional testing as specified in the Contract Documents prior to facility startup.

2. Sequence each unit process to the point that the complete facility is operational for the evaluation of unit process and facility performance.
3. Demonstrate the proper operation of required interfaces within and between the individual unit processes.
4. Provide the Subcontractors' and the equipment manufacturers' respective staff with adequate notice in order to prevent delays.
5. Schedule ongoing Works so as not to interfere with, or delay, the completion of facility startup.
6. After the facility is operating, complete the performance testing of those items of equipment which have not been previously tested.

B. Facility Startup and Performance Evaluation Plan:
1. Develop a plan detailing step by step instructions for the startup of each unit process and the complete facility.
2. Include a method of evaluation and an overall performance report for each unit process.
3. The plan shall consist of bound copies of the Startup and Performance Evaluation Forms. Use one form for each unit process; use the sample form attached as a supplement to this Section, or one designed by CONTRACTOR which is acceptable to OWNER.
4. The Startup and Performance Evaluation Form will include the following, at a minimum:
   a. Description of the unit process being started.
   b. All equipment and devices included in the unit process.
   c. Unit process startup procedures (including but not limited to, valves to be open/closed, order of equipment startup).
   d. Requirements for all water, power, and chemicals needed for startup.
   e. CONTRACTOR's certification that each unit process is capable of performing its intended function(s), including fully automatic operation.
   f. Space for evaluation comments.

C. ENGINEER's Responsibilities:
1. Assist CONTRACTOR in developing a Facility Startup and Performance Evaluation Plan.
2. Operate the process units and devices, with the support of CONTRACTOR.
3. Provide labor and materials as required for sampling and laboratory analyses.

D. Facility Startup Period:
1. Startup sequencing of unit processes shall be as determined by CONTRACTOR.
2. Make all adjustments, repairs, and corrections necessary to complete the facility startup.
3. Startup of the entire facility or any portion thereof shall be considered complete when, in the opinion of ENGINEER, the facility or a designated portion of the facility has operated in the manner intended for 7 continuous days without significant interruption. This period is in addition to any training, functional, or performance test periods specified elsewhere in the Contract Documents.
4. Significant Interruption: May include any of the following events:
   a. Failure of CONTRACTOR to provide and maintain qualified on-site startup personnel as scheduled.
   b. Failure to meet the specified performance for more than 2 consecutive hours.
   c. Failure of any critical equipment or unit process that is not satisfactorily corrected within 5 hours after the commencement of the failure.
   d. Failure of any noncritical equipment or unit process that is not satisfactorily corrected within 8 hours after the commencement of the

failure.

e. Any other event which ENGINEER, in its sole discretion, deems to be a significant interruption.

5. A significant interruption will require that the startup in progress be stopped and restarted after all corrections are made.

E. Facility Performance Evaluation:
1. During the facility startup period, CONTRACTOR shall conduct a performance evaluation for the purpose of evaluating the full capabilities of the facility.
2. Certify, on the Facility Performance Evaluation Form, that each unit process is capable of performing its intended function(s), including fully automatic operation.

3.3 ATTACHMENTS

A. The attachment listed below forms part of this Section:
1. Startup and Performance Evaluation Form.

END OF SECTION

STARTUP AND PERFORMANCE EVALUATION FORM

OWNER:_____ PROJECT:_____

Unit Process Description: (Include description and equipment number of all equipment and devices):

Startup Procedure (Describe procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):

Startup Requirements (Water, power, chemicals, etc.):_____

Evaluation Comments:_____

CONTRACTOR Certification that Unit Process is capable of performing its intended function(s), including fully automatic operation:

Firm Name:_____

Startup Representative:_____ Date:_____, 20
(Authorized Signature)

SECTION 02 55 00

WASTE MATERIAL SOLIDIFICATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Dewatering of waste material.
   2. Solidification of excavated waste material by blending with dry waste material or by adding solidification additives, where necessary.
   3. Sampling and analysis (moisture content and unconfined compressive strength, as required by disposal facility) of solidified waste material to demonstrate achievement of performance criteria.

B. Related Requirements:
   1. Section 46 07 01 Temporary Water Treatment System.

1.2 REFERENCES

A. Definitions:
   1. Waste material: Non-hazardous excavated solids and associated solids from water treatment system.

B. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.

1.3 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene 1 week prior to commencing work of this Section.

C. Purpose of the meeting is to:
   1. Define responsibilities of parties and individuals.
   2. Establish lines of authority and communication.
   3. Review schedules.
   4. Review sequence of operations.
   5. Review methods of measurement.
   6. Review Solidification Plan.
   7. Review Quality Assurance/Quality Control Plan.

1.4 SEQUENCING

A. Section 01 10 00 - Summary: Requirements for sequencing.

B. Sequence work of this Section to commence after the Temporary Water Treatment System is ready to receive wastewater and is operational.

C. Do not commence excavation and solidification activities prior to ENGINEER's review of submittals specified in PART 1, SUBMITTALS.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Solidification Plan: Submit within 7 days after the date of the Notice to Proceed and prior to mobilization to the Work Site. Include mixing methods, description of additives, results of bench scale testing on at least five representative samples demonstrating compliance with disposal facility performance criteria, sequence of operations, access, lay down area requirements, and equipment to be used.

C. Daily Field Installation Report:
   1. Submit no later than 3 days following date covered by report. Include:
      a. Types and amounts of additives used.
      b. Estimated quantity of additive used per cubic yard of waste material.
      c. Number and identification of quality assurance/quality control samples taken.
      d. Results of quality assurance/quality control testing on waste material and solidified waste material.
      e. Volume of dewatering from waste material.

D. Quality Assurance/Quality Control Plan:
   1. Submit with the Solidification Plan. Include sampling and testing protocol to confirm compliance with requirements. Include:
      a. List of test methods.
      b. Frequency of sampling (see Paragraph 3.6 B).
      c. Manufacturer's quality control plan for solidification additives.
      d. Means to confirm that shipments of solidification additives are capable of achieving performance criteria in solidified waste material.
      e. Disposal facility solidification performance criteria for acceptance of waste material by the disposal facility.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products..

B. Protect solidification additive materials from wind, rain, and humidity and store according to manufacturer’s instructions. Handle in such manner as to minimize generation of dust and to control particle agglomeration.

1.7 AMBIENT CONDITIONS

A. Suspend operations whenever climatic conditions, as determined by ENGINEER, are unsatisfactory for meeting requirements of this Section.

B. Runoff Control:
   1. Keep work area dewatered during solidification activities. Direct surface runoff collected within work area during solidification of waste material to the Temporary Water Treatment System.
   2. Ensure runoff from work area does not flow into or over adjacent lands. Restore areas impacted as result of inadequate surface runoff control.

C. Dust Control: Transport, store, and mix specified solidification additives in such manner as to minimize generation of dust. Include in the Solidification Plan material handling procedures and dust control measures sufficient to minimize or eliminate dust generation.

D. Do not solidify waste materials under conditions that would cause excessive dust (such as heavy winds) or in temperatures that would prevent adequate performance of additives.

E. Solidification shall not be performed during periods of heavy rainfall if this will result in the addition of excess water to the mixture.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. The treated waste material shall meet the solidification performance criteria of the disposal facility (i.e., pass paint filter test and have sufficient strength for acceptance at the landfill) based on samples collected and analyzed by CONTRACTOR.

B. Emission Controls: Include control apparatus necessary to meet local, state, and/or federal regulations for air emissions and dust.

C. Noise Control: System shall meet state and local noise pollution control regulations at any Site boundary.

D. Mixing Equipment: Minimum capacity adequate to meet performance criteria and schedule requirements and shall be equipped with positive means for controlling the mix proportions, maintaining the time of mixing constant, and maintaining the appropriate speed of rotation of the mixer.

E. Reagent Feed Units: Provide satisfactory means, incorporating weighing, metering, or volumetric measurement to separately batch the required amount of each reagent. Provision shall be made so that each reagent can be easily sampled.

F. Accuracy of Measurement Equipment: Scales, meters, and volumetric measuring devices used for measuring waste material, reagents, and water for waste material processing shall be accurate to plus or minus 0.1 percent of the quantity being measured. Perform a check of calibration of measuring equipment once every 5 working days.

G. Mix Design: Select a mix design. Data from solidification treatability tests can be made available upon request.

2.2 SOLIDIFICATION ADDITIVES

A. Solidification additives may include, but are not limited to:
   1. Portland Cement.
   2. Lime.
   3. Fly Ash.

B. Waste material from drier portions of the excavation, where present, should be used prior to the addition of solidification additives.

2.3 SUMPS

A. Weighted, perforated, filter-cloth-wrapped, 55-gallon drums, or system of equivalent effectiveness as proposed by CONTRACTOR.

2.4 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Required product and test data according to accepted Quality Assurance/Quality Control Plan.

C. Solidification additives data sheets and Safety Data Sheets (SDSs).

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that Temporary Water Treatment System is ready to receive water.

C. Verify that surfaces and Site conditions are ready to receive work.

3.2 EQUIPMENT

A. Capable of mixing and solidifying waste material in an efficient manner.

3.3 DEWATERING

A. Dewater waste material on constructed dewatering pad(s) as necessary prior to further solidification.

B. Provide pumps, piping, hoses, screens, fittings, valves, sumps, and appurtenances as required for removal of water from the dewatering pad.

C. Equip pump suctions with flotation devices, screens, and/or place within sumps to prevent removal of debris and sediment or sludge

3.4 WASTE MATERIAL SOLIDIFICATION

A. Following dewatering of waste material as necessary, prepare and mix solidification additives with waste material to ensure uniform physical properties, in accordance with accepted Solidification Plan. This may be conducted in situ prior to excavation of material, or ex situ on a prepared dewatering pad.

B. Collect and analyze samples of solidified material to confirm adequate solidification, according to disposal facility performance criteria. Collect and analyze samples in accordance with the requirements of the disposal facility. If mixed waste materials do not meet performance criteria, modify mix design and remix material until performance criteria are met.

C. Modifications to mix design to meet performance criteria shall be at no additional cost to OWNER.

3.5 TRANSPORTATION OF SOLIDIFIED WASTE MATERIAL

A. Load and transport solidified waste material into transport vehicles for off-site disposal in accordance with Section 02 61 16 Off-Site Transportation and Disposal.

3.6 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. CONTRACTOR shall sample solidified waste material for waste characterization analysis at a frequency to be determined by the disposal facility.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Remove equipment and surplus raw materials.

END OF SECTION

SECTION 02 61 14

MATERIAL HANDLING AND TRANSPORTATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Loading, handling, and transportation of waste materials excavated from work areas using CONTRACTOR-constructed access roads.

B. Loading and transportation of imported structural fill, topsoil, and aggregate from off-site source.

1.2 REFERENCES

A. Section 01 40 00 - Quality Requirements: Requirements for references.

B. Environmental Protection Agency (EPA): SW-846 Method 9095B - Paint Filter Liquids Test.

1.3 SYSTEM DESCRIPTION

A. This Section applies to planning, and providing equipment and services necessary to load, transport, unload and stockpile (as necessary), and handle the following materials, and to decontaminate the equipment.
   1. Soil fill (for between double sheet pile walls).
   2. Topsoil (general restoration).
   3. Coarse aggregate (access roads/ramps)
   4. Structural fill (base material for temporary access roads/ramps, and construction of restored south embankment).
   5. Sand (temporary dewatering facility and containment areas).
   6. Clear stone (treated water discharge to river and dewatering facility sump).
   7. Riprap (river discharge and south embankment restoration).
   8. Liquids (dewatering).
   9. Construction materials (impacted and non-impacted materials).

B. Refer to Section 02 61 16 for Off-Site Transportation and Disposal.

1.4 PROGRESS SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Material Handling and On-Site Transportation Plan:
   1. Submit within 14 days after the date of the Notice to Proceed and prior to mobilization to the Work Site.
   2. Before beginning any excavation, finalize the Material Handling and On-Site Transportation Plan based on comments received.

3. The Plan shall describe how consolidated materials will be handled, staged, loaded, transported on the Work Site and on public roads, and how equipment will be decontaminated, including list of type and size of transport vehicles. The Plan shall be designed so that handling and transportation measures prevent the spread of contamination and ensure compliance with local restrictions.
4. The Plan shall be designed with traffic controls which comply with applicable traffic regulations with respect to public roads. As a minimum, the Plan shall consider including the use of flagpersons and appropriate signage at all times when vehicles are utilizing entrances to public roads.
5. The Plan shall include local permits, if needed, to transport materials on public roads.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Safeguards and Protective Barriers:
   1. Provide protective barriers to minimize the spread of contamination during handling. Items may include tarpaulin on a wooden frame to protect the side of the truck during loading, plastic sheeting on the ground during loading and unloading, and dump ramps during unloading to protect the undercarriage.
   2. Provide appropriate safeguards (e.g., bump guards, signs) as necessary.

PART 2 PRODUCTS

2.1 VEHICLES AND CONTAINERS

A. Motor Vehicles and containers designated for use only for specific materials in the Material Handling and Transportation Plan shall be so labeled or identified.

B. Motor Vehicles: Refer to Section 02 61 16.

C. Containers, Truck Beds and Roll on/Roll off Boxes:
   1. Free from drain holes, cracks, or other conditions that might allow leakage of liquids or solids.
   2. Free from conditions that might allow waste to accumulate.
   3. Fully lined to prevent leakage when transporting waste material off-site.
   4. Covers to prevent accumulation of rain water or release of dust.

2.2 WATER STORAGE TANKS

A. Refer to Section 46 07 01.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that surfaces and the Work Site conditions are ready to receive work.

3.2 MATERIAL HANDLING AND TRANSPORTATION

A. General:
1. Take necessary precautions for safe operation of the equipment and protection of the public, workers, and the environment from injury and damage from equipment. Operators shall be properly licensed and insured.
2. Equipment and tools associated with impacted materials shall be used exclusively for that purpose until released. Items shall be decontaminated in accordance with Paragraph 3.2 E and the Material Handling and On-Site Transportation Plan.
3. Keep a log in each truck recording the following information for each trip:
   a. Date and time of loading.
   b. Area within the Work Site from which the material was obtained.
   c. Destination.
   d. Quantity (e.g., approximate cubic yards, approximate weight, or specific number of containers).
   e. Date and time of unloading.
4. When not in use, secure vehicles in the secured excavation support areas, with keys removed and doors locked. Security shall be solely the responsibility of CONTRACTOR.

B. Loading:
1. Inspect vehicles/containers before loading of excavated material (to be disposed of off-site) at the excavation areas to verify that no water or liquid has been introduced and the vehicle/container has not been damaged. Test seals on watertight containers on a weekly basis to confirm seals are watertight. Maintain a log of seal testing.
2. Use protective barriers around transport vehicles and take care to prevent spread of excavated materials to the ground surface beyond the excavation limits.
3. Install and secure truck bed covers over non-containerized material. Secure tailgates during transit.
4. Decontaminate vehicles before leaving the work area as required by the Material Handling and Transportation Plan. Collect and transport sediments removed from vehicles and equipment for off-site disposal in accordance with Section 02 61 16.

C. Transportation:
1. Control free water from the waste materials. Do not track material onto clean areas or transportation routes.
2. Collect, pump, and/or transport contact water to Temporary Water Treatment System. This includes water pumped from excavations, stockpile pads, and decontamination pad(s). Control water handling to prevent accidental spills in accordance with Section 01 50 00 – Temporary Facilities and Controls.
3. Do not deviate from the on-site transportation routes approved by ENGINEER without prior written approval from ENGINEER.
4. In the event of accidents, spills, or releases, comply with Paragraph 3.2 F.

D. Dewatering and Solidification of waste material: Dewater and solidify (as necessary) waste materials that fail the Paint Filter Liquids Test. Dewater by drainage, aeration, or other methods, including construction of dewatering pad at the CONTRACTOR's option. Transport collected water to temporary Water Treatment System. If natural dewatering is not successful, solidify waste material according to Section 02 55 00.

E. Decontamination:
   1. Decontaminate equipment that has been in impacted areas. Complete gross decontamination by removing soil, waste material, and debris from the exterior, underbody, and between tires before leaving an impacted area. Remove soil, waste material, and debris using scrapers, brushes, rags, or similar means.
   2. Collect materials removed from vehicles/containers and dispose off-site.
   3. Use decontamination areas only for light and final decontamination and not for gross decontamination (e.g., removal of bulk visible materials). Perform gross decontamination, if required, as part of earthwork at the area where trucks are loaded or unloaded. Repeat decontamination as needed.
   4. Visually inspect decontaminated vehicles and maintain log of inspections at the Work Site. Provide decontamination inspection log to ENGINEER on a monthly basis.

F. Spills and Accidents: Perform spill control and cleanup in accordance with Section 02 61 16. Notify ENGINEER and implement the appropriate response immediately upon learning of an accident, spill, or release of impacted material.

3.3 TEMPORARY STOCKPILES

A. Temporary stockpiles for excavated waste material will be allowed, however CONTRACTOR shall propose containment methods for both waste material and surface water.

B. Obtain ENGINEER's approval for locations of temporary stockpiles. Obtain ENGINEER's approval prior to placing material in such stockpiles.

C. Construct stockpile sites so that they are level, well drained, free of foreign materials, and of adequate bearing capacity to support the weight of the materials to be placed thereon.

D. Provide and maintain access to stockpiles.

E. Separate differing materials with substantial dividers or stockpile apart to prevent mixing.

F. Prevent intermixing, contamination, or segregation of soil types.

G. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

H. Maintain temporary stockpile slopes not steeper than 2.5 horizontal to 1 vertical. In no instance shall stockpiles be greater than 12 feet in height above original surrounding grade, unless otherwise approved by ENGINEER. Place hay or straw bales or other soil erosion and sediment control fencing at the base of and around each temporary stockpile to contain soil that may be washed off the stockpile.

I. Maintain area surrounding stockpiles in neat and tidy condition.

END OF SECTION

SECTION 02 61 16

OFF-SITE TRANSPORTATION AND DISPOSAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Supply, operation, and maintenance of transport vehicles/containers.

B. Preparing transport vehicles/containers for off-site transportation.

C. Loading and securing materials in transport vehicles/containers.

D. Decontaminating vehicles/containers prior to leaving the Work Site.

E. Transporting materials from the Work Site to OWNER-selected TSDF.

F. Preparation of shipping documents including manifests and bills of lading.

G. Maintaining transportation records as required by regulatory agencies.

H. Obtaining documents from TSDF.

1.2 REFERENCES

A. DEFINITIONS
1. DOT: Department of Transportation.
2. Non-Hazardous Materials: Materials not regulated by 40 CFR 261, 40 CFR 273, 40 CFR 279, and 49 CFR 761, or equivalent state regulation.
3. TSDF: Treatment, storage, or disposal facility.

B. REFERENCE STANDARDS
1. Section 01 40 00 - Quality Requirements: Requirements for references.
2. United States Federal Government - Code of Federal Regulations (CFR):
   a. 40 CFR 261 - Identification and Listing of Hazardous Waste.
   b. 40 CFR 262 - Standards Applicable to Generators of Hazardous Waste.
   c. 40 CFR 263 - Standards Applicable to Transporters of Hazardous Waste.
   d. 49 CFR 171 - General Information, Regulations, and Definitions.
   e. 49 CFR 172 - Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements.
   f. 49 CFR 173 - Shippers - General Requirements for Shipments and Packaging.
   g. 49 CFR 177 - Carriage by Highway.
   h. 49 CFR 178 - Specifications for Packagings.
   i. 49 CFR 383 - Commercial Driver’s License Standards; Requirements and Penalties.

j. 49 CFR 385 - Safety and Fitness.
k. 49 CFR 387 - Minimum Levels of Financial Responsibility for Motor Carriers.
l. 49 CFR 390 - Federal Motor Carrier Safety Regulations.
m. 49 CFR 391 - Qualifications of Drivers.
n. 49 CFR 392 - Driving of Motor Vehicles.
o. 49 CFR 393 - Parts and Accessories Necessary for Safe Operation.
p. 49 CFR 395 - Hours of Service of Drivers.
q. 49 CFR 396 - Inspection, Repair, and Maintenance.
r. 49 CFR 397 - Transportation of Hazardous Materials; Driving and Parking Rules.

1.3 PROGRESS SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Transportation and Disposal Plan: Submit for review and approval a plan for transportation and disposal of materials 14 days prior to transportation and disposal of materials from the Work Site, allowing time for review and approval prior to removing any material from the Work Site. Include relevant transporter and TSDF identification and regulatory classification and status, methods of transportation and disposal, contingency plans for spills during transportation, and schedule for transportation and disposal. Identify TSDF-specific requirements for waste profiling sampling and analyses to determine acceptance.

C. Transportation Emergency Response Plan addressing:
1. Instructions for compliance with 49 CFR 171.15 and 49 CFR 172, Subpart G.
2. All aspects and considerations arising from transport incidents involving impacted materials.
3. Procedures for incident response.
4. Methods to contain and clean up releases in accordance with Section 01 35 29 – Health and Safety.
5. Details of manpower and equipment available.
6. Coordination necessary to mobilize in an emergency.
7. Traffic maintenance and warning procedures.
8. List of emergency numbers for information and notification for each applicable state.
9. List of name and telephone number of the contact at the pickup and destination facilities.
10. Name and telephone number of CONTRACTOR's Emergency Response Coordinator and the Transportation Representative.
11. Accident/incident reporting requirements.
12. A current copy of the Federal Motor Carrier Safety Rating assigned by the Federal Highway Administration (FHWA) to transportation provider. Provider receiving notification by the FHWA of a "conditional" or "unsatisfactory" rating will be ineligible to transport impacted materials.
13. A copy of the TSDF permit, including both USEPA and state identification numbers.
14. A copy of the certificate of insurance, location of the TSDF facility, process description, and impacted materials packaging requirements.
15. Qualifications of motor vehicle operators:
16. Statement that motor vehicle operators meet the requirements of 49 CFR 383, 49 CFR 391, 49 CFR 392, and 49 CFR 395.
17. A listing of storage time limits for all material designated for off-site transportation, and methods for ensuring compliance with these limits.

D. TSDF Requirements:
   1. For each TSDF accepted by OWNER, provide TSDF requirements to ENGINEER including:
      a. Any TSDF-specific packaging requirements for shipments.
      b. TSDF restrictions by wastestream which may cause rejection of transported materials.
      c. Any wastestream-specific pre-approvals required by federal or state agencies prior to acceptance of wastestream by TSDF.
      d. Restrictions on delivery schedules.
      e. Type and frequency of routine additional sampling and analysis of materials by wastestream which are required during transport and disposal activities prior to delivery to TSDF.
      f. Additional sampling and analysis of materials that will be conducted by TSDF during receipt of shipments to verify waste profiles.
   2. Each TSDF shall disclose the name and telephone number of the contact at the lead agency responsible for TSDF primary permits who has knowledge of and can verify the existence of existing corrective action programs which may impact the ability of TSDF to accept materials from the Work Site.

E. Operating Licenses and Permits:
   1. Include letter from each proposed TSDF stating that it is in compliance with its federal, state, and local permits and that permits are current for the duration of the off-site disposal activities from the Work Site.
   2. Include copies of valid operating licenses and permits from each transporter for each proposed transport vehicle/container.

F. Transportation Routes: Submit plans showing transportation routes or alternate routes which will be used to transport materials to OWNER-selected TSDF prior to commencing transportation of materials from the Work Site. Comply with applicable federal, state, and local regulations.

G. Qualifications of Motor Vehicle Operators:
   1. Signed affidavit stating that all vehicle operators handling hazardous waste are HAZMAT trained in accordance with 49 CFR Part 172, Subpart H.
   2. Statement that motor vehicle operators meet the requirements of 49 CFR 383, 49 CFR 391, 49 CFR 392, 49 CFR 395, 49 CFR 397, 49 CFR 172 Subpart H, and 49 CFR 177.

H. Shipping and Disposal Documents:
   1. Include blank sample forms of proposed shipping and disposal documents.
   2. Include complete copies of waste profiles.
   3. Include completed copies of shipping and disposal documents including manifests and/or bills of lading on standard approved forms, including a copy of each form signed by the transporter prior to leaving the Work Site and a copy of each form signed by TSDF accepting the shipment.
   4. Use shipping and disposal documents of consignment state where so required. Obtain shipping documents from consignment state prior to shipment from the Work Site.

I. Supplemental Indemnifications: For each TSDF which provides a supplemental indemnification (e.g., Superfund Indemnification), obtain such indemnification for the benefit of OWNER.

J. Weigh Tickets: Submit weigh tickets generated at off-site weigh scale in accordance with PART 3, OFF-SITE IN-TRANSIT WEIGHING (BULK SHIPMENTS).

K. Weigh Scale Calibration: Submit prior to commencing transport of materials off-site, a calibration chart, completed within the previous 6 months, for the weigh scale. The weigh scale shall be calibrated by the State of Texas registered agency.

1.4 QUALITY ASSURANCE

A. ENGINEER will perform waste profiling analyses of Non-Hazardous waste materials scheduled for off-site disposal prior to the date of the Notice to Proceed. This information will be made available to the CONTRACTOR in coordination with transport of waste to TSDF.

1.5 QUALIFICATIONS

A. Motor Vehicle Operators:
   1. Before off-site transportation services are rendered, motor vehicle operators (drivers) shall meet the requirements defined in the Transportation Emergency Response Plan.
   2. Have available the following information before any off-site transportation activity:
      a. A medical examiner's certificate, or a legible photographic copy of a certificate, or a statement attesting to a record on file with CONTRACTOR of a medical examiner's certificate on each motor vehicle operator's physical qualifications to operate a motor vehicle in accordance with 49 CFR 391.43 and 49 CFR 391.41.
      b. A statement certifying that CONTRACTOR, at least once every 12 months, reviews the driving record of each motor vehicle operator it employs, in accordance with 49 CFR 391.25. Include in this statement a list of any violations of motor vehicle traffic laws in accordance with 49 CFR 391.27.
      c. A valid commercial driver's license for each motor vehicle operator.

B. Replace any motor vehicle operator deemed unacceptable for transporting impacted materials.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not spill, leak, or otherwise release materials from transport vehicles and containers during loading and unloading operations or while in transit from the Work Site to TSDF.

B. Do not generate dusting conditions when loading bulk solids.

C. Clean up any and all spills or leaks in transit.

PART 2 PRODUCTS

2.1 POLYETHYLENE SHEETING

A. Continuous sheeting, minimum 0.006 inch (6 mil) thick, fabricated from a single ply of construction-grade polyethylene plastic.

2.2 TUB LINER

A. Tub Liners for Bulk Solid Shipments: Pre-manufactured fitted polyethylene tub liner or continuous single sheet of polyethylene sheeting.

2.3 CONTAINERS, PACKING MATERIAL, AND LABELS

A. Comply with DOT, federal, state, and local regulations.

B. Transport vehicles (e.g., tractors and roll off containers) that meet the requirements of 49 CFR.

C. Securement systems, especially tiedown assemblies (e.g., chains, cables, steel straps, and fiber webbing); load binders and hardware (e.g., hooks, bolts, welds, or other connectors); and winches or other fastening devices that are without visual damage from wear or misuse and that meet the requirements of 49 CFR 393, Subpart I.

D. Weatherproof tarpaulins that are without visual damage from wear or misuse; are of a quality highly resistant to tears, rips, snags, punctures, abrasion, cracking, peeling, and weathering; and are suitable for use as an external cargo wrap.

E. Side boards that are suitable as a frame for use with tarpaulins to form a closed transport vehicle.

F. Motor vehicle operators who meet the requirements of 49 CFR 383, 49 CFR 391, 49 CFR 392, 49 CFR 395, 49 CFR 397, 49 CFR 172 Subpart H, and 49 CFR 177.

2.4 MOTOR VEHICLES

A. Provide equipment that is appropriate for accomplishing successful transportation of impacted materials from the Work Site to the TSDF. Maintain and operate motor vehicles in accordance with the manufacturer's recommendations; Occupational Safety and Health Administration requirements; federal regulations specified in 49 CFR 393 and 49 CFR 396; and applicable federal, state, and local regulations. Take all precautions necessary for safe operation of equipment and vehicles to safeguard the public and the environment from injury or accidental release of impacted materials.

B. Inspect all vehicles in accordance with 49 CFR 393, and comply with all applicable local, state, and federal requirements for registration, insurance, inspection, certification, and performance.

C. Motor vehicle inspections shall be performed by qualified inspectors, as required by 49 CFR 396.19. Have available a copy of the current certificate of commercial motor vehicle inspection before any transportation activities (or a statement certifying that all motor vehicles have been inspected in accordance with the requirements of 49 CFR 396.17, 49 CFR 396.19, and 49 CFR 396.23). Brake inspections shall be performed by a certified brake inspector for commercial motor vehicles, as described in 49 CFR 396.25.

D. The motor vehicle operator shall perform a safety inspection of each motor vehicle before it is used and at least once each day, in accordance with the requirements of 49 CFR 396.11 and 49 CFR 396.13.

E. Remove from the Work Site any motor vehicles determined to be potentially unsafe and/or unsuitable for their intended use. Reinspect repaired or replaced motor vehicles to determine whether they meet inspection standards.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Notify ENGINEER sufficiently in advance of intention to commence activities at the Work Site that require attendance by ENGINEER as provided hereinafter.

C. Activities requiring attendance by ENGINEER include:
   1. Final securement of loaded materials prior to transport from the Work Site.
   2. Decontamination of transport vehicles/containers prior to leaving the Work Site.

D. Do not cover up loaded material prior to ENGINEER's inspection.

3.2 TSDF SELECTION

A. OWNER may contract directly with the TSDF and ENGINEER will obtain the necessary approvals to dispose of Non-Hazardous Materials.

3.3 WASTE PROFILING

A. ENGINEER will conduct waste profile sampling and analysis.

B. ENGINEER will classify materials for off-site disposal according to waste stream based on waste profile analytical results and other pertinent data/information.

C. Select and submit proposals to ENGINEER for the appropriate disposition of all determined waste streams to be removed from the Work Site in accordance with applicable regulations for each wastestream. CONTRACTOR shall be responsible for disposition of materials to OWNER-selected TSDFs.

D. Waste profile will be signed by OWNER or an authorized agent of OWNER except for materials brought on the Work Site by CONTRACTOR that are not incorporated in the Works or impacted by performance of the Works.

3.4 SEGREGATION OF MATERIALS

A. Segregate and prepare materials for transportation and disposal in accordance with the delivery acceptance requirements of the transporter and TSDF and governing regulations, as appropriate based on waste characterization.

3.5 LOADING AND UNLOADING OPERATIONS

A. The motor vehicle operators shall remain inside the tractor cab at all times during loading and unloading.

B. Provide motor vehicles that are non-contaminated and free of mud, dirt, grease, or other accumulations. Motor vehicles shall arrive at the work area sufficiently clean to allow inspection.

C. Conduct loading and unloading operations in a highly controlled manner that prevents contamination of motor vehicles. Verify that CONTRACTOR motor vehicles are free of contamination before releasing them from the loading/unloading area.

D. Load for on-site transportation in accordance with Section 02 61 14.

E. Load for off-site transportation as follows:
   1. Decontaminate motor vehicles that become impacted during loading or unloading operations. After decontamination, check the motor vehicle again to verify that it is free of contamination before releasing it for transport.
   2. After loading and before leaving the Work Site or TSDF, the motor vehicle operator shall inspect and verify that the load is arranged and secured properly (based on experience and training, and in accordance with 49 CFR 392.9 and 49 CFR 393, Subpart I). Motor vehicle shall be weighed using built-in scales on the vehicle and the estimated weight of the vehicle will be recorded. Ensure compliance with applicable load restrictions.
   3. Upon acceptance of the load for transport, maintain the integrity of the load, the load arrangement, and any security seals. The motor vehicle operator shall examine and periodically reexamine the load and its load securing devices as necessary to maintain the integrity of the load and the load arrangement in accordance with 49 CFR 392.9. (Load inspections during transit do not apply to sealed trailers, only to the inspection of security seals.) Comply with the requirements of PART 3, ACCIDENT INVOLVING TRANSPORT VEHICLES upon discovery of any change in the load condition, load arrangement, or security seals (e.g., change caused by equipment/packaging failure, motor vehicle accident, adverse weather conditions, vandalism, or theft) that involves release of impacted materials.

3.6 PREPARATION AND SECUREMENT OF TRANSPORT VEHICLES/CONTAINERS

A. Do not load materials for transport for disposal without ENGINEER's approval.

B. Comply with applicable federal, state, and local regulations concerning shipping vehicles, containers, and materials.

C. Visibly display number for each transport vehicle/container.

D. Secure materials in transport vehicles/containers in accordance with regulations governing transportation of materials.

E. Bulk Solid Shipments:
   1. Clean the receiving box of the transport vehicle/container of loose debris or foreign material. Line the receiving box or container with a tub liner or polyethylene liner. Place

the liner on the floor, run up the sides, and drape over the sideboards. Neatly push the liner into corners to prevent tearing during loading and transport.

2. Load bulk materials into transport vehicles or containers in a manner which will not damage the placed tub liner. Limit the freefall of bulk materials being loaded. Place cushioning materials under and around each container for shipments of drummed/containerized materials.
3. Replace damaged liner which is incapable of providing containment.
4. Following loading, fold the liner over the loaded materials and place an overliner of polyethylene sheeting over the materials prior to securing with an approved tarpaulin in a manner to prevent loss of materials or fugitive dust emissions.

F. Perform packaging, labeling, marking, and placarding in compliance with 49 CFR 173 and 49 CFR 178. The motor vehicle operator(s) shall perform an inspection to verify that packaging, labeling, marking, and placarding are in accordance with the requirements listed above and the accompanying shipping documents. Maintain the integrity of packaging, labeling, marking, placarding, and the accompanying shipping documents in compliance with 49 CFR 177.800, Subpart A.

3.7 DECONTAMINATION

A. Decontaminate transport vehicles and containers at on-site equipment decontamination pad after loading and prior to leaving the Work Site. Remove material on the tires and axles of trucks and material on the vehicle resulting from loading operations. See Section 02 61 14 – Material Handling and Transportation: Decontamination.

3.8 DOCUMENTATION FOR THE TRANSPORTATION OF MATERIALS

A. Document the transport and disposal of materials to TSDFs on appropriate state and/or federal manifests or bills of lading, as prepared and provided by ENGINEER. Maintain shipping documents from the time the materials leave the Work Site to the time of release to TSDFs. Shipping documents for the transportation and disposal of materials will be signed by OWNER or an authorized agent of OWNER, except for materials brought on the Work Site by CONTRACTOR that are not incorporated in the Works or impacted by performance of the Works.

B. Inspect each truck before leaving the Work Site and maintain a log. Trucks shall not leave the Work Site until inspected.

3.9 NOTIFICATION

A. Notify applicable federal, state, and local representatives, or authorities having jurisdiction over the route and mode of transport, in advance of commencing transportation.

3.10 OFF-SITE IN-TRANSIT WEIGHING (BULK SHIPMENTS)

A. Weigh transport vehicles without loaded materials at certified off-site weigh scale facility approved by ENGINEER prior to entry to the Work Site.

B. Submit copy of weigh ticket for loaded vehicle to ENGINEER within 48 hours of weighing.

Ensure weigh scale receipts agree with the verbally reported weight.

3.11 TRANSPORTATION TO OFF-SITE TSDF

A. Comply with applicable requirements of regulations including, but not limited to 49 CFR 171, 49 CFR 172, 49 CFR 173, 49 CFR 177, 40 CFR 262, 40 CFR 263, and 40 CFR 761.

B. Transport material removed from the Work Site directly to TSDF approved by OWNER. Do not change either the route or mode of transport after commencing off-site operations without ENGINEER's prior written approval.

C. Mark and placard shipments in accordance with federal, state, and local regulations as applicable.

D. Employ transport vehicle operators trained in conformance with federal, state, and local regulations for hazardous materials haulers.

E. Materials shall be transported using vehicles licensed for the waste stream being transported.

3.12 DISPOSAL

A. Make all arrangements with TSDFs for the receipt and acceptance of materials removed from the Work Site.

B. Ensure that materials removed from the Work Site are properly prepared and will be accepted by TSDF selected by OWNER.

C. Weigh transport vehicles/containers at receiving TSDF weigh scales both before and after discharging their contents.

D. Such measurements will be used by ENGINEER to verify proper delivery of materials which have been removed from the Work Site and for payment purposes.

E. Immediately return to the Work Site any transported material delivered to a TSDF which is rejected by the TSDF.

3.13 ACCIDENT INVOLVING TRANSPORT VEHICLES

A. In the event of an accident, follow the procedures outlined in CONTRACTOR's Transportation Emergency Response Plan and comply with the requirements of 49 CFR 390.15 Subpart E and 49 CFR 172, Subpart G.

B. In the event of an accident involving a release of materials being transported, promptly notify ENGINEER via telephone, and prepare a written report within 5 days. The report shall include but not be limited to:
   1. Location, date, and time of the accident.
   2. Resultant damage or injury.
   3. Person(s) involved.
   4. Condition of the load.

5. Amount of materials released and amount recovered.
6. Any other pertinent information.

C. If applicable, weather conditions, distance to water sources, government agencies on the scene, and telephone number where communications can be maintained.

D. Copies of any accident/incident reports required or prepared by state or other governmental entities.

END OF SECTION

SECTION 22 05 53

PIPE DATA SHEET- PVDF TUBING AND CARRIER PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Polyvinylidene fluoride (PVDF) Tubing for chemical feed systems.

B. Carrier pipe for PVDF tubing and chemical feed systems.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Product Requirements: Requirements for transporting, handling, storing, and protecting products.

C. Inspect each shipment of tubing, pipe and fittings and make provisions for the timely replacement of damaged material. Unload by hand or use canvas slings to avoid scratching the pipe. Do not drop, slide, or drag pipe over an abrasive surface. Pipe with deep scratches and tubing with kinks and/or other signs of damage shall be removed from the Work Site and replaced with new stock.

D. Stack pipe no higher than 5 feet and provide support for the pipe barrel to prevent bending of the pipe. Cover stockpiled pipe and tubing to protect it from sunlight.

1.3 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Warranty: Include coverage for defects in material and workmanship.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. If specialized system or tools are used for installation, provide a complete set of required cutters, crimpers, etc., to allow for future maintenance or modification of the system to OWNER.

PART 2 PRODUCTS

2.1 GENERAL

A. All piping system components shall be products of the same manufacturer.

2.2 PVDF TUBING

A. NSF 61 Certified, Polyvinylidene fluoride (PVDF) tubing.

B. Opaque PVDF tube, nominal OD as required for service/selected by CONTRACTOR. Nominal working pressure of up to 150 psig.

C. Temperature Range: Minus 5 degrees C to plus 65 degrees C.

D. Fittings shall be compatible with tubing and with chemicals in use.

E. No tubing fittings shall be hidden/concealed within carrier pipe.

2.3 CARRIER PIPE

A. Carrier pipe shall be Schedule 80 CPVC piping.

B. Connections and fittings in the carrier pipe shall be long-radius bends and use wyes in place of tees to facilitate installation of PVDF tubing by pulling through assembled pipe.

C. Carrier pipe shall not be buried

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Execution Requirements: Verification of existing conditions before starting work.

C. All aboveground carrier pipe shall be installed and supported per manufacturer requirements with general slope towards open drainage points.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Nameplates.
   2. Plastic pipe markers.
   3. Plastic tape pipe markers.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Samples: Submit two labels.

D. Manufacturer's Instructions: Indicate special procedures and installation.

1.3 FIELD SAMPLES

A. Provide field Samples of labels.

B. Locate where directed by ENGINEER.

C. Accepted Sample may remain as part of the Work.

PART 2 PRODUCTS

2.1 EQUIPMENT NAMEPLATES

A. Provide name plates in accordance with the schedule at end of this Section.

B. Manufacturers standard nameplate.

C. Minimum Tag Size: 1 ½-inch tall and 3-inch wide minimum with minimum 1-inch tall lettering.

D. Indicate at a minimum the following:
   1. Manufacturer name.
   2. Model number.
   3. Serial number.
   4. Equipment size/capacity.

2.2 PLASTIC PIPE MARKERS

A. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

2.3 PLASTIC TAPE PIPE MARKERS

A. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Plastic Markers:
   1. Install plastic pipe markers in accordance with manufacturer's instructions.
   2. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

3.3 APPLICATION

A. Apply in accordance with manufacturer's instructions.

B. Apply after painting.

3.4 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean excess paint and adhesive.

3.5 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Protect finished work using clear plastic and tape.

3.6 MECHANICAL SCHEDULE

Service	Marking Type	Letter/Symbol Color	Color	Background Location	Required Markings
Process Piping	Adhesive Tape	Black	Blue	Terminations and every 12 feet	Service, Flow Direction(1)
Chemical Piping	Adhesive Tape	Yellow	White	Terminations and every 12 feet	Service, Flow Direction(1)
Valves	Nameplate	Manufacturer Standard	Manufacturer Standard	Manufacturer Standard	(2)
Equipment	Nameplate	Manufacturer Standard	Manufacturer Standard	Manufacturer Standard	(2)
Pumps	Nameplate	Manufacturer Standard	Manufacturer Standard	Manufacturer Standard	(2)

(1) As noted in PART 2, PLASTIC TAPE PIPE MARKERS
(2) As noted in PART 2, EQUIPMENT NAMEPLATES

END OF SECTION

SECTION 31 05 19.13

GEOTEXTILES FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Placement of woven geotextile material for the construction of temporary access roads.
2. Placement of non-woven geotextile material for the construction of temporary equipment decontamination pad, temporary dewatering facility, and temporary excavated material stockpiles.
3. Placement of non-woven geotextile material for the construction of temporary seasonal cover.

B. Related Requirements:
1. Section 31 23 23 - Fill.

1.2 REFERENCES

A. Definitions:
1. Geotextile: Synthetic fabric for use in geotechnical filter, separation, stabilization, or erosion control applications.
2. Minimum Average Roll Value: Average value for a specified parameter less two standard deviations.
3. TCEQ: Texas Commission on Environmental Quality.
4. TxDOT: Texas Department of Transportation.
5. USEPA: United States Environmental Protection Agency.

B. Reference Standards:
1. Section 01 40 00 - Quality Requirements: Requirements for references.
2. ASTM International:
a. ASTM D4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus.
b. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
c. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
d. ASTM D4595 - Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
e. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
f. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile.
g. ASTM D4873 - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples.
h. ASTM D4884/D4884M - Standard Test Method for Strength of Sewn or Bonded Seams of Geotextiles.

i. ASTM D5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
j. ASTM D5261 - Standard Test Method for Measuring Mass Per Unit Area of Geotextiles.
k. ASTM D6241 - Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.
l. ASTM D6706 - Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil.
m. ASTM D6767 - Standard Test Method for Pore Size Characteristics of Geotextiles by Capillary Flow Test.

1.3 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate installation of geotextile after satisfactory surface preparation.

1.4 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum 1 week prior to commencing work of this Section.

C. Purpose of Meeting:
1. Define Work Site-specific quality control and monitoring procedures.
2. Discuss pre-installation submittals.
3. Identify daily schedule.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit no later than 10 days prior to ordering.

C. Samples: Submit a representative sample at least 6 feet by roll width for each type of geotextile no later than 10 days prior to ordering.

D. Manufacturer's Instructions: Submit at least 14 days prior to installation. Include installation, handling, storage, and repair instructions.

E. Manufacturer's Certificates:
1. Deliver each roll to the Work Site accompanied by manufacturer's certificate.
2. Identify each roll by unique manufacturing number.
3. Include results of at least the tests specified for each respective product in PART 2, GEOTEXTILE.
4. Provide manufacturer's records for storage, handling, and shipping of geotextile.
5. Quality control certificates signed by manufacturer and notarized.

F. Daily Field Installation Report. Submit no later than 1 day following date covered by report. Include:
   1. Total amount and location of geotextile placed.
   2. Identifiers of rolls.
   3. Changes in layout drawings.
   4. Record of defects caused during transportation and handling.
   5. Observations of weather conditions, and results.
   6. Observations of anchor trench excavation, backfilling, and compaction.
   7. Observations of repairs, including locations and name of repairer.

G. Layout Drawings: Submit drawings of proposed geotextile placement patterns. Provide no later than 14 days prior to installation.

H. Qualification Statements:
   1. Installer: Submit copy of manufacturer's approval letter or license no later than 14 days prior to installation.
   2. Manufacturer: Submit no later than 14 days prior to ordering, list of previous projects totaling 3 million sq ft of installation, and five projects including name of project, description of project, area, client's name and address, contacts, and telephone numbers; engineer's name, address, contact, and telephone number; installer's name, address, contact, and telephone number; and date installed.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Project Record Documents: Record actual locations of all placed geotextile that is to remain in place at the completion of the project.

C. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer in accordance with Section 01 70 00.

1.7 QUALITY ASSURANCE

A. Perform work of this Section according to, and in conformance with, applicable codes and standards of TCEQ, USEPA, and TxDOT.

B. Certifications: Obtain certificate of compliance from authority having jurisdiction.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 20 projects, 10 million sq ft of manufacturing, and 3 years of documented experience.

B. Installer: Company specializing in performing work of this Section and approved by the manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver geotextile bearing manufacturer's seals and labels intact. Clearly label each roll to show geotextile identification, date of manufacture, lot number, analysis of contents, and special instructions.

C. Store and handle geotextile according to manufacturer's recommendations and ASTM D4873, in manufacturer's original covers. Protect from moisture, dust, light, and heat.

D. Notify ENGINEER 3 days in advance of delivery to the Work Site. Perform joint inspection with ENGINEER upon delivery. Defects or damage from shipping and handling will be grounds for rejection of a portion of geotextile or of the entire geotextile roll at ENGINEER's discretion. Remove rejected material from the Work Site and replace with new material.

1.10 AMBIENT CONDITIONS

A. Install geotextile according to manufacturer's instructions.

B. Suspend installation operations whenever climatic conditions, as determined by ENGINEER, are unsatisfactory for placing geotextile to the requirements of this Section.

1.11 EXISTING CONDITIONS

A. See the Drawings and Design Report.

PART 2 PRODUCTS

2.1 GEOTEXTILE

A. General:
1. Rot-proof, mildew-proof, and not subject to attack by insects or rodents.
2. Capable of retaining its structure during handling, placement, and long-term service.

B. Geotextile G1:
1. Description:
a. Non-woven, needle-punched geotextile made of polypropylene that meets or exceeds the following values:

Test	*Unit*	*Test Method*	*Minimum Average Roll Value*
Unit Weight	ounce/yd^2	ASTM D5261	8
Tensile Strength	pound	ASTM D4632/4632M	220
Elongation at Break	percent	ASTM D4632/4632M	50
Static CBR Puncture	pound	ASTM D6241	575
Trapezoid Tear Strength	pound	ASTM D4533	90
AOS(1)	US Sieve	ASTM D4751	80

Test	*Unit*	*Test Method*	*Minimum Average Roll Value*
Permittivity	sec^{-1}	ASTM D4491	1.26
Permeability	cm/s	ASTM D4491	0.30
Water Flow Rate	gpm/ft^2	ASTM D4491	95
Ultra Violet Resistance	percent retained/ 500 hours	ASTM D4355	70
(1) Maximum average roll value			

C. Geotextile G2:
   1. Description:
      a. Non-woven, needle-punched geotextile made of polypropylene that meets or exceeds the following values:

Test	*Unit*	*Test Method*	*Minimum Average Roll Value*
Unit Weight	$ounce/yd^2$	ASTM D5261	12
Tensile Strength	pound	ASTM D4632/4632M	320
Elongation at Break	percent	ASTM D4632/4632M	50
Static CBR Puncture	pound	ASTM D6241	900
Trapezoid Tear Strength	pound	ASTM D4533	125
AOS(1)	US Sieve	ASTM D4751	100
Permittivity	sec^{-1}	ASTM D4491	0.80
Permeability	cm/s	ASTM D4491	0.29
Water Flow Rate	gpm/ft^2	ASTM D4491	60
Ultra Violet Resistance	percent retained/ 500 hours	ASTM D4355	70
(1) Maximum average roll value			

D. Geotextile G3:
   1. Description:
      a. Woven geotextile weaved with polypropylene filaments to provide reinforcement strength, soil interaction, and water flow capabilities.
   2. Product:
      a. Mirafi® RS380i, as manufactured by Tencate Geosynthetics, or approved equal.
      b. Substitutions shall be made in accordance with Section 01 60 00.
      c. Proposed substitute shall meet or exceed the following performance criteria:

Mechanical Properties	*Unit*	*Test Method*	*Typical Roll Value*	*Minimum Average Roll Value*
Tensile Strength @ 2 percent strain (MD)	lbs/ft	ASTM D4595	720	600
Tensile Strength at 2 percent Strain (CD)	lbs/ft	ASTM D4595	1200	1020
Tensile Strength @ 5 percent strain (MD)	lbs/ft	ASTM D4595	2100	1800
Tensile Strength @ 5 percent strain (CD)	lbs/ft	ASTM D4595	2580	2256
Flow Rate	$gal/min/ft^2$	ASTM D4491	85	75[1]
Permittivity	sec^{-1}	ASTM D4491	1.2	0.9[1]
			Typical Roll Value	
Pore Size O_{95}	microns	ASTM D6767	365	

Mechanical Properties	*Unit*	*Test Method*	*Typical Roll Value*	*Minimum Average Roll Value*
Pore Size 0_{50}	microns	ASTM D6767	185	
Index Properties			Maximum Opening Size	
Apparent Opening Size (AOS)	U.S. Sieve	ASTM D4751	50	40
			Minimum Test Value	
Interaction Coefficient	--	ASTM D6706	0.89	
Factory Sewn Seam	lbs/ft	ASTM D4884/D4884M	2700	
UV Resistance (at 500 hours)	% strength retained	ASTM D4355	90	

[1] Minimum Roll Value

2.2 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Manufacturer Quality Control:
1. Sample and test geotextile material at a minimum once every 100,000 sq ft for tests specified for each respective product in PART 2, GEOTEXTILE, to demonstrate that the material conforms to requirements as specified. Test for UV stability and apparent opening size at a minimum once every month.
2. Perform samples on sacrificial portions of material so that repair of material is not required.
3. If geotextile sample fails to meet the quality control requirements of this Section, sample and test each roll manufactured in the same lot, or at the same time, as the failing roll. Continue sampling and testing of rolls until a pattern of acceptable test results is established.
4. At geotextile manufacturer's discretion and expense, additional testing of individual rolls may be performed to more closely identify the non-complying rolls and/or to qualify individual rolls.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution Requirements: Verification of existing conditions before starting work.

B. Verify that surfaces and Work Site conditions are ready to receive work.

3.2 PREPARATION

A. Prior to geotextile placement, provide necessary equipment and personnel to maintain an acceptable supporting surface during fabric installation.

B. Examine geotextile for defects including rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or handling.

C. Remove defective or damaged geotextile from the Work Site.

3.3 INSTALLATION

A. Notify ENGINEER at least 24 hours in advance of intention to commence placement of geotextile.

B. Do not permit placement of overlay materials until ENGINEER has inspected and approved installation of geotextile.

C. Obtain approval of ENGINEER prior to installation of geotextile.

D. Place geotextile on a prepared base as shown on the Drawings.

E. Unfold or unroll geotextile according to manufacturer's instructions, directly on prepared base, in conditions which will prevent damage to both geotextile and base grade. Unsuitable conditions include, but are not limited to, moderate to high wind conditions.

F. Overlap dimensions and method of joining adjacent sheets shall be performed in accordance with manufacturer's instructions.

G. Do not entrap stones in geotextile during placement.

H. Do not expose geotextiles to sunlight for more than 14 days, or as recommended by manufacturer.

I. Position and deploy geotextile to minimize handling. Lay smooth and free of tension, stress, folds, or creases. Protect properly placed geotextile from displacement, contamination by surface runoff, or damage, until and during placement of overlaid materials.

J. Place geotextile on sloping surfaces in one continuous length.

K. Do not permit passage of vehicular traffic directly on geotextile at any time.

L. Place geotextile by unrolling onto graded surface and retain in position as specified.

M. Remove and replace damaged or deteriorated geotextile as directed by ENGINEER.

N. Protect installed geotextile material from dust, fine particles, and debris prior to placing overlying layer.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. ENGINEER will inspect geotextile in place for tears, overlaps, and consistency before placement of materials thereon. Damaged sections, as judged by ENGINEER, will be

marked and their removal from the work area recorded. Repair minor damage and minor defects as specified in manufacturer's procedures, when approved by ENGINEER, to ENGINEER's satisfaction.

C. ENGINEER will verify that weather conditions (appropriate air temperature, non-excessive wind, and lack of precipitation) are acceptable for panel placement.

D. Conformance Testing:
   1. Samples of geotextiles may be removed by ENGINEER and sent to laboratory for testing to ensure conformance with the requirements of this Section.
   2. This testing will be carried out prior to installation of geotextile.
   3. ENGINEER may collect additional samples in the event that initial test results do not comply with requirements of PART 2. This additional testing will be performed at CONTRACTOR's expense.
   4. As a minimum, the following conformance tests will be performed on the geotextile sample: mass per unit area; tensile strength; grab strength; tear strength; and puncture strength, AOS and permittivity test.
   5. Geotextile material that is not certified according to PART 1, or that conformance testing indicates does not comply with PART 2, will be rejected by ENGINEER. Replace rejected material with suitable material, at no additional cost to OWNER.

END OF SECTION

SECTION 31 10 10

SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Removal and disposal of surface debris.

B. Clearing and grubbing, including tree/shrub removal.

C. Removal, salvage, and storage of existing fence.

1.2 DEFINITIONS

A. Clearing: Felling, trimming, and cutting of trees into sections and the satisfactory disposal of trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

B. Grubbing: Removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Control the amount of dust resulting from operations to avoid creation of a nuisance in the surrounding area.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that existing surface features designated to remain are tagged or identified.

C. Notify ENGINEER of intention to commence soil removal activities.

3.2 PREPARATION

A. Protect utilities and surface features designated to remain from damage resulting from construction operations by the erection of barriers or by such other means as circumstances require.

3.3 CLEARING AND GRUBBING

A. Clear areas required for access to the Work Site and execution of the Works.

B. Cut off trees, stumps, roots, brush, and other vegetation in areas to be cleared, flush with or below the original ground surface.

C. Remove debris, rock, and extracted plant life.

D. Dispose of trees, logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations off-site.

3.4 REMOVALS

A. Remove existing fencing as required to access excavation areas.
   1. Store salvaged fence and posts, so that they are protected from damage during Works. Replace materials damaged by CONTRACTOR at no additional cost to OWNER.
   2. Dispose fence and posts not suitable for reuse off site, as determined by ENGINEER.
   3. Reinstall fence in accordance with Section 32 31 13.

B. Continuously clean up and remove waste materials from the Work Site; do not allow waste materials to accumulate.

END OF SECTION

SECTION 31 23 16

EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavating impacted soil.

1.2 REFERENCES

A. DEFINITIONS
1. Excavation: Removal of materials of whatever nature encountered, whether wet, or otherwise, including dense tills, hardpan, cemented materials, concrete fragments, asphalt pavement, boulders or rock fragments, and weathered rock which can be removed by ripping or excavating with heavy duty mechanical construction equipment without drilling and blasting.
2. Excavation Limits: Areal excavation limits shown on the Drawings to specified depth or as directed by ENGINEER.
3. Additional Excavation: Excavation beyond initial excavation limits either areally or in depth, as directed by ENGINEER.
4. Rock: Material from solid masses of igneous, sedimentary, or metamorphic rock which, prior to its removal, was integral with its parent mass, and boulders or rock fragments having individual volume in excess of 1 cu yd.

B. Reference Standards:
1. Section 01 40 00 - Quality Requirements: Requirements for references.
2. ASTM International:
a. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.

1.3 PROGRESS SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Excavation Plan: 14 days prior to mobilization to the Work Site, submit a detailed Excavation Plan demonstrating compliance with specified requirements and to permit ENGINEER to schedule testing and measurement activities. Include written procedures, schedules, and drawings as applicable and, at a minimum, address each of the following items:

1. Methods and procedures which will be used to perform excavation.
2. Sequencing and scheduling of excavation activities.
3. Location of temporary decontamination facility.
4. Sequencing and layout of access routes to and from excavation areas.

5. Methods and procedures which will be used to perform additional excavation in open excavations, if required.
6. Anticipated crew sizes, worker hours, types of equipment, and equipment hours on a weekly basis.
7. Sloping of excavation faces and slope stability issues.
8. Methods of monitoring movement of adjacent structures (i.e., I-10 bridge).

1.4 ENVIRONMENTAL REQUIREMENTS

A. Protect open excavations against damage due to surface water runoff and runon. Take necessary precautions to prevent erosion of excavated or disturbed surfaces.

B. Suspend operations whenever climatic conditions, as determined by ENGINEER, may detrimentally affect the excavation work.

C. After occurrence of heavy rains, refrain from operating equipment on approved excavations until the material has dried sufficiently to prevent occurrence of excessive rutting.

D. Decontaminate equipment involved in excavation activities which may have come in contact with potentially impacted material before being removed from the Work Site or being relocated to clean areas of the Work Site.

1.5 SCHEDULING

A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.

B. Coordinate sequencing and scheduling of excavation activities with work of other Sections.

C. Do not allow or cause any of work performed to be covered up or enclosed prior to required inspections, tests, or approvals.

PART 2 PRODUCTS

2.1 PLASTIC SHEETING

A. In accordance with ASTM D4397.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that survey benchmarks and existing and design elevations for the Works are as shown on the Drawings.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Stake limits of excavation areas.

C. Arrange for utility company to identify and relocate utilities, if necessary.

D. Protect plant life, and other features remaining as a portion of final landscaping.

E. Maintain and protect from damage utilities, surface features, and structures encountered (not designated for demolition or removal). In the event of disturbance of or damage to any such well, utility, surface feature, or structure, immediately notify ENGINEER. Repair or replace, as directed by ENGINEER.

F. Protect existing facilities, surface features, and structures where temporary unbalanced earth pressures or uplift are liable to develop utilizing bracing, shoring, or other approved methods to counteract unbalance.

G. Employ procedures for excavation such that uplift and displacement or disturbance of lines, utilities, surface features, and structures is avoided.

H. Protect excavations from contamination.

I. Obtain direction from ENGINEER before moving or otherwise disturbing monitoring wells, utilities, surface features, and structures.

3.3 SHORING AND BRACING

A. Do not allow the sides of the excavation to become unsafe. Maintain sides and slopes of excavations in safe condition by appropriate methods as verified by CONTRACTOR’s registered engineer.

3.4 EXCAVATION

A. Excavate to lines, grades, elevations, and dimensions shown on the Drawings or as directed by ENGINEER.

B. Excavate to elevations and slopes, as shown on Drawings.

C. Remove debris and other obstructions encountered.

D. Notify ENGINEER of unexpected subsurface conditions and discontinue affected work in area until notified to resume work.

E. Open excavations shall be CONTRACTOR's sole responsibility.

3.5 OVER-EXCAVATING

A. Should unauthorized excavation be carried below the lines and grades shown on the Drawings and in excess of specified limits and tolerance because of CONTRACTOR's operations including errors, methods of construction, or to suit his convenience, correct unauthorized excavation as follows:

B. Excavations beyond the lines and grades shown on the Drawings not authorized in writing by the ENGINEER or additional excavation to remove weakened or disturbed soil caused by CONTRACTOR's error, unsuitable construction methods or procedures, or to suit CONTRACTOR's convenience and subsequent additional backfill and compaction to correct deficiencies shall be at no additional cost to OWNER.

3.6 PROTECTING CLEAN SOIL FROM CONTAMINATION

A. Prevent contamination of clean soil adjacent to the excavation.

B. Place plastic sheeting and/or plywood, as needed, under excavation equipment and alongside the excavation to prevent impacted soil from being mixed with surrounding clean soil. Use other means of preventing contamination subject to approval by ENGINEER. Do not mix excavated soil with imported materials.

C. Where possible, load soil and materials to be disposed of off-site directly into transport vehicles for on-site staging for dewatering and potential solidification prior to off-site disposal. ENGINEER may direct clean or non-characterized excavated soils to be handled as waste.

D. Decontaminate excavation equipment after handling excavated materials and prior to handling clean backfill materials or traveling on clean areas of the Work Site. ENGINEER will direct additional decontamination as necessary in the opinion of ENGINEER.

3.7 EXCAVATING IMPACTED MATERIALS

A. Identify excavated areas by survey stakes, or other appropriate method. Excavate each area by first removing the overlying TCRA cap (reusable) prior to removal of underlying materials.

B. Verify excavation depths using Topcon 3DXi/GPS, indication system, or equivalent grade control system, for excavation control. Enter 3D topographic data into the machine’s computer system prior to start of excavation activities. Ensure accuracy of GPS is within the machine’s typical +/-0.10 inch range or equivalent.

C. No personnel shall enter the excavation, when possible.

D. Excavate soils to depths and dimensions as shown on the Drawings and as directed by ENGINEER. Use GPS-based controls to remove materials to designated elevations.

E. Where possible. perform excavation in such a manner that only the excavation bucket and boom contacts materials from depth intervals to be excavated.

F. Keep limits of excavation undisturbed and free of loose, soft, or organic matter.

G. Maintain excavation depth tolerances. Unless directed by ENGINEER, excavation in excess of specified limits shall be considered unauthorized over-excavation.

H. Should unauthorized excavation be carried below the lines and grades shown on the Drawings and in excess of specified limits and tolerance because of CONTRACTOR's operations including errors, methods of construction, or for sake of convenience, correct unauthorized excavation as described in PART 3, OVER-EXCAVATING.

I. Use methods and equipment that result in minimal disturbance to areas outside the excavation limits.

J. Upon completion of excavation, confirm removal to the required elevations for each seasonal area, in accordance with the Drawings, by survey or grade control system data.

K. Keep excavations open until directed by ENGINEER to be covered pending receipt and review of survey results from the excavated surface. Following receipt of survey results, ENGINEER may direct CONTRACTOR to horizontally extend the limits of the excavation, excavate an additional depth of soil, or commence cap replacement. For the duration of an open excavation, maintain the excavation reasonably free from water and adequately mark the open excavation with temporary fencing to restrict access until the excavation is properly backfilled.

L. Schedule excavation activities in such a manner that access is available to any excavation area for additional excavation as directed by ENGINEER. When returning to an area for additional excavation, comply with previously specified access route restrictions.

M. Decontaminate excavation equipment periodically and as directed by ENGINEER. Decontaminate equipment when visibly contaminated. ENGINEER will direct additional decontamination when required in the opinion of ENGINEER.

3.8 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Within 2 inches greater or less than specified depth but not uniformly greater or less.

3.9 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. Survey and provide grade control system data to confirm vertical and horizontal limits of excavation. Submit surveying data to ENGINEER immediately to confirm the limits of removal.

3.10 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean and reinstate work areas and areas affected by equipment outside areas specified to be excavated, to specified restoration condition.

3.11 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Protect bottom of excavations from disturbance, and recontamination by soils to be excavated and removed.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Design, installation, operation, and maintenance of a Dewatering System.

B. Related Requirements:
   1. Section 01 57 13 – Temporary Soil Erosion and Sediment Controls.
   2. Section 01 57 19 – Temporary Environmental Controls.
   3. Section 31 23 16 – Excavation.

1.2 REFERENCES

A. Abbreviations:
   1. TSS: Total Suspended Solids.

B. Definitions:
   1. Dewatering System: A system to allow construction activities to be carried on in areas relatively free of standing water that will inhibit excavation activities, including but not limited to: lowering of groundwater table, surface water control, storm water and precipitation control, and seepage control.
   2. Surface Water Control: Removal of surface water within open excavations.
   3. Seepage Control: Removal of water originating from seepage, including seepage through any embankment and upward seepage from the bottom of excavations. Seepage control consists of the collection or control of seepage, preventing or controlling it from entering the construction area and directing the seepage to collection and treatment systems.

1.3 SYSTEM DESCRIPTION

A. Provide Dewatering System to maintain stability of the base of excavations, to keep the excavation reasonably dry and free of standing water to allow excavation of waste material.

B. The Dewatering System shall consist of sumps, sump pumps, ditches, trenches, dikes, berms, cofferdams and combinations thereof and all necessary appurtenances. The system may also include construction methods that divert the flow of water away from the construction area.

C. System capacity shall be continuously reviewed during operation and, if necessary, increased or otherwise modified to ensure that the installed capacity is adequate to provide the required removal of water to allow excavation activities to continue. Any required increases in system capacity shall be added at no additional cost to OWNER.

1.4 PRE-INSTALLATION MEETING

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum 1 week prior to commencing work of this Section.

1.5 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate work to permit construction to be completed on dry stable substrate.

C. Coordinate the work of this Section with relevant utility companies and authorities having jurisdiction.

1.6 SEQUENCING

A. Section 01 10 00 – Summary: Requirements for sequencing.

B. Sequence work to obtain required permits before start of dewatering operations.

C. Sequence work to install and test monitoring systems minimum 7 days before operating dewatering systems.

D. Sequence work to install and test dewatering and surface water control systems minimum 7 days before starting excavation.

1.7 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Dewatering Plan: The plan shall contain all supporting calculations and the following details:
   1. The planned location and layout, sizes, and capacities of the Dewatering System components.
   2. Proposed locations of collection sumps pipelines, and transfer pumps.
   3. Plan of normal operation.
   4. Capacities of power-supply facilities, backup power, and description of standby components and spare parts.

C. Shop Drawings:
   1. Indicate Dewatering System layout, sump locations and depths, bottom grade of excavation, pump locations, discharge piping and hose pathway locations, and location of any vertical or horizontal intake screens to be used.
   2. Indicate equipment location and capacity.
   3. Indicate layout of discharge hoses or pipe, including road crossing details where required.
   4. Include detailed description of Dewatering System capacity, operating procedures and maintenance of equipment.
   5. Include description of emergency procedures to follow when problems arise.
   6. Details of screens and filter media, if any proposed.

D. Product Data: Submit data for each of the following:
   1. Dewatering Pumps: Indicate sizes, capacities, priming method, motor characteristics.
   2. Other Equipment: Indicate sizes, capacities of any other equipment used in the dewatering system.

E. Design Data
   1. Indicate design values, analyses, and calculations to support design of equipment to be used.

1.8 QUALITY ASSURANCE

A. CONTRACTOR is responsible to prepare and implement a contingency plan should water overwhelm the specific work area within the BMP.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Design Dewatering System to reduce groundwater pressure and lower groundwater levels for stable undisturbed and substantially dry subgrade.

B. Design Dewatering System so that settlement is not caused by extraction of fine particles from soil during dewatering. Demonstrate to acceptance of ENGINEER that will meet TSS requirements 12 hours after commencement of pumping.

C. Design surface water control systems to collect and remove surface water and seepage entering excavation.

2.2 DEWATERING EQUIPMENT

A. Pumps: Suited for this application and actual field conditions. Pumping equipment for dewatering of the excavations to facilitate waste material removal shall be properly sized to maintain a dry excavation.

B. Pipes:
   1. Leak free with fittings of compatible materials and of corresponding weight and quality.
   2. Size, length, and type as required to accommodate flow from the pumps.
   3. Standpipe: Sufficient size to accommodate the flow.

C. Accessories:
   1. Furnish valves, fittings, and other necessary accessories of compatible material and of required strength and quality for application.

D. Keep available sufficient standby equipment to ensure continuous operation of the Dewatering System. The number of standby components and spare parts shall be determined by CONTRACTOR in consideration of known reliability and availability.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Examine Work Site to establish locations for dewatering equipment and related piping.

3.2 PREPARATION

A. Protect existing adjacent structures and improvements from damage caused by dewatering operations.

B. Intercept and direct surface water away from excavations and monitoring equipment by use of dikes, curb walls, ditches, pipes, sumps, or other means to ENGINEER's acceptance.

3.3 INSTALLATION

A. Install Dewatering System in accordance with approved Dewatering Plan.

B. During duration of operation, maintain Dewatering System safely in accordance with regulations and requirements of authorities having jurisdiction.

C. Clearly identify location of Dewatering System installations and install barricades and signs necessary to ensure safety to workers and to pose no hazard.

D. Prior to excavation for Dewatering System, locate existing underground utilities and make provisions in Dewatering System installation to accommodate such utilities.

3.4 DEWATERING

A. Operate Dewatering System in accordance with accepted Dewatering Plan and Shop Drawings.

B. Provide and maintain pumps, sumps, suction mains, and other Dewatering System components necessary to convey water away from excavations.

C. Keep precipitation and drainage water away and clear of the Works area. Keep excavation dry.

D. Operate dewatering sumps continuously until standing and free water has been removed from excavation area. Maintain operation of each sump in each work area to remove free water which accumulates in sump until sump is removed. Do not remove sumps from operation without approval of ENGINEER.

E. Maintain continuous and complete effectiveness of installation. Supply and install sufficient backup pumping and power equipment to maintain uninterrupted operation.

F. Design and operate dewatering systems to:
   1. Prevent loss of ground as water is removed.

2. Avoid inducing settlement or damage to completed work.
3. Relieve uplift pressures at bottom of excavation.

G. Provide standby equipment to ensure continuity of dewatering operations.

H. Transport water removed by Dewatering System to Water Treatment System.

3.5 OPERATION AND MAINTENANCE OF DEWATERING SYSTEM

A. Inspect Dewatering System on a daily basis in the presence of ENGINEER.

B. Operate Dewatering System continuously until excavation and restorations are completed or otherwise directed by ENGINEER.

C. Provide continuous supervision of Dewatering System by personnel skilled in operation, maintenance, and replacement of system components.

D. Conduct daily observation of Dewatering System and monitoring system. Make required repairs and perform scheduled maintenance.

E. Refill fuel tanks in a safe and environmentally sound manner.

F. Start emergency generators at least twice each week to check operating condition.

G. When Dewatering System cannot control water within excavation, notify ENGINEER and stop excavation work.
1. Supplement or modify Dewatering System and provide other remedial measures to control water within excavation.
2. Demonstrate Dewatering System operation complies with performance requirements before resuming excavation operations.
3. Modify Dewatering System when operation causes or threatens to cause destabilization of excavation.

H. Do not discontinue dewatering operations without ENGINEER's approval.

I. Route discharge lines and provide vehicle crossing over pipes or hoses without damage.

J. Flows from the Dewatering System shall be discharged to the Water Treatment System, unless otherwise authorized by ENGINEER.

3.6 REMOVAL OF DEWATERING SYSTEM

A. Remove Dewatering System after dewatering operations are discontinued.

B. Repair damage caused by Dewatering System or resulting from failure of Dewatering System to protect property.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. Where critical structures or facilities existing immediately adjacent to areas of proposed dewatering, reference points shall be established and observed twice daily to detect any settlement which may develop.

END OF SECTION

SECTION 31 23 23

FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Stockpiled material from existing berms for potential reuse.

B. Common Fill for construction of berms for temporary facilities.

C. Topsoil for restoration.

D. Structural Fill as base material for temporary access roads/ramps and construction of restored south embankment.

E. Soil Fill For between double sheet pile walls

F. Sand for temporary dewatering facility and containment areas.

G. Coarse Aggregate for temporary access road/ramps and raised bench.

H. Clear Stone for use at treated water discharge to river and dewatering facility sump.

I. Filling and grading prior to final restoration.

1.2 SUPPLIED MATERIALS FROM OFF-SITE SOURCES

A. General:
1. From accepted commercial source, as accepted by ENGINEER.
2. Free of unsuitable materials including:
   a. Trees, stumps, branches, roots, noxious weeds or other wood or lumber.
   b. Rocks larger than 2 inches.
   c. Wire, steel, cast iron, cans, drums, or other foreign material.

B. Common Fill:
1. Well graded.
2. Free of rocks larger than 2 inches, loam, organic matter, very soft clays, swelling clays, or fine uniform sands that may be difficult to compact.
3. A liquid limit of not more than 35 and plasticity index of not more than 12 in accordance with ASTM D4318.
4. ASTM D2487 Group Symbol: Any except those described as poorly graded and except CH, MH, OL, and OH.

C. Topsoil:
1. Friable loam neither of heavy clay nor of very light sandy nature.

2. Reasonably free of roots, fragments larger than 3 inches in size, rocks or lumps larger than 1 inch in diameter, debris, weeds, plants or their roots, vegetation, seeds of noxious weeds, stolons, seeds; salts; soil sterilants; chemical contaminants; invasive species; or other materials detrimental to plant growth.
3. Acidity Range (pH): 5.5 to 7.5, determined in accordance with ASTM D4972.
4. Containing minimum 2 percent and maximum 10 percent organic matter determined in accordance with ASTM D2974.
5. Containing salt less than 2.0 ms/cm (millisiemens/cm) total salts.
6. Capable of supporting growth of grass.

D. Sand:
1. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.

E. Soil Fill For Between Sheet Pile Walls, Structural Fill, Coarse Aggregate, and Clear Stone as specified in PART 2.

1.3 REFERENCES

A. Section 01 40 00 - Quality Requirements: Requirements for references.

B. Definitions:
1. SMDD: Standard Maximum Dry Density and in the context of this Contract means the maximum dry unit weight determined according to ASTM D698.

C. ASTM International (ASTM):
1. C117 - Standard Test Method for Materials Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing.
2. C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
3. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
4. D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
5. D2974 Standard Test Methods for Determining the Water (Moisture) Content, Ash Content, and Organic Material of Peat and Other Organic Soils.
6. D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
7. D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
8. D4972 - Standard Test Methods for pH of Soils.
9. D6913/D6913M - Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis.
10. D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
11. D7928 - Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis.

D. Texas Department of Transportation (TxDOT): Standard Specification for Construction and Maintenance of Highways, Streets, and Bridges.

E. United States Environmental Protection Agency (USEPA): Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846, Third Edition, Final Updates I (1993), II (1995), IIA (1994), IIB (1995), III (1997), IIIA (1999), IIIB (2005), IV (2008), V (2015), VI (2019), and VII (2020).

1.4 PROGRESS SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Submit evidence for each imported material, in form of chemical analysis for parameters specified in Paragraph 2.9 G-H, that material is free of hazardous substances. If fill materials will be obtained from a state-certified quarry, chemical characterization specified in 2.9 G-H may not be required.

C. Samples: Submit, in airtight bag or container, 5-pound sample of each type of imported fill to ENGINEER.

D. Independent Geotechnical Testing Firm: Submit the name and qualifications of the independent geotechnical testing firm proposed by CONTRACTOR to provide geotechnical testing services for work of this Section.

E. Independent Testing Laboratory: Submit the name and qualifications of the independent testing laboratory proposed by CONTRACTOR to provide chemical analysis for work of this Section.

F. Suppliers' Certificates: Submit certificate indicating that each type of imported fill meets or exceeds specified requirements.

G. Test Reports: Submit test reports certifying compliance with specified requirements prior to commencing transport to the Work Site.

H. Analytical Results: Submit chemical analytical results for each type of imported fill prior to commencing transport to the Work Site.

I. Geotechnical Data: Submit geotechnical data for materials prior to commencing transport to the Work Site. Submit grain size distribution curves, density, and moisture content for each type of aggregate material. Show average distribution and minimum and maximum variation in gradation for each grain size distribution curve.

J. Weigh Tickets: Submit at the start of the work day following delivery weigh tickets generated at Supplier's weigh scale of imported fill delivered to the Work Site.

K. Weigh Scale Calibration: Submit a calibration chart, completed within the previous 6 months, for weigh scale. Weigh scale shall be calibrated by State of Texas agency.

1.5 QUALIFICATIONS

A. Geotechnical Testing Firm: Company specializing in performing work of this Section and complying with ASTM D3740 to perform testing of fill materials including density, moisture content, permeability, and particle size analysis for both soil and aggregate samples.

B. Independent Testing Laboratory: Company specializing in performing work of this Section to perform chemical analysis of fill material samples for parameters specified in Paragraph 2.9 G-H.

1.6 QUALITY ASSURANCE

A. Perform work of this Section in accordance with TxDOT Standard Specification for Construction and Maintenance of Highways, Streets, and Bridges.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver, handle, and transport fill materials at all times in a manner and with equipment that will prevent intermixing of aggregate types, segregation, or contamination.

C. Minimize stockpiling requirements. Transport material from source directly to final position where possible.

D. Stockpile fill materials on-site in locations accepted by ENGINEER.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Suspend operations whenever climatic conditions, as determined by ENGINEER, are unsatisfactory for placing fill to the requirements of this Section.

B. After occurrence of heavy rains, do not operate equipment on previously placed material or on accepted surfaces until the material has dried sufficiently to prevent occurrence of excessive rutting.

C. Where surfaces or previously placed material have been softened or eroded, remove soft and yielding material or otherwise objectionable or damaged areas and replace with compacted fill as specified by ENGINEER.

D. Decontaminate equipment involved in grading activities which may have come in contact with potentially impacted material before being removed from the Work Site or being relocated to clean areas of the Work Site.

1.9 SEQUENCING AND SCHEDULING

A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.

B. Coordinate and sequence filling operations to minimize the need for double handling.

C. Coordinate and sequence filling operations to minimize open excavations at all times.

PART 2 PRODUCTS

2.1 GENERAL

A. Imported fill to be from an accepted source.

B. Fill material to be free of unsuitable materials including:
   1. Trees, stumps, branches, roots, vegetation, or other wood or lumber.
   2. Wire, steel, cast iron, cans, drums, or other foreign material.
   3. Materials containing hazardous or toxic constituents at hazardous or toxic concentrations.

C. Compactable to specified density at specified moisture content.

2.2 EXISTING BERM MATERIAL

A. Existing berm material to be excavated and stockpiled pending analysis in accordance with PART 2, SOURCE QUALITY CONTROL.

B. Reuse of stockpiled berm material to be determined pending analysis. Decisions regarding reuse of excavated material will be made by OWNER.

2.3 SOIL FILL FOR BETWEEN SHEET PILE WALLS

A. Soil Type S1:
   1. Unit weight = 130 pounds per cubic foot or less.
   2. Non-cohesive material.
   3. Gradation to allow self-compaction:

Sieve Size	**% Passing**
3/8”	100
#4	95-100
#16	45-80
#50	10-30
#100	0-10
#200	0-5

2.4 STRUCTURAL FILL

A. Soil Type S2: Sandy clay (CL) or clayey sand (SC)
   1. Liquid limit (LL) no greater than 35
   2. Plasticity indices (PI) between 8 and 18
   3. No less than 30 percent retained on the U.S. Standard No. 200 Sieve.

2.5 COMMON FILL

A. Soil Type S3: According to requirements for common fill (see PART 1, SUPPLIED MATERIALS FROM OFF-SITE SOURCES).

2.6 SAND

A. Soil Type S4: According to requirements for sand (see PART 1, SUPPLIED MATERIALS FROM OFF-SITE SOURCES).

2.7 COARSE AGGREGATE

A. Aggregate Type A1: #610 Limestone of the following gradation:

Sieve Size	**% Passing**
1 1/2”	100
1”	90-100
3/4”	70-95
3/8”	50-80
#4	35-65
#10	25-50
#40	10-26
#200	4-12

2.8 CLEAR STONE

A. Aggregate Type A2: Clear stone of gradation according to AASHTO #57:

Sieve Size	**% Passing**
1 1/2”	100
1”	95-100
1/2”	25-60
#4	0-10
#8	0-5
#200	0-2

2.9 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Testing and Analysis of Existing Berm Material:
   1. Particle Size, ASTM D6913/D6913M and D7928: One sample per 2,500 cu yd of material required.
   2. Soil Classification, ASTM D2487: One sample per 2,500 cu yd of material required.
   3. Chemical Analysis: One sample per 2,500 cu yd of material required, with analysis only for dioxins/furans in accordance with Paragraph 2.9 G-H.

C. Testing and Analysis of Aggregate Types A1 and A2 (Coarse Aggregate and Clear Stone):
   1. Grain Size, ASTM C117 and C136/C136M: 1 sample per 2,500 cu yd of aggregate required.
   2. Chemical Analysis: 1 sample per source. In accordance with Paragraph 2.9 G-H.

D. Testing and Analysis of Soil Types S1 and S2 (Fill for Between Sheet Pile Walls and Structural Fill):
   1. Particle Size, ASTM D6913/D6913M and D7928: One sample per 2,500 cu yd of material required.
   2. Soil Classification, ASTM D2487: One sample per 2,500 cu yd of material required.
   3. Chemical Analysis: 1 sample per source. In accordance with Paragraph 2.9 G-H.

E. Testing and Analysis of Soil Type S3 (Common Fill) and Sand:
   1. Chemical Analysis: 1 sample per source. In accordance with Paragraph 2.9 G-H.

F. Testing and Analysis of Topsoil:
   1. Particle Size, ASTM D6913/D6913M and ASTM D7928: 1 sample per 2,500 cu yd, or portion thereof, of topsoil required.
   2. pH, ASTM D4972: 1 sample per 2,500 cu yd, or portion thereof, of topsoil required.
   3. Organic Matter, ASTM D2974: 1 sample per 2,500 cu yd or portion thereof, of topsoil required.
   4. Phosphorus, potassium, calcium, and magnesium, in accordance with state-accredited method: 1 sample per 2,500 cu yd, or portion thereof, of topsoil required.
   5. Chemical Analysis: 1 sample per source. In accordance with Paragraph 2.9 G-H.

G. Chemical characterization in the laboratory in accordance with the following methods:

Analytical Parameters	*Analytical Methods(1)*
TAL(3) Metals	SW-846 6020A/7471A
Hexavalent Chromium	SW-846 7196A
Cyanide	SW-846 9010/9012
TCL(2) Volatiles	SW-846 8260B
TCL Semi-Volatiles	SW-846 8270D
TCL Pesticides	SW-846 8081B
Polychlorinated Biphenyls	SW-846 8082A
Herbicides	SW-846 8151A
Dioxin/Furans	SW-846 1613B
Total Petroleum Hydrocarbons	TX 1005/1006(4)

Notes:
(1) EPA SW 846.
(2) TCL: Target Compound List.
(3) TAL: Target Analyte List.
(4) Texas Commission on Environmental Quality Methods 1005 and 1006

H. Test and analyze all imported, non-virgin material to demonstrate compliance with EPA Class I criteria (residential).

I. If tests indicate materials do not meet specified requirements, change to appropriate material or change material source and retest.

J. Provide materials of each type from the same source throughout the Works.

K. In the event of changes to accepted sources of materials during the performance of the Works, immediately advise ENGINEER of revised locations and obtain acceptance of such locations and materials prior to use in the Works.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Do not allow or cause any of the work performed or installed to be covered up or enclosed by work of this Section prior to required inspections, surveys, measurements, tests, or approvals.

C. Submit required survey data to ENGINEER and obtain acceptance from ENGINEER for completed subgrade and previously placed material prior to placement of successive lifts.

D. Obtain acceptance from ENGINEER prior to placing fill against structures or around exposed buried utilities.

E. Ensure areas to be backfilled are free from trash, debris, snow, ice, water, soft soils, organic materials, or frozen ground.

3.2 PREPARATION

A. Remove debris, water, soft soils, organic materials, or frozen ground from areas to be filled.

B. Where not filling on previously worked area, scarify subgrade surface to a depth of 6 inches.

C. Compact subgrade to requirements for subsequent fill material.

D. Cut out soft areas of subgrade not capable of compaction in place. Backfill with appropriate fill and re-compact to meet requirements for subsequent fill material.

3.3 STOCKPILING

A. If necessary, stockpile fill materials at temporary stockpile areas according to the accepted Material Handling and On-Site Transportation Plan and as accepted by ENGINEER.

B. Segregate temporary stockpiles by material type and analytical results.

C. Provide and maintain access to temporary stockpiles.

D. Prevent contamination of stockpiled fill.

E. Direct surface water away from stockpile locations to prevent erosion or deterioration of materials.

F. Maintain stockpile slopes not steeper than 2 horizontal to 1 vertical. In no instance shall stockpiles be greater than 12 feet in height above original surrounding grade. Place berms and soil erosion and sediment control features around stockpiles as per the Drawings.

G. Maintain area surrounding stockpiles in safe, neat, and tidy condition.

H. Cover stockpiled fill at the end of each day with robust tarpaulin, or similar measures, to withstand adverse weather, wind, and other detrimental forces. Provide protection of stockpiled material from rain and other adverse weather effects.

3.4 FILLING

A. Load and transport fill from off-site sources in accordance with the accepted Material Handling and On-Site Transportation Plan.

B. Place and compact material according to specified requirements.

C. Employ a placement method that does not disturb or damage other work.

D. Slope grade away from structures at minimum 2 percent to match existing grade.

E. Make gradual grade changes. Blend slope into level areas.

F. Do not operate heavy compaction equipment closer than 5 feet to structures, underground utilities, or monitoring wells.

3.5 PLACEMENT OF TOPSOIL

A. Spread topsoil to a minimum settled depth of 6 inches over area to be seeded. Rake until smooth.

B. Place topsoil during dry weather and on dry subgrade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low, or soft areas, and to ensure positive drainage.

E. Till topsoil to incorporate materials to adjust soil pH, phosphorus fertilizers if recommended by soil test, and soil amendments to improve the soil structure.

F. Install edging at periphery of seeded areas in straight lines to consistent depth.

G. Obtain ENGINEER's acceptance of topsoil grade and depth before starting seeding.

3.6 PLACEMENT OF AGGREGATE A1 AND SOIL TYPES S2, S3, AND S4

A. Verify subgrade has been inspected, gradients and elevations are correct, and is dry.

B. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and recompacting.

C. Place material in maximum 6-inch thick layers.

D. Level and contour surfaces to elevations and gradients to match existing adjacent areas.

E. Add water to assist compaction. If excess water is apparent, remove material and aerate to reduce moisture content.

F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.7 PLACEMENT OF SOIL TYPE S1

A. Placement of soil fill between sheet pile walls varies in location along the sheet pile wall alignment. CONTRACTOR to follow specific instructions presented on structural sheet pile wall Drawings.

3.8 COMPACTION

A. Soil Type S1: No compaction (self-compacting).

B. Soil Type S2: Compact to at least 95 percent SMDD at ±2% optimum moisture content. Obtain in-place density measurements in accordance with ASTM D6938.

C. Soil Types S3 and S4: Compact to at least 90 percent SMDD at ±2% optimum moisture content. Obtain in-place density measurements in accordance with ASTM D6938.

D. Aggregate Type A1: Compact to at least 95 percent SMDD at ±2% optimum moisture content. Obtain in-place density measurements in accordance with ASTM D6938.

E. Apply water from an accepted source as necessary during compaction to obtain desired density. If material to be compacted is excessively moist, aerate with suitable equipment and methods until the moisture content is corrected. In areas not accessible to rolling equipment, compact material to specified density with mechanical tampers.

F. Do not direct jets of water at fill with such force that finer materials will be washed out.

G. Compaction Equipment: The type, size, and efficiency of compaction equipment shall be capable of achieving desired degree of compaction. When operating equipment adjacent to and immediately above structures, exercise care so as not to cause damage or displacement of the structure.

3.9 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Top Surface of Fill: Plus or minus 1 inch, but not uniformly high or low, from required elevations.

3.10 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. Select samples of uncompacted fill intended for the Works and samples of compacted fill in the Works.

C. Test installed materials to confirm compliance with Specifications.

D. Submit copies of test reports to ENGINEER.

E. Verification Testing by ENGINEER:
   1. ENGINEER may select samples of uncompacted fill intended for the Works and samples of compacted fill in the Works.
   2. Testing by ENGINEER will in no way relieve CONTRACTOR of his responsibility to test all material prior to notifying ENGINEER of materials' suitability for the work involved.

F. Methods of Testing:
   1. Particle size analysis shall be performed in accordance with ASTM D6913/D6913M and ASTM D7928 or ASTM C117 and ASTM C136/C136M, whichever is appropriate to material being tested.

G. Frequency of Testing: according to requirements stated in PART 2.

H. The methods used and the frequency of tests may be modified by ENGINEER.

I. Failure to Meet Specified Requirements: If tests indicate that material specifications have not been achieved or cannot be obtained with equipment in use, procedure being followed, or material being incorporated, remove and replace work, and modify operations so that the equipment, procedures, and materials will produce the required results. Additional testing required by ENGINEER will be to CONTRACTOR's account.

3.11 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for adjusting.

B. Finish fill surfaces to within 1 inch of grades as shown on the Drawings but not uniformly high or low. Correct surface irregularities by loosening and adding or removing material until the surface is within specified grade.

C. Leave work areas in a properly graded condition sloped as required to permit proper drainage and free of depressions that will pond or collect water or debris that will restrict flow.

3.12 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Reshape and recompact fills subjected to vehicular traffic or areas disturbed by other Works prior to installing finish topsoil layer.

END OF SECTION

SECTION 31 35 26.16

GEOMEMBRANES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Linear-low density polyethylene (LLDPE) geomembrane for construction of impermeable cover system for construction of temporary equipment decontamination pad, temporary dewatering facility, and water storage tank containment pad.

1.2 REFERENCES

A. Abbreviations and Acronyms:
1. IAGA: International Association of Geosynthetic Installers.
2. LLDPE: Linear-Low Density Polyethylene.

B. Definitions:
1. Conform to ASTM D4439 for interpretation of terms used in this Section.
2. Minimum Average Value: Average of test values calculated in accordance with specified standard at minimum frequency specified in GRI GM17.
3. Wrinkles: Corrugations in geomembrane that will fold over during placement of materials overlying geomembrane.

C. Reference Standards:
1. Section 01 40 00 - Quality Requirements: Requirements for references.
2. ASTM International:
a. ASTM D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
b. ASTM D1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
c. ASTM D1238 - Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
d. ASTM D1505 - Standard Test Method for Density of Plastics by the Density Gradient Technique.
e. ASTM D1603 - Standard Test Method for Carbon Black Content in Olefin Plastics.
f. ASTM D4218 - Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle Furnace Technique.
g. ASTM D4437/D4437M - Standard Practice for Nondestructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
h. ASTM D4439 - Standard Terminology for Geosynthetics.
i. ASTM D4833/D4833M - Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
j. ASTM D5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
k. ASTM D5323 - Standard Practice for Determination of 2 % Secant Modulus for Polyethylene Geomembranes.

l. ASTM D5596 - Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
m. ASTM D5617 - Standard Test Method for Multi-Axial Tension Test for Geosynthetics.
n. ASTM D5721 - Standard Practice for Air-Oven Aging of Polyolefin Geomembranes.
o. ASTM D5885/D5885M - Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry.
p. ASTM D6370 - Standard Test Method for Rubber—Compositional Analysis by Thermogravimetry (TGA).
q. ASTM D6392 - Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
r. ASTM D6497 - Standard Guide for Mechanical Attachment of Geomembrane to Penetrations or Structures.
s. ASTM D6693 - Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.
t. ASTM D7238 - Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.
u. ASTM D8117 - Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by Differential Scanning Calorimetry.

3. Geosynthetic Research Institute:
   a. GRI GM6 - Practice for Pressurized Air Channel Test for Dual Seamed Geomembranes.
   b. GRI GM9 - Practice for Cold Weather Seaming of Geomembranes.
   c. GRI GM17 - Test Properties, Testing Frequency and Recommended Warranty for Linear-Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes.
   d. GRI GM19a - Specification for Seam Strength and Related Properties of Thermally Bonded Homogeneous Polyolefin Geomembranes/Barriers.

1.3 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene a minimum 1 week prior to commencing installation of geomembranes.

C. Purpose of Meeting:
1. Define responsibilities of each party.
2. Establish lines of authority and lines of communication.
3. Establish Work Site-specific quality assurance/quality control and monitoring procedures.
4. Define installation procedures.
5. Define method of acceptance of completed geomembrane.
6. Define installation schedule.
7. Discuss submittals.
8. Review personal protective equipment and applicable regulations.
9. Review safety plan and procedures.
10. Review panel layout and numbering system for panels, seams, and test samples.
11. Review methods for protecting installed work.
12. Visit the Work Site for review of surface preparation, physical location of the Work Site, and access to the Work Site.
13. Review critical design details.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate installation layout, dimensions, and details including field seams and protrusion details.

C. Product Data: Submit no later than 14 days prior to ordering.

D. Samples: Submit minimum 2 m length of standard width membrane no later than 14 days prior to ordering.

E. Manufacturers' Instructions: Submit at least 14 days prior to installation. Include written installation, handling, storage, and repair instructions.

F. Manufacturer's Certificate: At least 14 days prior to delivery to the Work Site, certify that products meet or exceed specified requirements. Include test results.

G. Manufacturer's Quality Assurance Plan or Manual: Submit no later than 14 days prior to ordering.

H. Installer's Quality Assurance Plan or Manual: Submit no later than 14 days prior to ordering.

I. Source Quality Control Submittals: Indicate results of testing no later than 14 days prior to ordering.

J. Daily Field Installation Report: submit no later than 1 day following date covered by report. Include:
   1. Subgrade surface acceptance form signed by manufacturer's representative and ENGINEER.
   2. Total quantity, type, and location of geomembrane placed.
   3. Identifiers of rolls with manufacturer's number.
   4. Quality control tests of materials used during the day.
   5. Total quantity and location of seams completed, identification of seamer, and welding equipment used.
   6. Observations of test seams, including seaming unit number and identification of names of seamers, weather conditions, speed, temperature setting, and results.
   7. Location and results of non-destructive testing.
   8. Location and results of destructive testing.
   9. Reasons for and observations of repairs and retesting, including locations, type of repair, name of repairer, and seaming equipment or product used.
   10. Observations of field seaming operations, including weather conditions, cleaning, overlaps, rate of seaming, names of seamers, and units used.
   11. Observations of placement and seams around appurtenances, and connection to appurtenances.

K. Manufacturer Qualifications Statements:
   1. Submit qualifications for manufacturer, no later than 30 days prior to ordering list of previous projects totaling 3 million sq ft of installation, and five projects including name of project, description of project, area, client's name and address, contacts, and telephone numbers; engineer's name, address, contact, and telephone number.
   2. Submit installer's name, address, contact, and telephone number; and date installed.
   3. Manufacturer shall be ISO 9001 certified.

L. Installer Qualification Statements:
   1. Submit manufacturer's approval of installer no later than 14 days prior to installation.
   2. Submit IAGI Certified Contractor Status.
   3. Submit IAGI Certificates and Certified Welding Technician Certificates for each seamer.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Project Record Documents: Indicate panel layout, including panel identifiers, date placed, installer's name, location of seams, and location and details of repair.

C. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Provide manufacturer's quality assurance plan or manual to ensure that geomembrane is manufactured in accordance with and will meet the requirements of this Section.

B. Provide installer's quality assurance plan or manual to ensure that geomembrane will be installed in accordance with this Section and the noted references.

C. Certifications: Submit certificates based on GRI-required properties and testing frequencies.

D. Certificates pertaining to rolls or panels of geomembrane delivered to the Work Site shall accompany rolls or panels. Each roll or panel shall be identified by a unique manufacturing number. Quality control certificates shall be signed by a responsible party employed by manufacturer.

E. Certificates pertaining to raw materials and manufactured rolls or panels shall be provided by geomembrane manufacturer. ENGINEER will review test results for completeness and for compliance with minimum properties specified for both raw materials and manufactured rolls or panels. Materials and rolls or panels which are in non-compliance with minimum properties specified will be rejected.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 20 projects, 25 million sq ft, and 5 years of documented experience.

B. Installer: Company specializing in installing products specified in this Section with minimum five projects, 10 million sq ft, 3 years of documented experience, certified/licensed by manufacturer, and a holder of IAGI Certified Contractor Status.

C. Seamers: Certification by IAGI and certification as a Certified Welding Technician is required for all personnel performing seaming operations.

D. Master Seamer: Same certification requirements as seamer, with at least 10 million sq ft of geomembrane of the same generic type as geomembrane used for the Project using the same type of seaming method. The master seamer will provide direct supervision over all seamers and will be present during all seaming operations.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Package and label rolls or panels prior to shipment to the Work Site. Label shall indicate manufacturer, type of geomembrane, thickness, lot number, roll number, and roll dimensions. Manufacturer is responsible for initial loading and shipping of geomembrane. Methods of unloading geomembrane shall be approved by manufacturer prior to shipment.

C. When transported to the Work Site, handle geomembrane rolls or panels by appropriate means so that no damage is caused, as recommended by geomembrane manufacturer.

D. During delivery and storage, protect geomembrane from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris, and rodents.

E. Take adequate measures to keep geomembrane away from possible deteriorating sources (e.g., vandalism, theft).

F. Use handling equipment approved by manufacturer when moving geomembrane from one place to another. Lift rolls by inserting bar, sized to limit deflection detrimental to geomembrane, through roll core. Attach slings or lifting chains at both ends of bar. Use a spreader bar to support and spread slings. Bar and support pipe shall be long enough to prevent damage to edges of geomembrane during hoisting.

G. Notify ENGINEER 3 days in advance of geomembrane delivery to the Work Site. Perform joint inspection with ENGINEER upon delivery. Defects or damage from shipping and handling will be grounds for rejection of a portion of geomembrane or of entire geomembrane roll or panel at ENGINEER's discretion. Remove rejected materials from the Work Site and replace with new materials.

1.9 AMBIENT CONDITIONS

A. Suspend installation operations whenever climatic conditions, as determined by ENGINEER or manufacturer's representative, are unsatisfactory for placing geomembrane to requirements of this Section.

B. Weather Conditions for Geomembrane Placement:
   1. Comply with manufacturer's recommendation.
   2. Do not unroll, unfold, or place geomembrane at an ambient temperature below 32 degrees F or above 104 degrees F, unless CONTRACTOR obtains written acceptance from geomembrane manufacturer and ENGINEER.
   3. Install on dry ground.
   4. Geomembrane placement shall take into account the Work Site’s drainage, wind direction, construction, access to the Work Site and production schedule of the Works.

5. Geomembrane placement shall not proceed if subgrade conditions have deteriorated due to moisture, or in the presence of high winds, as determined by ENGINEER, which might damage geomembrane.
6. Adequately ballast deployed geomembrane at all times to limit risk of wind damage.

C. Weather Conditions for Geomembrane Seaming:
1. Comply with manufacturer's recommendations.
2. Make no weld below 34 degrees F unless:
   a. CONTRACTOR strictly follows guidelines for field seaming of geomembrane in cold weather, as identified in GRI GM9.
   b. CONTRACTOR obtains written approval from geomembrane manufacturer to weld at temperature below 32 degrees F according to GRI GM9.
   c. Between 34 and 50 degrees F, seaming is possible if geomembrane is preheated by either sun or hot air device, and if there is not excessive cooling resulting from wind.
   d. Make no weld below minus 5 degrees F.
   e. In all cases, geomembrane must be dry while being welded.

1.10 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Furnish 20-year manufacturer's warranty against manufacturing defects.

C. Warranty: Include coverage for:
1. Defective product found to be not in compliance with the requirements of this Section.
2. Replacement of geomembrane with new material, including costs associated with geomembrane installation.

PART 2 PRODUCTS

2.1 LLDPE GEOMEMBRANE

A. Manufactured from virgin resin with no more than 10 percent rework. Rework shall be of same formulation as the parent material. No post-consumer resin permitted.

B. Free of holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.

C. Melt index value less than 1.0 g/10 minutes in accordance with ASTM D1238.

D. Conforming to the following specifications:

LLDPE Geomembrane – Smooth – 40 mils			
Properties	**Test Method**	**Test Value**	**Testing Frequency (Minimum)**
Thickness (min. ave.) – mils • lowest individual of 10 values	ASTM D5199	nom. (40) -10% (36)	per roll
Formulated Density (max) - g/cc	ASTM D1505/D792	0.939	200,000 lb
Tensile Properties(1) (min. ave.) • break strength – lb/in. • break elongation - percent	ASTM D6693 Type IV	 152 800	20,000 lb
2% Modulus (max.) - lb/in.	ASTM D5323	2400	per formulation
Tear Resistance (min. ave.) – lb	ASTM D1004	22	45,000 lb
Puncture Resistance (min. ave.) – lb	ASTM D4833/D4833M	56	45,000 lb
Axi-Symmetric Break Resistance Strain (min.) - percent	ASTM D5617	30	per formulation
Carbon Black Content (range) - percent	ASTM D4218(2)	2.0 - 3.0	45,000 lb
Carbon Black Dispersion	ASTM D5596	note (3)	45,000 lb
Oxidative Induction Time (OIT) (min. ave.)(4) a) Standard OIT – min. -or- b) High Pressure OIT – min.	 ASTM D8117 ASTM D5885/D5885M	 100 400	200,000 lb
Oven Aging at 85°C(5) a) Standard OIT (min. ave.) – percent retained after 90 days -or- b) High Pressure OIT (min. ave.) – percent retained after 90 days	ASTM D5721 ASTM D8117 ASTM D5885/D5885M	 35 60	per formulation
UV Resistance(6) a) High Pressure OIT (min. ave.) – percent retained after 1600 hrs(7)	ASTM D7238 ASTM D5885/D5885M	 35	per each formulation

Notes:
min. ave. – minimum average
nom. – nominal
(1) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction.
- Break elongation is calculated using a gage length of 2.0 in. at 2.0 in./min.
(2) Other methods such as D1603 (tube furnace) or D6370 (TGA) are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.
(3) Carbon black dispersion (only near spherical agglomerates) for 10 different views:
- 9 in Categories 1 or 2 and 1 in Category 3
(4) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
(5) Also evaluate samples at 30 and 60 days to compare with the 90-day response.
(6) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.
(7) UV resistance is based on percent retained value regardless of the original HP-OIT value.

2.2 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Manufacturer shall perform test for parameters specified in PART 2, at a minimum frequency specified in GRI GM17.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Obtain ENGINEER's acceptance in writing prior to installing geomembrane and prior to placing subsequent materials on geomembrane.

C. Coordinate activities so that ENGINEER can observe testing. ENGINEER will observe all testing and collect samples for destructive testing.

3.2 PREPARATION

A. Do not begin installation of geomembrane until subgrade surface has been accepted by ENGINEER.

3.3 INSTALLATION

A. Maintain area of installation free of water.

B. Do not proceed with panel placement and seaming during precipitation, in presence of excessive moisture (e.g., fog, dew), nor in presence of high winds.

C. Place geomembrane in accordance with manufacturer's instructions. Minimize wrinkles, avoid scratches and crimps to geomembranes, and avoid damage to supporting material.

D. Designate each roll or blanket with an individual panel number and correlate with manufacturer's identification number. Mark each designation in each roll as it is deployed.

E. Protect installed geomembrane from displacement, damage or deterioration before, during and after placement of material layers.

F. Require workers to wear shoes which will not damage geomembrane.

G. Minimize pulling of geomembrane panels to reduce permanent tension.

H. Take the following precautions to minimize the risk of damage by wind during panel placement:

1. Orientate work according to the direction of prevailing winds if possible, unless otherwise specified.
2. Adequately secure the geomembrane panels to prevent uplift by wind, by any means necessary that will not damage geomembrane. Along the edges, ensure loading is continuous, to avoid possible windflow under the panels.

I. Replace damaged, torn or permanently twisted panels until accepted by ENGINEER. Remove rejected damaged panels from the Work Site.

J. Keep field seaming to minimum. Locate field seams up and down slopes, with no horizontal field seam less than 5 feet beyond toe or crest of slope.

K. Keep seam area clean and free of moisture, dust, dirt, debris and foreign material.

L. Make field seam samples in accordance with requirements specified in PART 3, FIELD QUALITY CONTROL on fragment pieces of geomembrane and test to verify that seaming conditions are adequate.

M. Test field seams as seaming work progresses by non-destructive methods over their full length, in accordance with ASTM D4437/D4437M. Repair seams which do not pass non-destructive test. Reconstruct seam between failed location and any passed test location, until non-destructive testing is successful.

N. Repair minor tears and pinholes by patching until non-destructive testing is successful. Patches to be round or oval in shape, made of same geomembrane material, and extend minimum of 3 inches beyond edge of defect.

3.4 INSTALLATION AROUND APPURTENANCES

A. Install geomembrane around appurtenances protruding through geomembrane.

B. Obtain ENGINEER's written acceptance for materials to be used to seal gaps between the geomembrane skirt and appurtenances.

C. Perform installation on rough surfaces carefully to minimize geomembrane damage. Additional loosely placed geomembrane sections may be used by geomembrane installer as protection for geomembrane, if accepted by ENGINEER.

D. Ensure clamps, clips, bolts, nuts, or other fasteners used to secure geomembrane around each appurtenance have a lifespan equal to or exceeding geomembrane.

E. Geomembrane penetration shall be in accordance with ASTM D6497 or as recommended by geomembrane manufacturer.

3.5 FIELD SEAMING

A. Overlap the panels a minimum of 4 inches for extrusion welds and a minimum of 4 inches for hot wedge welds.

B. Panel Preparation: Prior to seaming, clean the seam area and ensure it is free of moisture, dust, dirt, debris of any kind, and foreign material.

C. Seaming Equipment and Products: Seam geomembrane using extrusion or hot wedge welding equipment and installation methods recommended by manufacturer. For extrusion welding, use an extrudate composition identical to that of the geomembrane material, or weld all panels together using the hot wedge welding system. Include thermometers on the extrusion welding equipment to measure the temperature of the extrudate in the machine extruder and at the nozzle. Use wedge welding equipment capable of continuously monitoring and controlling the wedge temperature.

D. Orient seams downslope so that direction of seaming will not hinder flow of water over top of geomembrane. Specifically for hot wedge weld seams, overlap geomembrane on downslope side of seam.

E. If the supporting soil is yielding, provide a firm substrate by using a homogeneous board, a conveyor belt, or similar hard surface directly under seam overlap to effect proper rolling pressure.

F. Seaming Wrinkles: Cut fishmouths and corrugations so as to effect a flat overlap. Seam the cut fishmouths or wrinkles as well as possible, then install patch of the same generic geomembrane extending a minimum of 6 inches beyond the cut in all directions.

G. Do not cross slope seam less than 5 feet from the toe of slope unless slope is less than 10 percent. Cross slope seams may be utilized if cut at an angle of approximately 45 degrees.

H. Label each seam with date, seamer, equipment seaming temperature and speed, and time seam started and completed.

I. Seaming Tie ins: Only proceed with seaming of geomembrane tie ins once all panels to be seamed are at a uniform temperature (i.e., early in the morning or late in the day) to avoid excessive distortion in the geomembrane due to geomembrane contraction and expansion.

3.6 REPAIR PROCEDURES

A. Clean and dry surfaces at the time of repair.

B. Repair pinholes by applying a patch. Repair defective seams by re-seaming, flap welding, or applying a patch, as accepted by ENGINEER.

C. Repair tears, blisters, larger holes, undispersed raw materials, and contamination by foreign matter, or corrugations determined by ENGINEER to be excessive, by patches.

D. Patches:
1. Abrade surfaces as appropriate.
2. Label each patch with date, number, seamer, and equipment.
3. Ensure patches are round or oval in shape.
4. Make of same generic geomembrane.
5. Extend patch a minimum of 4 inches beyond edge of defects.

3.7 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. Test quality of resin and geomembrane to ensure consistency of raw material and geomembrane quality in accordance with manufacturer's recommendations.

C. Inspect each panel for damage after placement and prior to seaming. Mark damaged panels or portions of damaged panels which have been rejected, as judged by ENGINEER, and record their removal.

D. Verify that weather conditions (appropriate air temperature, non-excessive wind, and lack of precipitation) are acceptable for panel placement.

E. Field Seaming Operations: Verify as follows:
   1. Seaming personnel have the specified qualifications.
   2. Overlaps meet specified requirements.
   3. Seaming area is clean and dry, as specified.
   4. A hard substrate such as a board or a piece of conveyor belt is used if the supporting soil is soft or uneven.
   5. Seaming equipment is available and meets specified requirements.
   6. Weather conditions for seaming are acceptable, as specified.
   7. Seaming procedures as specified are followed.
   8. Panels are properly positioned to prevent wrinkling.
   9. Equipment for testing seams is available on-site and operational.
   10. Field tensiometer has been correctly calibrated.

F. Provide test results to ENGINEER at the end of each shift for each shift's production, including documentation of non-destructive testing and repairs.

G. Test Seams:
   1. Perform test seams in shear and peel in accordance with ASTM D4437/D4437M to verify that seaming conditions are adequate. Conduct test seams at discretion of ENGINEER and at least two times each day (at the beginning of each seaming period, at least once every 4 hours thereafter, and at least once every 4 hours thereafter if welding operations are interrupted) for each seaming apparatus and each seamer used that day. Perform test seaming under the same conditions as production seaming. Provide 4-foot test seams for extrusion welds and 10-foot test seams for hot wedge welds. Perform test seams on scrap geomembrane not to be incorporated into the Works.
   2. Cut 1-inch-wide coupons from the test seam and assign to peel or shear test alternatively as they are cut across panel. Test coupons in shear and peel using a calibrated field tensiometer. Required minimum strength of geomembrane test seams are:
      a. Shear Test: 60 lb/in for both hot wedge and extrusion welded seams.
      b. Peel Test: 50 lb/in for hot wedge welded seams and 44 lb/in for extrusion welded seams.
   3. In addition, test coupons must not delaminate. Passing test results must be obtained from four of five coupons when tested in shear, and four of five coupons when tested in peel. For geomembrane test seams performed using a hot wedge welder, perform peel tests on both inside and outside welds; both welds must pass peel test. If a test seam fails, reject seaming equipment for field seaming until deficiencies are corrected and a successful test seam is produced.
   4. A passing test seam will be an indicator of seaming unit adequacy and seamer working under prevailing conditions at the Work Site, but not necessarily an indicator of field seam adequacy.
   5. Coordinate completion of test seams such that ENGINEER can observe such seams. ENGINEER will observe all test seams. Retain a sample from each test and label with

date, ambient temperature, serial number of seaming units, seamer, and pass or fail description. One half of sample will be retained by ENGINEER.

H. Non-destructive Seam Testing:
   1. Non-destructively test field seams over their full length by pressure testing according to GRI GM6 and ASTM D4437/D4437M. Pressure test results will be written on geomembrane near seam. Number or otherwise designate each seam. Record location, date, test unit, name of tester, and outcome of all non-destructive testing.
   2. Passing non-destructive test of field seams, meeting or exceeding requirements according to GRI GM6, indicates the adequacy of field seams, subject to results of destructive seam testing, as specified in PART 3, FIELD QUALITY CONTROL.
   3. Coordinate activities such that ENGINEER can observe all testing. ENGINEER will observe all testing. Non-destructive testing performed in absence of ENGINEER will be repeated. Conduct testing as seaming work progresses. Number and mark all defects found during testing immediately after detection. Repair, re-test, and re-mark all defects found to indicate completion of repair and acceptability. If pressure testing is performed, repair hole resulting from pressure needle following testing.

I. Destructive Seam Testing: Collect 2-foot long field seam samples at a frequency of approximately one sample per 1,000 linear feet of field seam at locations directed by ENGINEER, or more frequently if requested. Field test five coupons in peel and five coupons in shear according to GRI GM19a and ASTM D6392, using a calibrated field tensiometer. Perform peel tests on the inside and outside weld. At least four of each of the five coupons must not delaminate and must pass tensile strength requirements, based on field testing. Required minimum strength of geomembrane field seams for field tests:
   a. Shear Test: 60 lb/in for both hot wedge and extrusion welded seams.
   b. Peel Test: 50 lb/in for hot wedge welded seams and 44 lb/in for extrusion welded seams.

J. If either field tests fail, isolate defective seam and re-test as follows:
   1. Collect additional 2-foot long samples from field seam for testing using a field tensiometer, within 10 feet of each side of the failing sample as determined by ENGINEER, until passing test locations are identified.
   2. Repair field seam between passing test locations (based on field tensiometer results) by extrusion welding or patching.
   3. Non-destructively test patch or extrusion weld and repair, as required, until non-destructive test standards are achieved.
   4. Repeat above noted procedure until passing field test results are achieved, thereby delineating extent of defective seam.

K. Verification of Seams in Special Locations:
   1. Non-destructively test seams in special locations (i.e., appurtenances) if seam is accessible to testing equipment. ENGINEER will observe all seam testing operations. If seam cannot be tested in place, it will be observed by ENGINEER and CONTRACTOR for uniformity and completeness.
   2. In the case of visual inspections, record the seam number, date of inspection, name of tester, and outcome of inspection.
   3. Promptly repair, re-test, and re-mark defective seams to indicate completion of repair.

L. Defects and Repairs:
   1. Identification: inspect seams and non-seam areas of geomembrane for identification of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.

2. Evaluation: non-destructively test each suspect location, both in seam and non-seam, using methods specified in PART 3, FIELD QUALITY CONTROL. Mark and repair each location which fails non-destructive testing.
3. Verification of Repairs: Non-destructively test each repair using the method specified in PART 3, FIELD QUALITY CONTROL. Tests which pass non-destructive test standards will serve as an indication of an adequate repair. Re-repair and test failed test locations until a passing test results. Record the number of each repair, date, location, repair personnel initials, and test outcome. ENGINEER will observe non-destructive testing of repairs.

M. Geomembrane Acceptance:
1. Geomembrane will be accepted by ENGINEER when:
   a. Installation is finished.
   b. Documentation of installation is completed and submitted to ENGINEER.
   c. Verification of the adequacy of field seams and repairs, and associated testing, is complete.

3.8 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.

B. Furnish services of a qualified manufacturer's representative to observe placement of geomembrane, subgrade preparation, geomembrane installation, and backfilling operations. Manufacturer's representative will provide guidance to installer on proper installation techniques, but will not assume liability or responsibility in overall installation.

3.9 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Remove construction debris from the Work Site and dispose in an environmentally responsible and legal manner.

3.10 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Do not permit vehicular traffic directly on geomembrane.

C. Place soil cover layer from lower elevations to higher elevations. Push soil cover layer by traveling only on previously placed material, never directly on geomembrane, and by avoiding sudden turns or accelerations.

END OF SECTION

SECTION 31 37 00

RIPRAP

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Riprap for river discharge and raised bench.

1.2 REFERENCES

A. Reference Standards:
   1. Section 01 00 00 - General Requirements: Requirements for references.
   2. ASTM International:
      a. ASTM C88 – Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
      b. ASTM C127 – Standard Test Method for Specific Gravity and Absorption of Coarse
      c. ASTM C666 – Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.

1.3 SUBMITTALS

A. Section 01 00 00 - General Requirements: Requirements for submittals.

B. Material Source: Submit to ENGINEER the proposed source of riprap at least 14 days prior to commencing production, including any change in material source during performance of the Works.

C. Quality Control Plan:
   1. Submit at least 2 weeks prior to commencement of riprap production.
   2. Submit gradation test results, stone quality tabulations, or other data required for the Quality Control Plan as directed by ENGINEER.
   3. Make stone source inspector and loading facility inspector logs available at any time during the project for review by ENGINEER.
   4. At project closeout furnish copies of the complete Quality Control Plan records to ENGINEER.

D. Source Quality Control: Provide results of gradation testing prior to loading riprap for transport to the Work Site.

1.4 QUALITY ASSURANCE

A. Perform work of this Section in accordance with State of Texas Standards.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 00 00 - General Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver, handle, and transport riprap at all times in a manner and with equipment that will prevent intermixing of riprap types, segregation, or contamination.

C. Stockpile riprap on the Work Site in locations approved by ENGINEER.

D. Minimize stockpiling requirements. Transport riprap from source directly to final position where possible.

E. Exercise care in loading, hauling, and unloading riprap and stone to prevent crushing and splitting that would lead to rejection.

1.6 AMBIENT CONDITIONS

A. Suspend operations whenever climatic conditions, as determined by ENGINEER, are unsatisfactory for placing riprap to the requirements of this Section.

PART 2 PRODUCTS

2.1 RIPRAP

A. Unweathered, durable crushed or blasted igneous, metamorphic, or sedimentary rock.

B. Free from organic material, mica, shale, or other unsuitable material.

C. Individual Rock Fragments: Hard, dense, sound, and resistant to abrasion and free of cracks, seams, and other structural defects that would tend to increase unduly their destruction by water and frost action and handling.

D. Do not use rock exhibiting marked deterioration by water or weather.

E. Bulk Specific Gravity of Rock Fragments: ASTM C127, minimum 2.6.

F. Maximum aspect ratio (greatest to least dimension) of any piece of riprap shall not be greater than 2.5 when measured on mutually perpendicular axes.

G. Gradation limits for riprap are in-place requirements. Make adjustment in production, transportation, and placement as necessary to ensure that placed materials are within specified range.

H. Rock Size:

D_{15} (in): Min 3.7, Max 5.2
D_{50} (in): Min 5.7, Max 6.9
D_{85} (in): Min 7.8, Max 9.2
D_{100} (in): Max 12.0

I. Well graded and not exhibiting gap grading or scalping from individual size ranges.

J. Rock Quality:
1. Absorption: ASTM C127, 2 percent maximum water absorption.
2. Soundness: ASTM C88, 15 percent maximum loss at 5 cycles.
3. Freeze-Thaw: ASTM C666, 12 percent maximum loss at 35 cycles.

2.2 SOURCE QUALITY CONTROL

A. Section 01 00 00 - General Requirements: Testing, inspection, and analysis requirements.

B. Gradation Testing: Perform quality assurance gradations at riprap source as follows:
1. Select a random sample of stone equal to a least 50 times the median stone weight in each classification.
2. Measure each individual piece in the sample along 3 mutually perpendicular axes.
3. Compute weights from measurements and record in table format using smallest axes size.
4. Using this recorded information, assemble a gradation curve.
5. Conduct 3 gradations for each stone type, unless gradation test results or observations of stone materials indicate additional gradations are required.

C. Bulk Specific Gravity: Perform bulk specific gravity in accordance with ASTM C127 on a representative sample of each gradation test sample.

D. If tests indicate materials do not meet specified requirements, change material or material source and retest.

E. Provide materials from the same source throughout the Works.

F. In the event of change to approved source of materials during performance of the Works, immediately advise ENGINEER of revised location, provide ENGINEER with the source testing results for the change, estimated quantity of material to be imported, and obtain approval of such locations and materials prior to use in the Works.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 00 00 - General Requirements: Verification of existing conditions before starting work.

B. Do not place riprap or stone over spongy subgrade surfaces.

3.2 PLACEMENT OF RIPRAP

A. Place riprap by suitable methods to ensure minimum breakage of individual pieces during placing.

B. Ensure riprap does not mix with or damage foundation material.

C. Place riprap to layer thickness and details shown on the Drawings.

D. Place riprap in an approved manner to secure the surface and to provide a stable mass.

E. Uniformly distribute larger rock over the entire area and distribute the remainder uniformly with smaller pieces filling voids between larger pieces.

F. Finish surfaces in such a manner so as to ensure they are stable, reasonably uniform, free from bumps or depressions, with no excessively large cavities below or individual rock pieces projecting above the general surface.

G. Place riprap as follows:
   1. Use larger pieces in lower course and as headers for subsequent courses.
   2. Stagger vertical joints and fill voids with rock spalls or cobbles.
   3. Finish surface even, free of large openings, and neat in appearance.

H. Riprap may be placed in location by equipment; however, take care in placing to obtain a good gradation of materials so that the riprap will be firm and solid. Level surfaces to the required alignment and slopes by hand placing the stone so as to fill large voids and to make the surface even.

3.3 FIELD QUALITY CONTROL

A. Section 01 00 00 - General Requirements: Field inspecting and testing.

B. ENGINEER shall have free access to CONTRACTOR's plant and equipment used for mixing and placing grout. Provide proper facilities for ENGINEER to sample material and view processes implemented in the mixing and placing of grout and for collecting grout test samples.

END OF SECTION

SECTION 31 41 16

SHEET PILES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Steel sheet piling to create a retaining and/or flood-protection wall.

1.2 REFERENCES

A. Section 01 40 00 - Quality Requirements: Requirements for references.

B. ASTM International:
1. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
2. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
3. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
4. ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
5. ASTM A563 / A563M – Standard Specification for Carbon and Alloy Steel Nuts
6. ASTM A572/A572M - Standard Specification for High Strength Low Alloy Columbium Vanadium Structural Steel.
7. ASTM A576 – Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
8. ASTM A588/A588M – Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance
9. ASTM A690/A690M – Standard Specification for High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments.
10. ASTM A722/A722M – Standard Specification for High-Strength Steel Bars for Prestressed Concrete
11. ASTM F436 – Standard Specification for Hardened Steel Washers
12. ASTM F3125/F3125M – Standard Specification for High Strength Structural Bolts and Assemblies

C. American Welding Society:
1. AWS D1.1/D1.1M - Structural Welding Code - Steel.

1.3 DEFINITIONS

A. Sheet Pile: Pile that is specially shaped to generally interlock with adjacent piles to form a reasonably tight wall with principal purpose of resisting lateral pressures, usually from soil or water with minimal water leakage.

1.4 SCHEDULING

A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.

B. Schedule sheet piling submittals sufficiently in advance of pre-installation meeting to ensure ENGINEER's review is complete.

1.5 PROGRESS SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:
1. Submit details of sheet piling.
2. Storage and handling procedures.
3. Interlock sealing material data and application procedures.
4. Details of templates or other temporary guide structures.
5. Datasheet for Pile Driving Equipment, including various attachments and installation capacity.

C. Shop Drawings:
1. Indicate location and extent of sheet piling, details of top protection, tip reinforcement, tip protection, splices, fabricated additions to plain piles, cut off method, interlock sealing.
2. Include complete dimensions and details of sheet piling sections and connectors.
3. Include sequence of driving, placement of fill material, and detailed drawings of templates or other temporary guide structures.

D. Test Reports:
1. Submit certified materials tests reports showing that sheet piling, and appurtenant metal materials meet the specified requirements, for each shipment and identified with specific lots. Include in the identification data piling type, dimensions, chemical composition, mechanical properties, section properties, heat number, and mill identification mark.
2. Submit Welding Procedure Specification (WPS) and Procedure Qualification Record for all welds as required by AWS D1.1/D1.1M.
3. Submit Inspection and Test Reports for review and approval by the ENGINEER prior to Closeout.
4. Test reports shall meet ASTM A6/A6M requirements.

E. Wall Installation:
1. Prior to commencement of pile driving, submit descriptions of pile driving equipment, including manufacturer's name, model numbers, capacity, rated energy, rated reaction, hammer or hydraulic equipment details, cushion material, helmet, templates, augering, and jetting equipment.
2. Submit qualifications of the sheet pile installer. Include in the qualifications, evidence of at least three (3) successfully completed steel sheet pile driving projects in last five (5) years, one (1) of which must have been completed by the press-in method. The steel sheet pile driving portion of the submitted projects must account for a minimum of five thousand (5,000) linear feet of successful installations.

1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents:
1. Record actual locations of sheet piling and top and bottom elevations.
2. Submit driving records with hammer blows for final 12 inches of driving.
3. Submit a complete and accurate record of each sheet pile within one day of completion of pile driving operation. The record shall indicate the pile location (as driven or installed), date driven, size, driven length, embedded length, final elevations of tip and top, pile weight, and the total driving time. The record shall also include the type and size of the hammer or hydraulic equipment used and the rate of operation.
4. Any unusual conditions encountered during pile installation such as delays during driving, damage to pile resulting from driving, or heave in adjacent piles shall be recorded and immediately reported to ENGINEER.
5. Submit records indicating piles pulled.

1.7 REGULATORY REQUIREMENTS

A. Conform to the Project regulatory permits and approvals.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 5 years documented experience.

B. Installer: Company specializing in performing the work of this Section with minimum 15 years documented experience.

C. Design and select sheet pile components under direct supervision of professional structural Engineer experienced in design of this work and licensed in State of Texas.

D. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver sheet piling with manufacturer's logo and mill identification mark on each sheet piling.

C. Store and handle sheet piling in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks or the interlock sealants.

D. Handle using handling holes or lifting devices.

E. Support on level blocks or racks spaced not more than 10 feet apart nor more than 2 feet from the ends. Arrange supports for multiple lifts aligned vertically.

F. Protect sheet piling with factory-installed joint sealant.

G. Storage of sheet piling should facilitate required inspection activities and prevent corrosion prior to installation.

1.10 PRE-INSTALLATION MEETING

A. Convene prior to commencing work of this Section.

PART 2 PRODUCTS

2.1 STEEL SHEET PILING

A. Sheet Piling: ASTM A572 Grade 60.

B. Interlock Swing Allowable: 5 degrees or maximum allowed by Sheet Pile manufacturer.

C. Connectors: A572 Grade 60, or equivalent compatible with Sheet Piling.

D. Single manufacturer or provide certification for interlock compatibility.

2.2 COMPONENTS

A. Walers
   1. Structural Steel Bars, C, MC, and L Shapes: ASTM A36, Galvanized.
   2. Splice Connection: Galvanized, ASTM A325 Bolts with A563 Nuts and Hardened Washer

B. Tie-Rod & Connections:
   1. Full Threaded Bars, Grade 150 ksi, meeting requirements of ASTM A722, encapsulated in grease or appropriate single corrosion protection (SCP) and protective smooth-walled PVC tube.
   2. Hex Nut with Jam Nut for Tie-Rod connections: ASTM A108 / A576, Galvanized.
   3. Hardened Washer for Tie-Rod Connections: ASTM F436, Galvanized.
   4. Bearing Plate: ASTM A572 / A588 Grade 50, Galvanized.

C. Welding Materials: AWS D1.1; type required for materials being welded.

2.3 INTERLOCK SEALANTS

A. WADIT as manufactured PilePro Group, or an approved equivalent.

2.4 SHOP FABRICATION

A. Fabricate sheet piling and special fabricated sections to full length.

B. Fabricate tees, wyes, corners, and cross pieces to match sheet piling sections, with 1/2-inch minimum web thickness.

C. Perform welding according to AWS D1.1.

D. Fabricate sheet piling with standard pulling holes.

2.5 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Allow witnessing of factory inspections and test at manufacturer's test facility. Notify OWNER before inspections and tests are scheduled.

C. Materials Tests:
1. Sheet piling and appurtenant materials shall be tested and certified by the manufacturer to meet the specified chemical, mechanical and section property requirements prior to delivery to the Work Site.
2. Testing of sheet piling for mechanical properties shall be performed after the completion of all rolling and forming operations.
3. Testing of sheet piling shall meet ASTM A6/A6M requirements.

D. Make completed sheet piling available for inspection at manufacturer's factory prior to packaging for shipment. Notify OWNER before inspection is allowed.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Examine the Work Site, subsurface conditions, and become familiar with conditions that may affect work of this Section.

C. In the presence of ENGINEER, conduct a condition survey of existing services, structures, and survey benchmarks and monuments, which may be affected by the Works. Document condition of adjacent structures prior to commencing the Works.

D. Check and locate buried utilities, including piping in the work area. Record location and depth of all utilities and surface features encountered.

E. Protect buried utilities from damage during construction operations. Notify ENGINEER of conflicts with underground utilities before proceeding with the Works. Damage to utilities due to work of this Section shall be repaired at CONTRACTOR's expense and at no additional cost to OWNER.

F. Select methods of construction suitable for actual conditions encountered in the Works. CONTRACTOR is solely responsible for the safety and adequacy of the method employed.

G. Once the work has begun, interpret each of the previous piles for data to be employed on subsequent piles.

H. Should an obstruction be encountered during driving of sheet piles that prevents placing of the sheet pile within the specified tolerances to the required depths, as herein specified, clear the obstruction, if possible. If it is not possible to clear the obstruction, relocate the pile to a new position, under direction of ENGINEER.

3.2 TEMPLATES

A. Prior to driving, provide template or driving frame suitable for aligning, supporting, and maintaining sheet piling in correct position during setting and driving:
   1. Structural frame sufficiently rigid to resist lateral driving forces.
   2. Provide at least two levels of support at 1/3 points or not less than 20 feet apart.
   3. Provide wood blocking to bear against webs of alternate sheet piling.
   4. Provide outer restraints to prevent sheets from warping or wandering.
   5. Provide visible markings on templates to verify correct sheet piling location and direction.

3.3 PREPARATION

A. Retain a registered land surveyor to locate the position of each pile prior to construction, and to determine the top elevation of each pile after construction. Submit written, signed reports for each pile as an attachment to the daily record.

B. Use equipment accepted by ENGINEER.

C. All pile driving equipment shall be free from defect and subject to ENGINEER's review and acceptance prior to and during the placement of the piles.

D. If a piece of pile driving equipment becomes damaged or in need of repair which, in the opinion of ENGINEER may cause damage to the piles or incorrect placement of the piles, the CONTRACTOR shall not use that piece of equipment. The equipment must be replaced or repaired prior to subsequent use.

E. Use driving method that will not cause damage to nearby structures.

F. Protect structures including overhead and buried utilities near the Works, from damage.

3.4 SHEET PILING INSTALLATION EQUIPMENT

A. HYDRAULIC PRESS-IN EQUIPMENT
   1. Where approved and permitted by ENGINEER, pile driving may be accomplished by using the hydraulic press-in method.

2. Steel sheet piling shall be hydraulically pressed in using the following approved equipment, or an approved equal utilizing a non-percussive hydraulic press-in method:

   Silent Piler / Giken Reaction Base System (GRBS)
   Manufactured/distributed by:
   Giken America Corporation
   5802 Hoffner Ave. #707
   Orlando, Florida, 32822
   Phone # (407) 380-3232

3. The hydraulic press-in equipment shall not produce more than 84 dB of noise, at a distance of twenty-five (25) feet from the equipment, while in operation.
4. It shall not produce any strongly perceptible vibration at the ground surface, at a distance of fifteen (15) feet from the equipment, while in operation.

B. PILING HAMMER

1. Where approved and permitted by the ENGINEER, pile driving may be accomplished by using a piling hammer.
2. Keep hammer in good mechanical condition.
3. Operate hammer at speed and pressure recommended by manufacturer.
4. During piling driving operations, ENGINEER may make occasional measurements of velocity of hammer ram.
5. When energy per blow is less than 80 percent of rated energy per blow as specified by manufacturer of piling hammer, make necessary repairs to improve energy output to value of at least 80 percent of rated energy per blow, or replace piling hammer.
6. Use protective cap during driving to prevent damage to top of sheet piling.

3.5 EARTHWORK

A. Pre-excavation will not be permitted.

3.6 INSTALLATION

A. When driving is interrupted before refusal, drive additional 12 inches before resuming recording of performance data.

B. Placing: Pilings properly placed and driven shall be interlocked throughout their length with adjacent pilings to form a continuous diaphragm throughout the length or run of piling wall.
   1. Pilings shall be placed plumb with out of plumbness not exceeding deviations listed in PART 3, TOLERANCES and true to line. Manipulation of piles to force them into position will not be permitted without review and approval by the ENGINEER. Check all piles for heave. Re-drive all heaved piles to the required tip elevation.
   2. Provide temporary walers, templates, or guide structures to ensure that the pilings are placed and driven to the correct alignment.

C. Driving:
   1. Drive pilings with the approved equipment and by approved methods so as not to subject the pilings to damage and to ensure proper interlocking throughout their lengths.

2. Maintain installation equipment in proper alignment during driving operations by use of leads or guides attached to the equipment. Caution shall be taken in the sustained use of vibratory hammers when a hard driving condition is encountered to avoid interlock melt or damages. Discontinue the use of vibratory hammers and impact hammers employed when the penetration rate due to vibratory loading is one foot or less per minute.
3. Employ a protecting cap in driving when using impact hammers to prevent damage to the tops of pilings. Use cast steel shoe to prevent damage to the tip of the sheet piling. Remove and replace pilings damaged during driving or driven out of interlock at no additional cost to OWNER.
4. Drive pilings without the aid of a water jet unless otherwise authorized.
5. Take adequate precautions to ensure that pilings are driven plumb. Where possible, drive Z pile with the ball end leading. If an open socket is leading, a bolt or similar object placed in the bottom of the interlock will minimize packing material into it and ease driving for the next sheet. If at any time the forward or leading edge of the piling wall is found to be out of plumb in the plane of the wall the piling being driven shall be driven to the required depth and tapered pilings shall be provided and driven to interlock with the out of plumb leading edge or other approved corrective measures shall be taken to ensure the plumbness of succeeding pilings. The maximum permissible taper for any tapered piling shall be 1/8 inch per foot of length.
6. When using Pile hammer, sheet pilings in each run or continuous length of piling wall shall be driven alternately in increments of depth to the required depth or elevation. No piling shall be driven to a lower elevation than those behind it in the same run except when the pilings behind it cannot be driven deeper. Incrementally sequence driving of individual piles such that the tip of any sheet pile shall not be more than 4 feet below that of any adjacent sheet pile. When the penetration resistance exceeds five blows per inch, the tip of any sheet pile shall not be more than 2 feet below any adjacent sheet pile. If the piling next to the one being driven tends to follow below final elevation it may be pinned to the next adjacent piling.
7. If obstructions restrict driving a piling to the specified penetration, the obstructions shall be removed or penetrated with a chisel beam. If CONTRACTOR demonstrates that removal or penetration is impractical, make changes in the design alignment of the piling structure as directed by ENGINEER to ensure the adequacy and stability of the structure. Pilings shall be driven to depths shown and shall extend up to the elevation indicated for the top of pilings.
8. Pre-augering, jetting or spudding of piles will not be permitted.

D. Cutting Off and Splicing: Pilings shall be driven to refusal or to the point of termination. Piles extending above the required top elevation in excess of the specified tolerance shall be cut off to the required elevation. Pilings driven below the required top elevation and pilings damaged by driving and cut off to permit further driving shall be extended as required to reach the top elevation by splicing when directed by ENGINEER at no additional cost to OWNER. If directed by ENGINEER, pilings shall be spliced as required to drive them to depths greater than shown and extend them up to the required top elevation.
   1. Pilings adjoining spliced pilings shall be full length unless otherwise approved. Where spliced pilings adjoin, the welded joints shall be staggered to ENGINEER’s approval. Ends of pilings to be spliced shall be squared before splicing to eliminate dips or camber. Pilings shall be spliced together with concentric alignment of the interlocks so that there are no discontinuities, dips or camber at the abutting interlocks. Spliced pilings shall be free sliding and able to obtain the maximum swing with contiguous pilings. The tops of pilings excessively battered during driving shall be trimmed when directed by ENGINEER, at no additional cost to OWNER. Piling cut offs shall become the property of CONTRACTOR and shall be removed from the Work Site.

E. Acceptance Criteria for Pile Refusal: It shall be considered Pile Refusal when penetration of the sheet pile is slowed or stopped in such a way that further pressing or hammering may cause damage to the pile.

A 1/2 pair pile section installed up to 5 feet above the design tip elevation (short pile) will only be accepted if it conforms to the criteria provided in the table below and at least 3 consecutive strokes (extraction and press-in) yield less than 2 inches of 1/2 pair pile section advancement using the lesser of 150% of the normal press-in force of the machine or the force that could potentially cause damage to the sheet pile.

1/2 pair pile section installed within 5 feet of design tip elevation	All piles within 5 pile pairs on both sides of the short pile shall be installed to within 1.5 feet of design tip elevation.
1/2 pair pile section installed within 3 feet of design tip elevation	All piles within 5 pile pairs on both sides of the short pile shall be installed to within 1.5 feet of design tip elevation.
1/2 pair pile section installed within 1.5 feet of design tip elevation	No spacing requirement provided the force/advancement criteria outlined above is met.

F. Inspection During Sheet Pile Installation: Perform continuous inspection during pile driving. Inspect all piles for compliance with tolerance requirements. Bring any unusual problems which may occur to the attention of ENGINEER. Inspect the interlocked joints of driven pilings extending above ground. Pilings found to be out of interlock shall be removed and replaced at no additional cost to OWNER.

3.7 INSTALLATION RECORDS

A. Maintain a pile driving record for each sheet pile driven.

3.8 WELDING AND SPLICING

A. Perform welding according to AWS D1.1 for shielded metal arc welding.

B. Splice sheet piling sections with one of the following:
1. AWS D1.1 Prequalified CJP Groove Welded Joints.
2. Splicer sleeve with flanges welded with full penetration groove welds.

C. Use jig or alignment device during welding to maintain required shape and alignment.

D. Use only butt weld splices within 20 feet from sheet piling cut off elevation or design grade, whichever is lower.

E. Inspect 10% of all complete penetration butt welds for each splice. Where inspected welds do not meet the acceptance criteria of AWS D1.1, repair welds and inspect 100% of welds of the repaired splice.

F. Comply with the following for number, type, and location of splices:
   1. No more than three splices for sheet piling over 100 feet long.
   2. No more than two splices for sheet piling up to 100 feet long.
   3. No splice closer than 25 feet from tip.
   4. Stagger splices in consecutive pairs of sheet piles by minimum 5 feet.

3.9 INTERLOCK SEALING

A. Clean off rust and debris from interlock section of piles and prepare interlocks in accordance with manufacturer's instructions.

B. Apply sealer to pile interlocks in horizontal configuration and tape ends in accordance with manufacturer's instructions.

C. Protect from moisture until ready to install piles.

D. After installation of piles, repair seal with cartridge application of sealer in accordance with manufacturer's instructions as required to provide fully sealed sheet pile wall.

3.10 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

Deviation normal to the wall line at the top of the pile	2 inches ±
Finished level deviation from nominal level of top of pile	¼ inches ±
Finished level deviation from nominal level of toe of pile	+ 4 / - 0 inches
Vertical deviation normal to line of piles as percent of driving depth	0.5% ±
Vertical deviation along line of piles as percent of driving depth	0.5% ±

3.11 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. Inspect for imperfections in joint interlock capable of impeding installation.

C. Reject damaged sheet piling sections or repair as required prior to installing.

D. Unacceptable Piles: Piles that are placed out of position, are below cutoff elevations, not plumb, or are damaged.

E. Replace piles to conform to specified requirements.

F. Repair interlock sealants damaged during installation.

G. Monitor deflections at top of piles during installation, fill placement, installation of tie-rods and take remedial action to maintain alignment within allowable tolerances.

END OF SECTION

SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Removal and Replacement of existing fence fabric and slide gates.
2. Removal of fence posts by cutting off at ground surface (with remainder of post being disposed of with excavated soils)
3. Excavation for new post bases.
4. Fence framework, fabric, and accessories, where existing materials are not reusable.

1.2 REFERENCES

A. Reference Standards:
1. Section 01 40 00 - Quality Requirements: Requirements for references.
2. ASTM International:
a. ASTM A121 - Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
b. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
c. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
d. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
e. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
f. A1011/A1011M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
g. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
h. ASTM F567 - Standard Practice for Installation of Chain-Link Fence.
i. ASTM F900 - Standard Specification for Industrial and Commercial Swing Gates.
j. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
3. Chain Link Fence Manufacturers Institute:
a. CLFMI Product Manual.

1.3 SYSTEM DESCRIPTION

A. Fence Height: 6 feet nominal, with 12 inches barbed wire on top.

B. Line Post Spacing: At intervals not exceeding 10 feet.

C. Fence Post and Rail Strength: Conform to ASTM F1083, Light Industrial Fence quality.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit data on fabric, posts, accessories, fittings, and hardware.

C. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

D. Manufacturer's Instructions: Submit installation requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines.

1.6 QUALITY ASSURANCE

A. Supply material in accordance with CLFMI Product Manual.

B. Perform installation in accordance with ASTM F567.

C. Certifications: Provide certificate of compliance from authority having jurisdiction.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3 years of experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.

C. Identify each package with manufacturer's name.

D. Store fence fabric and accessories in secure and dry place.

PART 2 PRODUCTS

2.1 MATERIALS

A. Framing (Steel): ASTM F1083, Schedule 40; galvanized steel pipe, welded construction, minimum yield strength of 25 ksi; coating conforming to ASTM F1043, Type A on pipe exterior and interior.

B. Fabric Wire (Steel): ASTM A392, Class 1; zinc-coated steel wire.

C. Concrete: Normal Portland Cement, 3,000 psi strength at 28 days.

2.2 COMPONENTS

A. Line Posts: 2.38-inch diameter.

B. Corner and Terminal Posts: 2.88-inch diameter.

C. Gate Posts: 4-inch diameter.

D. Top and Brace Rail: 1.66-inch diameter, plain end, sleeve coupled.

E. Gate Frame: 2-inch diameter for welded fabrication.

F. Fabric: 2-inch diamond mesh interwoven wire, 9 gage, top selvage knuckle end closed, twisted tight, bottom selvage twisted tight, knuckle end closed.

G. Tension Wire: 7 gage steel, single strand.

H. Tension Band: 0.188-inch steel.

I. Tension Strap: 0.188-inch steel.

J. Tie Wire: Aluminum alloy steel wire.

2.3 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

2.4 FINISHES

A. Components and Fabric: Galvanized to ASTM A123/A123M for components; ASTM A153/A153M for hardware; ASTM A392 for fabric; 1.8 ounces per sq ft coating.

B. Hardware: Galvanized to ASTM A153/A153M, 1.8 ounces per sq ft coating.

C. Accessories: Same finish as fabric.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install framework, fabric, and accessories in accordance with ASTM F567.

B. Set posts plumb, in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.

C. Line Post Footing Depth Below Finish Grade: 3 feet.

D. Corner, Gate and Terminal Post Footing Depth Below Finish Grade: 3 feet.

E. Brace each gate and corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.

F. Install top rail through line post tops and splice with 6-inch-long rail sleeves.

G. Install center and bottom brace rail on corner gate leaves.

H. Place fabric on outside of posts and rails.

I. Do not stretch fabric until concrete foundation has cured 7 days.

J. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

K. Position bottom of fabric 2 inches above finished grade.

L. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on center.

M. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

N. Install bottom tension wire stretched taut between terminal posts.

O. Connect to existing fence at existing terminal post or existing line post converted to terminal post by installation of brace rails and brace rods.

P. Install posts with 6 inches maximum clear opening from end posts to fences and other structures.

Q. Excavate holes for posts to diameter and spacing shown on the Drawings without disturbing underlying materials.

R. Center and align posts. Place concrete around posts and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.

S. Allow footings to cure minimum 7 days before installing fabric and other materials attached to posts.

3.2 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Tolerances.

B. Maximum Variation From Plumb: 1/4 inch.

C. Maximum Offset From Indicated Position: 1 inch.

D. Minimum Distance From Property Line: 6 inches.

3.3 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspection and testing.

B. Repair damaged galvanized surfaces in accordance with ASTM A780/A780M.

C. Apply field repair coating to damaged galvanized surfaces at dry film thickness at least equal to specified galvanized coating thicknesses.

END OF SECTION

SECTION 32 92 19

SEEDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hydroseeding.
   2. Maintenance.

B. Related Requirements:
   1. Section 31 23 23 - Fill.

1.2 REFERENCES

A. Definitions:
   1. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.
   2. Noxious Weeds:
      a. Harmful, undesirable, hard to control. Including, but not limited to:
         1) Johnson Grass or Johnson Grass Crosses, Canadian Thistle, Quackgrass, Wild Garlic and Wild Onion, Bermuda Grass, Annual Blue Grass, Corn Cockle, Dodder, and Blindweed.

B. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.
   2. ASTM International:
      a. ASTM C602 - Standard Specification for Agricultural Liming Materials.
      b. ASTM D2974 - Standard Test Method for Moisture, Ash and Organic Matter of Peat and Other Organic Soils.
      c. ASTM D4972 - Standard Test Method for pH of Soils.
   3. Texas Department of Transportation (TxDOT):
      a. Standard Specifications Item 161 – Compost.
      b. Standard Specifications Item 164 – Seeding for Erosion Control.
      c. Standard Specifications Item 169 – Soil Retention Blanket.
   4. Texas Seed Law.

1.3 SCHEDULING

A. Section 01 30 00 - Administrative Requirements: Requirements for scheduling.

B. Schedule topsoil placing to permit seeding operations under optimum conditions during normal planting seasons. The permanent seed mix shall be applied between January 15 and

May 15, when possible.

C. Coordinate planting with specified maintenance periods to provide maintenance until acceptance by ENGINEER.

D. Seed areas within 10 days of completion of topsoiling. Use seed within 12 months from the date of analysis.

E. Apply fertilizer at least 1 week after application of lime.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Seeding and Erosion Control Plan: Submit to ENGINEER for approval CONTRACTOR's Seeding and Erosion Control Plan including, but not limited to the following:
   1. Seed mixture(s) and fertilizers and application rates.
   2. Time of year for planting.
   3. Methods of preparing seedbed, seeding, rolling seeded areas, and irrigation.
   4. Methods to provide erosion control until seed is placed and grass is established (i.e., use of any or a combination of emulsifiers, tackifiers, mulches, adhesives, nurse crop seed).

C. Samples: Submit minimum 10-pound sample of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.

D. Materials Sources: Submit name of proposed imported topsoil sources prior to commencing transport of topsoil to the Work Site.

E. Seed Certificates: Submit certificates from seed vendors stating botanical and common name for each species, percentage by weight for each species, percentage of pure seed, germination percentage, and percentage weed seed for each species.

F. Fertilizer Certificate: Submit certificate confirming conformance with recommendations provided by laboratory based on topsoil analysis.

G. Test Results: Submit test results of manufactured topsoil. Indicate, by test results, information necessary to determine suitability, including, but not limited to, organic content, percent of sand with grain size results, pH, phosphorus, potassium, calcium, and magnesium; and laboratory or supplier recommendation for fertilizer application rate for specified seed mixture.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.6 QUALITY ASSURANCE

A. Perform work of this Section in accordance with Texas Seed Law and TxDOT Standard Specifications, Items 161 and 164.

B. Provide seed mixture in containers showing percentage of seed mix, germination percentage, inert matter percentage, weed percentage, year of production, net weight, date of packaging, and location of packaging.

C. Regulatory Requirements: Comply with regulatory agencies for fertilizer and herbicide composition.

D. Certifications: Provide certificate of compliance from authority having jurisdiction indicating approval of seed mixture.

1.7 QUALIFICATIONS

A. Seed Supplier: Established vendor capable of providing adequate seed quality and quantities.

B. Fertilizer Supplier: Established vendor capable of providing adequate fertilizer quality and quantities.

C. Installer: Company specializing in performing the work of this Section with minimum 5 years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver grass seed mixture in sealed containers bearing seed Supplier's label and certificate indicating the content of species, grade, and mass. Seed in damaged packaging is not acceptable. Label containers showing:
1. Analysis of seed mixture.
2. Percentage of pure seed.
3. Percentage of weeds.
4. Year of production.
5. Net weight.
6. Date when tagged and location.
7. Percentage germination.
8. Name and address of distributor.

C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

D. Deliver mulch and erosion control agent in moisture-proof containers showing manufacturer, content, and net weight (air dry).

E. Store materials in accordance with manufacturer's instructions and in a manner to prevent damage or deterioration.

F. Remove from the Work Site seed which has become wet, moldy, or otherwise damaged in transit or storage.

G. Store seed in weatherproof enclosures.

1.9 AMBIENT CONDITIONS

A. Do not apply seed slurry when wind conditions are such that material would be carried beyond designated area or that materials would not be uniformly applied or when wind velocity exceeds 5 miles per hour.

B. Do not apply materials over snow, ice, frozen ground, or standing water.

PART 2 PRODUCTS

2.1 SEED MIXTURE

A. Grass Seed: Fresh, clean, new-crop seed harvested previous year meeting the requirements of the Texas Seed Law, including the testing and labeling for pure live seed (PLS = Purity x Germination).

B. Mixture of the following:

Districts	***Approximate Planting Dates***	***Plant Species***	***PLS Rate (lbs/acre)***
12 (Houston)*	January 15 to May 15	Green Sprangletop	0.3
		Bermudagrass	2.1
		Sideoats Grama (Haskell)	3.2
		Little Bluestem (Native)	1.4
		Illinois Bundleflower	1.0
12 (Houston) and 20 (Beaumont)	September 1 to November 30	Oats	72
All	May 1 to August 31	Foxtail Millet	34

2.2 SOIL AMENDMENTS

A. Soil amendments to be applied in accordance with soil test recommendations and ENGINEER's approval. Soil amendments shall be free from clay subsoil, sawdust, commercial wood products, stones, lumps, plants, sticks, weed stolons and seeds, chemical contaminants, and other materials harmful to plant life.

B. Organic Components:
1. Sphagnum peat moss shall be a horticultural grade. Peat moss suitable for horticultural purposes shall be medium to coarse shredded with a texture varying from porous to spongy fibrous and substantially homogeneous with a pH value between 3.4 and 5.5.

2. Commercially prepared compost shall be virtually free from all viable weed seeds or other plant reproductive parts, pathogens, chemicals or toxic contaminates. Physical contaminants such as rock, plastic, metal or glass shall be less than 0.5 percent. Total carbon to nitrogen ratio in the growing medium not to exceed 30:1.
3. Mushroom compost and/or animal manure and compost shall be leached with fresh water prior to installation (electrical conductivity not to exceed 2.0 mmhos/cm).

2.3 MULCHING MATERIAL

A. Free of weeds and other foreign materials, free of growth- or germination-inhibiting ingredients; manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material will become uniformly suspended to form a homogeneous slurry; dyed a suitable color to facilitate inspection of the placement of the material. When applied, capable of forming an absorptive mat, which will allow moisture to percolate into the underlying soil.

B. Straw Mulch: Oat or wheat, free from weeds, foreign matter detrimental to plant life, and dry; seasoned for spreading with mulch blower equipment. Hay or chopped cornstalks are not acceptable.

2.4 FERTILIZER

A. Granular form, dry, free flowing, and free from lumps.

B. Recommended for grass, with 50 percent of the elements derived from organic sources; of proportion necessary to eliminate deficiencies of topsoil.

2.5 WATER

A. Clean, fresh, and free of oil, salt, acid, alkali, sugar, vegetable matter, and any contaminants and substances or matter which could inhibit germination and vigorous growth of grass.

2.6 ACCESSORIES

A. Lime: ASTM C602, Class T agricultural limestone containing a minimum 80 percent calcium carbonate equivalent.

B. Water: Clean, fresh, and free of substances or matter capable of inhibiting vigorous growth of grass.

2.7 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.

C. Test in accordance with the following methodology:

Parameter	Test Method
Organic Content	ASTM D2974
Potassium, Phosphorus, Calcium, Magnesium	(1)
pH	ASTM D4972

Note:
(1) In accordance with state-accredited method.

D. Provide recommendation for fertilizer and lime application rates for specified seed mix as result of testing.

E. Chemical Characterization: One sample per source; in accordance with Section 31 23 23.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify prepared soil base is ready to receive the work of this Section.

3.2 PREPARATION - SUBGRADE

A. Prepare subgrade to eliminate uneven areas and low spots. Maintain lines, levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Obtain ENGINEER's approval of subgrade before placing topsoil.

3.3 HYDROSEEDING

A. Seeding and mulching shall be a one-step process in which seed, fertilizer, hydraulic mulch, and mulch adhesive are applied simultaneously in a water slurry via hydraulic seeder/mulcher.

B. Apply seed mixture at a rate specified in PART 2, SEED MIXTURE in two intersecting directions.

C. Hydraulic Seeder/Mulcher: Apply seed, fertilizer, hydraulic mulch, and temporary cover adhesive using an acceptable hydraulic seeder/mulcher equipped with mechanical agitation equipment capable of mixing the materials into a homogeneous slurry and maintaining the slurry in a homogeneous state until it is applied. The discharge pumps and gun nozzles shall be capable of applying the materials uniformly.

D. Volume Certification: Hydraulic seeding/mulching equipment shall have the tank volume certified by a plate affixed by manufacturer and confirmed to ENGINEER by means of measurements or tests prior to the commencement work. This plate shall be affixed in

plain view on the hydraulic seeder/mulcher and shall not be removed or altered. The plate shall certify tank volume only and shall imply equipment conformance to other requirements of this Section.

E. Application of Materials: Measure the quantity of each material to be charged into the hydraulic seeder/mulcher tank either by mass or by a system of mass-calibrated volume measurements acceptable to ENGINEER. Add the materials to the tank while it is being loaded with water. Thoroughly mix the materials into a homogeneous water slurry and distribute uniformly over the designated surface area via the hydraulic seeder/mulcher. Apply seed, fertilizer, and where applicable, hydraulic mulch adhesive within 2 hours of being charged into the hydraulic seeder/mulcher tank. During loading of the hydraulic seeder/mulcher tank, add materials in the following sequence:
   1. Seed, then fertilizer, then, where applicable, hydraulic mulch and adhesive.

F. Blend into existing adjacent grass areas to bond new growth to existing adjacent areas or to previous applications to form uniform surfaces.

G. Areas to be seeded with slopes steeper than 10H:1V shall also utilize a soil retention blanket as specified in TxDOT, Item 169.

3.4 OVERLAP

A. Hydroseeding and temporary cover shall overlap adjoining vegetation by 12 inches.

3.5 MAINTENANCE FOR VEGETATION ESTABLISHMENT

A. Start maintenance immediately after area is seeded.

B. Maintain seeded area for not less than the period stated below and longer, as required to establish an acceptable stand, as determined by ENGINEER:
   1. Not less than 60 days after last area seeded.

C. Maintain vegetative cover by watering, fertilizing, weeding, mowing, trimming, overseeding, and other operations such as rolling, regrading, and replanting as required to establish a smooth, acceptable grassed surface, free of eroded or bare areas.

D. Cutting Height: Mow vegetative cover as soon as there is enough top growth to cut with mower set at the specified height for the principal species planted. Repeat mowing as required to maintain specified height. Do not remove more than a third of grass height. Do not mow when grass is wet. Time initial and subsequent mowings as required to maintain the following grass height:
   1. Mow grass at 4 to 5-inch height. Do not mow lower than 4 inches.

E. Provide and maintain temporary piping hoses and watering equipment as required to convey water from water sources and to keep grassed areas uniformly moist as required for proper growth.

F. Vegetative cover will be accepted by ENGINEER provided all requirements have been complied with, including completion of 60-day maintenance period, and the following:
   1. Vegetative cover is properly established.
   2. Turf is free of eroded, bare, or dead spots and 98 percent free of weeds.

3. No surface is visible when vegetative cover has been cut to a height of 4 to 5 inches.

3.6 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Immediately clean up soil, mulch, broken sod, or other debris spilled onto pavement and dispose of deleterious materials.

C. Take precautions and prevent contamination by seeding and mulching slurry on structures, signs, guardrails, fences, utilities, or other surfaces not specified to be landscaped.

D. Where contamination occurs, remove seeding slurry to satisfaction of, and by means approved by ENGINEER.

3.7 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished work.

B. Protect landscaped areas from damage.

END OF SECTION

SECTION 35 24 00

DREDGING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Furnish all material, equipment and labor to complete the mechanical dredging of subsurface material to the target limits and the transport, handling, and placement of the dredged material at a designated on-site area for material solidification.
2. Furnish all materials, equipment and labor to apply and mix chemical additives in the water column to increase the settling rate after dredging.
3. Furnish all materials, equipment and labor to place a residual management layer and final cover material over the entire surface of removed material (and beyond, where required) upon completion of dredging.

1.2 MATERIALS TO BE REMOVED

A. Materials include subsurface soil within the defined northwest corner of the Work Site, as shown on Drawings. The subsurface soil is described as heterogeneous comprised of highly interbedded alluvial deposits consisting of silty sands, sands, silts, lean clays, fat clays, and sandy clays down to an elevation of approximately -30 feet NAVD88.

B. Soil boring logs, geotechnical properties and analytical results of the subsurface material at the dredge site can be found in the Final 100% Remedial Design Report, Northern Impoundment, San Jacinto River Waste Pits Site.

1.3 PHYSICAL DATA

A. Vertical datum shown in Drawings is referenced to the North American Vertical Datum of 1988 (NAVD88), measured in feet.

B. Horizontal coordinates shown in Drawings is referenced to the Texas State Plane Zone 4, TX-South Central.

1.4 REFERENCES

A. Related Sections:
1. Section 01 10 00 – Summary
2. Section 01 33 00 – Submittal Procedures
3. Section 01 40 00 – Quality Requirements.
4. Section 01 50 00 – Temporary Facilities and Controls
5. Section 01 57 19 – Temporary Environmental Controls
6. Section 02 61 14 – Material Handling and Transportation
7. Section 35 49 25 – Turbidity Curtain

1.5 QUALIFICATIONS

A. CONTRACTOR shall have completed at least three (3) dredging projects of similar size and scope using mechanical methods.

B. The dredging supervisor shall have a minimum of five (5) years of experience with dredging projects in the role of dredging supervisor or superintendent.

C. CONTRACTOR's equipment operators, supervisory engineering staff, and technical staff shall have a minimum of two (2) years of experience with dredging by mechanical methods.

1.6 PRE-MOBILIZATION AND PRE-DREDGE MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-mobilization and pre-dredge meetings.

B. Convene 1 week prior to installation of turbidity curtains.

C. Mandatory attendance includes ENGINEER, CONTRACTOR and Subcontractor.

D. Purpose of Meeting:
   1. Review the Work Site-specific quality assurance/quality control and monitoring procedures.
   2. Review time schedules.
   3. Review applicable personal protective equipment and regulations.
   4. Review safety plan and procedures.

1.7 SEQUENCE OF WORK

A. Mobilize to the Work Site and construct staging area and Solidification Containment Area.

B. Install turbidity curtains outside the active dredge site, as shown on Drawings.

C. Perform bathymetric survey to confirm pre-dredge surface and develop dredge prisms.

D. Conduct mechanical dredging for Production Dredging pass to remove the subsurface material to the lines and grades shown on Drawings and as described in this specification.

E. Apply chemical additives (e.g., polymers, coagulants) with the specified dosage to facilitate settling of suspended solids. Sufficiently mix within the water column to provide maximum effectiveness of chemical additives.

F. Perform bathymetric survey after settling of suspended solids. Develop dredge prisms based on surveyed surface and target elevations provided by ENGINEER for final pass.

G. Conduct mechanical dredging for Final Dredging pass to remove settled material and/or additional subsurface material to limits determined by ENGINEER.

H. Place granular material within dredge limits while pumping excess water to the Water Treatment System (WTS).

I. Place granular material in area beyond the dredge site (i.e., northwest) as indicated on Drawings.

1.8 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Plan for installation of turbidity curtains including equipment to be used and deployment procedures.

C. Manufacture Data (chemical additives): Include material properties and safety data sheets (SDS) and manufacturer's certified report of test.

D. Dredge Operation Plan for Approval: Include as a minimum the followings:
1. Description of mobilization/demobilization activities.
2. Schedule of dredging and ancillary works.
3. Method and equipment to accomplish the dredging operation, including ancillary equipment.
4. Description and Shop Drawing of environmental dredging bucket that will be used.
5. Description of dredging procedures to minimize resuspension.
6. Method of verification of pre-dredge and post-dredge site conditions.
7. Site access procedures, including location of staging areas and access to dredging equipment before each shift.
8. Proposed dredging plan and method of verification of dredge positioning and dredging depth.
9. Procedures and equipment layout for solidification procedures.
10. Information to be included in the daily records of operation.

E. Water Quality Monitoring and Control Plan describing the methods and procedures for controlling water quality outside the work area during dredging operations. Include monitoring procedures to demonstrate that the controls are effective.

F. Chemical Additives Dosing Plan: include as a minimum the following:
1. Proposed chemical additives - Include plan for treatability testing using site water and sediments to determine appropriate additives and dosage.
2. Dosage to be used based on the treatability testing.
3. Plan for placing residual management layer including equipment to be used and placement procedures.

G. Daily records of operation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Package and label chemical additives bearing manufacturer's markings to clearly identify it with applicable safety data sheet (SDS) submitted to ENGINEER.

C. When transported to the Work Site, handle chemical additives by appropriate means as recommended by manufacturer.

D. Store chemical additives as recommended by manufacturer to prevent degradation, theft, and vandalism.

1.10 AMBIENT CONDITIONS

A. Suspend operations whenever climatic or water conditions, or equipment proposed for the operation, as determined by ENGINEER, are unsatisfactory for performing the tasks in accordance with the requirements of this Section.

PART 2 PRODUCTS

2.1 CHEMICAL ADDITIVES

A. CONTRACTOR is required to use chemical additives in the water column after the completion of the Production Dredging pass to settle out the suspended solids.

B. Chemical additives may also be used to settle suspended solids after the Final Dredging pass at the direction of the ENGINEER.

2.2 TURBIDITY CURTAIN

A. Impermeable Turbidity Curtains. Two parallel turbidity curtains shall be installed to contain the suspended soils from dredging operation within the dredge site.

B. Describe curtain material type and deployment procedures in Dredging Operation Plan.

2.3 GRANULAR MATERIAL

A. Supply granular material with the following mixture:
   1. 70 to 80 percent sand between No. 30 and No. 200 sieve sizes
   2. 20 to 30 percent fines (passing No. 200 sieve)

PART 3 EXECUTION

3.1 EQUIPMENT

A. Provide dredging equipment as described in CONTRACTOR’s Dredging Operation Plan. Equipment must provide sufficient capacity to satisfactorily complete the Work scope within the scheduled time and in accordance with this specification. Equipment should be selected for implementation that is the most protective of the environment for this project.

B. Provide environmental bucket that is specifically designed to reduce the release of sediments during closure and retrieval to minimize resuspension.

C. Provide equipment for transportation of the dredge material to the shore (dry land outside of dredging limits) and offloading to facilitate efficient management and transportation of material.

D. Material barges must be sealed to prevent leakage.

E. Provide Solidification Containment Area at location shown on Drawings to meet the following requirements:
   1. Sufficient size and capacity to manage a minimum of two days of production.
   2. Capable of containing material for off-loading, solidification and loading of dredge spoils.
   3. Provide secondary containment to prevent potential spillage from operation.
   4. Follow layout and details shown on Drawings.

3.2 TURBIDITY CONTROL

A. Work in the dredge site shall be done to minimize resuspension of material outside of the active work area. Take all precautions to minimize and contain suspended solids from the dredging operation.

B. Deploy turbidity curtain along the boundary of the dredge site where the land elevation is below -9 feet NAVD88 prior to dredging as shown on Drawings. The bottom of the turbidity curtain shall be installed at the mud line and anchored in place adjacent to the dredge site such that the resuspended sediment will be contained inside the work area during the dredging operation.

C. Follow the approved Water Quality Monitoring and Control Plan to maintain and monitor the water quality outside the work area.

3.3 DREDGING

A. Perform Dredging Production pass to the target limits shown on Drawings, or as directed by ENGINEER.
   1. Begin dredging in the direction and sequence as proposed in the approved Dredging Operation Plan. Attain full grade at each transect prior to moving to the next transect location.

B. Maintain water level during dredging so that it does not go below -10.9 ft NAVD88.

C. Dredging tolerances are +0 foot and -0.5 feet from the required final elevation to cover the inaccuracies of the dredging process.

D. The side slopes shall not be steeper than shown on Drawings. Side slopes shall be dug from top to bottom and to the grades shown on Drawings.

E. Begin dredging at the highest elevation of material to be removed and work toward the lowest elevation to minimize sloughing of material.

F. Do not overfill dredge bucket.

G. Monitor dredge operation throughout the course of work for depth, slopes, location, and tolerances.

H. CONTRACTOR shall be responsible for damages due to dredging beyond the specified depth or horizontal limits.

I. Use real-time kinematic (RTK) GPS to accurately position dredge and remove material in dredge prism. Use Hypack, Inc. Dredgepack® software or similar product to monitor and process the data.

J. Track progress with bathymetric surveys.

K. Dredge to minimize resuspension of sediments.

L. Set and sequence production cuts to reduce concentrations in residuals.
   1. Place bucket accurately to avoid missing sediments between bucket placements.
   2. Control bucket overpenetration and overfilling.

M. Dredge entire limit to remove all material within the allowable tolerance.

N. Notify the ENGINEER when all dredging operations are completed. A post-dredge bathymetric survey of the dredge site and confirmation sampling will be completed by the ENGINEER. Assist ENGINEER by providing equipment and labor support.

O. Apply chemical additives to promote settling of the resuspended sediments after ENGINEER approval the Production Dredging pass.
   1. Evaluate the GHD treatability data and perform additional testing as necessary to develop a plan for application and mixing of polymers, coagulants and/or other additives.
   2. Sufficiently mix within the water column to provide maximum effectiveness of chemical additives.

P. ENGINEER to develop requirements for Final Dredging pass to be performed by CONTRACTOR.

Q. Follow ENGINEER’s requirements for Final Dredging pass.

3.4 TRANSPORT OF DREDGE MATERIAL

A. Place dredged material in sealed hopper and transport onshore to the on-site material processing area.

B. Transfer the dredged material from the hopper barge to the Solidification Containment Area for waste solidification.

C. Keep material barges in good working condition to prevent spillage or overflow of dredged material.

3.5 FIELD QUALITY CONTROL

A. Lay out work area using benchmarks and baselines established by the surveyor. Be responsible for accuracy of work relative to established benchmarks and baseline.

B. Maintain buoys and markers required to define transects in dredge site.

C. Use real time kinematics (RTK) positioning GPS to accurately position dredge and remove material in dredge prism. Use Hypack, Inc. Dredgepack® software or similar product to process the data.

D. Track progress with bathymetric surveys referenced to survey benchmarks.

E. Provide a daily quality control report to ENGINEER as specified in the approved Dredging Operation Plan.

F. Provide a final post-dredge survey of the project dredging limits to ENGINEER for final acceptance of dredging work prior to site restoration.

3.6 SITE RESTORATION

A. After completion and approval of Final Dredging pass by ENGINEER, place chemical additives to promote settling of the resuspended sediments, as directed by ENGINEER.
   1. Develop the procedures for the final round of settling of resuspended sediments based on the condition of the water and of the water and the effectiveness of the additives during the first application.
   2. Sufficiently mix within the water column to provide maximum effectiveness of chemical additives.

B. Upon acceptance and approval of the dredging operation by ENGINEER, backfill the entire dredge site with granular material.

C. Initially place minimum of 2 feet of granular material as residual management layer in thin lifts to minimize disturbance of the settled solids

D. Subsequently place remainder of granular material to elevation -13 ft NAVD88.

E. Remove water while placing granular material. Maintain water level between elevation -9 ft NAVD88 and -13 ft NAVD88 during granular material placement. Treat water in WTS.

F. Place granular material to elevation -13 ft NAVD88. As an alternative, there may be a potential to reuse the removed riprap or aggregate material that comprised the existing rock layer that was removed to facilitate dredging

G. After completion of granular material placement, pump water to elevation between -13 ft NAVD88 to -13.5 ft NAVD88.

H. Place granular material to lines and grade shown on Drawings to the northwest of the dredging area.

I. Demobilize Equipment.

J. Remove rock and liner from Solidification Containment Area and transport off site for disposal at direction of ENGINEER.

END OF SECTION

SECTION 35 49 25

TURBIDITY CURTAIN

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Turbidity curtain to be installed in the river during installation and removal of sheet piling around the Northern Impoundment.

B. Related Requirements:
   1. Section 01 57 19 - Temporary Environmental Controls.

1.2 REFERENCES

A. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.
   2. ASTM International:
      a. ASTM D4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon Arc-Type Apparatus.
      b. ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
      c. ASTM D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
      d. ASTM D4632/D4632M- Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
      e. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile.
      f. ASTM D6241 - Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.
      g. ASTM D4595 - Standard Test Method for Tensile Properties of Geotextiles by the Wide-width Strip Method.
      h. COE-02215 – US Army Corps of Engineers Test Method for Percent Open Area.

1.3 PRE-INSTALLATION AND PRE-REMOVAL MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation and pre-removal meetings.

B. Convene 1 week prior to commencing installation of turbidity curtain and installation of sheet pile for each segment of sheet pile.

C. Convene 1 week prior to commencing installation of turbidity curtain and removal of sheet pile for each segment of sheet pile.

D. Mandatory attendance includes ENGINEER, CONTRACTOR and Subcontractor.

E. Purpose of Meeting:
   1. Review the Work Site-specific quality assurance/quality control and monitoring procedures.
   2. Review time schedules.
   3. Review applicable personal protective equipment and regulations.
   4. Review safety plan and procedures.

1.4 SEQUENCING

A. Sheet piles will be installed and removed in increments. At each increment (area of work) where the direction of water flow is away from the impoundment, the area will be enclosed by turbidity curtains.

B. Turbidity curtains will be deployed prior to the start of sheet pile installation or removal.

C. Prior approval of the ENGINEER is required before work proceeds in an area where turbidity curtains are deemed unnecessary.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Samples: If requested by ENGINEER, submit a sample of the curtain material prior to its incorporation into the work.

C. Test Reports: Include material properties sheets and manufacturer’s certified report of test.

D. Manufacturer’s Certificates: Certify that curtain meets or exceeds specified requirements prior to installation.

E. Deployment Plan: Include placement of curtain and location of anchoring system.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Package and label curtain bearing manufacturer's markings to clearly identify it with applicable test report submitted to ENGINEER.

C. When transported to the Work Site, handle curtain by appropriate means as recommended by manufacturer so that no damage is caused.

D. When not immediately incorporated into the Works, store curtain as recommended by manufacturer to prevent damage, degradation, and theft or vandalism.

E. Use appropriate handling equipment when moving curtain from one place to another.

F. Notify ENGINEER in advance of curtain delivery to the Work Site. Perform joint inspection with ENGINEER upon delivery. Defects or damage arising from shipping and handling will be grounds for rejection of a portion of, or the entire curtain at the discretion of ENGINEER. Remove damaged curtain from the Work Site and replace with new material at no additional cost to OWNER.

1.7 AMBIENT CONDITIONS

A. Suspend installation operations whenever climatic or water conditions, or equipment proposed for placing the curtain, as determined by ENGINEER, are unsatisfactory for placing the curtain in accordance with the requirements of this Section.

B. Curtain placement shall account for wave, wind, and other related factors on the River at the proposed time of placement.

C. Deployed curtain shall be adequately ballasted at all times to limit the risk of wind damage and/or displacement from curtain placed alignment due to wave action and/or water velocities at the Work Site.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Provide 2 years manufacturer's warranty. Warranty shall not be pro-rated in a manner that would diminish coverage with increasing time from installation.

C. Warranty: Include coverage for:
   1. Full refund or replacement.
   2. Labor and equipment to repair or replace the curtain and consequential and incidental damage that occurs as a result of failure of the curtain.

D. Warranty coverage starts from the date of placement of the curtain in the water.

PART 2 PRODUCTS

2.1 PERMEABLE TURBIDITY CURTAIN (TURBIDITY BARRIER)

A. ABASCO Type 3 Heavy Duty Turbidity Curtain (TC-3-HD) with sufficient ABASCO Anchor package(s) to secure the curtain in place or an approved equal.
   1. Any substitution shall be made in accordance with Section 01 60 00 - Product Requirements.
   2. Proposed substitution shall meet or exceed the followings:
      a. Dual 5/16" galvanized steel Top Tension cables contained in polyethylene tubes, one above and one below the float
      b. 10" expanding polystyrene EPS Flotation enclosed in individually sealed upper pockets
      c. 22 oz/yd2 Coated PVC Fabric with 40-oz PVC fabric to reinforce all corners
      d. 3/8" galvanized steel ballast chain

e. Aluminum universal slide connectors with anchor points and toggle pins
f. Lighted buoys
g. Variable length permeable skirt (WINFAB 2199 or equivalent) with the technical properties provided. Values are Minimum Average Roll Value.

PROPERTY	TEST METHOD	UNIT	VALUE
Tensile Strength (grab)	ASTM D-4632	lbs	370 X 250
Elongation	ASTM D-4632	%	15 X 15
CBR Puncture	ASTM D-6241	lbs	950
Trapezoidal Tear	ASTM D-4533	lbs	100 X 60
Wide Width Tensile (Ultimate)	ASTM D-4595	lbs/ft	2700 X 1740
Ultraviolet Resistance	ASTM D-4355	%	90
Apparent Opening Size (AOS)	ASTM D-44751	US Std Sieve	70
Percent Open Area (POA)	COE-02215	%	4
Permittivity	ASTM D-4491	sec^{-1}	0.28
Permeability	ASTM D-4491	cm/sec	0.01
Water Flow Rate	ASTM D-4491	gpm/ft^2	18

B. ABASCO AS-40 Boom/Barrier Anchor Package or Equivalent
1. Any substitution shall be made in accordance with Section 01 60 00 - Product Requirements.
2. Proposed substitution shall meet or exceed the followings:
h. Galvanized steel Danforth type anchor, min 40 lbs
i. 3/8” chain leader 8 ft long with 3/8” shackles
j. 3/4” polypropylene rope (yellow) with thimble eyes and 1/2” shackle
k. Anchor buoy Polyform A-2 (Orange) with ½” shackle
l. 3/4” polypropylene rope (yellow) painter line with thimble eyes and 1/2” shackle
m. Fabricated with a PVC coated nylon upper and lower pockets to receive ballast and flotation billets. Double over and stitch ends for reinforcement with the addition of grommets for connecting additional sections of curtain.

2.2 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Manufacturer Quality Control:
1. Sample and test permeable skirt material at a minimum once every 100,000 sq ft for tests specified for each respective product in PART 2, PERMEABLE TURBIDITY CURTAIN (TURBIDITY BARRIER), to demonstrate that the material conforms to requirements as specified. Test for UV stability and apparent opening size at a minimum once every month.
2. Perform samples on sacrificial portions of material so that repair of material is not required.
3. If permeable skirt sample fails to meet the quality control requirements of this Section, sample and test each roll manufactured in the same lot, or at the same time, as the failing roll. Continue sampling and testing of rolls until a pattern of acceptable test results is established.
4. At permeable skirt manufacturer's discretion and expense, additional testing of material may be performed to more closely identify the non-complying material and/or to qualify individual rolls of material.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution Requirements: Verification of existing conditions before starting work.

B. Verify depth of the water body along specified alignment prior to ordering.

3.2 PREPARATION

A. Placement shall not proceed until CONTRACTOR's Work Site-Specific Health and Safety Plan has been approved by ENGINEER.

B. Prepare and submit drawings identifying anchor locations.

C. Obtain required permits for placement of curtain.

D. Take appropriate health and safety precautions when working on the river.

3.3 PLACEMENT

A. Place the curtain in accordance with manufacturer's instructions.

B. The top of the curtain shall be installed a minimum of 12 inches above the water surface elevation.

C. Install curtain and secure it prior to commencing any work activity related to sheet pile installation and removal that could generate silt or sediment in the River.

D. Replace any portion of the curtain that is damaged during its installation or during any work activity related to sheet pile installation and removal at no additional cost to OWNER.

E. Attach adjacent sections of curtain by the use of grommet clips, lacing with rope through the end grommets, or as directed by ENGINEER.

F. Provide grommets in end sections at spacing recommended by the manufacturer, vertically at both ends of each unit.

G. Install a reinforcement belt of polyester webbing at the top of the curtain to provide additional tensile reinforcement and dimensional stability, as required.

H. Use anchoring devices as required by River bottom conditions.

I. Mark curtain location with flags, buoys, or other devices as required by applicable regulations, permits and the U.S. Coast Guard.

3.4 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspections and testing.

B. ENGINEER will inspect curtain for proper placement and maintenance and confirmation it is being maintained in good working order. If any maintenance or repairs are to be made to any part of the curtain, the work shall be initiated immediately after CONTRACTOR is informed of deficiency.

C. Inspect installed curtain for tears and gaps. Confirm top edge of curtain is above the water surface and bottom edge is free of sediment.

3.5 REMOVAL

A. Remove curtain on completion of sheet pile installation or removal and when approved by ENGINEER.

3.6 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Protect curtain from damage. Utilize marking/warning devices required by permits and local regulations.

C. Check curtain for damage daily. Repair any damage and restore the curtain functionality to the satisfaction of ENGINEER.

END OF SECTION

SECTION 40 05 13

COMMON WORK RESULTS FOR PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. General engineering requirements.
2. General product requirements.
3. General fabrication and testing requirements.
4. General installation and commissioning requirements.

B. Related Requirements:
1. Section 40 05 31.13 - Polyvinyl Chloride Process Pipe.
2. Section 22 05 03 - Pipe Data Sheet- PVDF Tubing and Carrier Piping
3. Section 40 05 33 - High-Density Polyethylene Process Pipe

1.2 REFERENCES

A. Definitions:
1. The following are industry abbreviations for plastic materials:
a. ABS: Acrylonitrile-butadiene-styrene plastic.
b. CPVC: Chlorinated polyvinyl chloride plastic.
c. HDPE: High-density polyethylene plastic.
d. PE: Polyethylene plastic.
e. PVC: Polyvinyl chloride plastic.
2. The following are industry abbreviations for metal materials:
a. CLDI: Cement-lined ductile iron.
b. CS: Carbon steel.
3. The following are industry abbreviations for rubber materials:
a. EPDM: Ethylene-propylene-dieneterpolymer rubber.
b. NBR: Acrylonitrile-butadiene rubber.
4. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
5. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
6. Exposed Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
7. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
8. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

B. Reference Standards:
1. Section 01 40 00 - Quality Requirements: Requirements for references.

2. American Society of Mechanical Engineers:
   a. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
   b. ASME B18.2.1 - Square and Hex Bolts and Screws - Inch Series.
3. ASTM International:
   a. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   b. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
   c. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
   d. ASTM D2672 - Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement.
   e. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
   f. ASTM D3138 - Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Non-Pressure Piping Components.
   g. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
   h. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
   i. ASTM F402 - Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
   j. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
4. American Water Works Association: AWWA C110 - Standard for Ductile-Iron and Gray Iron Fittings 76 mm Through 1219 mm.
5. Underwriters Laboratories (UL).

1.3 SCHEDULING

A. Coordinate with work of other trades for piping fabrication, supporting, installation, insulation, connection to equipment and packages, and testing.

B. Coordinate installation of required in-line instrumentation and control valves.

C. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Coordinate installation of required supporting devices and other structural components as they are constructed.

1.4 SUBMITTALS

A. Product Data: Submit detailed catalog information on selection, identification, shop and/or Work Site fabrication procedure, installation, and adjusting, for the following products, including components:
   1. Pipes.
   2. Flanges.
   3. Fittings.
   4. Expansion joints, flexible hoses, and hose adapters.

5. Mechanical sleeve seals.
6. Supports, hangers, guides, and anchors.

B. Shop Drawings:
1. Include descriptive information as required to fully describe the materials and procedures to be used in fabrication of the piping system. Submit all data as specified below. Partial submittals / submittals without all information as listed below in a single submittal will not be accepted by ENGINEER and will be returned Revise and Resubmit.
2. Clearly specify pipe material and joint type selected for each pipeline, where alternatives are specified.
3. Include Shop Drawings for fabricated components of pipe, fittings, anchors, and guides.
4. Include a complete laying plan and section, detailing dimensions, location of each pipe section and each special length, special fittings, bends, coatings, and other pertinent information.
5. Include double-lined to-scale drawings of each pipe support system to the scale shown on the Drawings.
6. Locate each support and hanger, identify with type of catalog number or Shop Drawing detail number. Show anchor locations and identify them by Shop Drawing detail number.
7. Include detailed installation drawings, catalog information, and complete component selection list for tie rods and thrust restraints systems.
8. No change in material or joint selection will be permitted after submittal of Shop Drawings and their final review by ENGINEER.

C. Certificates and Reports:
1. Certify that products meet or exceed specified requirements.
2. Indicate results of field hydrostatic testing.

1.5 CLOSEOUT SUBMITTALS

A. Record Documents: Indicate location, size, and service of piping systems.

B. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Fabrication of flanged, threaded, and grooved piping shall be in accordance with ASME and AWWA standards.

1.7 QUALIFICATIONS

A. Fabricator: Company specializing in the works of this Section, and supplementary individual piping specification Sections, with minimum 3 years documented experience.

B. Installer: Company specializing in performing the work of this Section, and supplementary individual piping Sections, with minimum 3 years documented experience.

C. Independent Testing Firm: Company specializing in inspection of AWWA piping material, fabrication final pressure testing, with minimum 5 years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Handle piping items strictly in accordance with manufacturer instructions, during all stages of delivery and storage.

C. Ensure no damage is done to exterior, interior, shape of pipe during activities prior to fabrication and installation.

D. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect the products from dirt, damage, deformation, non-compatible materials, heat, cold, sunlight exposure, rain, and moisture.

F. Receive the products in factory finish condition. Inspect for damage or deterioration of product quality. Replace damaged or deteriorated quality product as required and directed by ENGINEER.

1.9 WARRANTY

A. Provide 3-year manufacturer's warranty for products covered in this Section.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Design the system to ASME and AWWA standards.

B. Piping Sizes and Materials: TBD by CONTRACTOR.

2.2 JOINING MATERIALS

A. Refer to Section 40 05 33 for specific details on individual system joining methods and materials.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents:
1. ASME B16.21, nonmetallic, flat, asbestos-free, 3.2 mm maximum thickness unless thickness or specific material is indicated in piping data sheet.
2. Full-face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
3. Narrow-face Type: For raised-face, Class 250, cast-iron and steel flanges.
4. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and

full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

E. Solvent Cements for Joining Plastic Piping:
1. PVC Piping: ASTM D2564. Include primer according to ASTM F656.

F. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 PIPE, FITTINGS, JOINTS, AND EXPANSION PROVISIONS FOR EXPOSED PIPING

A. Refer to the Drawings for location and overall arrangement of piping systems.

B. CONTRACTOR is required to install pipe anchors and flexible couplings to facilitate piping installation, provided that completed details describing location, pipe supports, and hydraulic thrust protection are submitted to ENGINEER for review.

C. Provide thrust ties for flexible couplings, transition couplings, and flanged coupling adapters on pressure piping as specified, including those shown on the Drawings. Thrust protection shall be adequate to sustain the force developed by 1 1/2 times the operating pressures and the test pressure specified.

D. Pipe or tube connections of dissimilar metals / materials shall be made as shown on Drawings. CONTRACTOR may use the following methods for joining pipes of different materials unless specifically stated on the Drawings. All pipe connections shall be rated to 150 psi at 120 degrees F:
1. Stainless steel compression fittings for joining stainless steel pipe to HDPE pipe or tube. Compression fittings shall be axially restrained.
2. Stainless steel threaded transition adapter nipple fitting with O-ring seals for joining HDPE pipe to stainless steel pipe by ISCO pipe or equal.
3. Stainless steel reinforced PVC threaded adapter fittings for joining PVC to metal pipe by Spears or equal.

E. Quick disconnect fittings shall be stainless steel camlock couplers with rated pressure of 250 psi:
1. Female coupler with hose shank shall be used with movable pipes.
2. Male coupler shall be used on fixed pipes.
3. Quick disconnect fittings shall be Dixon "Andrews" couplers or equal.
4. Provide caps and plugs for all quick disconnect fittings.

2.4 PIPING SUPPORT AND RESTRAINING SYSTEMS

A. Support piping, in general, as described hereinafter and as shown on the Drawings.

B. Manufacturer's catalog figure numbers are typical of the types and quality of standard pipe supports and hangers to be employed. Special support and hanger details are shown to cover typical locations where standard catalogue supports are inapplicable.

C. Pipe supports shown on the Drawings are intended to present the general arrangement of

pipe supports in the area, represented as typical of similar arrangements to be used. No attempt has been made to show all required pipe supports and restraints in all locations, either on the Drawings or in the details, standard or custom made. CONTRACTOR shall be responsible for providing adequate number, size, and type of piping supports required.

D. Pipe support and restraining system components shall withstand the dead loads imposed by the weight of the pipes filled with water and shall have a minimum safety factor of 5, and live loads created by pumped fluid thrust and shall be adequately anchored to resist such forces without undue shock, vibration, or damage to the piping system or related equipment.

E. Support horizontal piping with adjustable swivel-ring, split-ring, or clevis type hangers as shown, Grinnel Figure 104 or 260, galvanized; or welded steel wall bracket, Grinnel Figure 199, galvanized, or approved equal; or approved alternative.

F. Support stacked horizontal runs of piping along walls by a metal framing system attached to concrete insert channels; Unistrut, or approved alternative. No pipe shall be supported from the pipe above or below itself.

G. Horizontal piping hanger support rods shall attach to steel beams with I-clamps, to concrete with inserts or flanges fastened with flush shells, to wood not less than 2-5/8 inch thick with lag screws and angle clips.

H. Vertical piping hangers and supports shall be Unistrut channel and pipe clamps, or approved alternative.

I. All hangers, rods, clamps, protective shields, metal framing support components, and hanger accessories shall be galvanized unless otherwise specified. Expansion anchors shall be Type 316 stainless steel. Submerged supports shall be Type 316 stainless steel and shall be electrically isolated from metal piping with a 1/4-inch by 3-inch neoprene rubber wrap.

J. Support Spacing: Maximum distance between pipe supports as set out below unless otherwise indicated on the Drawings:

	Maximum Distance Between Support Points		
Pipe Size	*CS*	*DIP, SST, STL*	*PVC*
Up to 3/4 inch diameter	3' 3"	3' 3"	2' 0"
1 inch to 1 1/2 inch	6' 0"	6' 0"	3' 3"
2 inch to 3 inch	6' 0"	6' 0"	3' 3"
3 inch to 4 inch	6' 0"	8' 3"	3' 3"
5 inch to 8 inch	6' 0"	8' 3"	3' 3"
8 inch and over	6' 0"	8' 3"	3' 3"

* Spacing above are for specific gravity of 1.0, reduce spacings for greater specific gravities. Reduce spacings to 50 percent of above where valves occur in lines. Actual spacing will depend on pipe size and special loading conditions.

K. Hanger rod sizing for plastic pipe shall be the same as for steel pipe. Spacing of hangers shall be as recommended by the manufacturer for the flow temperature in the pipe.

L. Support piping in a manner that will prevent undue strain on any valve, fitting, or piece of equipment. In addition, provide pipe supports at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown. Do not install pipe supports and hangers

in equipment access areas.

2.5 PIPING FABRICATION AND ERECTION

A. Join pipe and fittings according to the following requirements.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before fabrication and assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

E. Do not use pipe sections that have cracked or open welds.

F. Piping fabrication, inspection and testing shall be in accordance with this specification, ASME and AWWA standards.

G. Erect piping with flanged and threaded connections as applicable in accordance with good engineering practice suitable for hydrocarbon processing industry. Use suitable lubricants on bolt threads.

H. The overall fabrication, supporting, and erection of piping shall be done in such a way as to impose minimum possible loading on connected equipment and valves. Wherever required, verify the alignment of the equipment and drive motor in pipe-connected and disconnected state, to verify that piping is not imposing undue load on the equipment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and the Work Site conditions are ready to receive work.

3.2 INSTALLATION OF PIPING SYSTEMS - GENERAL REQUIREMENTS

A. Install piping as shown on the Drawings unless deviations to layout are approved by ENGINEER.

B. Mark each pipe and fitting on the outside to indicate the class of pipe and location number of the laying plan. Furnish and install piping in accordance with the reviewed Shop Drawings. All marking shall be coded to the Shop Drawings.

C. Provide allowance for piping to be modified around CONTRACTOR supplied equipment. Piping and piping systems may be modified up to 5 ft in any direction after receipt of equipment Shop Drawings to suit provided equipment. All Piping shown on drawings shall be confirmed in field prior to installation.

D. Specific flange joint requirements are shown on the Drawings. Provide other break flanges / unions in accordance with general industrial practice.

E. Install piping to maximum possible extent at right angles, and club together to manage in designated piping-ways. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Install piping to permit valve servicing.

H. Install piping at indicated slopes.

I. Install piping free of sags and bends.

J. Install manufactured fittings for changes in direction and branch connections. Fabricated fittings shall not be accepted where standard manufactured fittings are available.

K. Install piping to allow application of insulation where indicated.

L. Select system components with pressure rating equal to or greater than system operating pressure.

M. Valves shall be accessible from relevant level flooring, and shall be installed in accordance with manufacturers instructions.

N. Support all piping connections to dynamic equipment suitably to prevent overstressing of equipment casing beyond limits specified by the equipment manufacturers. Provide spring supports wherever necessitated due to variable loads.

O. Hard-pipe and route overflow and drain lines to appropriate drain collection points.

P. Verify final equipment locations for roughing-in.

Q. Refer to equipment specifications in other Sections of these specifications for roughing-in requirements.

R. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Coordinate sleeve sizes with the seal manufacturer for required annular space.
   1. Install steel pipe for sleeves smaller than 150 mm in diameter.
   2. Install cast-iron wall pipes for sleeves 150 mm and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required

for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and individual Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

F. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D2235 and ASTM D2661 Appendices.
   3. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D1785 PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D2855.
   5. PVC Non-pressure Piping: Join according to ASTM D2855.
   6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D3138 Appendix.

G. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D3139.

H. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D3212.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment as shown on the Drawings.

3.5 GROUTING

A. Mix and install grout for piping base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for pipe supports.

G. Place grout around anchors.

H. Cure placed grout.

3.6 FIELD QUALITY CONTROL

A. Clean piping systems by flushing with water or blowing with air with valves wide open prior to testing and before installing any primary element instrumentation on the piping systems.

B. Provide temporary restraints or isolate expansion joints which cannot sustain the reactions due to test pressure.

C. Isolate from the piping, equipment that is not to be subjected to the test pressure.

D. Piping must pass field tests.

E. No leakage will be allowed.

F. Hydrostatically test piping using clean water at ambient temperature except where there is risk of damage due to freezing. Another fluid may be used if it is safe for workmen and compatible with the piping.

G. Apply the hydrostatic test pressure (1.5 times design pressure) for 4 hours.

H. If leaks are found, repair and retest until no leakage units found.

I. Drain piping and blow dry following successful completion of testing.

J. Prepare a report for each test. Include in the report the following:
   1. Location or section of piping.
   2. Time and duration of test.
   3. Test pressure at start and completion.
   4. Ambient and water temperatures.

3.7 CLEANING

A. Following assembly and testing, prior to disinfection of potable water lines, and following final acceptance, flush pipelines, except as stated below, with water at 160 gpm minimum flushing velocity until foreign matter is removed.

B. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

END OF SECTION

SECTION 40 05 33

HIGH DENSITY POLYETHYLENE PROCESS PIPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Section defines the minimum requirements for supply and installation of High-Density Polyethylene (HDPE) pressure piping and associated appurtenances.
   1. All jointing and gasketing materials, harnessing, and other miscellaneous appurtenances and accessories shall be provided.

1.2 RELATED SECTIONS

A. Section 40 05 13 – Common Work Results for Process Piping

1.3 QUALITY ASSURANCE

A. Manufacturers Qualifications: Piping for each service or system specified herein shall be provided by a manufacturer who has thoroughly familiarized himself with the design intent of the system and will provide piping suitable for the service intended.

B. Source Quality Control: All pipe shall be marked with a class designation thereon. The name or trademark of the manufacturer shall also be marked on the pipe.

C. Each type of pipe shall be obtained from no more than one manufacturer.

D. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
   1. ASTM D 2657, Standard Practice for Heat Joining Polyethylene Pipe and fittings.
   2. ASTM D 2683, Standard Specifications for socket type Polyethylene fittings for outside diameter controlled Polyethylene Pipe and Tubing.
   3. ASTM D 2837, Standard Testing Methods for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials.
   4. ASTM D 3261, Specifications for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Plastic Pipe and Tubing.
   5. ASTM D 3350, Standard Specifications for Polyethylene Plastic Pipe and Fitting Materials.
   6. PPI TR- 3, Policies and Procedures for Developing Recommended Hydrostatic Design Stress for Thermoplastic Pipe Materials.
   7. PPI TR-4, Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fitting Compounds.
   8. ANSI/NSF, Standard No. 61 for Drinking Water Systems Components- Health Effects.
   9. AWWA C901, Standards for Polyethylene (PE) Pressure Pipe and Tubing 1/2 inches through 3 inches for Water Service.
   10. AWWA C906, Standards for Polyethylene (PE) Pressure Pipe and Tubing 4 inches through 63 inches for Water Service.

E. Shop Tests:
   1. Piping manufacturer shall maintain a continuous quality control program. All Polyethylene molding materials used to manufacture pipe and fittings under this Section shall be tested for conformance to the requirements of AWWA C901 or AWWA C906.

1.4 SUBMITTALS

A. Shop Drawings: CONTRACTOR shall submit for approval Shop Drawings showing the following:
   1. Detailed procedures to be used in jointing and installing piping system including manufacturer's recommendations.
   2. Interfacing of piping system to equipment, appurtenances, and other types of pipe.
   3. Detail requirements for burial, supports, anchors, guides, expansion joints, and all accessories required for a satisfactory piping system.
   4. Affidavit of Compliance in accordance with AWWA C901 or AWWA C906.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing, and protecting products.
B. Inspect for damage.

1.6 WARRANTY

A. Provide 3-year manufacturer's warranty for products covered in this Section.

PART 2 PRODUCTS

2.1 MATERIALS

A. General

B. Polyethylene (HDPE) Pipe
   1. Materials used in the manufacture of the polyethylene pipe shall be PE 4710, high density polyethylene meeting the requirements of ASTM D 3350, cell classification of 445474C.
   2. The material shall have a minimum hydrostatic design basis of 320 psi at 73 degrees Fahrenheit when tested in accordance with PPI TR-3 and shall be listed in the name of the pipe manufacturer in PPI TR-4.
   3. Polyethylene pipe shall be manufactured in accordance with AWWA C901 for sizes 1/2 inches through 3 inches and in accordance with AWWA C906 for sizes 4 inches through 63 inches.
   4. The pipe and fittings shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.
   5. All piping and tubing furnished for use on this project shall meet the following

requirements, unless indicated otherwise on the Contract Drawings:
   a. Iron Pipe Size (IPS) PE4710
   b. Nominal 10-Inch HDPE (excluding creek crossing HDD installations): DR 21
   c. Nominal 10-Inch HDPE for creek crossing HDD installations: DR 11
   d. Nominal 8-Inch HDPE: DR 11
   e. Nominal 3-Inch HDPE: DR 11
   f. Nominal 2-Inch HDPE: DR 11
6. Restrained joints for polyethylene piping shall be accomplished by completion of butt fusion joints.
7. Restrained polyethylene pipe connections to stainless steel or carbon steel mechanical joint fittings shall be accomplished by use of a HDPE adapter piece which must be butt fused to the plain end of the HDPE piping. The adapter piece shall be PE 4710, with the same DR rating as the HDPE piping which it will be fused to.
8. When transitioning from one pipe material to HDPE pipe flex-restraints are required, and an electrofusion flex restraint by Central Plastics shall be used with a concrete collar to prevent pull outs from expansion of HDPE pipe or approved equal.
9. Product and manufacturer: HDPE piping shall be manufactured by:
   a. Plexco
   b. ISCO Industries
   c. Or equal

C. Butt Fusion Fittings:
1. Fittings shall be made of HDPE material with a minimum material designation of PE 4710 and with a minimum Cell Classification as noted in B.1. Fittings shall have a minimum pressure rating equal to or greater than the pipe to which they are joined unless otherwise specified on the plans or accepted by OWNER/ENGINEER. All fittings shall meet the requirements of AWWA C901 or AWWA C906.
   a. Molded fittings shall comply with the requirements of ASTM D 32610
   b. All fabricated elbows, tees, reducing tees, and end caps shall be produced and meet the requirements of ASTM F 2206, holding an ISO 9001 quality system certificate. Each fitting will be marked per ASTM F 2206 Section 10 including nominal size and fitting EDR, which will meet or exceed the pipe DR identification for the project. Fabricated fittings shall be manufactured using a McElroy DataLogger to record fusion pressure and temperature and shall be stamped with unique joint number that corresponds to the joint report. A graphic representation of the temperature and pressure data for all fusion joints made producing fittings shall be maintained for a minimum of 5 years as part of the quality control and will be available upon request of OWNER/ENGINEER. Test results validate ASTM section 7.3 and 9 shall be provided to OWNER/ENGINEER upon request.
   c. Socket fittings shall meet ASTM D 2683.

D. Magnetic Tape Marker for Underground Pipe:
1. All below ground Polyethylene (HDPE) pipe shall have a magnetic tape marker laid directly above the pipe for the full length of the pipe and approximately 18 inches below ground surface. At each concrete structure, cleanout, and/or valve box, the CONTRACTOR shall install the tape in such a manner where the tape runs up the exterior wall of the structure and is affixed at the top. The tape shall be affixed in such a fashion where OWNER can attach his detection device to the tape to produce a stronger signal for pipeline detection.
2. Tape shall be 3 inches wide consisting of two (2) exterior plies of polyethylene with an aluminum alloy foil core.

3. Tape shall be manufactured by Paul Potter Warning Tape, Alarm Tape, or approved equal.
4. Tape shall be green color and shall be labeled "Sewer" in black letters.
5. Splices, where needed, shall be made in accordance with manufacturer's recommendations.
6. At completion of the project, before final payment, the CONTRACTOR shall test the entire length of the pipe using pipe location equipment. Tests shall be made only in the presence of OWNER and ENGINEER. Any section of tape not continuous or that is undetectable shall be removed and relayed.

PART 3 EXECUTION

3.1 EXAMINATION

A. CONTRACTOR shall inspect all piping prior to installation to assure that pipe is free from defects in material and workmanship. The compatibility of all pipe and fittings shall be verified. Pipe fittings and accessories that are cracked, damaged, not identified, or in poor condition shall be rejected. Any pipe section or fitting containing significant scratches, dents, or marks shall be deemed unusable and rejected, or the suspect section removed from service. Any fitting or pipe section containing scratches, dents, or marks exceeding ten percent of the calculated wall thickness shall be rejected. Any substantial scratch in the opinion of ENGINEER may be cause for rejection. Rejection will be at the sole discretion of ENGINEER.

B. The Inspector shall have free access to all joints and test joints for determining the suitability of the joining procedure. Where construction restrictions limit inspection of joints, ENGINEER may have the person joining the pipe and/or fittings perform a test joint in the presence of ENGINEER or have the joint in question tested. ENGINEER shall determine the method of testing: either visual inspection, bent strap testing, or ultrasonic testing, per DOT CFR 49, Part 192.286 (b)(ii) or (b)(iii).

C. During construction, the first fusion of the day shall be a trial fusion which shall be allowed to cool completely and destructively tested as directed by ENGINEER. If the trial fusion fails, additional trial fusions shall be made and tested until successful fusions are completed. The procedure used to join the successful trial fusion shall be used for the balance of the day’s work, provided the procedure is within the limitations recommended by the manufacturer. ENGINEER shall have the authority to disallow any installer from completing heat fusion of HDPE pipe if that installer has consecutively failed trial joints. Any person deemed unqualified by ENGINEER will require training as specified in 1403.0102 before being permitted to heat fuse HDPE pipe.

D. During construction, CONTRACTOR shall report any occurrence of potential soil contamination in the vicinity of the pipe trench to ENGINEER immediately. Work shall be stopped until the contamination is remedied.

3.2 FIELD QUALITY CONTROL

A. Placing and Laying. All HDPE pipe shall be installed to minimize shear and tensile stresses. The minimum radius of field bends shall be ten pipe diameters for pipe twenty-four inches and larger.

B. Field Testing. CONTRACTOR shall perform hydrostatic leakage tests on all HDPE pipe in accordance with the non-monitored makeup water test.

3.3 MONITORED MAKE-UP WATER TEST

A. The test procedure consists of initial expansion, and test phases. During the initial expansion phase, the test section is pressurized to the test pressure, and enough make-up liquid is added each hour for three (3) hours to return to test pressure.

B. The test phase follows immediately, and may be one (1), two (2), or three (3) hours. At the end of the test time, the test section is returned to test pressure by adding a measured amount of liquid. If the amount of make-up liquid added does not exceed Table 1 values presented in PART 3, TEST PHASE MAKE-UP AMOUNT, leakage is not indicated.

C. For any test pressure from 1 to 1-1/2 times the system operating design pressure, the total test time including initial pressurization, initial expansion, and time at test pressure, must not exceed eight (8) hours. If the test is not completed due to leakage, equipment failure, etc., depressurize the test section, then allow it to “relax” for at least eight (8) hours before bringing the test section up to test pressure again.

3.4 TEST PHASE MAKE-UP AMOUNT

TABLE 1

Nominal Pipe Size (in.)	Gallons/100 ft. of Pipe		
	1 Hour Test	2 Hour Test	3 Hour Test
3	0.10	0.15	0.25
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.0	1.5
10	0.75	1.3	2.1
12	1.1	2.3	3.4
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.2	4.3	6.5
20	2.8	5.5	8.0
22	3.5	7.0	10.5
24	4.5	8.9	13.5
26	5.0	10.0	15.0
28	5.5	11.1	16.8
30	6.3	12.7	19.2
32	7.0	14.3	21.5
34	7.0	16.2	24.3
36	9.0	18.0	27.0

END OF SECTION

SECTION 40 05 51

COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ball valves.
   2. Butterfly valves.
   3. Check valves.

1.2 REFERENCES

A. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.
   2. American National Standards Institute: ANSI B16.1 - Cast Iron Pipe Flanges and Flange Fittings Classes 25, 125, and 250.
   3. American Petroleum Institute (API).
   4. ASTM International:
      a. ASTM A126 – Standard Specification for Gray Iron Casings for Valves, Flanges and Pipe Fittings.
   5. American Water Works Association:
      a. AWWA C509 - Standard for Resilient Seated Gate Valves for Water Supply Service.
      b. AWWA C550 – Protective Epoxy Interior Coatings for Valves and Hydrants.
   6. Manufacturers Standardization Society: MSS SP-110 – Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
   7. Underwriters Laboratories Inc. (UL).

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate dimensions, inlet and outlet size connections and connection ratings, materials of construction, CV/pressure loss curve, trim finish, coatings, mounting requirements and valve operators.

C. Product Data: Include vendor information.

D. Design Data: Indicate operating pressure data.

E. Manufacturer's Instructions: Indicate installation instructions.

F. Power and control wiring diagrams, including terminals and numbers.

G. Complete motor nameplate data.

H. Sizing calculations for open close/throttle and modulating.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents: Indicate location of valves and valve number, tests and inspection data.

C. Manufacturer's Certificate of Proper Installation.

D. Certificate of Compliance for:
1. API ANSI Classes 150 valves; full compliance with API standards.

E. Operation and Maintenance Data: Indicate instructions for operation, maintenance, and cleaning.

F. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Blank off ends of valves with plywood or install plugs in valves for shipment to protect valve internals from debris during handling. Leave valves blanked off until installation.

C. Accept valves on the Work Site in original packaging. Inspect for damage.

D. Protect valves from damage.

1.6 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Provide one-year manufacturer's warranty for valves.

C. Warranty: Include coverage for defects in material and workmanship.

PART 2 PRODUCTS

2.1 GENERAL

A. All valves shall include operator, actuator (as indicated on the Drawings) handwheel, extension stem, operating nut and accessories for a complete operation.

B. Valve shall be suitable for intended service. Renewable parts shall not be of a lower quality than specified.

C. Valve shall be same size as adjoining pipe.

D. Valve ends to suit adjacent piping.

E. Size operator to operate valve for the full range of pressures and velocities.

F. Valve shall open by turning counterclockwise.

G. Factory-mount operator, actuator, and accessories.

2.2 FACTORY FINISHING

A. Epoxy Lining and Coating:
   1. Use where specified for individual valves described herein.
   2. In accordance with AWWA C550 unless otherwise specified.
   3. Either two-part liquid material or heat activated (fusion) material except only heat activated material if specified as "fusion" or "fusion bonded" epoxy.
   4. Minimum 1.5 mm dry film thickness except where limited by valve operating tolerances.

B. Exposed Valves: Safety isolation valves and lockout valves with handles, handwheels, or chain wheels "safety yellow".

2.3 BUTTERFLY VALVES

A. Butterfly valves shall be used for pipeline greater than 2.0 inches unless otherwise specified.

B. Pressure ratings, 200 psi cold working pressure.

C. Operators: Provide valves six inches and less with handwheel operators. Provide valves over 6 inches with gear box and wheel operator unless otherwise specified.

D. Accessories: Provide chain wheel operator for valves mounted over six feet above floor level.

2.4 BALL VALVES

A. Ball Valve (2.0 inches and smaller):
   1. Ball valve shall be designed for two-way blocking capability. Valve shall provide bubble-tight shut-off.
   2. Ball valve shall be constructed of PVC Type 1, Grade 1. All elastomeric parts shall be made of Viton.
   3. Ball valve shall be of a True Union design with socket end connectors and be rated at 150 psi at 120 degrees F.
   4. As manufactured by Chemline, Type 21, Hayward Gordon or approved equal.

2.5 CHECK VALVES

A. PVC Check Valve (1.5 inches and smaller):
   1. PVC check valves shall be used for chemical service (includes methanol, ferric chloride, and phosphoric acid).
   2. Check valve shall be designed to be non-clog, fully automatic with internal ball as the only moving part. Valve shall provide a tight shut-off under pressure.
   3. Check valve body shall be constructed of PVC Type 1, Grade 1. Valve seat and O-rings shall be Viton.
   4. Check valve shall be of a True Union design with socket end connectors and be rated at 150 psi at 120 degrees F.
   5. As manufactured by Chemline, Hayward Gordon or approved equal.

B. Swing Check Valve (2.0 inches and larger):
   1. Swing check valve, cast iron body to ASTM A126 Class B, bolted bonnet, bronze disc under 6 inches, cast iron disc above 8 inches, bronze trim, stainless steel hinge pin, flanged ends to ANSI B16.1 Class 125, rated 150 psi, as manufactured by Crane, or approved equal.

2.6 VALVE OPERATORS

A. General: All valves shall be equipped with operators. The valve operator types, as specified herein, describe only the general characteristics of the operator. The operator shall be compatible with the valve with which it will be used and shall be of the same manufacturer, or a product that is recommended by the valve manufacturer. The operator shall be sized to operate the valve for the full range of pressures and velocities imposed by the service. All valve operators shall open by turning counterclockwise.

B. Manual Operators:
   1. General:
      a. Manual handwheel operators shall be provided unless otherwise shown or specified. Ferrous handwheels shall be galvanized and painted the same color as the valve and associated pipeline. Lever operators may be supplied on quarter-turn type valves 6 inches and smaller, if recommended by the manufacturer; however, operator force shall not exceed initial breakaway.
      b. When the maximum force required to operate a valve under full operating head exceeds 40 pounds, gear reduction operations shall be provided. Gear operators shall be totally enclosed and lubricated.
      c. On quarter-turn valves, the valve operators shall be of the self-locking type to prevent the disc or plug from creeping and shall be provided with position indicators to show the position of the valve disc or plug. Operators of the worm and gear type shall have self-locking worm gears, one-piece design, of bronze material, and accurately machine cut. The worm shall be hardened alloy steel, with thread ground and polished. Operators of the geared travelling nut type shall have threaded steel reach rods with an internally threaded bronze or ductile iron nut.
   2. Exposed Operators:
      a. Valves with operating nuts located more than 6 feet above finish floor elevation shall be fitted with chain wheels and guides, as manufactured by DeZurik Corporation, Series W or LWG, or equal. Chain wheels and guides shall be galvanized or cadmium plated. Chains shall be of the size recommended by the valve manufacturer and shall extend to within 4 feet of the operating floor. Where

chains hang in normally travelled areas, appropriate "L" type tie-back anchors shall be provided and located as approved by ENGINEER.

b. Level type operators shall have some means of being fixed in any given position to prevent accidental movement; shall be of rugged, noncorrosive construction; and shall be fully compatible with the valve.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that installations of previous trades are complete and ready to receive work.

3.2 HANDLING OF VALVES

A. Chains, cables and ropes must not be placed through valve ports or attached to operating cylinders or handwheels. Slings must be used either around the valve body or with bolts or rods through the flange bolt holes.

3.3 STORAGE OF VALVES

A. Store valves in a cool location clear of moving vehicles or other objects. Prevent dirt and debris from entering the valve internals. On no account shall the valve seats on butterfly valves be painted. Valves must not be rested on handwheels or operating shafts.

B. Store butterfly valves with valves slightly off the closed position.

C. Cover the valves to shield them from dirt and to avoid exposing the seats to sunlight or mercury arc light.

3.4 INSTALLATION OF ACTUATORS

A. Install actuators where shown as per manufacturer's recommendations. Secure the base of actuator in place. Field support from building steel or concrete block structure, if valve body does not properly support actuator body. Do not install actuators in such a position that makes them inaccessible or with hard maintenance access. Maintain spacing and access. Position indicators shall be visible and legible from the floor level.

B. Supply testing equipment and manufacturer technical representatives at the Work Site to verify actuator installation, adjustment of travel limits based on valve operation, torque and speed settings, and valve operational tests prior to the control system commissioning. Provide written report confirming proper installation.

C. Supply touch-up paint and touch up all exterior finish damage when installation is complete. Hand the remainder of touch-up paint in an identified container(s) to OWNER.

3.5 INSTALLATION OF VALVES

A. Install valves in accordance with manufacturer's instructions. Before installing valves, inspect the pipeline to ensure that no foreign debris or objects may work loose and prevent the valve from closing.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Provide clearance for installation of insulation and access to valves and fittings.

D. Provide access where valves and fittings are not exposed.

E. Provide support for valves where required for proper support and operation.

F. Install operator in position for convenient operation. Ensure space is available for operation of separators.

G. Install valves with stems upright or horizontal, not inverted. Ensure that each valve operates freely after installation into pipe.

H. Install unions downstream of valves.

3.6 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting and testing.

B. Perform hydrostatic test with piping.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Clean valves prior to painting.

3.8 PROTECTION OF FINISHED WORK

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Keep valves in closed position following installation.

3.9 VALVE SCHEDULE

Service	**Valve Type**
Process Piping (Influent/Effluent)	Swing Check Valve (PVC)
	Ball Valve (PVC)
	Butterfly Valve (PVC)
Solids Handling (Sludge)	Ball Valve (PVC)
	Swing Check Valve
Chemical Piping	PVDF Ball Valve

END OF SECTION

SECTION 40 70 00

INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Instrumentation for flow, turbidity, pH, and level measurement.

1.2 REFERENCES

A. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.
   2. National Fire Protection Association, Inc.:
      a. NFPA 70 - National Electrical Code.
   3. Underwriters Laboratories Inc. (UL).

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Reference Data:
   1. Include process measurement device type, process tag, name, manufacturer's name, list of supplied items with complete model numbers and process measurement device calibrated range.
   2. Provide Supplier/distributor contact and location of manufacturer's closest service location.

C. Description and Engineering Data: Indicate minimum/maximum range, operating, and performance data, application conditions and limitations of use, layout drawings with overall dimensions, clearance requirements, size and location of connections, wiring diagrams, materials, process connection, mounting details, control schematics with signals identified, wiring connection details, and other technical specifications required to describe product.
   1. Provide detailed description of operation, when applicable.
   2. Provide detailed product data and operating manuals, sheets or manuals for review when required to evaluate submittal, or as requested by ENGINEER.

D. Test Reports: Process measurement device calibration certificates including process measurement device reference data; identify testing/calibration equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory/location.

E. Manufacturer's Instructions: Provide installation details, manufacturer's instructions, and instructions for storage, handling, protection, examination, preparation, setup, and installation of product.

F. Manufacturer's Field Reports: Commissioning report on field tests, including all test forms and confirming proper installation prior to introduction to process media and energization.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents:
   1. Indicate actual locations of instrumentation.
   2. Include actual setpoints and analog signal spans including any field modifications.

C. Operation and Maintenance Data: Indicate and submit maintenance data for incorporation into Operations and Maintenance Manuals.
   1. Process measurement device reference data, and description and engineering data. As-built product data including any field modifications.
   2. Copies of factory test/manufacturer's calibration report, field report, and process measurement device setup/parameter configuration (including passwords) datasheets for each process measurement device. Include data communication registers layout.
   3. Provide detail installation drawings.
   4. Certificates or letters stating each piece of equipment has been installed to the satisfaction of the factory technical representative.
   5. Include operating manuals, manufacturer's setup, calibration instructions and control descriptions. Recommended renewal parts list and service/calibration schedules.
   6. Submit operation and maintenance data in printed and electronic Adobe Acrobat PDF format on electronic media. Upon approval, large manuals may be provided only in PDF format.
   7. Furnish special inspection certificates, when applicable.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Conform to NFPA 70.
   2. Electrical components must comply with requirements of current edition of applicable electrical safety regulations.
   3. Process measurement devices with electrical components to be UL certified. Manufacturers and approval marks must be accessible and legible after equipment is installed.
   4. Mechanical components must comply with of current edition of applicable standards and safety regulations.

1.6 QUALIFICATIONS

A. Installer: Company specializing in performing work of this Section with minimum 5 years of experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Ship process measurement devices to the Work Site in factory containers. Store equipment on Work Site in clean, dry, temporary storage containers for security purposes. Indicate any specific requirements for storage of process measurement devices during proposal stage.

C. Do not purchase sensors, probes, reagents, etc. or install sensors which have short storage/life time until they are ready to be put into continuous operation.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

B. Provide one-year manufacturer's warranty for instruments.

C. Warranty: Include coverage for defects in material and workmanship.

PART 2 PRODUCTS

2.1 INSTRUMENT LIST

A. Appended to this Section is Attachment 1, Instrument List, which tabulates the instruments that form part of the Works. Use this list in conjunction with Drawings.

2.2 ANALYTICAL INSTRUMENTATION-pH/ORP ANALYZER

A. Manufacturer List:
1. Emerson Rosemount
2. Endress + Hauser
3. Or Approved Equal

B. Differential electrode measurement pH/ORP analyzer with built in temperature compensation.

C. Output: 4-20 mA output signal proportional to range.

D. Operating Temperature Range: Minus 5 degrees C to 70 degrees C.

E. Materials: Wetted parts to be PEEK material or approved equal.

F. Mounting Assembly: Immersion in process tanks or in process piping. See P-02 drawing.

G. Sensor Cable: Integral, as long as required.

H. Controller:
1. The controller shall be suitable to accept multiple different sensors and have a quick connect capability. Sensors to be connected via a termination box.
2. Controller to provide 2 independent 4-20 mA outputs.
3. Manufacturer: Hach SC-200 or approved equal.

4. Enclosure: Type 4.
5. Electrical Requirements: 120V single phase 60 Hz.

I. Accessories: Sensor mounting hardware as required, junction box and 4-conductor extension cables with one shield and jacket. All in-line instrumentation shall be "hot tap" assemblies allowing instrumentation to be removed from piping while piping remains in service.

J. Ranges: Refer to table below.

Tag No.	Operating Range	Process Fluid	Location	Classification
AIT-2100	1 to 14 pH Sensitivity of 0.01	Impacted water	Rapid Mix Tank	Unclassified
AIT-2803	1 to 14 pH Sensitivity of 0.01	Final treated effluent	Final discharge pipe	Unclassified

2.3 FLOW INSTRUMENTATION– MAGNETIC FLOW METERS

A. Manufacturer List:
1. Emerson Rosemount.
2. Endress + Hauser.
3. Or Approved equal.

B. Description:
1. Four-wire, microprocessor-based dc magnetic flowmeter transmitter with integral display of measured flow and flow totalizer values in engineering units (m^3/h, L/s, m^3), HART protocol, sensor/electronics failure mode and annunciation, field programmable, menu driven limit and control settings (units, range, zero and span adjustment), non-volatile memory, local or remote mounted as indicated above.
2. Flow Tube:
   a. Flanged style capable of monitoring liquids with conductivity greater than 5 µS/cm in vertical or horizontal position; with full tube.
   b. Housing: Steel.
   c. Metering Tube: Lined, Type 304 stainless steel.
   d. Electrodes: Hard rubber liner, Hastelloy C, rated and certified for use in potable water installation.
      1) Accuracy: Plus or minus 0.5 percent of calibrated span.
      2) Stability: Plus or minus 0.2 percent of calibrated span for 12 months.
3. Power Supply: 120 VAC plus or minus 10 percent power, internal fusing.
4. Outputs:
   a. 4-20 mA linear, analog current signal with superimposed digital HART protocol into load between 0 and 500 Ω minimum.
   b. Pulse, digital; totalizer signal for flow totalizing.
5. Diameters: As required for design process flow.
6. Enclosure:
   a. Transmitter: NEMA 4X.
   b. Flow Tube: Rated IP 68, suitable for occasional submergence.
   c. Permanently attached engraved tags associating each tube and flowmeter.
7. Application: Unclassified area.
8. Connections: Flanged to ASME B16.5 Class 150.

9. Accessories:
   a. Type 316 stainless-steel ground ring.
   b. Stainless-steel protective inlet ring.
   c. Calibration certificate from factory.
   d. Tube to transmitter cable.
   e. Mounting Hardware: Where applicable for remote-mounted transmitter, provide mounting bracket as required to mount to pipe or wall.
10. Schedule: Refer to table below.

Tag No.	Flowrate	Pipe Size	Process Fluid	Service/Notes
FE-2002	0-1,000 gpm	TBD by CONTRACTOR	Impacted water	Installed on influent to Rapid Mix Tank
FIT-2804	0-500 gpm	TBD by CONTRACTOR	Final treated effluent	Installed on discharge of the water treatment system

2.4 PRESSURE INSTRUMENTATION – GAGES

A. Manufacturer List:
   1. Ashcroft.
   2. Dwyer.
   3. Endress + Hauser.
   4. Winters.
   5. Or approved equal.

B. Description:
   1. Pressure gages and accessories conforming to ANSI/ASME B40.1 and CRN approved.
      a. Accuracy: Plus or minus 0.5 percent of scale range, Grade 2A.
   2. Pressure Gages: Steel case (black epoxy painted), 113 mm dial size, threaded ring, solid front with blow-out back, molded acrylic window, white painted aluminum face with dual black reading dials (PSIG and kPa), micrometer adjustable type black pointer. Stainless-steel rotary type movement with stainless-steel bushings, Type 316 stainless-steel Bourdon tube and socket suitable for potable water service, throttling device (screw, pressure snubber), standard 13 mm NPT bottom process connection. Liquid-fill capability.
   3. Range and scale sized according to process conditions.
      a. Accuracy: Plus or minus 2.5 percent of full scale.
   4. Gages shall be calibrated. Submit a three-point factory calibration certificate for each gage or perform a three-point field calibration and submit results to ENGINEER. Gages not having an accuracy of 5 percent within 30 to 100 percent span shall be replaced.
   5. Accessories:
      a. As required, such as isolation ball valves, nipples, reducers to match seal and process connection, mounting hardware.
      b. Identification tagging/engraving as indicated below.
   6. Provide pressure gauges (0-100 psig) at the discharge of all water treatment system pumps. Provide pressure gauges upstream and downstream of each of the multimedia filters, bag/cartridge filters, as well as upstream/downstream of each of the GAC vessels.

2.5 LEVEL INSTRUMENTATION – ULTRASONIC

A. Manufacturer List:
1. Emerson Rosemount.
2. Endress + Hauser.
3. Or approved equal.

B. Description:
1. Microprocessor based non-contact ultrasonic level transmitter.
2. Four-wire electronic level transmitter with LCD display of measured level in engineering units, sensor/electronic failure mode and annunciation, fully field programmable (limit and control setting, range, zero and span adjustment), non-volatile memory, self-calibration, remote mounted.
3. Ultrasonic sensor with built-in temperature compensation, rated NEMA 4X, corrosion resistant to listed media, and rated for location when listed. The sensor will withstand accidental submersion and be mounted as approved by ENGINEER.
   a. Beam Angle: Maximum 8 degrees.
   b. Accuracy: Plus or minus 0.5 percent of calibrated span.
   c. Stability: Plus or minus 0.5 percent of calibrated span for 12 months.
4. Power Supply: 120 VAC.
5. Output: 4-20 mA analog, linear isolated signal into load between 0 and 500 Ω
6. minimum.
7. Enclosure: NEMA 4X.
8. Mountings: Stainless-steel sensor flange mounting hardware for connection to tank nozzles or open-top tanks.
9. Application: Unclassified areas; indoor applications.
10. Accessories: Sensor to transmitter cable, mounting brackets/hardware for sensor and, where remote transmitter is required, separate hardware for transmitter as indicated. Identification tagging/engraving as indicated in table below.

Tag No.	Range	Location	Process Fluid	Notes
LIT-2000 LIT-2001	0 to 10 m	Influent Tanks (2)	Impacted water	Outdoor Installation - Remote mount transmitter/readout with minimum 20 m cable length and hardware as required to mounting location.
LIT-2400	0 to 10 m	Filter feed tank	Clarifier effluent	Outdoor Installation - Remote mount transmitter/readout with minimum 20 m cable length and hardware as required to mounting location.
LI-3500 LI-3300 LI-3100 LI-3200 LI-3210 LI-3400	0-5 m	Chemical storage tanks (totes)	Coagulant, flocculation polymer, organosulfide acid, caustic, thickener polymer	TBD by CONTRACTOR.

2.6 TURBIDITY INSTRUMENTATION– TURBIDIMETER

A. Manufacturer List:
1. Emerson Rosemount.
2. Endress + Hauser.
3. Hach.
4. Or Approved equal.

B. Description:
1. Four-wire, microprocessor-based dc turbidity transmitter with integral display of measured turbidity value in NTU, HART protocol, sensor/electronics failure mode and annunciation, field programmable, menu driven limit and control settings (units, range, zero and span adjustment), non-volatile memory, local or remote mounted as indicated above.
2. Power Supply: 120 VAC plus or minus 10 percent power, internal fusing.
3. Outputs:
   a. 4-20 mA linear, analog current signal with superimposed digital HART protocol into load between 0 and 500 Ω minimum.
4. Enclosure: NEMA 4X
5. Application: Unclassified area.
6. Schedule: Refer to table below.

Tag No.	Range	Pipe Size	Process Fluid	Service/Notes
AIT-2302	0-XXX NTU	TBD by CONTRACTOR	Clarifier effluent	Installed after clarifier to show any failure in clarification process.
AIT-2803	0-XXX NTU	TBD by CONTRACTOR	Final treated effluent	Installed on the final discharge line of the treatment system.

2.7 DESIGN REQUIREMENTS

A. Furnish products listed and classified as suitable for purpose specified and indicated. Supplied process measurement devices must conform to the details specified. Except as specified elsewhere, equipment to be provided by acceptable manufacturers for each process measurement device or element as specified in equipment Sections.

B. Provide new devices unless otherwise specified. Provide process measurement devices of minimum specified design and quality, conforming to published ratings and for which replacement parts are readily available. Use products of one manufacturer for equipment or material of same type or classification unless otherwise specified. Refurbished devices are not considered new.

C. Devices that are removed but not re-used are the property of OWNER and are to be disposed of or stored as directed by ENGINEER. Items to be re-used, when listed to be checked, recalibrated and cleaned, then shown to ENGINEER, before being re-installed. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

D. Process measurement devices and components to be approved for the area classification and location in which it is being installed. Wetted parts of primary elements to be suited for process medium. External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, assembly.

E. Process measurement devices ranges indicated are for general guidance only and do not limit the device. Coordinate requirements based on actually installed equipment.

2.8 ACCESSORIES

A. Include mounting hardware, sampling lines, fittings, tubing, check valves, vacuum, and pressure relief valves, pressure and flow reducing control valves, selection and isolation valves, and other appurtenances necessary for process measurement devices operation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Review, verify, and confirm compatibility and performance of the proposed instrument for treatment process and conditions.

C. Field verify process conditions and locations.

3.2 INSTALLATION

A. Install and assemble according to manufacturer's instructions. Exactly follow manufacturer's instructions and installation procedures for sensors directly interfacing process medium.

B. Install components of process measurement devices located as indicated. ENGINEER may change location of any process measurement device within process stream. Provide changes without extra cost if requested before installation.

C. Do not install process measurement devices at locations where other equipment is to be installed, obstruct walkway, or makes inaccessible or hard maintenance access. Maintain spacing and access.

D. Support process measurement devices, process connection lines, and sensors on pipe stands, plates, or channel brackets. Install and securely mount all devices in accessible locations with all gauges, dials, displays, or indicators visible and legible from floor level.

E. Provide electrical and control signals connections to all process measurement devices with manufacturer's instructions.
   1. Bond devices.
   2. Provide electrical identification.
   3. Wire process measurement device through junction box with terminal blocks if more than two wires have to be connected to a single terminal block inside process

measurement device, or process measurement device terminal blocks require wire size reduction. Wire size reduction by cutting the strings is not acceptable.

F. Configure, calibrate, and test all process measurement devices.

G. Provide digital network communication devices (HART handheld terminal, modem with PC software), obtain instrument current electronic data/configuration files, and configure digital communication, and device variables (registers).

H. Touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint. Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Sequence, schedule, and coordinate work with other trades involved with process measurement device installation. Make arrangements for process measurement device process connection required to install electrical components.

B. Coordinate testing with SCADA integrator and verify data network communication.

3.4 MANUFACTURER'S FIELD SERVICES

A. Where specified, provide manufacturer's representative to inspect after installation and submit report prior to startup, verifying installation and operation of process measurement devices is according to specifications and manufacturer's instructions.

3.5 SYSTEM STARTUP

A. Provide startup and commissioning support for all process measurement device testing and calibration.

B. Energize all process measurement devices and introduce to the process medium. Alternative procedures may be implemented for process measurement devices, which cannot be safely tested and energized.

C. Provide assistance during start up and rectify deficiencies, conduct troubleshooting and otherwise take corrective action of installed systems.

D. Perform operational tests using process media. Include operation of all process measurement devices by actuation of their controlling variable and monitoring of received signals. If the process media are not physically available or not available at required level (e.g., high pressure or temperature), provide testing means and media to simulate process conditions. Remove and reinstall sensors when required for testing.
   1. Provide digital meter, 4-20 mA signal readers and 24 VDC portable power supply for loop powered devices including accessories (alligator clips, metering leads, temporary wiring, etc.).
   2. Provide temporary tubing, fittings, and pressure regulators for testing.
   3. Provide testing solutions to verify operation of analytical process measurement devices.
   4. Provide movable targets to verify operation of level process measurement devices.

5. Provide vacuum/pressure calibration pump complete with reference gauges to verify operation of pressure process measurement devices.
6. Provide ice and hot water in suitable containers complete with reference thermometers to verify operation of temperature process measurement devices.

E. Keep copy of manufacturer's instructions on Work Site, available for review during startup.

3.6 ADJUSTING

A. Calibration of analysis process measurement devices, sensors, gauges, and meters must proceed on a system by system basis. No equipment or system performance acceptance tests to be performed until process measurement devices, gauges, and meters to be installed in that particular system have been calibrated, the calibration work has been witnessed by ENGINEER and reports have been submitted to ENGINEER.

B. Analytical process measurement devices and sensors used for performance testing to be subject to recalibration, if necessary, to confirm accuracy after completion, but prior to acceptance of each performance test. Recalibrate process measurement devices not meeting specifications or process conditions. Field change of process measurement device signal range, units, display configuration, etc. to suit process is considered a part of calibration work and it will not be considered as an extra to the Contract.

C. Provide calibration tags complete with technician name and date of calibration performed, next date of calibration to be performed and range.

D. Adjust process measurement device set points as listed on process measurement device list and as directed by ENGINEER.

E. Provide assistance during start up to rectify deficiencies, conduct troubleshooting, and otherwise take corrective action of installed systems.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

B. Prior to energization of process measurement devices, clean inside of all enclosures such that it is free of any dust and debris, cause corrosion, or arc (wire strings).

C. Clean process lines prior to process measurement device installation. Clean process measurement devices process connection components, manifolds, fittings, etc. from construction debris and chemicals to avoid sensor damage or contamination.

3.8 DEMONSTRATION AND TRAINING

A. Section 01 80 00 - Facility Operation: Requirements for demonstration and training.

B. Demonstrate process measurement devices operation.

C. Provide training services for operator training on proper operating and maintenance procedures after satisfactory startup and commissioning.

D. Provide two non-consecutive 8-hour days of training, spread over 3 weeks.

E. Operation and Maintenance Training:
   1. Class training with overview of process measurement devices, technology, and principles. Provide study and training materials and manuals.
   2. Field hands-on training. Provide presentation by instructor with plant operators. Include:
      a. Instrument overview.
      b. Sensor process connection.
      c. Operator interface.
      d. How to setup and configure process measurement device.
      e. How to calibrate instrument. Provide hands-on presentation by instructor with plant operators following and physically calibrating instrument mandatory for all analytical process measurement devices.
      f. Maintenance and basic checks.
      g. Troubleshooting; simulate alarms and explain causes and procedures.

F. Provide simulators for practice purposes.

3.9 PROTECTION

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Protect all process measurement devices from moisture, dust, debris, and environmental, mechanical or electrical damage during construction. Allow for mechanical protection, removals and reinstallation where required for construction activities.

END OF SECTION

SECTION 46 07 01

WATER TREATMENT SYSTEM (WTS)

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Design, construction, operation, and maintenance of contact water treatment system capable of treating contact water generated during performance of Work. Sources are:
      a. Mounded Water: drains into excavation from surrounding soils.
      b. Persistent Infiltration: water that infiltrates through the soil from the river.
      c. Stormwater: accumulates in the excavation and containment area during a rain event.
      d. Equipment Decontamination Water: generated by the washing/rinsing of equipment (e.g., Truck Wash)
      e. Miscellaneous Contact Water: other water that comes into contact with waste material not associated with water types listed above.
   2. Treated water discharge criteria are presented in Table 3.

B. Related Requirements:
   1. Section 01 91 00 - Water Treatment Consumables
   2. Section 22 05 53 - Pipe Data Sheet – PVDF Tubing and Carrier Piping
   3. Section 23 05 53 - Identification for Piping and Equipment
   4. Section 40 05 13 - Common Work Results for Process Piping
   5. Section 40 70 00 - Instrumentation for Process Systems
   6. Section 40 05 51 - Common Requirements for Process Valves

1.2 REFERENCES

A. Acronyms:
   1. ARARs: Applicable or Relevant and Appropriate Requirements
   2. FRP: Fiberglass Reinforced Plastic
   3. GAC: Granular Activated Carbon
   4. GPM: Gallons Per Minute
   5. HMI: Human-machine Interface
   6. HRT: Hydraulic Retention Time
   7. ISO: International Organization for Standardization
   8. PLC: Process Logic Controller
   9. PID: Process and Instrumentation Diagram
   10. PFD: Process Flow Diagram
   11. SSPC: Steel Structures Painting Council
   12. TSS: Total Suspended Solids.
   13. TBD: To be Determined

14. WTS: Water Treatment System

B. Definitions:
   1. Contact Water defined as:
      a. Stormwater: accumulates in the excavation and containment areas (e.g., WTS, excavated materials storage, dewatering) during a rain event.
      b. Persistent Infiltration: water that infiltrates through the soil from the river when the base of the excavation is below the average mean sea level (AMSL) of the river (i.e., 1.5 ft-AMSL)
      c. Mounded Water : Drains into excavation from surrounding soils when the bottom of the exaction is lower than the groundwater level.
      d. Equipment Decontamination Water: generated by the washing/rinsing of equipment (e.g., Truck Wash)
      e. Miscellaneous Contact Water: other water that comes into contact with waste material not associated with water types listed above.
   2. Hazardous Material: Solid or liquid materials regulated by federal or state regulations as hazardous materials.
   3. Hazardous Waste: Listed in applicable regulations as a hazardous waste or exhibiting the characteristics of hazardous substances including properties such as ignitability, corrosiveness, toxicity or reactivity.
   4. Non-hazardous Waste: Waste that in not classified as a Hazardous Waste.
   5. Commissioning or Commission: the overall process of starting, testing, adjusting, and balancing the various components, equipment, and subsystems of a system or facility to place the system or facility into a fully operational condition.
   6. Work: All activities related to excavation, material transportation, contact water collection and treatment which is include but not limited to mobilization, start up and commissioning, operation, decommissioning and demobilization.
   7. WTS Effluent: all treated water discharged to the river .

C. Reference Standards:
   1. Section 01 40 00 - Quality Requirements: Requirements for references.
   2. American National Standards Institute (ANSI).
   3. Institute of Electrical and Electronics Engineers (IEEE).
   4. National Electrical Manufacturer's Association (NEMA).

1.3 SYSTEM DESCRIPTION

A. WTS will be required to manage contact water for the Northern Impoundment RA. Design, obtain ENGINEER's approval, and implement water management program compatible with construction schedule and methodologies selected to perform the Works.

B. WTS must be placed in a secondary containment area with available volume (i.e., area not occupied by other tanks) equal to or greater than the volume of the largest tank plus precipitation captured within the containment area.

C. Contact water shall be directed from the excavation and all containment areas to the Influent Tanks using transfer pump(s) at a rate to be determined by CONTRACTOR to prevent delay of work.

D. Provide sufficient storage capacity for contact water (including storm water falling into excavations and BMP area) collected within the work area to prevent delay of Works.
   1. Equalization storage capacity shall be provided upstream of the WTS. This capacity is currently estimated at 1.8 million gallons
   2. Stormwater
      a. Rainfall will comprise a majority of the contact water generated at the Work Site
      b. The storage and treatment capacities included herein shall be designed to account for a worst-case assumption that all stormwater that falls within the BMP area and the WTS containment area is contact water. The area inside the BMP is ~730,000 ft^2. The area inside the WTS is ~60,000 ft^2.
      c. Largest, historic 24-hour storm event during the construction period of November 1st to April 30th is 6.2 inches/day
      d. The maximum expected 24-hr contact water generation during the remediation period from the BMP area is ~415,000 ft^3 or ~2.8 million gallons
      e. The maximum expected 24-hr contact water generation during the remediation period from the WTS containment area is ~31,000 ft^3 or ~232,000 gallons
   3. Mounded Water
      a. Contact water generated from mounded water will primarily be generated at the start of the season as the mounded drains into the excavation
      b. The highest predicted daily flowrate of mounded water into the excavation is ~90,000 GPD
   4. Additional water that may be generated from sources like truck washing, excavated materials storage, dewatering areas are included in the stormwater volumes above.

E. The WTS shall be fed contact water by treatment feed pump which shall be connected to Influent Tanks. The design flow rate from the Influent Tanks to the WTS shall be at least 300 GPM.

F. Summary of estimated contact water sources is provided in Table 1.

Table 1: Summary of Contact Water Influent Sources

Influent Sources	Maximum 24-Hour Contact Water Generation	Notes
BMP Area	2.8 million GPD	Assumes all rain that falls within the BMP could be contact water. Area = 730,000 ft^2. Maximum 24-hour rain event (1930 to 2019) = 6.2 inches
Rain Collection - WTS Containment Area	232,000 GPD	24-hr rain event, 60,000 ft^2. Maximum 24-hour rain event (1930 to 2019) = 6.2 inches
Mounded Water (gpd)	90,000 GPD	See assumption above

Influent Sources	Maximum 24-Hour Contact Water Generation	Notes
Rain Collection in Dewatering Areas (gpd)		Assumed to be accounted for in the BMP Area contact water
Truck Wash		Assumed to be accounted for in the BMP Area contact water

G. Take all necessary steps to protect WTS equipment and conveyance equipment (e.g., pumps, pipes, hoses) from extreme weather condition, including, but not limited to, storms, sunlight, extreme temperature.

H. WTS shall be designed to treat contact water that will vary in quality/quantity. The overall treatment strategy shall conform to the details of this Section. Collected contact water is expected to contain elevated levels of suspended solids (sediment), dioxins and furans, and heavy metals, based on historical analytical data obtained during a recently executed treatability study. Applicable discharge criteria are provided in Table 3.
   1. WTS is not intended for management of domestic sanitary wastewater that will be generated on the Work Site. This liquid waste stream is to be managed by other means.

I. Should WTS process adjustment/optimization of the proposed treatment equipment fail to meet the discharge criteria listed in Table 1, make modifications to treatment systems as necessary based on actual conditions observed during execution of Works. Modifications may include, but not be limited to bulk solids removal equipment (i.e., clarifier) changing treatment chemicals, reducing flow rate, and/or installation of additional treatment equipment. Any modifications to the WTS equipment configuration will be reviewed/approved by OWNER/ENGINEER prior to implementation.

J. Sequence the Works, including temporary storage in active areas, to provide adequate water treatment to meet the project schedule.

1.4 SEQUENCING

A. CONTRACTOR shall be solely responsible for managing and coordinating related work that affects the quality and quantity of the contact water that is routed to the WTS for treatment and discharge.

B. Coordinate contact water treatment and discharge rates to maintain WTS capacity.

C. Minimize TSS transferred from the excavation to the WTS.

D. Sequence and coordinate work so that the WTS is operational prior to beginning operations that will generate contact water.

E. Continuously maintain the WTS and continue all contact water treatment efforts until all of the following conditions have been met:

1. All of the on-site operations that could potentially generate contact water have been completed.
2. All of the impacted materials have been transported off-site.

F. WTS shall be installed, tested, and inspected by ENGINEER prior to commencing work which may generate contact water.

G. Works included:
1. Supply of specified treatment system equipment to meet the specified system requirements.
2. Delivery of equipment to Work Site and field installation.
3. Provision/construction of necessary foundations for WTS equipment.
4. Calibration, certification, and commissioning of the supplied equipment.
5. Provision of complete O&M manual for ENGINEER and OWNER reference.
6. Perform pressure testing and provide pressure testing reports to ENGINEER.
7. Supply, testing, and calibration of all process instrumentation associated with treatment equipment within the WTS.
8. Provide load list and all electrical requirements for the treatment equipment.
9. Provide electrical panel and process logic controller (PLC) and human-machine interface (HMI) for automated operation of the WTS.
10. Provision of all required spare parts so as to minimize system downtime during maintenance.
11. Provide access hatches for system enclosures to allow for expendable media replacement and equipment clean-out/maintenance.
12. Provide treatment equipment enclosures shall include ventilation systems to prevent internal temperatures in excess of 40 deg. C. Provisions shall be made to maintain a minimum temperature within the containerized system of 10ºC or as specified by equipment manufacturer.

1.5 SUBMITTALS

A. Contact Water Treatment Plan: Submit a Contact Water Treatment Plan, including process and instrumentation diagrams (P&IDs), equipment selected (cutsheets), storage and pumping capacities, draft process control narrative, electrical load list and power distribution plan, effluent monitoring program, general arrangement of equipment within containers/enclosures and overall intended layout of containers and operating plan compatible with and demonstrating compliance with specified requirements. Design of WTS shall be approved by ENGINEER prior to construction. The WTS will include example operations log sheets identifying operational data that will be routinely collected by the WTS operators and/or WTS PLC.

B. Example operations data collection is provided in Table 2.

Table 2: Example of Operation Data Collection

Operating Parameter	Value
Minimum Daily Flow	

Maximum Daily Flow	
Average Daily Flow	
Total Daily Flow	
Rapid Mix Tank pH Set Point	
Daily Coagulant Consumption	
Coagulant Dose Set Point	
Daily Polymer Consumption	
Polymer Dose Set Point	
Filters/GAC Pressure	
Effluent pH	
Backwash Event (vessel, flow, duration)	

C. Residuals, Solids, and Sediment Waste Management Plan: As part of the Contact Water Treatment Plan, submit a Residuals, Solids, and Sediment Waste Management Plan, including details for management of solids, soils, and sludge resulting from treatment activities as well as the management of expendables such as multimedia filter, GAC media, tank liners, etc.. Such plans will detail testing of residuals to identify required disposal requirements per applicable local, state and federal laws and regulations.

D. Shop Drawings
   1. CONTRACTOR shall submit drawing, datasheets, and other information outlined below for the equipment selected for the WTS to OWNER/ENGINEER for review
   2. Equipment Data to include:
      a. Performance criteria, compliance with appropriate reference standard, characteristics, limitations, and trouble-shooting protocol.
      b. Product transportation, storage, handling, and installation requirements.
      c. Inlet pressure requirements, inlet/outlet diameters, included controls, included options, brochure cuts indicating dimensions and weights, surface loading rates, number of installations in North America, and location from where system services and technical support would be provided.
      d. A list of all supplied equipment including the length of supplied piping/hose as part of the hookup requirements.
      e. A system schematic and process control narrative.
      f. Overall dimensions of equipment.
   3. Drawings:
      a. Work Site plan including containment area.
      b. General arrangement and dimensions of accessories.

c. Process and Instrumentation Drawings (P&IDs).Process Control Narrative detailing the automatic water treatment operations associated with the WTS including proposed set points and alarms.
d. Work Site Acceptance Test (SAT) Plan: CONTRACTOR shall provide and implement a Work Site acceptance test to demonstrate satisfactory automatic operation of the WTS. SAT will be executed as part of overall commissioning of the WTS.
e. Provide required drawings and calculations sealed by a professional engineer licensed in state of Texas for non-standardized components.
f. Electrical load list and details of electrical distribution/control for powered equipment.
g. Design Data: Indicate tanks sizes, pump sizes, and treatment rates.

E. Test Reports/Commissioning Reports:
1. Provide records of commissioning performance and final set points, indicate on the reviewed shop drawings all adjustments made during commissioning.
2. Submit commissioning procedure to ENGINEER for review a minimum 4 weeks prior to WTS commissioning. Commissioning report documentation (e.g., checklists) shall be provided for review. If intended commissioning documentation is deemed unsatisfactory by ENGINEER, ENGINEER-provided commissioning documentation will be utilized by CONTRACTOR.
3. Final effluent testing will be completed by an independent laboratory chosen by the OWNER/ENGINEER. OWNER/ENGINEER shall carry all costs for contact water sampling and analysis.
4. The system is to be fully commissioned using clean water (supplied by CONTRACTOR).
5. Following clean water commissioning, CONTRACTOR shall store an initial volume of treated contact water until analytical results are received that document compliance with ARARs.

F. Operation, Maintenance and Equipment Data:
1. Operation and maintenance data: Indicate and submit maintenance data for incorporation into Operation and Maintenance Manuals.
2. Identification: Manufacturing name, type, year, serial number, number of units, capacity, and identification of related systems.
3. Data necessary for maintenance of equipment.
4. Manufacturer's recommended list of spare parts and associated costs.

1.6 CLOSEOUT SUBMITALS

A. Facility Operation Report: Include all operational data from each operating day including flow rates, volumes, test results and effect on process, actual quantities of chemicals added, process modifications, etc. See Table 2

1.7 QUALIFICATIONS

A. Design WTS under direct supervision of professional engineer experienced in design of work of this Section and licensed in the State of Texas.

B. Manufacturer/Supplier of WTS equipment: Company specializing in supply and operations of containerized/skid mounted contact water treatment equipment for substantially similar applications, with minimum 5 years documented product development, testing, and operations experience. Project references over the past five years shall be provided outlining application, treatment flow, and treatment technologies. Reference Project contact information may be required upon request of ENGINEER.

1.8 QUALITY ASSURANCE

A. Perform work of this Section in accordance with approved Contact Water Treatment Plan and ARARs.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Contactor shall store equipment, supplies and consumables (e.g., treatment chemicals, filtration media, GAC, etc.) under suitable covers or structures to protect from environment (e.g., heat, moisture, wind, etc.). in a manner consistent with manufacturer recommendations

B. Contactor shall maintain adequate supplies to maintain operations including all expendable materials and treatment chemicals. Store products in an appropriate manner with all health and safety/environmental requirements satisfied.

C. Contactor shall maintain and service equipment to ensure they are in working order.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

A. Design WTS to operate for the duration of the Works. The minimum design flow rate and the maximum allowed treated effluent discharge shall be within the limits of ARARs which are presented in Table 3.

B. The WTS shall be designed based on the influent parameters outlined in Table 3. Influent water quality is based pilot testing conducted during the Northern Impoundment RD. 20,000 gallons of representative contact water were generated from the Northern Impoundment. In order to produce this volume, waste material was excavated from a 20-ft by 20-ft by 10-ft cell. The excavated material was stored in roll-off containers. Approximately 20,000 gallons of potable water was then transferred into the excavation and mixed with the excavated material using an excavator bucket to generate a worst-case suspended solids mixture that may be encountered in stormwater during the Works. This simulated contact water was then pumped to two storage tanks and the contents of the two tanks were homogenized and subsequently sampled.

C. CONTRACTOR is fully responsible for the provision of temporary power to the WTS. CONTRACTOR shall obtain all necessary permits and coordinate with local utility/authorities as required. CONTRACTOR shall obtain all necessary permits associated with the provision of temporary power to the WTS.

D. CONTRACTOR is responsible to make any necessary modifications to the WTS due to changing influent concentrations to continually optimize treatment to achieve target criteria. Any required changes shall be made in a timely manner so as to not hinder Works. Changes to the WTS shall be reviewed and approved by the ENGINEER prior to implementation.

E. Table 3 provides expected concentration of constituents of concern and their estimated discharge. limits.

F. Water Treatment System shall include equalization, coagulation/flocculation, clarification, filtration, and GAC adsorption. Filtration step shall involve media filtration, 10-micron cartridge or bag filter. 1-micron cartridge or bag filter. Precipitation of metals may be added if needed. Design criteria for major equipment are summarized in Table 4 below.

Table 3: Concentrations of Constituents of Concern and Estimated Discharge Criteria

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
Dioxins/Furans				
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	pg/L	100	590	370 J
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	pg/L	100	15000 J+	8800 J
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	pg/L	50	880 J-	600 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	pg/L	50	840	540 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	pg/L	50	320	240 J

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	50	3100	2500 J-
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	50	11 U	4.9 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	50	790	650 J-
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	50	30 J	20 J-
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	pg/L	50	53	40 J-
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	pg/L	50	18 J-	8.5 J-
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	50	2100	1900
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	pg/L	50	160	130
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	pg/L	50	93	73 J-
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	pg/L	50	1200	1100
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	pg/L	10	50000	46000

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
2,3,7,8-Tetrachlorodibenzo- p dioxin (TCDD)	pg/L	10	18000	15000
Total heptachlorodibenzofura (HpCDF)	pg/L	50	1600 J	1100 J
Total heptachlorodibenzo-p- dioxin (HpCDD)	pg/L	50	2000 J	1300 J
Total hexachlorodibenzofuran (HxCDF)	pg/L	50	4600 J	3800 J
Total hexachlorodibenzo-p- dioxin (HxCDD)	pg/L	50	260 J	180 J
Total pentachlorodibenzofura (PeCDF)	pg/L	50	5000 J	4600 J
Total pentachlorodibenzo-p- dioxin (PeCDD)	pg/L	50	190 J	160 J
Total tetrachlorodibenzofuran (TCDF)	pg/L	10	100000 J	100000 J
Total tetrachlorodibenzo-p- dioxin (TCDD)	pg/L	10	20000 J	16000 J
Dioxins/Furans (dissolved)				
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF) (dissolved)	pg/L	100	170	11 U
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD) (dissolved)	pg/L	100	5400 J+	280 J+

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
1,2,3,4,6,7,8- Heptachlorodibenzofuran (HpCDF) (dissolved	pg/L	50	240	12 J
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD) (dissolved)	pg/L	50	250	27 J
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF) (dissolved)	pg/L	50	88	4.9 U
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	750	31 J
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) (dissolved)	pg/L	50	4.6 U	3.1 U
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	190	9.8 J
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD) (dissolved)	pg/L	50	6.7 J	2.1 J
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	14 J	4.8 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD) (dissolved)	pg/L	50	5.7 J	1.7 U
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF) (dissolved)	pg/L	50	450	20 J
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD) (dissolved)	pg/L	50	40 J	3.0 J

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	23 J	2.8 U
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF) (dissolved)	pg/L	50	250	11 J
2,3,7,8-Tetrachlorodibenzofuran (TCDF) (dissolved)	pg/L	10	11000	540 J
2,3,7,8-Tetrachlorodibenzo- p dioxin (TCDD) (dissolved)	pg/L	10	3800	150 J
Total heptachlorodibenzofura (HpCDF) (dissolved)	pg/L	50	430 J	20 J
Total heptachlorodibenzo-p- dioxin (HpCDD) (dissolved)	pg/L	50	630 J	51 J
Total hexachlorodibenzofuran (HxCDF) (dissolved)	pg/L	50	1100 J	48 J
Total hexachlorodibenzo-p- dioxin (HxCDD) (dissolved)	pg/L	50	74 J	6.9 J
Total pentachlorodibenzofura (PeCDF) (dissolved)	pg/L	50	1100 J	44 J
Total pentachlorodibenzo-p- dioxin (PeCDD) (dissolved)	pg/L	50	51 J	3.0 J
Total tetrachlorodibenzofuran (TCDF) (dissolved)	pg/L	10	21000 J	920 J

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
Total tetrachlorodibenzo-p- dioxin (TCDD) (dissolved)	pg/L	10	4000 J	170 J
Metals				
Antimony	mg/L	25.623	0.0039 U	0.0039 U
Arsenic	mg/L	0.164	0.026	0.023
Barium	mg/L	N/A	1.1	0.96
Cadmium	mg/L	0.0439	0.0028 J	0.0025 J
Chromium	mg/L	0.389	0.12	0.11
Copper	mg/L	0.0167	0.11	0.093
Lead	mg/L	0.107	0.12	0.098
Mercury	mg/L	0.000598	--	--
Mercury	ng/L	598	28 J	6.3 J
Mercury	ug/L		--	--
Nickel	mg/L	0.103	0.095	0.081
Selenium	mg/L	0.619	0.0029 U	0.0029 U
Silver	mg/L	0.00493	0.0013 U	0.0013 U
Thallium	mg/L	0.5	0.0042 U	0.0042 U
Zinc	mg/L	0.165	0.40	0.36
Metals (dissolved)				
Antimony (dissolved)	mg/L	25.623	0.0039 U	0.0039 U
Arsenic (dissolved)	mg/L	0.164	0.014	0.0041 J
Barium (dissolved)	mg/L	N/A	0.55	0.30

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2
Cadmium (dissolved)	mg/L	0.0439	0.0013 J	0.00040 J
Chromium (dissolved)	mg/L	0.389	0.048	0.0039 J
Copper (dissolved)	mg/L	0.0167	0.036	0.0081 U
Lead (dissolved)	mg/L	0.107	0.037	0.0022 U
Mercury (dissolved)	mg/L	0.000598	--	--
Mercury (dissolved)	ng/L	598	--	22 J
Mercury (dissolved)	ug/L	0.598	--	--
Nickel (dissolved)	mg/L	0.103	0.033	0.0030 J
Selenium (dissolved)	mg/L	0.619	0.0029 U	0.0029 U
Silver (dissolved)	mg/L	0.00493	0.0013 U	0.0013 U
Thallium (dissolved)	mg/L	0.5	0.0042 U	0.0042 U
Zinc (dissolved)	mg/L	0.165	0.15	0.026 J
pH	SU	6-9		
TSS	mg/L	30	3500	4600

Component	Units	Discharge criteria[1,2]	North Impoundment Pilot Contact Water	
			Tank #1	Tank #2

Notes:

-- Data not available

[1]Per an EPA email dated February 18, 2020, compliance with the Texas Surface Water Quality Standards will be determined using the minimum level of the EPA approved method (1613B), cited in 40 CFR Part 136, in sampling of dioxin concentrations for surface water discharges during the Remedial Action.

[2]Estimated discharge criteria were calculated for all parameters except dioxins and furans utilizing the TCEQ model, TEXTOX MENU # 5 for bays or wide tidal rivers.

pg/L - picograms per Liter
mg/L - milligrams per Liter
ug/L - micrograms per Liter
s.u. - standard unit
U - Not detected at the associated reporting limit.
J - Estimated concentration.
UJ - Not detected; associated reporting limit is estimated.

Table 4: Preliminary WTS Treatment Equipment List

Equipment/Process Description	Sizing/Selection Criteria Assumptions	Design Value	Notes
Remediation Cell Dewatering Pump	Dewater BMP area after largest expected rain event within 24 hours after rain event stops	Dewatering flowrate of up to 1000 GPM.	
Influent Tanks	Working volume to hold 3.4-inch, 24-hour rain event in BMP area, containment area, truck wash, excavated materials storage, and dewatering area	1.72 million-gallons (~860,000 gallons working volume/tank)	Lake Tank B-24 portable storage tank was used for design. Assumes 8 inches of freeboard and minimum water level of 24 inches to keep liner in place.
Containment Area Sump Pump(s)	CONTRACTOR shall select pump to dewater Containment Area after a rain event to allow work to resume. Preliminary flowrate provided on the Drawings.	TBD by CONTRACTOR. Preliminary flowrate provided on the Drawings.	Largest 24-hour rain event for the construction period (November to April) for the years 1930-2019 was ~6.2."
Sludge Dewater Sump	CONTRACTOR shall select pump to ensure the contact water draining from the Sludge Dewatering Boxes and any rain water is discharged to the Influent Tank with backing up in the sump. Preliminary flowrate provided on the Drawings.	TBD by CONTRACTOR. Preliminary flowrate provided on the Drawings.	
Treatment Feed Pump	300 GPM base treatment flow	300 GPM to accommodate return streams	Pump will operate on VFD to adjust treatment rate, as required. Pump will shutdown on high level in Inclined Plate Clarifier.
Rapid Mix Tank	Minimum retention time: 7 minutes	Minimum working volume of 2,100-gallon capacity	Provide mixing at high enough velocity to full mix coagulant, organon sulfides, acid and/or caustic, and polymer. Overflow of tank shall be set above the operating level of the Inclined Plate Clarifier to allow for gravity flow.
Flocculation Tank	Minimum retention time: 7 minutes	Minimum working volume of 2,100-gallon capacity	Tank will include baffles to prevent vortexing, if needed. Tank will be mixed by top entry mixer(s) with paddle-type blades to prevent shearing solids. Mixer shall be variable speed. Overflow of tank shall be set above the operating level of the Inclined Plate Clarifier to allow for gravity flow.
Inclined Plate Clarifier	Maximum Hydraulic Loading rate: 0.25 GPM/ft^2	3,200 ft^2 of inclined plate separation area	Clarifier shall include integral sludge hopper to allow for sludge withdrawal. Overflow shall be set above the operating level of the Filter Feed Tank to allow for gravity flow.
Filter Feed Tank	Nominal retention time: 20 minutes	Minimum working volume of 6,000-gallon capacity	Overflow of tank shall be set above the operating level of the Inclined Plate Clarifier.
Filter Feed Pump	300 GPM base treatment flow	Up to 400 GPM	Pump will operate on VFD and controlled by level in Filter Feed Tank.
Multimedia Filters	5-15 GPM/ft^2 Hydraulic Loading	Minimum of 60 ft^2 of active media filter area	Minimum of three vessels, forward-feed automated backwash.
10-um Bag Filtration System (2 in parallel)	10-micron bag or cartridge filters with minimum 95% removal efficiency	25 GPM/cartridge elements with total system capacity of 400 GPM	Rosedale Filter Cartridge Model PL-POMF-R1-10-P2 or equal
1-um Bag Filtration System (2 in parallel)	1-micron bag or cartridge filters with minimum 95% removal efficiency	25 GPM/cartridge elements with total system capacity of 400 GPM	Rosedale Filter Cartridge Model PL-POMF-R1-1-P2 or equal
Granular Activated Carbon	10-minute Empty Bed Contact Time (min) per stage 5 GPM/ft^2 Hydraulic Loading	400 ft^3 Bed Volume; 60 ft^2 of active bed area	GAC vessels will be configured in a lead-lag configuration providing a total contact time up to 20 minutes (total).
Sludge Wasting/Recycle Pump	75 GPM (~25% of Influent Feed Pump)	50 GPM to 150 GPM	Sludge Wasting/Recycle pump will be positive displacement pump (e.g, air diaphragm). Flowrate will depend on solids accumulation rate and will be adjusted during start-up and operations.

Equipment/Process Description	Sizing/Selection Criteria Assumptions	Design Value	Notes
Sludge Dewater Boxes	Allow for dewatering of sludge from Inclined Plate Clarifier. Filter fabric over a false bottom to trap solids and allow contact water to drain into sump.	25-CY filter box	25-CY Filter Boxes are available.
Coagulant Feed Pumps	Flow paced at dosage of 50 ppm coagulant solution - treatability study used 100 ppm	Up to 2 GPH	Chemical metering pumps. (e.g., diaphragm, peristaltic).
Organ sulfide Feed Pumps (if needed)	Flow paced at dose of 50 ppm organ sulfide solution	Up to 2 GPH	Chemical metering pumps. (e.g., diaphragm, peristaltic).
Acid/Caustic Feed Pumps (if needed)	Flow paced based on measured pH of contact water in Rapid Mixing Tank	Up to 2 GPH	Chemical metering pumps. (e.g., diaphragm, peristaltic).
Polymer Feed Pumps	Flow paced at dose of 25 ppm (neat polymer)	Up to 15 GPH (dilute polymer solution)	Chemical metering pumps. (e.g., diaphragm, peristaltic), polymer activation/aging equipment will be provided, as needed.

Notes:
The 90% process flow diagram (drawing P-01) and piping and instrumentation diagrams (drawings P-02 through P-05) illustrate the major water treatment system equipment and components.

GPM - Gallons per minute
VFD - Variable frequency drive
ft^2 - Square feet
CY – Cubic yard
ppm - Parts per million
GPH - Gallons per hour

2.1 STORAGE TANKS

A. Operating Conditions:
   1. Fluid: Impacted contact water (sediment dewatering effluent, impacted precipitation, etc.).
   2. Size: See attached equipment list and drawings. Final selection approved by ENGINEER.

B. Type and Materials:
   1. Model: Lake Tank B-24
   2. Volume: ~1.03 Million Gallons.
   3. Quantity: 2
   4. Dimensions: 125 ft (dia). X 12 ft (H)

C. Performance Requirements:
   1. Storage of contact water to minimize construction downtime due to contact water in the excavation area.

D. Fabrication:
   1. All materials shall be suitable for continuous contact with contact water.

E. Make and Model:
   1. Lake Tank B-24.

F. Other Requirements
   1. None

2.2 RAPID MIX TANK

A. Operating Conditions:
   1. Fluid: Chemical dosed impacted water (sediment dewatering effluent, impacted precipitation, etc.).
   2. Size: TBD by CONTRACTOR. It should be sized to adequately provide HRT and mixing regime for coagulation and floc formation.

B. Type and Materials:
   1. Frame: TBD by CONTRACTOR.
   2. Piping and Flanges: TBD by CONTRACTOR.
   3. Chemical Injectors: TBD by CONTRACTOR.

C. Performance Requirements:
   1. Flow Capacity: Design Flow.
   2. Mixing Requirement: The motor rpm and size of mixing paddles shall be sized/selected by equipment supplier to completely mix treatment chemicals with influent contact water utilizing static mixing elements. The speed of the slow mix tank shall be adjustable by mechanical (gear reducer) or electrical (variable frequency drive) means.

D. Fabrication:
   1. All materials shall be suitable for continuous contact with contact water.

E. Make and Model: TBD by supplier.

F. Other Requirement: The rapid mix tank shall be configured to allow for gravity flow into the flocculation tank and subsequently the clarifier.

2.3 FLOCCULATION TANK

A. Operating Conditions:
   1. Fluid: Rapid mixing tank (above) effluent.
   2. Size: TBD by CONTRACTOR. It should be sized to adequately provide HRT and mixing regime for coagulation and floc formation.

B. Type and Materials:
   1. Piping and Flanges: TBD by CONTRACTOR.

C. Performance Requirements:
   1. Flow Capacity: Design Flow.
   2. Mixing Requirement: The electromotor rpm and size of mixing paddles shall be sized/selected by equipment supplier to completely mix treatment chemicals and promote floc growth. The speed of the slow mix tank shall be adjustable by mechanical (gear reducer) or electrical (variable frequency drive) means.

D. Fabrication:
   1. All materials shall be suitable for continuous contact with contact water.

E. Make and Model:
   1. TBD by supplier.

2.4 INCLINED PLATE CLARIFIER

A. Operating Conditions:
   1. Fluid: Flocculation tank effluent

B. Unit Type: Inclined plate clarifier. The unit shall consist of the lamella tank with sludge hopper. Alternative bulk solids removal may be provided by CONTRACTOR with ENGINEER approval.

C. Performance Requirements:
   1. Hydraulic Capacity: Design flow (operation flow plus recirculation sludge flow as identified in PFD (P-01)).
   2. The clarifier shall allow for a hydraulic loading rate (surface overflow rate) of 0.25 -1.0 GPM/ft2 at the design flow. Settling plates shall be installed at a 45-60 deg. angle (above horizontal). Nominal plate spacing shall be 2 inches
   3. Additional Clarifier Specifications:
      a. The sludge hopper shall be outfitted with a minimum of 1 manual sludge blanket sample ports.
      b. Plates shall be a minimum of 2 mm thick.

c. The clarifier sludge hopper shall include an actuated sludge purge valve that will allow for manual or timer-based sludge wasting. Sludge will be discharged with the assistance of a sludge wasting pump provided by CONTRACTOR.
d. The clarifier shall be equipped with sludge recirculation/transfer pump.

4. The ability to access and clean the clarifier media must be available.

D. Fabrication:
1. All materials shall be suitable for continuous contact with contact water.

2.5 SLUDGE DEWATERING BOX

A. Operation condition:
1. Fluid: Clarifier underflow dosed with polymer (to accelerate flocculation).
2. Location: Outdoor.
3. Operational volume: See equipment list. Final selection approved by ENGINEER

B. Type and Materials:
1. Model: 25-yard Dewatering Box
2. Volume: 25 yd^3.
3. Quantity: 2
4. Dimensions: ~23 ft x ~8 ft x ~5 ft

C. Unit type
1. 25-yd^3 Filter Box

D. Performance Requirements:
1. Capable of dewatering clarifier solids by gravity to 6 to 8 percent solids.
2. Use of filter fabric to prevent significant amounts of solids from being discharged into the collection sump.

E. Fabrication:
1. All materials shall be suitable for continuous contact with contact water.

F. Make and Model:
1. Roll-off 25 Yard Filter Box

2.6 FILTER FEED TANK (OR CLARIFIER EFFLUENT STORAGE TANK)

A. Operating Conditions:
1. Fluid: Clarifier Effluent.
2. Location: Between clarifier and multimedia filter.
3. Collection of clarified contact water from clarifier and feed tank for pumps feeding the multimedia filters, bag filters, and GAC.
4. Operational volume: TBD by CONTRACTOR.

B. Performance and Connection Requirements:
1. Model: TBD by supplier.
2. Material: TBD by CONTRACTOR.
3. Nozzles: Flanged.

a. Outlet/drain: Flanged (bottom).
b. Inlet: Flanged (bottom).
c. Level Transmitter: Flanged (bottom).
d. Sample Port: Flanged (side).

C. Performance Requirements:
1. Hydraulic Capacity: Adequate capacity to regulate flow between clarifier and filtration units.
2. Minimum Capacity 6000 gallons
3. Minimum Residence Time: 20 minutes

D. Fabrication:
1. All materials shall be suitable for continuous contact with contact water.

2.7 MULTIMEDIA FILTERS

A. Operating Conditions:
1. Fluid: Clarifier Effluent.
2. Operational Flow: Design Flow.

B. Unit Type: Mixed media (sand) pressure filtration units.

C. Performance Requirements:
1. Hydraulic Capacity: Design flow.
2. Solid Separation: Nominal particulate removal range of 10 microns.
3. Quantity: TBD by CONTRACTOR.
4. The multimedia filters should be sized/selected to allow for a maximum filtration rate of 10 GPM/ft^2 with one vessel out of service.
5. Forward Feed Backwash

2.8 CARTRIDGE/BAG FILTERS (10 um)

A. Operation condition:
1. Fluid: Multimedia Filter Effluent.
2. Operational Flow: Design flow.

B. Unit type:
1. Manually operated duplex filter (n+1)
2. 10-micron bag or cartridge filters with minimum 95% removal efficiency (Rosedale Filter Cartridge Model PL-POMF-R1-10-P2 or equal)
3. 25 GPM/cartridge elements with total system capacity of 400 GPM

C. Performance requirement
1. Solid Separation: Particulate removal range of 10 micron and larger.
2. Quantity: TBD by CONTRACTOR.
3. Parallel filters shall be provided, to allow for replacement and maintenance without affecting the operation of the treatment system.

2.9 CARTRIDGE/BAG FILTERS (1 um)

A. Operation condition:
   1. Fluid: Multimedia filter effluent.
   2. Operational flow: Design flow.

B. Unit type:
   1. Manually operated duplex filter (n+1)
   2. 1-micron bag or cartridge filters with minimum 95% removal efficiency (Rosedale Filter Cartridge Model PL-POMF-R1-1-P2 or equal)
   3. 25 GPM/cartridge elements with total system capacity of 400 GPM

C. Performance requirements:
   1. Solid Separation: Particulate removal range of 1 micron and larger.
   2. Quantity: TBD by CONTRACTOR.
   3. Parallel filters shall be provided, to allow for replacement and maintenance without affecting the operation of the treatment system.

2.10 GAC VESSELS

A. Operating Conditions:
   1. Fluid: 1-micron filter effluent.
   2. Operational flow: Design flow.

B. Unit Type: Pressurized granular activated carbon contactor for additional removal of chemicals of concern.

C. Performance Requirements:
   1. Quantity: TBD by CONTRACTOR (Lead and lag configuration).
   2. The GAC contactors should be sized/selected to allow for a maximum hydraulic loading rate of 2- 5 GPM/FT2). Each granular activated carbon contactor should provide a minimum effective media contact time of 10 minutes.

2.11 DISCHARGE DIFFUSERS

A. Operating Conditions:
   1. Fluid: GAC Vessel Effluent.
   2. Operational Flow: Design Flow.

B. Unit Description:
   1. Diffuser to disperse treated effluent from the WTS into the river
   2. Perforated Pipe: Dual Wall HDPE Perforated Pipe
   3. Pipe Perforation Pattern: AASHTO Class II perforations with a minimum inlet area of 1.5 in^2/ft
   4. Geotextile: 3 oz. Light weight non-woven geotextile
   5. Pipe elevation to be minimum of 6” above average water surface elevation of river
   6. Assumed length of pipe leading to energy dissipator – 20 ft
   7. Final design approved by ENGINEER

C. Operating Conditions:
   1. Design flow – up to 400 GPM

2.12 CHEMICAL DOSING EQUIPMENT

A. Unit Description:
   1. Chemical metering pumps dose treatment chemicals from the chemical storage area to the WTS as it shown in drawing P-01 (PFD).
   2. The metering pumps are controlled by the plant PLC in auto mode or locally in manual mode. Metering pumps shall modulate dosing flow to an adjustable dose setpoints (flow- paced model). The list of chemical dosing pumps presented below.

Pump #	Capacity	Liquid pumped	Note
P-3006, P-3007	0.2 – 2.5 GPM	Polymer solution	0.5-1.0%(w/w)
P-3010, P-3011	0.02 – 2.5 GPM	Coagulant solution	
P-3008, P-3009	0.015 – 2.5 GPM	Acid/Caustic	
P-3004, P-3005	0.03 – 2.5 GPM	Organosulphide	
P-3014, P-3015	0.2 – 2.5 GPM	Polymer solution	0.5-1.0%(w/w)

B. Design Requirements:
   1. Type: Chemical metering pumps, sized by supplier, materials of construction to be suitable for fluid mentioned above. Metering pump/accessories for each chemical system to be mounted on independent chemical pump panel.
   2. Provide polymer mixing, activation/maturation tank, and dilution equipment as required. Polymer shall be received as liquid emulsion (or powder) to be activated and diluted as a solution of 0.5-1.0 weight percent or less.

C. Make and Model: TBD by supplier.

D. Performance Requirements:
   1. See design drawings
   2. See Table 4.

E. Other Requirements:
   1. Backpressure valve, internal pressure relief valve, isolation valves, calibration column, pulsation dampener, drain/flushing port to be included on pre-plumbed skid. Pump to come with all accessories mounted on a board with a single inlet/outlet connection.
   2. See Table 4

2.13 WTS PROCESS PUMPS

A. Operating Conditions:
   1. Fluid: Impacted contact water (see Article 1.3).

2. Size: See attached equipment list and drawings. Final selection approved by ENGINEER.

B. Type and Materials:
1. Model: various
2. Flowrate: 400 GPM
3. Quantity: See design drawings. Final selection approved by ENGINEER.
4. See Table 4
5. Material: Suitable for operating conditions

C. Performance Requirements:
1. See design drawings
2. See Table 4.

D. Fabrication:
1. All materials shall be suitable for continuous contact with contact water.

E. Make and Model:
1. TBD by CONTRACTOR and submitted for approval by ENGINEER.

F. Other Requirement:
1. The process pumps are controlled by the WTS PLC in auto mode or locally in manual mode.
2. Final pump sizing/selection is the responsibility of CONTRACTOR based on identified service flows below. Operating pressure for pumps will be confirmed by CONTRACTOR based on the physical configuration of the WTS.
3. All temporary discharge /piping from the WTS to discharge point is the responsibility of CONTRACTOR. This includes piping associated with the discharge of treated water.
4. Provide upstream/downstream isolation, discharge check valves, and pressure gauges for all process pumps.

2.14 TREATMENT EQUIPMENT ENCLOSURES

A. All proposed WTS equipment shall be installed in one or more containers or other approved weather enclosure with the exception of equipment suitable for operation outdoors. Larger exterior tanks may not fit within ISO containers and can be installed in other approved temporary enclosure or be protected from weather harsh conditions.

B. General arrangement of equipment within containers shall be provided by supplier as well as arrangement of shipping containers on Work Site plan.

C. The enclosures shall include at a minimum:
1. Plywood floor.
2. Barn style rear double doors.
3. Ventilation fan/heater(s) with thermostat and hood. Ventilation system shall be sized to prevent enclosure temperature from exceeding 40 degrees C. Heating systems shall be provided to ensure temperature within temporary enclosures does not fall below 10 degrees C or based on equipment manufacturer's requirements

4. Access hatches as required for removal of spent treatment media from the media filters, vessels, and GAC Contactors.
5. Structural review of modified ISO container shall be completed and sealed by a professional engineer licensed in the state of Texas.
6. CONTRACTOR shall provide appropriate foundations for treatment equipment enclosures to prevent shifting or settling.

2.15 CONTROL NARRATIVE

A. See Attachment A at the end of this Section

2.16 ELECTRICAL CONTROL PANEL AND PLC SYSTEM

A. Operating Conditions: Outdoor (NEMA 4)

B. Control Panel:
1. Enclosure: A PLC (Programmable Logic Controller) Panel must be provided based on treatment equipment supplier PLC IO list, which calls out specific PLC hardware.
2. The electrical instrument design, specification portion of this Project shall conform to the latest editions of the NEMA, ANSI, IEEE, UL, the National Electrical Code, the Occupational Safety and Health Act, and any regulations or codes of any governmental jurisdictions, that may be more exacting than these references and related codes and standards as designated herein.
3. All specifications, standards, codes, etc. referenced are to be the latest edition, and together with all addenda, revisions, and supplements shall be considered part of this Project.
4. Hardware:
   a. Other Requirements: All automatic equipment and process set points shall be controlled through an HMI touch screen. All alarms generated by the process shall activate a written description of the alarm on the HMI touch screen.

C. Programming: The software for the controls system shall be developed using the latest software development tools. The design of the automation system is based upon the criteria listed below:
1. All systems are operated at all times to meet required quality metric, and process data storage requirements along with client requirements, standards and objectives.
2. All systems are designed for automatic, unattended operation. The status of operating equipment is continuously monitored to detect operational excursions, equipment failures, and automatic shutdowns.
3. Manual control is provided for maintenance, startup and emergency shutdown where appropriate.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install Water Treatment Facility in location approved by ENGINEER.

B. Installation: According to manufacturer's instructions and in accordance with state of Texas standards.

C. Maintain working area free of standing water.

D. Provide all necessary temporary piping/hose/etc. for interconnection of WTS tanks and treatment equipment.

3.2 FIELD QUALITY CONTROL

A. Functional Test: Prior to facility startup, all equipment shall be inspected and verified for installation of equipment by others is satisfactory.

B. Testing Equipment: Furnish all instruments and labor as required for this procedure.

C. Provide online monitoring of turbidity at the clarifier overflow, filter effluent, and service tank effluent.

D. Provide online monitoring of flow prior to rapid mix tank and after service water storage tank.

E. Provide online monitoring of pH in rapid mix tank and after service water storage tank.

F. Provide TSS analysis results per operation cycle or as requested by ENGINEER.

G. Monitor lead GAC column for dioxins to ensure compliance with ARARs at effluent.

3.3 COMMISSIONING AND PERFORMANCE VERIFICATION

A. Commissioning:
   1. Verify that equipment and systems are installed according to manufacturer's instructions, industry accepted minimum standards, and the Contract Documents.
   2. Verify that equipment and systems receive adequate operational checkout by CONTRACTOR.
   3. Verify and document proper performance of equipment and systems.
   4. Verify that complete operation and maintenance documentation is delivered to OWNER.
   5. Verify that operating personnel are adequately trained.
   6. Commissioning does not relieve CONTRACTOR of responsibility to provide a finished and fully functioning Project.
   7. Work Site Acceptance Testing:
      a. Supplier shall test the system as a whole to bring the system online to treat the influent to the required effluent criteria.
      b. Chemicals and consumables required for the start up and performance verification shall be provided by CONTRACTOR. CONTRACTOR shall provide additional consumables as needed throughout project duration.
      c. In general, equipment start up and performance verification shall include:
         i Bring temporary systems into operating condition.

ii Ensure operation of equipment, devices, instrumentation and alarms required for the proper operation of the temporary systems.
iii Operate WTS, perform multiple start and stop sequences and adjust settings as required. The number of operational treatment trains shall be dependent on the impacted water generation rates. During low flow periods, the WTS may need to operate in a batch mode.
iv Simulate failures for WTS and shut down sequence. Adjust as required.
v Operation of the associated equipment.

8. Performance Verification:
   a. Performance verification shall happen after all equipment has completed start up testing and has been signed off by equipment supplier.
   b. Operate the system as a whole, bringing each system online as required by plant operation to treat water.
   c. Fine tune dosing points of chemical coagulant and flocculent at clarifier to meet the performance requirements of the system. Record all adjustments made and record final set points.
   d. If a system must be removed from service in order to perform a cleaning cycle or other regular maintenance, the cleaning or maintenance activities shall be considered part of the WTS provided that the activities are not required to address failure of mechanical components or failure to meet operational standards.
   e. Malfunctions shall be defined as an event of 1) mechanical failure of a system or component, or 2) failure to meet the operational standards required for the system. In the event of a malfunction, the system shall be required to be re tested to ensure system performance is met.

3.4 DEMONSTRATION

A. Supplier shall supervise CONTRACTOR's operating personnel during the startup period. Startup operations shall be continuous until it is satisfactorily demonstrated that the equipment is suitable for continuous services.

3.5 OPERATION

A. Do not operate the WTS until ENGINEER has inspected facility and authorization for discharge has been received from ENGINEER.

B. Operate the WTS and do work necessary to treat collected contact water. Operation shall include treatment of feed tank contact water and discharge of treated water for duration of the Works.

C. Operate and maintain treatment units as required to meet ARARs. Provide for removal of solids as necessary.

D. Provide for removal and disposal of solids as approved by ENGINEER.

E. Provide for removal and disposal of media in approved CONTRACTOR-supplied containers to an approved off-site disposal facility.

F. Provide for removal and disposal of media in approved CONTRACTOR-supplied containers to an approved off-site disposal facility.

G. Provide daily flow rate and turbidity data to ENGINEER on a daily basis in a Log Sheet format acceptable to ENGINEER.

H. Operate treatment system in compliance with OWNER's permit.

I. Provide daily flow rate data to the OWNER on a daily basis in a Log Sheet format acceptable to the OWNER. Daily log sheets shall also detail volume/mass of consumables utilized as well as any major upkeep/maintenance activities (e.g., GAC media replacement).

J. Start up and Shutdown Procedures – WTS:
   1. The WTS may need to operate intermittently and in a batch fashion. CONTRACTOR shall provide one full time operator (minimum) to execute WTS operations. Before starting the WTS, the operators should prepare the chemical solutions. These solutions must be maintained over the course of the operating period.
   2. The operators should make sure all monitoring and instrumentation devices are online and operational per manufacturer recommendations. All instrumentation should be cleaned and calibrated per manufacturer recommendations.

K. System Monitoring and Automatic Shutdown for Equipment – WTS (Refer to design drawings for instrumentation location)
   1. Control of the WTS shall be achieved by a programmable logic controller (PLC) and operator intervention.
   2. The Transfer Pumps shall shutdown on high-level in Influent Tank Treatment Feed Pump flowrate shall be flow controlled using an operator adjusted setpoint and the flow meter located at the feed line of the WTS treatment trains
   3. Treatment Feed Pump shall shutdown if high-level is detected in Inclined Plate Clarifier or Filter Feed Tank
   4. Treatment Feed Pump shall shutdown if high turbidity (operator adjustable) is detected in effluent of Inclined Plate Clarifier
   5. Treatment Feed Pump shall shutdown if flowrate drops below operator setpoint TBD which indicates a potential break in the influent pipeline
   6. Chemical dosing systems shall be on a flow-paced mode to adjust the injection flow rate to achieve a desired dose
   7. If needed, pH adjustment chemicals shall be added based on the pH in Rapid Mix Tank
   8. Chemical dosing systems shall shutdown upon stopping of mixer in the Rapid Mix Tank or Flocculation Tank
   9. Chemical dosing systems shall shutdown if flowrate of the Influent Feed Pump drops below operator adjustable flowrate
   10. Filter Feed Pump shall shutdown on high turbidity as measured by filter effluent
   11. Filtration Feed Pump shall shutdown on high-level in Treated Effluent Holding Tank(s).
   12. Settled sludge collected from the underflow of the Clarifier unit shall be conveyed by a sludge pump to the Sludge Dewatering Boxes

13. Sludge shall be discharged from Clarifier based on adjustable timer controls (e.g., frequency and duration of sludge transfer events) or by the operator at their discretion when the height of sludge reaches a certain level in the clarifier.
14. Decanting Pump shall shutdown on high-level in Influent Tanks
15. The treated water shall be monitored for pH, turbidity, and flow before discharge to the outfall

3.6 MONITORING OF CONTACT WATER TREATMENT AND DISCHARGE

A. CONTRACTOR shall monitor contact water that is treated and discharged from the Water Treatment System. Monitoring shall include periodic field and laboratory testing of Water samples.

B. CONTRACTOR may conduct additional testing of the water in support of operational or discharge decisions.

C. CONTRACTOR shall conduct water testing in accordance with approved Contact Water Treatment Plan – to be submitted by CONTRACTOR.

3.7 DISCHARGE LIMITS

A. Comply with ARARs in Table 3.

3.8 FAILURE TO MEET CRITERIA

A. Should analyses indicate that effluent has not met treatment criteria as agreed upon in the Contact Water Treatment Plan, discharge shall cease immediately. Further action shall be performed in accordance with the Field Sampling Plan.

B. Provide sufficient water storage until treatment criteria can be met. Store contact water, carry out the treatment system checks, and repair the WTS.

3.9 DECOMMISSIONING

A. Decontamination of all WTS equipment shall be completed by CONTRACTOR prior to removal from the Work Site.

B. All impacted material such as exhausted activated carbon, media filters, bag filters, cartridge filters, tank liners, etc. need to be disposed of by CONTRACTOR.

C. At the completion of each season of the Works, CONTRACTOR shall be responsible for the removal all equipment and materials from Work Site unless otherwise directed by OWNER.

END OF SECTION

Attachment A
Process Control Narrative

1. P&ID P-02

1.1 Description

Several sources are pumped into the influent tanks TK-2000 and TK-2001 prior to subsequent treatment by the Water Treatment System (WTS):

1. Contact water from excavation activities
2. Contact water from excavation material stockpile area
3. Contact water from excavation dewatering areas
4. Contact water from equipment decontamination wash stations
5. Water collected in sumps from inside the water treatment system (WTS) containment area
6. Backwash from Multimedia Filters in the WTS
7. Contact water from dewatering of solids generated by the WTS

Sources will be pumped to one of the Influent Tanks based on the orientation of installed manual valves, ready to send to the WTS for treatment, after which point flow will be directly into the other Influent Tank. Contact water is pumped to the WTS by the Treatment Feed Pump P-2001, which is equipped with a Variable Frequency Drive (VFD).

1.2 Controls

TK-2000 has a continuous level transmitter LIT-2000 to provide feedback for level control. Level in TK-2000 is controlled as follows:

1. Low level turns OFF P-2001 at operator adjusted setpoint and per tank supplier specifications.
2. High-high level alarm informs the WTS Operator to stop discharges into TK-2000 and to start feeding flow into the WTS, if not already started.

TK-2001 has a continuous level transmitter LIT-2001 to provide feedback for level control. Level in TK-2001 is controlled as follows:

1. Low level turns OFF P-2001 at operator adjusted setpoint and per tank supplier specifications.
2. High-high level alarm informs the WTS Operator to stop discharges into TK-2001 and to start feeding flow into the WTS, if not already started.

1.3 Operations

P-2001 operates to maintain constant flow to WTS and to empty the operating Influent Tank (either of TK-2000 or TK-2001) as quickly as possible so that it is available to receive water sources for subsequent treatment by the WTS.

2. P&ID P-03

2.1 Description

Contact water from P-2001 is pumped into the Rapid Mix Tank TK-2100, which has a submersible mixer MX-2100 with VFD, operated at a high speed. Chemicals are fed into TK-2100 to facilitate chemical mixing:

1. Coagulant is fed by Coagulant Feed Pumps (1 duty/1 spare) P-3501 and P-3502.
2. Organosulfide (if needed) is fed by Organosulfide Feed Pumps (1 duty/1 spare) P-3101 and P-3102.
3. Acid (if needed) is fed by Acid Feed Pumps (1 duty/1 spare) P-3201 and P-3202.
4. Caustic (if needed) is fed by Caustic Feed Pumps (1 duty/1 spare) P-3211 and P-3212.

Contact water from TK-2100 flows by gravity to the Flocculation Tank TK-2200, which has a submersible mixer MX-2200 with a VFD. MX-2200 is operated a low speed to facilitate the formation of flocs. Polymer is added to TK-2100.

1. Polymer is fed by Polymer Feed Pumps (1 duty/1 spare) P-3301 and P-3302.

Contact water from TK-2200 flows by gravity to the Inclined Plate Clarifier (IPC) CLR-2300, where flocs settle to allow for liquid-solids separation. Solids from CLR-2300 are pumped via Sludge Transfer Pump P-2310 to be returned to TK-2100 or to Sludge Dewatering Boxes (TK-3600 and TK-3601) for dewatering, while clarified water flows by gravity to TK-2400 for further treatment by the WTS.

2.2 Controls

2.2.1 P-2001

P-2001 is controlled by on-off Flow Control Valve FCV-2002 and Flowmeter FE-2002. Flow from P-2001 is controlled as follows:

1. To send flow to the WTS, FCV-2002 to OPEN prior to turning ON P-2001. P-2001 VFD starts slowly and increases in speed until the flow measured by FE-2002 reaches an operator-adjustable setpoint (nominally 300 gpm).
2. To stop flow to the WTS, P-2001 VFD slowly decreases in speed until the flow measured by FE-2002 reaches 0 gpm and P-2001 turns OFF. FCV-2002 to CLOSE after turning OFF P-2001.
3. P-2001 VFD adjusts speed to maintain the operator-adjustable flow setpoint for the WTS.
4. P-2001 will shutdown is pump is running and 0 gpm is measured by FE-2002 for a period of time beyond WTS operator setpoint.

2.2.2 TK-2100

TK-2100 has a high-level switch LSH-2100 to provide feedback for level control. Level in TK-2100 is controlled as follows:

1. High level sends an alarm to WTS Operator
2. High level turns OFF P-2001.

TK-2100 has a pH probe and transmitter AIT-2100 to monitor and control pH inside the tank. If used, acid and/or caustic controls the pH in TK-2100 as follows:

1. pH below an operator-adjustable setpoint adds Caustic to TK-2100 via pumps P-3201 or P3202.
2. pH above an operator-adjustable setpoint adds Acid to TK-2100 via pumps P-3211 or P3212.

The other chemicals are fed (as needed) manually by the WTS Operator into TK-2100, by manually setting the pumping rates and turning ON pumps P-3401/3402, P-3301/3302, P-3501/3502, P-3101/3102, and/or P-3111/3112 based on jar testing.

2.2.3 CLR-2300 and TK-2400

The discharge chamber of CLR-2300 and the Filter Feed Tank (TK-2400) are hydraulically connected. CLR-2300 receives flocculated contact water from TK-2200. turbidity meter (AIT-2301) CLR-2300 has two high level switches. LSH-2300 in the main chamber of the CLR-2300, and LSH-2301 in the discharge chamber. LSH-2300 is a redundant high-level switch to LSH-2100. LSH-2301 serves as a high-level switch for TK-2400.

The discharge CLR-2300 also has a turbidity analyzer and transmitter (AIT-2301) that continuously measures turbidity in the clarified water from the IPC to check the efficiency of the clarifiers for removal of TSS. A high turbidity indicates that operational changes to the chemical dosage rates may need to be made.

1. The effluent of the CLR-2300 should have a TSS of less than 50 ppm to prevent excessive backwashing of the media filters.
2. During set-up, operator will calibrate the AIT-2301 to TSS.
3. High turbidity send alarm to operator indicating that chemical feed rates into TK-2100 and/or TK-2200, and/or P-2310 sludge flowrate (as measured by P-2310) need to be adjusted to improve clarified water quality.
4. High turbidity sends an alarm to WTS Operator based on operator-adjusted setpoint.

Level in CLR-2300 is controlled as follows:

1. High level as measured by LSH-2300 sends an alarm to WTS Operator
2. High level as measured by LSH-2300 turns OFF P-2001.

2.2.4 P-2301

P-2310 is operated manually by the WTS Operator based on the sludge blanket depth in CLR-2300. Flowmeter FIT-2314 continuously measures sludge flow from P-2310 to TK-2100 (for return) and FIT-2313 continuously measures flow of sludge to sludge dewatering boxes. Isolation valves are provided to the return and disposal sludge lines, and the WTS Operator opens the respective valve for return or disposal as required. Flow information from FIT-2313 and FIT-2314 is provided for WTS Operator information only, so that he can adjust P-2310 sludge flowrate as needed to adequately return/remove solids from CLR-2300 and measure volume of sludge recycled or discharged to sludge dewatering boxes.

2.3 Operations

P-2001 operates to maintain flow through the WTS at the operator-adjustable setpoint. LSH-2100, LSH-2300, and LSH-2301 prevent overflow of TK-2100, TK-2200, CLR-2300, and TK-2400 due to system malfunction such as pump failure, clogged pump, etc..

3. P&ID P-04

3.1 Description

Clarified water from CLR-2300 flows by gravity to the Filter Feed Tank TK-2400. Filtration Feed Pump P-2401, equipped with a VFD, sends water through the three (3) sets of filters, in order as follows:

Four (4) Multimedia Filters (n+1) FLT-2500A, 2500B, 2500C and 2500D,

Two (2) 10-micron Bag Filter Systems (1 duty/1 spare) FLT-2600A and 2600B,

Two (2) 1-micron Bag Filters Systems (1 duty/1 spare) FLT-2700A and 2700B, and

Two (2) Granular Activated Carbon (GAC) Adsorbers (lead/lag) GAC-2800 and 2800.

Flow from the GAC adsorbers is sent to Effluent Storage Tanks.

3.2 Controls

TK-2400 has a continuous level transmitter LIT-2400 to provide feedback for level control. TK-2400 has low--level switch LSL-2400 and high-level switch LSH-2301 to provide redundant control. Flow from P-2401 is controlled by level as follows:

1. LSL-2400 turns OFF P-2401
2. High-high level as measured by LIT-2400 or LSH-2301 sends alarm to WTS Operator and turns OFF P-2100 to reduce likelihood of overfilling TK-2400, and provides the following redundant control to LIT-2400
3. The VFD associated with P-2401 ramps up and down to maintain the operator adjustable setpoint for TK-2400 as measured by LIT-2400

P-2401 is controlled by on-off Flow Control Valve FCV-2401 and LIT-2400. LIT-2400 will have four (4) operating setpoints as described below

Low-Low Level Setpoint (L-01):

- Operator adjustable Level
- Pump stops and FCV-2401 will close
- Initially set at 1 ft of water about level at which LSL-01 activates

Low Level Setpoint (L-02):

- Operator adjustable level
- FCV-2401 will open and pump will start at minimum speed.
- Operator adjustable speed
- Assume 35 Hz at start-up
- Initially set at 2 ft of water

Operating Setpoint (L-03):

- Operator adjustable
- Pump speeds up and slows down to maintain constant level in sump
- Initially set at 4 ft of water
- When the when the contact water enter TK-2400 is less than the P-2401 discharge rate at the minimum speed, the water level in the sump will decrease until the level reach L-01 and the pump shuts off and FCV-2401 will close

High-Level Setpoint (L-04):

- Operator adjustable
- Initially set at 7 ft of water
- Pump speed up to 60 Hz
- Alarm sent to operator

4. To send flow to the filters, FCV-2401 to OPEN prior to turning ON P-2401. If contact water level in T-2400 is above.

Pressure indicators PI-2402, PI-2501, PI-2601, PI-2701 and PI-2802 monitor pressures upstream and downstream of FLT-2500A/B/C/D, FLT-2600A/B, FLT-2700A/B, and GAC-2800/2801.

1. PI-2402 and PI-2501 monitor the pressure across FLT-2500A/B/C/D. The WTS Operator visually monitors the differential pressure across the filters. Filter backwash will be automatic based on the differential pressure across each individual filter.
2. PI-2501 and PI-2601 monitor the pressure across FLT-2600A/B. The WTS Operator visually monitors the differential pressure across the operating filter. Once the differential pressure exceeds a prescribed setpoint, the Operator will manually send flow to the non-operating filter and isolate the previously operating filter for filter bag change-out.
3. PI-2601 and PI-2701 monitor the pressure across FLT-2700A/B. The WTS Operator visually monitors the differential pressure across the operating filter. Once the differential pressure exceeds a prescribed setpoint, the Operator will manually send flow to the non-operating filter and isolate the previously operating filter for filter change-out.
4. PI-2701 and PI-2802 monitor the pressure across GAC-2800/2801. The WTS Operator visually monitors the differential pressure across the GAC system.

The effluent line out of the FLT-2700A/B has a turbidity analyzer and transmitter AIT-2702 that continuously measures turbidity in the treated effluent from the 1-micron bag filters. High turbidity indicates a malfunction of the FLT-2700A/B (e.g., missing filter bag, ruptured filter bag).

1. High turbidity level sends an alarm to WTS Operator based on an operator-adjustable setpoint and turns OFF P-2401

The effluent line out of the GAC-2800/2801 has a turbidity analyzer and transmitter AIT-2803 that continuously measures turbidity in the treated effluent. High turbidity indicates a potential problem with the GAC or the upstream treatment system.

1. High turbidity level sends an alarm to WTS Operator based on an operator-adjustable setpoint and turns OFF P-2401

3.3 Operations

P-2401 VFD adjusts speed to maintain the water level in TK-2400 at an operator-adjusted setpoint. Flow from P-2401 will increase and decrease based on the flowrate of P-2001. Turbidity of discharges from FLT-2700A/B and GAC-2800/2801 are continuously. Turbidity above operator-adjustable setpoint indicates a malfunction in the system and will turn OFF P-2401 and send WTS operator an alarm.

4. P&ID P-005

4.1 Description

4.1.1 Chemical Feed and Sludge Dewatering

P-2301 pumps sludge from CLR-2300 to one of two Dewatering Boxes TK-3600 and TK-3601. Contact water that drains out of TK-3600 and TK-3601 is collected in a sump and pumped to TK-2000.

The chemical storage and feed systems are provided as part of the WTS:

- Coagulant sent to TK-2100 is stored in TK-3500 and pumped (1 duty/1 spare) via P-3501 or P-3502.
- Polymer sent to TK-2200 is made down and stored in TK-3300 equipped with mixer MX-3300 and pumped (1 duty/1 spare) via P-3301 or P-3302.
- Polymer sent to TK-3600/3601 is made down and stored in TK-3400 equipped with mixer MX-3400 and pumped (1 duty/1 spare) via P-3401 or P-3402.
- Organosulfide (if used) sent to TK-2100 is stored in TK-3100 and pumped (1 duty/1 spare) via P-3101 or P-3102.
- Acid (if used) sent to TK-2100 is stored in TK-3200 and pumped (1 duty/1 spare) via P-3201 or P-3202.
- Caustic (if used) sent to TK-2100 is stored in TK-3210 and pumped (1 duty/1 spare) via P-3211 or P-3212.

4.2 Controls

4.2.1 Chemical Feed and Sludge Dewatering

Polymer for dewatering is fed manually by the WTS Operator into the sludge line feeding TK-3600/3601, by manually setting the pumping rates and turning ON P-3401/3402 based on jar testing.

The WTS Operator selects and monitor which of TK-3600 or -3601 will receive and store sludge for dewatering. When visually inspected to be full, the WTS Operator will arrange for the full dewatering box to be trucked off for disposal and manually begin filling the other empty dewatering box.

Level indicators/transmitters are installed in each chemical storage LIT--3100, -3200, -3300, -3400, and -3500 for TK-3100, -3200, -3300, -3400, and -3500, respectively, so that the WTS Operator can keep track of the chemical volumes available for the system.

4.3 Operations

4.3.1 Sludge Dewatering

WTS Operator to dispose of full dewatering boxes (either of TK-3601 or -3601) as quickly as possible so that storage is available for sludge to be dewatered.

END OF PCN

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