TM No.6
Regulatory Compliance & Implementation Plan

Oso Water Reclamation Plant
Nutrient Removal Project (Ammonia)

City Project No.E09007
LNV Project No.100140.00

Submitted to:

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April 15, 2013

Oso Water Reclamation Plant
Nutrient Removal Project (Ammonia)
City Project No. E09007
LNV Project No. 101040.00

TECHNICAL MEMORANDUM NO. 6 - FINAL

Date: April 15, 2013

To: Dan Biles, P.E. - Director of Engineering

From: Logan Burton, P.E., Joshua Brown, P.E., Mike Colwell, P.E., Rex Hunt, P.E.

Subject: Regulatory Compliance and Implementation Plan

Copies To: Bill Green, P.E., Foster Crowell, Joe Trejo, P.E.

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FIGURES

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1.0 INTRODUCTION

The Oso Water Reclamation Plant (Oso WRP) serves a large and growing portion of the City of Corpus Christi, Texas (City). On April 29, 2011, the Texas Commission of Environmental Quality (TCEQ) issued a renewal of the plant's Texas Pollutant Discharge Elimination System (TPDES) permitwhich included a new monthly effluent ammonia limit of 4 mg/L. Prior to this renewal, the Oso WRP permit did not contain an ammonia limitation. The renewed permit also included a compliance date of October 29, 2013 to meet the new ammonia limit. The purpose of the compliance schedule was to provide sufficient time so that the City could design, construct, and commission the necessary improvements to meet this ammonia limit. As a result of these factors, the City retained LNV team consisting of Jacobs, Colwell & Associates, and Alan Plummer Associates, to provide engineering services for the Oso WRP Nutrient Removal Project (Ammonia).

The proposed improvements identified by the LNV Team are proposed to be implemented in two phases:

- Phase 1 of this project includes the temporary Breakpoint Chlorination Facility and Step Feed Improvements which are currently under construction and are scheduled for completion in August 2013. The near-term (temporary) solutions are described in more detail in Technical Memorandum No. 3 – Ammonia Removal Alternatives Evaluation dated January 3, 2012. The BPC facility is currently being designed as a temporary, short-term, low-capital cost means to meet the plant's new effluent ammonia requirements while planning and implementation of the permanent long-term Phase 2 improvements are completed.

- Phase 2 of the improvements will include significant facility upgrades necessary for the plant to meet anticipated regulatory requirements and plant flows, to ensure continued plant reliability and to replace the Phase 1 Breakpoint Chlorination (BPC) Facility.

This Regulatory Compliance and Implementation Plan details and describes the capital improvements necessary to meet the current and anticipated (future) effluent regulations.

1.1 PURPOSE

This memorandum focuses on the Phase 2 improvements which include long-term process modifications and enhancementsintended to replace the temporary, near-term improvements included in Phase 1. The long-term improvements described in this memorandum will address anticipated capacity and regulatory requirements along with providing accommodations tostreamlinepotential upgrades in the future(i.e. improvements for total nitrogen and phosphorus removal).

1.2 OBJECTIVES

Based on workshops conducted with City staff, the team identified the objectives and capabilities of the Oso WRP Phase 2 improvementswhich include the following:

- Maintain TPDES permit compliance
  - Biological ammonia and total nitrogen removal
  - Accommodations for implementing future phosphorus removal
  - Effective and reliable disinfection
- Re-rate the average daily flow capacity to meet anticipated future flows
- Maintain peak hour flow capacity of 98 MGD

- Improved process automation and monitoring
- Reduce process and maintenance costs
- Reduce process odors
- Provide operational and maintenance flexibility
- Maximize the value of existing assets
- Improvements must be located within existing property boundaries

Upgrades to the following process facilities were specifically omitted from the scope of this project:

- Solids dewatering.The existing solids dewatering (belt press) facility is being replaced with a new facility designed to handle all foreseeable flows. The new dewatering facility is currently under construction.
- Recycled water systems.A City-wide recycled water master plan is currently being prepared by others.

2.0 BACKGROUND

The Oso WRP is the largest of 6 treatment plants owned and operated by the City of Corpus Christi. The plant was originally constructed in 1941 and the most recent major upgrade to the Oso WRP was completed in 1985 where the plant's activated sludge process was converted to contact stabilization and capacities were increased to accommodate average daily flows of 16.2 MGD and peak hour flows of up to98.0 MGD. The Oso WRP is configured as two identical parallel trains; each rated at 8.1 MGD average daily flow. The contact stabilization configuration is designed to remove BOD efficiently, but is not well-suited for ammonia removal and is actually precluded from use as a nitrifying process by TCEQ. As a result, the long-term improvements will require major facility upgrades. Figure 2-1 below and Exhibit A in the Appendix show an aerial photograph of the existing plant.

Figure 2-1Oso WRP Aerial Photograph

2.1 SERVICE AREA AND FLOWS

The Oso WRP serves approximately 24,143 acres in the southern part of the City, including much of the City's planned growth areas. Refer to Exhibit B in the Appendix for a service area map. The table below summarizes the service area according to developed and undeveloped areas.

Table 2-1 Service Area Summary

Service Area	Total Area (acres)	% Developed	Developed Areas (acres)	Undeveloped Areas (acres)
Excluding A1 & A2	20,088.49	88%	17,677.87	2,410.62
Area 1[(1)]	1,490.54	15%	223.58	1,266.96
Area 2[(1)]	2,563.74	10%	256.37	2,307.37
TOTAL	**24,142.77**	**75%**	**18,157.83**	**5,984.94**

NOTES:

1. Area 1 and Area 2 reference the Sub-basin master plan studies adopted in 2007.
2. Refer to Oso WRP Service Area Map for aerial photograph.

As shown in the table above, the existing service area is approximately 75% developed. With the anticipated growth in the area, the plant flows are expected to rise as the undeveloped areas become urbanized. Average daily influent flow data from 2006 through 2012 indicates average daily flows of 11.5 MGD. Dividing the average daily flow by the developed acreage currently being served (18,157 acres) correlates to a wastewater production of 0.63 MGD per 1,000 acres of developed service area. The full build-out flow rates have been projected as shown in the table below to be 15.2 MGD.

Table 2-2Oso WRP Service Area Flows

Service Area	Developed Areas (acres)	Flow per 1000/ac (MGD)	ADF (MGD)
Existing	18,157.83	0.63	11.5
Build-out (≈30 yrs)	24,142.77	0.63	15.2

With respect to TCEQ's 75/90 "forced planning rule" (§305.126), the plant should have an absolute minimum average daily plantrating of approximately 20.3 MGD (15.2 MGD / 75%)to avoid exceeding 75% of its capacity in the foreseeable future. In addition, to provide maintenance flexibility where a train can be taken out of service for equipment repairs, cleaning and/or servicing, the plant should have an absolute minimum firm capacity (1 train out of service) of 15.2 MGD. With these design criteria in mind, the Oso WRP Phase 2 improvements must provide one of the following options:

- Four (4) trains rated at 5.1 MGDeach providing:
  - ADF Capacity = 20.4 MGD
  - 2-Hr Peak Capacity = 98.0 MGD
  - Firm Treatment Capacity = 15.3 MGD

- Three (3) trains rated at 7.6 MGDeach providing:
  - ADF Capacity = 22.8 MGD
  - 2-Hr Peak Capacity = 98.0 MGD
  - Firm Treatment Capacity = 15.2 MGD

In order to maximize the value of the City's existing assets and to maintain the footprint within the City's existing property, it is absolutely necessary that the existing plant trains be retrofitted

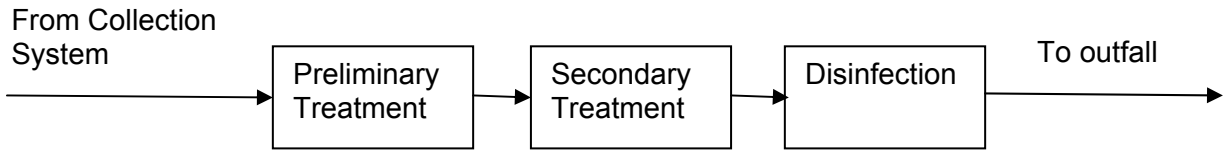
and re-rated. Process modeling results show that the two (2) existing 8.1 MGD treatment trains must be downgraded with a maximum capacity of 6.0 MGD for all retrofit alternatives intended to remove nutrients biologically.As a result, the second option is considered impractical as it would involve the complete demolition of the existing treatment trains and the construction of three (3) new trains. Not only would this alternative be more costly, the plant property does not have the necessary open space for such improvements.

The modeling indicates that the two existing trains can be cost effectively converted to two (2) 6.0 MGD trains. To maximize the City's current investment at the plant, to provide excess capacity for possible future inter-basin transfers and/or expansion of the service area boundary, it is recommended that the two (2) existing trains bemodified to two (2) 6.0 MGD trains along with the construction of two (2) new treatment trains also rated at 6.0 MGD each. The required improvements associated with this are described in greater detail in later sections.

2.2 EXISTING FACILITIES DESCRIPTION

A very simple schematic of the existing treatment process is shown below and a more detailed process flow schematic is shown on Exhibit C in the Appendix.

Figure 2-2Oso WRP Process Schematic



Additional details describing each processand the recommended improvements are provided in subsequent sections.

2.3 FLOW AND LOADINGS

The projected flows and loads determine a plant's design capacity requirements. For the purposes of this report and as required by TCEQ, the design flows and loads to the Oso WRP are based on historical data. TCEQ design criteria for wastewater treatment require that design average and peak flows be derived from the most recent5 yearsof data when an existing facility is re-rated, expanded, or materially altered. BOD_5, TSS and ammonia nitrogen design loadings must be based on the most recent 1 year of data. (§217.34) Design loads are calculated as the sum of the historical average loading plus 1 standard deviation.

A summary of the design flows and loads derived from plant data and modeling are shown in the following table:

Table 2-3Design Flows and Loads

Parameter	Existing	Phase 2A	Phase 2B
Average Daily Flow (MGD)	16.2	18	24
Influent BOD (mg/L)	280	280	280
Influent Ammonia (mg/L)	30	30	30

The existing facilities have been designed to treat 16.2 MGD average daily flow, but hydraulically accommodate 98 MGD for peak hour flows. Peak hour flows will remain at 98

MGDfor Phase 2A and 2B improvements. Many process units are designed based on peak hour flows and although some units may require improvements due to age and/or compatibility with other processes, their design capacity will not need to be increased to achieve the objectives of this report. These treatment units include:

- Influent pumping
- Influent screens
- Influent grit removal
- In-plant piping and hydraulic structures
- Secondary clarifiers
- Disinfection systems and chlorine contact basins

Other systems are sized based onBOD, TSS, and ammonia loading, and must be expanded to accommodate future increased loadings. These systems include:

- Process aeration system (blowers, piping & diffusers)
- Aeration basins
- Biosolids Stabilization
- Solids dewatering***(Not included in this study)***

The existing biosolids stabilization is adequate for producing biosolids suitable for disposal to landfill, even with increased biosolids loadings from increasing plant influent flows up to 24 MGD. The biosolids stabilization alternatives presented in this Technical Memorandum are intended to provide a path forward in the event that the City is no longer able to dispose of the biolids via landfill or has the need to produce Class B sludge.

Anew solids dewatering facility is currently under constructionand has been designed to meet the projected increase in solids production for flows up to 24 MGD.

2.4 CURRENT PERMIT AND CONDITIONS

The Oso WRP is authorized by TCEQ to treat domestic wastewater and discharge treated effluent under authority of TPDES Permit No. WQ0010401004. The current TPDES permit for Oso WRP was issued on April 29, 2011 and expires on June 1, 2014.

In accordance with the TPDES permit, the treated effluent may be discharged to surface waters via a single outfall (001). The discharge outfall is described in the permit as via a 72-inch pipe to a 40-foot wide tidal channel; thence to Oso Bay in Segment No. 2485 of the Bays and Estuaries of the State of Texas. Because the discharge is to a relatively shallow area of Oso Bay with minimal dilution, the critical dilution for this discharge is 90%, according to the TPDES permit; meaning there is a high percentage of effluent in the mixing zone.

The TPDES permit includes an Interim Phase and a Final Phase for allowable discharges. The Interim Phase is effective for 30-months from the date of issuance and is the current phase of operation at the plant (ends on October 29, 2013). The Final Phase is effective after 30-months through the expiration date. Within each phase, the flow and quality limitations for the discharge are defined. The Final Phase limits are summarized in the table below.

Table 2-4TPDES Permit Limits (Final Phase)

Parameter	30-day average	7-day average	Daily maximum
Average annual flow (mgd)	16.2	N/A	N/A
Peak two-hour flow (gpm)	N/A	N/A	68,000 (98 MGD)
CBOD (mg/L)	20	30	45
TSS (mg/L)	20	30	45
Ammonia-Nitrogen (mg/L)	4.0	6	10
Chlorine Residual (mg/L)	N/A	N/A	0.1
Minimum DO (mg/L)	5.0		
pH (standard units)	6.0 to 9.0		
Enterococci (cfu or mpn/100 mL)	35	N/A	89

The Interim Phase differs from the Final Phase in only two respects. The Interim Phase contains a report-only requirement for ammonia-nitrogen rather than a numeric ammonia-nitrogen limit and a Five-Day Biochemical Oxygen Demand (BOD_5) limitation rather than a Five-Day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$) limitation.[1] The phasing provides an interim-phase 30-month compliance period for the City to achieve the final-phase ammonia-nitrogen limit of 4 mg/L.

2.5 POTENTIAL FUTURE PERMIT LIMITATIONS

The addition of the ammonia-nitrogen limit in the current TPDES permit is significant in terms of the changes in the level of treatment required by the Oso WRP to meet the new limit. The next few years may see the inclusion of other new or increased water-quality limitations that have the potential of driving additional changes in treatment. Changes may be imposed by TCEQ based on updated surface water quality standards for Oso Bay, changes in dissolved oxygen modeling protocols for Oso Bay, or changes in the status of Oso Bay with respect to water quality impairments.

The Oso WRP discharge to Oso Bay could also eventually be shown to be impacting sea grass beds, which could drive changes to the water quality limits in the permit. Following is a summary of potential new effluent limits or potential increases in existing effluent limits that could affect treatment requirements for the Oso WRP within the next one to two permit cycles.

2.5.1 Potential for Reduced Ammonia-Nitrogen and/or Carbonaceous Biochemical Oxygen Demand Limits

Permit limits for BOD_5 or for $CBOD_5$ and ammonia-nitrogen are, in part, driven by the expected impact of the effluent on dissolved oxygen levels in the receiving water body. The impact is determined by modeling of the receiving water body. For the OWRP, the TCEQ has used a dissolved oxygen (DO) model for Oso Bay that is several years old. The TCEQ has indicated that it plans to revise the DO model for the bay prior to the next permit cycle in 2014. If so, this is likely to affect the effluent limits in the next permit for $CBOD_5$ or ammonia-nitrogen, or both. Limits in the next permit cannot easily be predicted without knowing how the DO model will be revised. However, 30 TAC §309.4 regulations contain the following potential effluent sets (30-day average values) for wastewater plants that provide secondary treatment with nitrification:

$CBOD_5$: 10 mg/L
Ammonia-Nitrogen: 2 mg/L or 3 mg/L

[1] For permits without an ammonia-nitrogen limit, the total oxygen demand is addressed by BOD_5, which includes both carbonaceous and nitrogenous oxygen demand. When the discharge contains an ammonia-nitrogen limit, the nitrogenous oxygen demand is addressed by the ammonia-nitrogen limit. The BOD_5 limit is then typically converted to a $CBOD_5$ limitation.

The $CBOD_5$ and ammonia-nitrogen limits in the next Oso WRP permit will not be known until the model is revised, but could easily be driven to one of the above regulatory effluent sets. The outcome of the DO model revisions could drive one or both of these parameters to lower levels, as necessary to ensure that DO standards in Oso Bay are maintained.

2.5.2 Potential for Total Nitrogen Limits

Seagrass, an important ecological component of some bays and estuaries, is sensitive to an over-abundance of algae that can cause eutrophication of the water body and prevent sunlight from reaching seagrass beds. In tidal environments, algae growth is generally a function of the amount of nitrogen in the water body. If nitrogen concentrations are controlled, algae may be contained at levels that are not detrimental to seagrass propagation.

In the next permitting cycle, it is likely that the TCEQ will perform nutrient screening for the Oso WRP discharge to Oso Bay in order to determine whether a limit for total nitrogen (TN) is needed for the effluent. If it is determined that a TN limit is needed, the allowable concentration is likely to be 6 to 8 mg/L. Depending on the sensitivity of seagrass beds (i.e., the nearness of the beds to the discharge, etc.), a lower TN limit could be required.

2.5.3 Potential for Total Phosphorus Limits

The TCEQ's *Procedures to Implement the Texas Surface Water Quality Standards (RG-194; June 2010)* (IPs), state that nutrient impacts in tidal or salt-water environments are primarily due to nitrogen inputs rather than phosphorus inputs. As such, screening for phosphorus impacts in tidal waters is rarely performed. It is not expected that the TCEQ will screen for phosphorus impacts by Oso WRP in the next permit cycle; and, therefore, a total phosphorus (TP) limit is not likely to be included in the next permit. However, it is possible that TCEQ will include a TP limit in future permits beyond the next couple of cycles and as a result, the Phase 2 improvements will consider accommodations in the design for ease of implementing TP removal at some point in the future.

2.6 EVALUATION OF OUTFALL RELOCATION

The potential permit limits addressed above are based on the continuation of the use of the outfall to Oso Bay. The City requested a preliminary evaluation of moving the outfall to Corpus Christi Bay, as a potential means of reducing impacts of new water quality standards or regulations on effluent limits. Moving the outfall would require construction of a pipeline from the plant, across Oso Bay, and extending approximately ¼ mile into Corpus Christi Bay. The effluent discharge could be distributed via a diffuser at the end of the pipeline, significantly reducing the critical dilution for the effluent. This could enable the City to effectively treat wastewater to meet water quality standards without having to increase treatment levels as much as with the current discharge.

The preliminary evaluation determined the following:

- Prohibitive Cost (Estimated Construction Cost of $6,500,000)
- An ammonia-nitrogen limit would still be required, although it might be somewhat less stringent given the increased dilution in a Corpus Christi Bay outfall.Ultimately, an outfall relocation is not a stand-alone improvement.
- The impact due to seagrass could be avoided because the outfall would be deeper than seagrass beds could exist; however, this would not necessarily prevent the TCEQ from screening for nitrogen impacts.
- An amendment of the TPDES permit will be required in order to develop an outfall to Corpus Christi Bay. A permit amendment will require public notice of the proposed

action and undoubtedly result in a significant response from the public. A minimum of two to three years to complete permitting should be expected.

As a result of these findings, the alternative to create a new outfall to Corpus Christi Bay was eliminated from further consideration.

3.0 TREATMENT FACILITIES EVALUATION

3.1 INFLUENT PUMPING

Influent is delivered to the Oso WRP by two (2) in-plant lift stations (LS1 and LS2) and a remote lift station, LS3, all of which outfall at the plant's headworks facility. The existing in-plant lift stations were recently rehabilitated to help restore the majority of theiroriginal design capacities. The capacities shown in the following table are based on calculated system curves and manufacturer provided pump curves. Currently, there are no flow meters on these force mains to confirm actual flow rates.

Table 3-1Existing Influent Pump Capacity

Lift Station	Design Capacity (MGD)	Actual Capacity (MGD)	Firm Capacity (MGD)
Lift Station 1(1)	22.9	30.3 @ 28'	30.3 @ 28'
Lift Station 2(1)	39.4	39.6 @ 38'	30.3 @ 33'
Williams (Lift Station 3)	54.6	44.7 @ 122'	41.8 @ 110'
Total	**116.9**	**114.6±**	**102.4±**

NOTE 1 –When calculating firm capacity, LS1 and LS2 were considered a single LS due to the inter-connecting EQ line.

3.1.1 Proposed Improvements

Although recent work was performed (rotating assembly replacements) on the six (6) existing pumps at Lift Stations 1 & 2 to help restore pumping capacity, the infrastructure associated with Lift Station 1 is a maintenance concern and is approaching its useful service life. In addition, the City currently has four (4) temporary Godwin pumps located at the plant for emergency high-flow scenarios and has a need to upgrade the pumping capacity at the plant site. The proposed influent lift station will ultimately replace Lift Station 1 and 2, willbe located at the north end of the plant adjacent to the new headworks facility and will provide up to 80-90 MGD capacity. The new lift station will also be designed with an inlet valve so that it can be easily isolated from the other lift stations for maintenance purposes. Refer to Exhibit E in the Appendix for the proposed location of the new lift station.

Table 3-2Proposed Lift Station Design Criteria

Parameter	Value
Number of pumps	8
Type of pumps	Submersible
HP	215±
Design flow (MGD)	±15 MGD/each
Design head (ft)	30'±

3.2 HEADWORKS

The existing headworks was constructed in the early 1980s and includes two large bar screens, and an aerated grit basin which has been out of service for many years. Effective preliminary treatment at the headworks significantly reduces maintenance of downstream equipmentand reduces labor costs associated with unclogging pumps or removing trash and grit from the basins. In addition, investment in preliminary treatment increases the life of downstream equipment.

3.2.1 Screenings

Rags, floatables and other large debris are removed from the wastewater by the bar screens. The existing 1-in screens were designed for automatic raking but one rake has been continuously out of service and must be cleaned manually. The screenings drop to a conveyor where they discharge into a screenings box for disposal. The plant estimates screenings production at approximately 100 lbs/day.

3.2.2 Grit Removal

The existing aerated grit basin has been out of service for many years, due in part to continual clogging of the grit air-lift pumps. Without grit removal, the grit entering the plant accumulates in the aeration basins and clarifiers. Although difficult to accurately estimate, previous work requiring basin shut downs indicate that grit accumulation may account for up to 25% of the aeration basin volume and approximate 10% of clarifier volume.

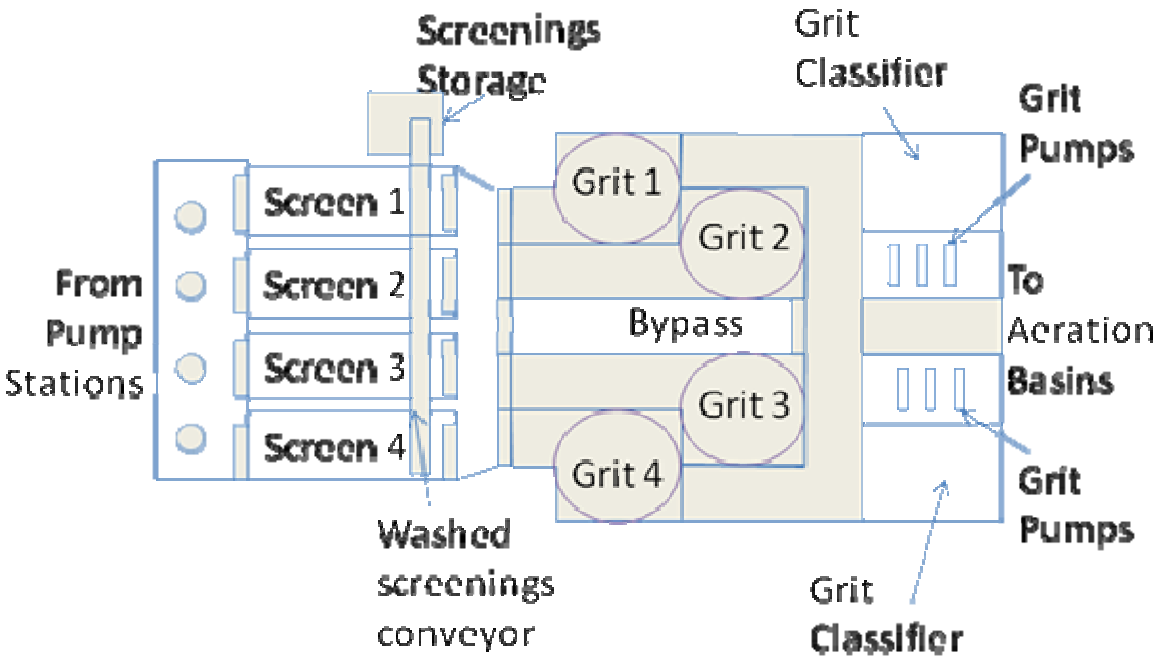
A reliable grit system must be in place for the plant to upgrade to fine bubble aeration (discussed in other sections). Fine bubble membranes cover a large portion of aeration basin floor and are much less efficient whensubmerged by grit. In addition, fine bubble aeration agitates the water much less than coarse bubble aeration which will result in a greater amount of grit will accumulation.

3.2.3 Proposed Improvements

A new headworks facility is necessary for Phase 2 improvements. The existing headworks is aging, the mechanical equipment is approaching the end of its useful life and the existing structure is not sufficient to accommodate a new grit removal system. It is recommended that the new headworks facility consist of four (4) bar screens, with associated washers and compactors, and be designed to provide peak hour capacity with one screen out of service. The new screens should have smaller openings (approximately ¼-in bar spacing) to reduce the amount of rags and debris that reach the plant basins and equipment.

A new grit facility will also be required to improve grit removal, which is necessary to accommodate fine bubble aeration. Many alternatives are available for grit removal, including the aerated grit basin currently used, a detritor tank, or a vortex separator. To be effective, both the aerated grit basin and detritor tanks require submerged mechanical sludge collection equipment, which is vulnerable to corrosion and break downs. The Vortex grit basin is circular, and the grit is directed to a single point without sludge rakes. The vortex action also efficiently removes grit at a wide range of influent flows.For these reasons, four(4) vortex grit basins are recommended as a part of the new headworks. A sketch of theproposedheadworksfacility is shown below.

Figure 3-1ProposedHeadworks Facility



Enclosing the bar screens within a building is not recommended, as the ventilation requirements for the building will be very high, and corrosive gasses and odors will accumulate in spite of the ventilation. It is recommended that the bar screens and grit basins have odor covers as specified by the manufacturer.

Table 3-3Bar Screen Design Criteria

Parameter	Value
Quantity	4
Width (ft)	8±
Bar Spacing (in)	1/4
Rake Type	Catenary/Mult-Rake

Table 3-4Grit Basin Design Criteria

Parameter	Value
Number	4
PeakCapacity (MGD)	98
Low flow (MGD)	3
Type	Vortex
Grit Pumping	Flooded suction centripetal
Grit Dewatering Capacity (cf/hr)	5

3.3 ODOR CONTROL

Odor control is currently implemented at the headworks, influent lift stations and the proposedbelt press facility currently under construction. The headworks and lift stations have modular biofilter systems installed in the past 5 years. Foul air is collected from the influent pump station wet wells, screened channels, and the covered aerated grit basin. The H_2S concentration levels have exceeded the design criteria for the biofilter odor control system at Lift Station 2 and as a result, the system is currently undergoing upgrades as a part of the belt press project. The proposed belt press facility has a bond odor control device where foul air is

collected from each belt press.If the existing biofilter system at the existing headworks/LS1 is unable to be modified to accommodate the proposed headworks and Lift Station 4 facilities, a new bio-filter system will be recommended. Further investigation will be completed during the preliminary design phase to determine whether it will be necessary. The City has been satisfied with previous bio-filter systems and they have performed well in all cases where they have been properly sized.

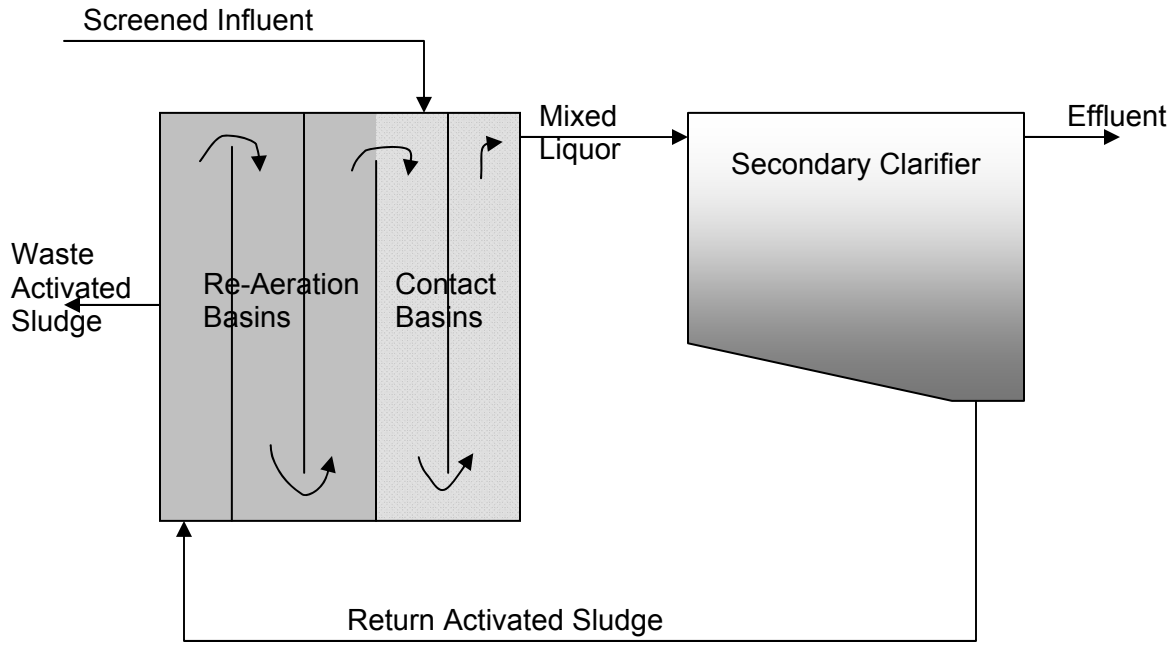
Table 3-5Odor Control Design Criteria

Parameter	Value
Capacity (scfm)	2500±
Inlet duct size (in)	16
Type	Bio-filter

3.4 SECONDARY TREATMENT

The Oso WRP uses the contact stabilization activated sludge process which involves a large inventory of microbes for absorbing and aerobically metabolizing BOD. The contact stabilization process is schematically illustrated below.

Figure 3-2Existing Oso WRP Secondary Treatment Schematic



Screened influent is introduced into the contact basins where it is “contacted” with a high concentration of activated sludge (microorganisms). The microorganisms rapidly absorb the BOD (biodegradable carbonaceous organic contaminants), as they have been without an external source of food while passing through the re-aeration basins. As the influent and activated sludge progresses though the contact basins, nearly all availableBOD is consumed, leaving a mixture of effluent and microorganisms. This mixed liquor is directed to the secondary clarifier, where the activated sludge settles, separating it from the effluent. Activated sludge is then returned to the re-aeration basins, and the effluent proceeds to the disinfection process. Return activated sludge (RAS) is delivered to the re-aeration basins where plentiful oxygen from aeration promotes metabolism of absorbed BOD.

A disadvantage of contact stabilization is the short contact time between the RAS and influent, which reduces the extent of nitrification. Nitrifying bacteria do exist, but most nitrification occurs in the re-aeration basins, where the microorganisms spend the most time.

3.4.1 Aeration Basins

As shown in the figure above, the aeration basins are rectangular concrete structures divided into 5 passes. Three passes are re-aeration basins, which receive RAS flow only. RAS and influent combine at the head of the first contact basin, flow through the two contact basin passes, and on to the clarifier inlet channel. Individual aeration basin passes cannot be taken out of service unless the entire train is shut down. However, a train cannot currently be taken out of service because the total plant flow is beyond the capacity of a single process train. This represents a significant challengein performing maintenance work on the aeration basins and associated equipment.

The existing aeration basin parametersare summarized in the table below:

Table 3-6Existing Aeration BasinParameters

Parameter	Both trains	Single train
Total Volume (MG)	6.79	3.39
Design flow (MGD)	16.2	8.1
Peak flow (MGD)	98	49
Side water depth (ft)	15.7	
Aerator type	coarse bubble	
Design DO (mg/L)	5	
Design MLSS (mg/L)	2,500	
Design SRT (day)	5	
Design max loading (ppd BOD/1000cf)	45	
Passes Width x Length (SF)	28,875	

3.4.2 Retrofit Existing Aeration Basins

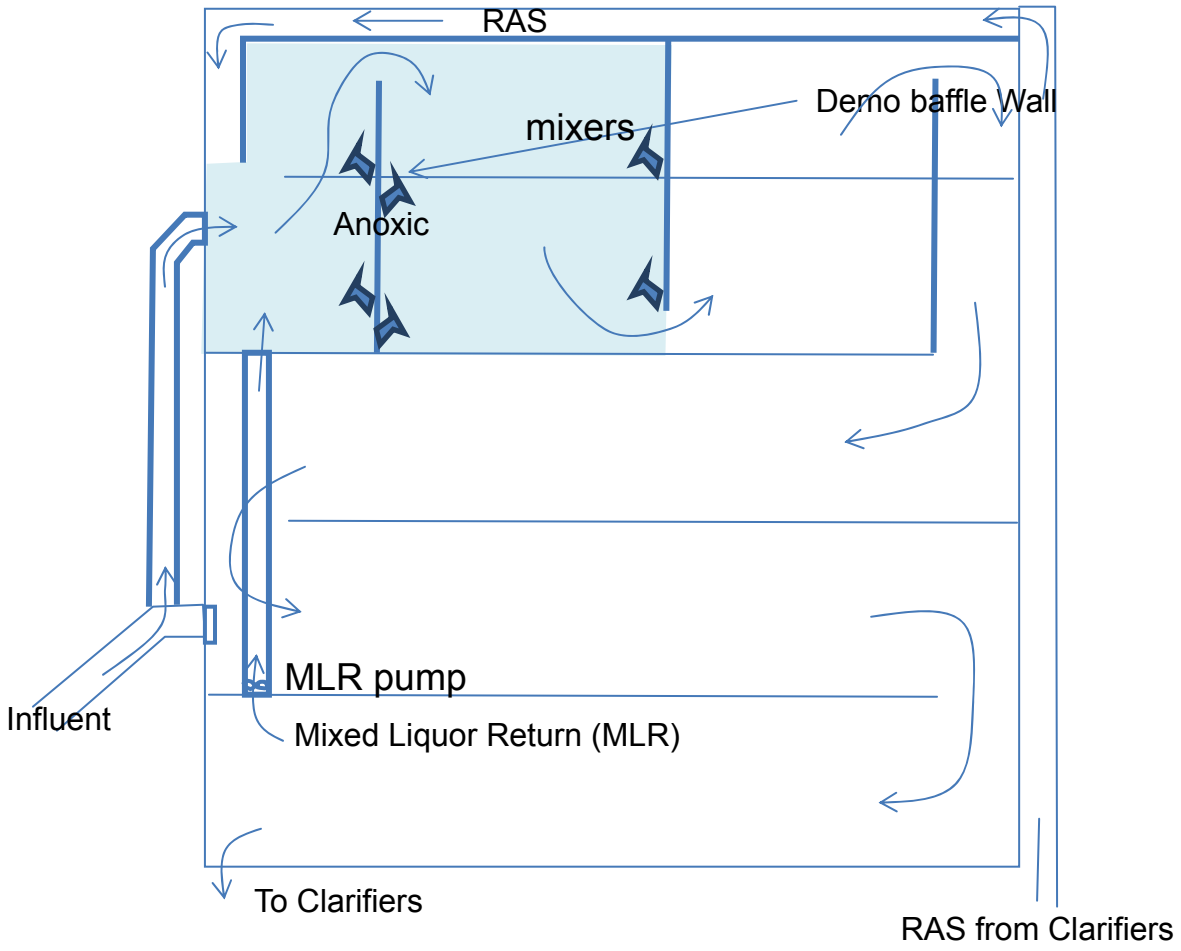
Many alternatives that would allow the existing aeration basins to remove ammonia were discussed and evaluated in TM-03. Conventional biological ammonia removal is the most common process and is the recommended process for the Oso WRP for the following reasons:

- Does not require proprietary media or equipment
- Can be modified to remove phosphorus or additional total nitrogen in the future as needed
- Does not require tertiary process vessels and associated in-plant pumping

It is recommended that the process be configured to the “Modified LudzakEttinger” or MLE process. This configuration provides ammonia removal and total nitrogen removal. The denitrification, that results in total nitrogen removal, also helps restore alkalinity to the effluent, and reduces process air demand. Since the MLE process requires more aeration basin volume than the contact stabilization process, the existing aeration basins capacity will be reduced to 6 MGD per process train. This capacity is based on winter water temperatures and conservative design parameters. This will provide the City with flexibility to improve total nitrogen removal and provide phosphorus removal in the future.

The MLE process is shown in the following figure that depicts the aeration basin modifications:

Figure 3-3Existing Aeration Basin Retrofit



Influent and RAS is combined at the head of the aeration basin in a well-mixed, un-aerated zone called the anoxic zone. Mixed liquor is also pumped here at double or triple the raw influent flow rate, providing nitrate. Facultative bacteria use the nitrate as they metabolize BOD in the absence of oxygen. The anoxic zone is sized to ensure that the nitrate is consumed before the flow reaches the aerated zones within the basin. In the aerobic zone, oxygen is present, and the facultative bacteria consume BOD aerobically. The oxygen allows nitrifying bacteria to convert ammonia to nitrate. By the end of the aerated zones, most of the ammonia has been converted to nitrate. Much of this nitrate is recycled to the anoxic zone through the MLR pump. The mixed liquor that escapes the MLR pump will flow to the clarifiers.

To convert the existing basins to the MLE process, we recommend that the first two re-aeration basins be combined into a single basin divided by baffle walls. The influent must be re-directed to this new basin, and the RAS channel extended to reach the influent end of the basin as shown in the figure. A mixed liquor pump delivers mixed liquor to the anoxic zone through a pipe that runs through the aerated zones.

Fine bubble aeration grids will be installed to replace the coarse bubble aeration. Fine bubble aeration greatly improves the oxygen transfer efficiency, which results in much less air required to supply the necessary oxygen to the process. Converting to fine bubble aeration may reduce air requirements by up to 50 percent, resulting in significant energy savings.

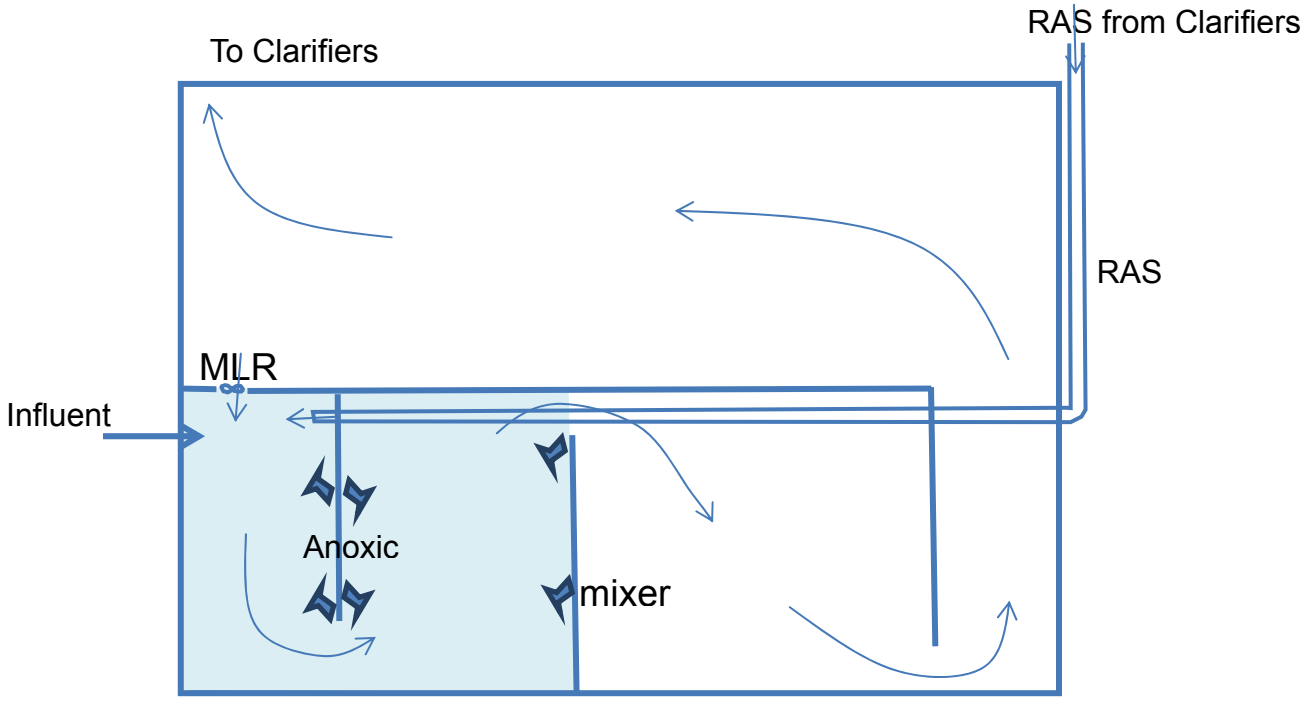
3.4.3 Proposed Aeration Basins

Retrofit of the existing aeration basins will require that each basin be taking completely out of service while the existing aeration systems are removed and replaced with fine bubble aeration. Since a single existing train is not capable of accommodating existing flows and loads, a third process train at minimum will need to be constructed and placed in service prior to retrofit of the existing aeration basins.Addition of the third train and retrofit of the existing aeration basins will increase treatment capacity to 18 MGD.Addition of the fourth train will increase the plant's capacity to 24 MGD.

Table 3-7ProposedAeration Basin Design Criteria

Parameter	Value per Train
Volume (MG)	3
Design Flow (MGD)	6
Side water depth (ft)	15.4
Aerator type	Fine Bubble
Design DO (mg/L)	2
Design MLSS (mg/L)	2,500 to 3,500
Design SRT (day)	6-8
Design max loading (ppd BOD/1000cf aerated volume)	40
Side water depth (ft)	15.4
Anoxic volume (% of total)	15
Passes Width x Length (SF)	30,000

Figure 3-4Proposed Aeration Basin Schematic



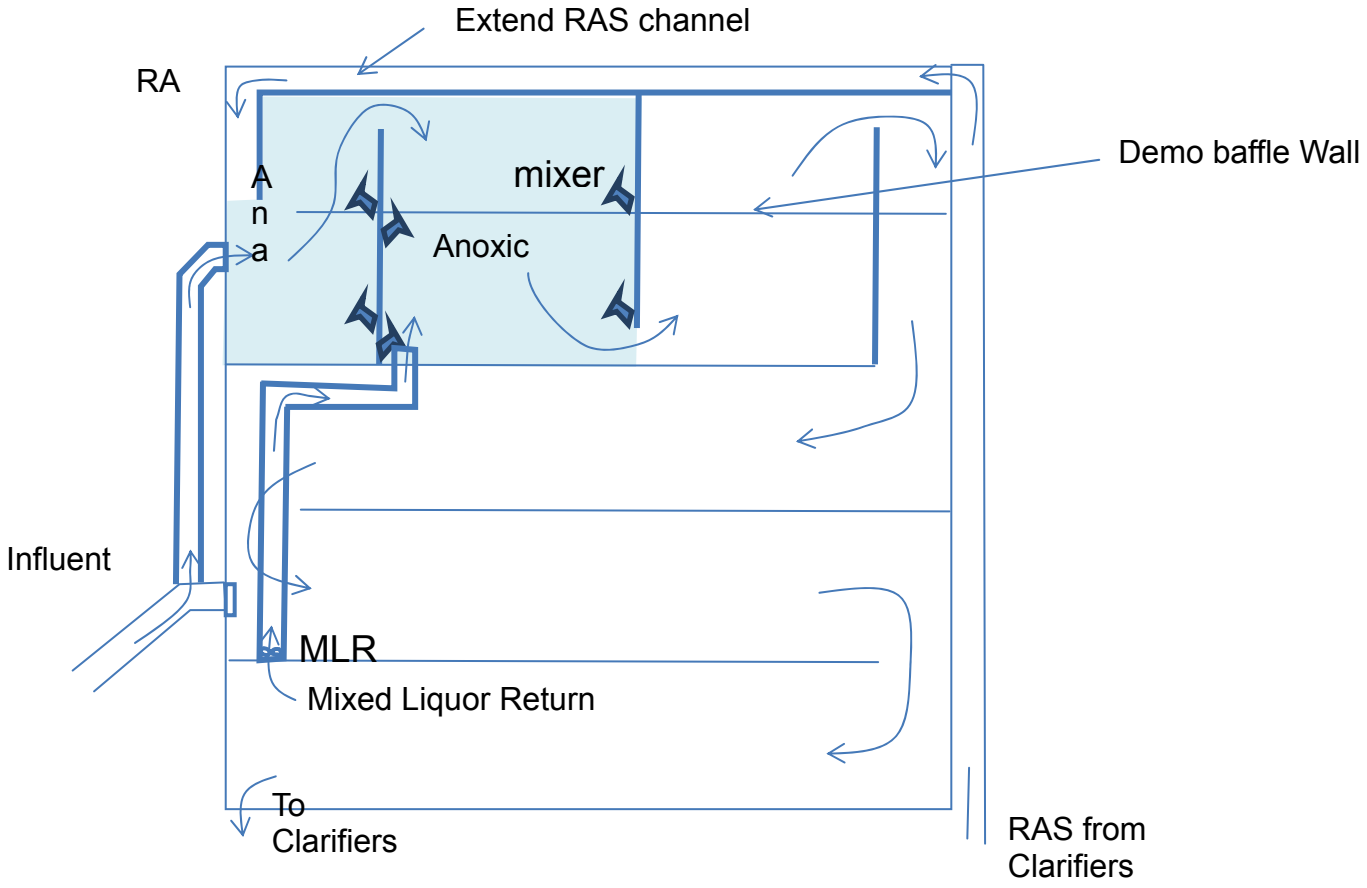
Theproposed aeration basins will be configured similar to the existing retrofitted basins.Refer to Exhibit E in the Appendix for the proposed layout of the proposed and retrofitted aeration basins.

3.4.4 Future Phosphorus Removal

Based upon the regulatory focus to reduce nutrient discharges from treatment facilities by both the Environmental Protection Agency on a national level and TCEQ on a state level, it is likely that phosphorus limitations will be implemented in future TPDES permit renewals. Phosphorus is biologically removed by encouraging the growth of phosphate accumulating organisms, or PAOs in the mixed liquor. The phosphate that PAOs store allows them to thrive in anaerobic conditions where neither dissolved oxygen or nitrate (which contains molecular oxygen) is available. In anaerobic conditions, the organism releases phosphate (which also contains molecular oxygen)which provides the PAO with energy to grow. It then flows into the anoxic zone of the MLE process where nitrified MLR is introduced. The PAOs then intake more phosphate than was released in the anaerobic condition, which reduces the phosphate levels in the aeration basin effluent.

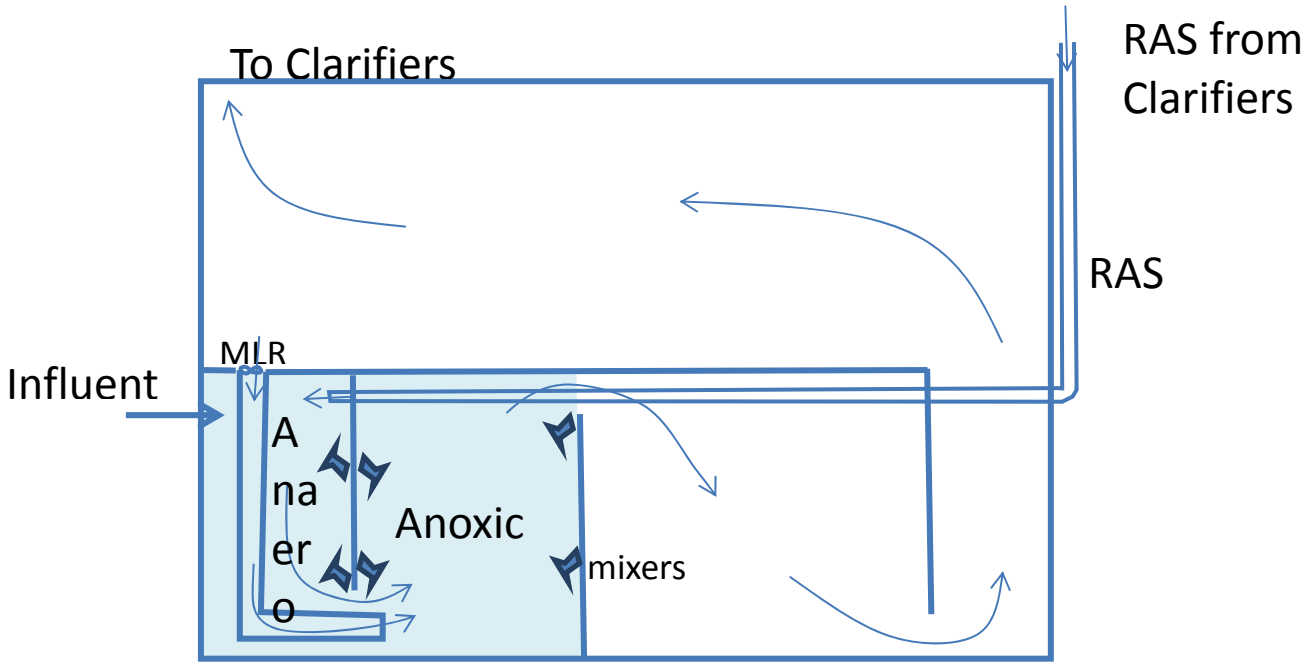
The MLE process can easily be modified to include an anaerobic zone to select for PAOs. The following figure shows how this is done

Figure 3-5Existing Aeration Basin – Altered for P Removal



To create an anaerobic zone, the MLR pump discharge will be relocated. The following figure shows the relocated MLR piping on the new aeration basins.

Figure 3-6New Aeration Basin – Altered for P Removal



3.4.5 Process Air Blowers

Aeration blowers supply oxygen required for aerobic biological treatment both in the aeration basins and the aerobic digesters. The Oso WRP has three operational blower houses each equipped with blowers. Blower House 2 (BH2), BH3 and BH4 supply air to the secondary treatment facilitiesand to the aerobic digesters. The following table details the existing blowers.

Table 3-8Existing Blowers

Size (HP)	Blower House	Capacity	Condition	To Be Replaced
250	2	5,362	Good	No
250	2	5,362	Good	No
250	2	5,362	Good	No
250	2	5,362	Good	No
125	3	2,361	Vintage	Yes
125	3	2,361	Vintage	Yes
125	3	2,361	Good	Yes
300	4	5,324	Vintage	Yes
300	4	5,324	Vintage	Yes
300	4	5,324	Vintage	Yes
250	4	5,324	Good	Yes
	Total	**49,828**		

All blowers at the plant are operated continuously due to a lack of redundant blowers. The proposed conversion to fine bubble aeration will reduce the plant's air demand as tabulated below.

Table 3-9Process Air Demands

Facility	Existing Plant	Phase 2A (3 trains)	Phase 2B (4 trains)
Aeration Basin (scfm)	40,000	30,000	40,000
Aerobic Digester (scfm)	10,000	10,000	10,000
Total	50,000	40,000	50,000

Upgrading to fine bubble aeration will significantly reduce process air demands. However, with four process trains, additional blower capacity will be needed to provide redundant and/or firmblower capacity. To achieve this, it is recommended that the three (3) 125 HP blowers be replaced withthree (3) 250 HP blowers. To avoid future maintenance concerns, it is also recommended that the three (3) vintage 300 HP blowers be replaced with blowers of identical size. This will increase the capacity by approximately 6,000 scfm for a total capacity of approximately 56,000 scfm and a total firm capacity of 50,000 scfm.

3.4.6 Secondary Clarifiers

The Oso WRP has rectangular secondary sedimentation basins designed for peak influent flow of 98 MGD. The basins are integral to the biological process and their performance has a direct and significant impact on effluent quality.

Each existing process train has four (4) equivalent rectangular clarifiers that operate in parallel. Mixed liquor from the clarifier influent channel flows into the clarifiers though square openings at the water surface level. Activated sludge settles to the bottom of the basins and traveling bridge sludge scrapers remove the sludge from the clarifiers. The bridges are equipped with pumps that draw the sludge from the front of the scrapers and discharge to RAS channels that run the length of the clarifier, and flow into the common RAS channel. Effluent flows over weirs that are also located along the clarifier's length and into channels that feed the common effluent channel.

The bridges were recently upgraded and further upgrades are not recommended at this time. The following table provides pertinent clarifier details.

Table 3-10Secondary Sedimentation Basin Equipment

Parameter	Design Criteria	TCEQ Requirement
Number of clarifiers	8	-
Side water depth (ft)	15.0	>10
Width (ft)	56	-
Length (ft)	195	-
Effluent weir peak loading (gpd/ft)	15,000	<30,000
Freeboard (in)	19	>18
Peak overflow rate (gpd/sf) 98 MGD all basins in service	1,120	<1,200
Detention time at 98 MGD (hours)	2.4	>1.8

The secondary clarifiers are in good condition at this time. Normal maintenance and replacement of mechanical equipment such as scum removal, RAS pumps, and traveling bridges will be required. Such work is not detailed in this report because the work does not impact the plant's footprint or require additional tankage.

Constructing the proposedprocess trains requires that the clarifiers be dedicated to a particular aeration basin. This will be accomplished by installing an isolation structure (divider wall) in the clarifier inlet channel and the RAS channelin the middle of the four clarifiers at each existing train. The isolation structure in the clarifier inlet channel will assign two existing clarifiers per proposed train and ultimately preserve the flow split achieved upstream. The RAS channel isolation structurewill keep the solids from each train separate and avoids the need to control the RAS flow split to each aeration basin. A RAS flow imbalance would upset plant performance and prevent efficient control.

3.5 BIOSOLIDS STABILIZATION

Solids wasted from the secondary treatment process are stabilized by aerobic digestion. Only minimal stabilization is required, as the City currently disposes of the solids to a landfill. The existing biosolids stabilization process has adequate capacity to accommodate future increased biosolids loadings assuming that the City continues to dispose of the biosolids to landfill.

3.5.1 Federal Regulations

Federal regulations regarding biosolids are presented in the Code of Federal Regulations, Volume 40 Part 503. One disposal option for the waste sludge is to haul it offsite for disposal in a permitted landfill. For disposal in a permitted landfill, the sludge must not contain any free liquid as defined by Method 9095 – Paint Filter Liquids Test. The test is described in Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods (EPA publication No. SW-846). In order to pass the Paint Filter Liquids Test, the sludge must have a minimum dry solids content of approximately 16%. If the biosolids are to be land applied, Subpart B for Part 503 defines such a practice and delineates the characteristics that they must comply with. The reasoning of the regulations is that the sludge will be applied on land at a rate equal to or smaller than the agronomic rate, defined by the nitrogen requirements of the crop to be planted on the land. In addition to metal concentrations presented in Table 3-11, the sludge needs to satisfy the vector attraction requirements and a specific pathogen concentration that will define it as either Class A or B. Biosolids with low metal concentrations are considered to be Exceptional Quality (EQ).

Table 3-11 Allowable Land Application Pollutant Limits

Pollutant	Ceiling Concentration (mg/Kg)*	Cumulative Pollutant Loading Rate (Kg/ha)	Monthly Average Concentration (mg/Kg)*	Annual Pollutant Loading Rate (Kg/ha/365 days)
Arsenic	75	41	41	2.0
Cadmium	85	39	39	1.9
Copper	4300	1500	1500	75
Lead	840	300	300	15
Mercury	57	17	17	0.85
Molybdenum	75	-	-	-
Nickel	420	420	420	21
Selenium	100	100	100	5.0
Zinc	7500	2800	2800	140

*Dry weight basis

The main purpose of the vector attraction requirements is to reduce the amount of putrescible organic matter that will draw rodents and insects that will then interact with humans. Vector attraction is satisfied by reducing the incoming organic matter (in the form of volatile solids) to the stabilization process by a minimum of 38%

3.5.1.1 Class B Biosolids

Class B biosolids are those that have a Fecal Coliform or Enteric Virus concentration lower than 2,000,000 Most Probable Number (MPN)/g TS or Colony Forming Units (CFU)/g TS. Treatment technologies recognized as Process to Significantly Reduce Pathogens (PSRP's) are certified to achieve Class B pathogen concentrations. They are:

- Aerobic digestion where the biosolids are mixed with air or oxygen to maintain aerobic conditions for a mean cell residence time and temperature between 40 days at 20°C and 60 days at 15°C.
- Air drying for a minimum of three months (two of them at a mean temperature above freezing).
- Anaerobic digestion with a mean cell residence time and temperature between 15 days at 35 to 55°C and 60 days at 20°C.
- Composting using within-vessel, static aerated pile, or windrow composting methods. The temperature should increase to at least 40°C and remain at 40°C or higher for five days. For four hours during the five days, the temperature in the pile must exceed 55°C.
- Alkaline stabilization, with a lime dose high enough to raise the pH of the sludge to 12 and maintain it at that temperature for two hours of contact. In order to satisfy Vector Attraction requirements, lime should have a pH greater than 11.55 for 22 hours or more.

Biosolids that satisfy Class B requirements are subject to the following site restrictions:

- Food crops that touch the sludge/soil mixture and are completely above ground cannot be harvested for 14 months after the sludge is applied.
- Food crops that are below ground cannot be harvested for 20 months after the sludge is applied and left on the soil surface for 4 months before incorporating into the soil matrix. If the sludge is left on the soil surface for a period shorter than 4 months before it is incorporated, subterranean food crops cannot be harvested for 38 months.
- Feed and fiber crops cannot be harvested for 30 days after the sludge is applied.
- Animals cannot be allowed to graze for 30 days after the sludge application.
- Turf cannot be harvested and public access to land has to be denied for a year if the potential for human exposure will be high.
- Public access to land will be restricted for 30 days after application if the potential for human exposure is low.

3.5.1.2 Class ABiosolids

Class A biosolids do not have the site restrictions that Class B has, and that is mainly due to its strict pathogen allowances of a Fecal Coliform concentration less than 1,000 MPN/g TS or a Salmonella concentration less than 3 MPN/4g TS, in addition to six alternatives:

- Satisfy a residence time-temperature combination, as a function of solids concentration.
- Raise the pH of the sludge above 12 for 72 hours, and maintain a temperature of 52°C for 12 or more of those hours. After the 72 hour period, the sludge shall be air dried to a solids concentration greater than 50%.

- Process must reduce the concentration of enteric viruses in the sludge to less than 1 Plaque Forming Unit (PFU)/4g TS, in addition to reducing the concentration of viable helminth ova to less than 1 viable egg/4g TS.
- Measure the concentrations of enteric viruses and helminth ova and satisfy the requirements stated previously (<1 PFU/4g TS and <1 viable ova/4g TS) at the time the biosolids are disposed or being prepared for use or disposal.
- Use a technology identified as a Process to Further Reduce Pathogens (PFRP).
- Use a technology accepted by the EPA to be equivalent to a PFRP.

Just as in the case of PSRP's for Class B, PFRP's assure Class A biosolids. These technologies are:

- Composting within-vessel or static aerated pile, where the temperature is maintained at 55° C or higher for three days. For windrow, the temperature shall be 55°C or greater for 15 days or longer.
- Heat drying of the sludge to a moisture content of 10% or lower using a temperature of 80°C or greater.
- Heat treatment, by raising the temperature of the sludge to 180°C or higher for at least 30 minutes.
- Thermophilic aerobic digestion using a mean cell residence time of 10 days at 55 to 60°C.
- β ray irradiation at 1.0 megarad at room temperature (approximately 20°C).
- γ ray irradiation from 60Co or 137Cs at room temperature.
- Pasteurization, by exposing the sludge to 70°C or higher for at least 30 minutes.

3.5.2 State of Texas Regulations

The State of Texas has been delegated by the EPA to regulate biosolids and has its own regulations regarding biosolids, which are part of the Texas Administrative Code, Title 30, Part 1, Chapter 312, Subchapter A. Although the Texas regulations are structured differently than the federal regulations, the technical requirements for Class A and Class B sludge are the same.

3.5.3 Class B BiosolidsOptions

Land application is another alternative disposal option, which is currently not practiced for two reasons. First, suitable sites for land application are much farther than the landfill, which results in prohibitively high transportation costs. Second, land applied sludge must meet at lease the Class B requirements as defined in the EPA's Part 503 Biosolids regulations as described above. To comply with Class B requirements, the City would have to provide an aerobic digester solids resident time (SRT) of 40 days at 20°C and 60 days at 15°C. If there is not recycle or decanting within the digesters, the SRT and they hydraulic retention time (HRT) are equal

Currently, the 2.7 million gallon aerated digester capacity provides an SRT of approximately 10 days at a solids concentration 0.5%, which does not comply with the Class B requirements. To produce a Class B biosolids for land application, a SRT of 40 days for the existing plant could be obtained by increasing the solids concentration in the aerobic digesters to 2.1% through either decanting the supernatant in the digesters or the addition of a mechanical thickening process. In order to land apply the biosolids at the future flow of 24 MGD, an additional 1.8 million gallons of digester capacity and mechanical thickening are needed to increase the solids concentration to 3.5% and obtain a SRT of 40 days at 20°C.

Anaerobic digestion is generally the preferred form of stabilizing the residual solids in plants with average flows above 5 to 10 MGD. The process involves a numerous different bacterial populations that utilize enzymatic and biochemical processes to reduce the incoming volatile solids concentration by conversion into biomass and metabolic byproducts. The complexity of anaerobic digestion comes from process sensitivity and the interactions of components that make up the complete system. As with any other biological reaction, temperature will affect the rate in which reactions are carried out. Hydrolysis, organic acid formation, and methane formation will both be dependent on temperature, and can be affected by fluctuations in it. Therefore, it is necessary to design a system with close temperature tolerances that is efficiently mixed. Most anaerobic digestion processes are designed to operate in the mesophilic temperature (35°C), but some operate in the thermophilic temperature range (55°C). While selection of the operating temperature is important, maintaining a stable operating temperature in the digester is more important. Temperature fluctuations greater than 1°C/day can result in process failure due to the sensitivity of methane formers. This requirement may limit feed rates and schedules, unless preheating or heat exchangers are used.

For the Oso WRP design flow of 24 MGD, four 85-ft diameter anaerobic digesters with a side water depth of 25-ft and a building containing the boilers and recirculation pumps is required. In addition, the efficient operation of anaerobic digestion requires the addition of primary clarification to the liquid stream process train; otherwise the anaerobic is difficult to operation and maintain process stability, effectively rendering the process unfeasible. To treat the peak flow of 98 MGD, four 130-ft diameter primary clarifiers and a primary sludge pump station are required. As the Oso WRP does not current have primary clarification and is very constrained, anaerobic digestion does not appear to be feasible.

3.5.4 Class A Biosolids Options

To produce Class A biosolids, the treatment process must meet the time and temperature requirements described in 3.5.1.2. For the aerobic digestion process, auto-heating to raise the temperature to the thermophilic range of 55°C is required. For anaerobic digestion, either a pasteurization step or a thermophilic acid phase must be added to the biosolids stabilization treatment process.

3.6 DISINFECTION

Disinfection at the Oso WRP is achieved with sodium hypochlorite where the chlorinated effluent passes through the chlorine contact basins. The contact basins provide the necessary contact time to kill most pathogens. Just prior to discharge, sodium bisulfate is added to neutralize any remaining chlorine residual.

The existing disinfection system design parameters are shown in the following table:

Table 3-12 Disinfection System Design Parameters

Parameter	Design Criteria	TCEQ Requirement
Design Dose (mg/L)	6	6
Peak sodium hypochloriteflow (ppd)	6,500	-
Existing sodium hypochlorite flow capacity (ppd)	8,000	-
Contact Basin Volume (MG)	1.38	-
Peak Flow Contact Detention Time (min)	20.3	20

The disinfection process is sized to accommodate peak hour flows. Since the peak hour design flow will not be increased, the existing chlorine contact basins and sodium hypochlorite storage and feed systems will not require upgrades.

The existing disinfection system has recently struggled to meet the effluent permit limits for enterococci (35 and 89 MPN/100 ml for daily average and max respectively). This level of "kill" should be reliably accomplished with the plant's existing disinfection equipment unless there is excessive effluent turbidity or short circuiting of the chlorine contact basins. This issue will be studied further during the Phase 2 preliminary design to determine whether the system would benefit from the installation of baffles in the contact basins. In addition, the Wastewater Department has experienced a significant number of maintenance problems associated with the vacuum feed system currently in place. Peristaltic or diaphragm-type metering pumps would provide a more reliable alternative, which has proven effective at other local plants.

3.6.1 Impact of Sodium on Disinfection

Over the past 12 months, the City has experienced challenges in meeting its permit limits with respect to *enterococci*. These challenges occurred at times when mixed liquor concentrations were above 5,000 mg/l and NaOCl dosages were above 6 mg/l. Anecdotally, NaOCl dose was reduced to approximately 3 mg/l and disinfection results improved. Others have suggested that reduced disinfection effectiveness may have been the result of increased sodium levels in the Oso WRP effluent.

Based on this recent experience, the City is concerned that break point chlorination with its corresponding high dosages of NaOCl may adversely impact disinfection at the Oso WRP.

The LNV/Jacobs team reviewed available literature and concludes that elevated sodium levels are not known to impact disinfection effectiveness, particularly at the sodium concentrations encountered in the Oso WRP effluent or expected in the effluent as a result of breakpoint chlorination. Our conclusions are based on the following:

- Chlorine is routinely used to control biofouling in seawater cooling towers. Sodium concentrations in this application are substantially higher than those found in the Oso WRP effluent.

- Higher TDS can affect the ionic strength of the plant effluent, which can then affect the equilibrium between hypochlorous acid and hypochlorite ion. An order of magnitude increase in TDS reduces the amount of hypochlorous acid in solution by approximately five

(5) percent (see figure 14, p 1502, Handbook of Chlorination 4th ed, White). Although no data quantifying the Oso WRP effluent sodium levels are available, we estimate that sodium levels range from 400 to 700 mg/l based on reported effluent chloride levels. The addition of 40-70 mg/L sodium due to breakpoint chlorination represents an approximately 10 percent increase in TDS, which should decrease hypochlorous acid by much less than five percent.

Based on the above information, we do not believe that higher dosages of NaOCl contributed to a decrease in disinfection effectiveness. It is more likely that the increase in mixed liquor concentration impacted the levels of suspended solids in the effluent overall chlorine demand.

3.7 ELECTRICAL SYSTEM

3.7.1 Existing Electrical System

The existing electrical system at the Oso WRP was upgraded in 2007 under Project No. 7231, ELECTRCIAL/ALTERNATE POWER FACILTY UPGRADE. Under Part 1 of this project, all of the existing switchgear and motor control centers were replaced with new facilities. Three new electrical control rooms (ECR's) were installed with new transformers, switchgear and motor control centers to serve the existing plant loads. Each ECR is a climate controlled building with fully redundant transformers and indoor switchgear.

ECR-2/3 contains the 12.47 kV main switchgear that supplies power to the entire plant and supplies 480 volt power to Blower Houses No. 1, 2, 3 &5, Lab/Office building, aeration basins, pre-thickeners, clarifiers and chlorination facilities. ECR-4 supplies 480 volt power to Blower House No. 4, the bar screen, re-aeration basins, belt press building, and the post-thickeners. ECR-LS2 serves Lift Station No. 2, chlorination, de-chlorination and the non-potable water system.

The project included new 12.47 kV main-tie-main switchgear with automatic controls capable of switching the entire plant load from the preferred (normal) AEP source to the alternate (standby) source in the event of an unplanned power interruption.

This upgrade project also included the installation of a plant-wide, above ground, cable tray system to replace the existing underground duct and manhole system. At this time, only the 12.47 kV feeder circuits are installed in the tray system, but there is adequate space for installation of new low voltage power, control and instrument circuits to replace the underground circuits that still remain in service.

The Oso WRP currently has two (2) 500 kW diesel engine driven standby generators, one that serves ECR-LS2 and one that serves ECR-4. These generators are set up for manual start-stop. Switching between the normal utility source and the standby generators is by manual operation only. These generators do not have sufficient capacity to operate normal plant load, but are only sized to operate Lift Stations 1 and 2, one blower at ECR-4 and the chlorination facilities. When operating on generator power, the plant operators must disconnect or manually turn off non-essential loads at ECR-4 and ECR-LS2 to prevent the generators from overloading and tripping off line.

3.7.2 Electrical System Improvements

Electrical system improvements and additions will be required to support the new plant process facilities recommended in this report. AEP's two 12.47 kV feeder circuits that serve the Oso WRP are already heavily loaded and may require an upgrade to maintain fully redundant capability at the new power demand levels. The existing 12.47 kV switchgear and feeder

system has adequate capacity to supply the new load requirements. However, new ECR buildings will be required since the existing ECR's do not have adequate transformer capacity or MCC space to serve the proposed loads.

A new ECR-5 will be required on the north end of the plant to serve the new Lift Station No. 3, screening facilities and blowers. A new ECR-6 will be needed at the south end of the plant to provide power for MLR pumps and anoxic mixers. These ECR buildings will be climate controlled, prefabricated metal buildings similar to the existing ECR's with fully redundant transformers, switchgear and motor control centers.

Recommendations for standby power improvements include relocating the two existing 500 kW generator units to a centralized generation plant located near ECR-2/3 and providing four (4) additional 500 kW units for 3,000 kW total standby capacity. These generators would operate in parallel with automatic start/stop and load sharing controls and will provide adequate capacity to run the entire plant in the event of an extended failure of both normal utility sources. The generators will be connected to the main 12.47 kV switchgear system through a step-up transformer and automatic paralleling 480 volt switchgear.

3.7.3 Electrical Energy Savings and Conservation

Electrical costs represent a significant portion of the plant's operating cost. Reductions in electrical consumption will save money as well as reduce the plant's carbon footprint. Conversion to fine bubble aeration will provide significant energy savings. It is recommended that new pumps and blowers be equipped with premium efficiency motors to provide further savings. Improved control of the blowersthrough the proposed SCADA system will also reduce electrical costs. DO levels beyond 2 mg/L signals excess air is being fed to the process basins. This excess air is not harmful, but provides no benefit for its electrical cost.

3.8 INSTRUMENTATION AND CONTROLS

3.8.1 Existing SCADA System

The existing Oso WRP has limited instrumentation and controls. The existing SCADA system includes RTU's located in the three existing ECR's that transmit minimal plant status and alarm points to the City wide SCADA network. No operator control is provided through the existing system. Normal display and monitoring of these SCADA points is done only at the Greenwood WWTP and at the City Wastewater Dept. offices located on Civitan Dr. The Oso WRP plant operators do not have the ability to monitor or control the process from a central plant control room.

3.8.2 SCADA Improvements

It is recommended that the existing SCADA system be replaced with a new system that will provide full monitoring and supervisory control for the new plant facilities. Additionally, the existing process facilities will be integrated into the new SCADA equipment to the extent that I/O points are available to provide more extensive monitoring and control than the present system can provide. The new SCADA facilities will include a programmable logic controller (PLC) based RTU located in each new and existing ECR building with process I/O connections to MCC's, control panels and field instruments located in or near that ECR. These RTU's will communicate with a MTU (master terminal unit) located in the plant control room across a fiber optics or wireless Ethernet network. The new SCADA network will communicate to the existing City wide SCADA system through the existing 900 MHz radio link. The plant control room will be provided with a PC based, dual monitor operator work station.

3.9 BUFFER ZONE

TCEQ (§309.13.E.3)necessitates a 150 foot buffer zone as a compliance requirement to abate and control odor nuisances prior to construction of a new wastewater treatment plant unit. The rule requires the permittee to submit sufficient evidence of legal restrictions prohibiting residential structures within the 150 foot portion of the buffer zone not owned by the permittee. This evidence typically involves a suitable restrictive easement, right-of-way, covenant, deed restriction or a private agreement provided to TCEQ for their review.

The plant property is bound on the north, west, south, and southeast boundaries by TAMU-CC owned property. TAMU-CC is currently constructing a master planned athletic facility on the portion of land along the southern plant boundary. The master plan currently shows no improvements along the north, west and southeast property lines. The City has coordinated the proposed plant buffer zone with TAMU-CC since November 2011 and finalized the buffer zone agreement in January 2013. The buffer zone, as filed and recorded in the Official Public Records of Nueces County, offsets the existing property lines on the north, west, and southeast by 150 feet and offsets the southern property line by only 40 feet. This results in approximately 110 feet of the southern buffer zone being located on the plant property, meaning that no wastewater treatment unit is allowed to encroach within 110 feet of the plants southern property line. Refer to the executed and recorded buffer zone easement documents in Appendix C.

For this reason, the southern buffer zone and plant property lines have dictated the shape of the proposed aeration basins. Although unlikely, it is possible that TCEQ will adopt more stringent odor regulations (larger buffer zone requirements) in the future which may result in having to relocate or modify the footprints of the proposed aeration basins.

In addition, TAMU-CC has requested permission to construct a 13 foot high berm on the City's property within the proposed southern buffer zone which will serve as a visual barrier between the athletic facilities and the plant. This berm will be outside of the plants fence and will be maintained by TAMU-CC. Refer to Exhibit F inAppendix A for the berm layout.

4.0 PROJECT IMPLEMENTATION

Upgrading the Oso WRP for biological nutrient removal is a significant part of the City's Capital Improvement Plan. This section summarizes the process upgrades detailed in the previous section and presents estimates of construction costs.

4.1 RECOMMENDED PLAN

The following upgrades are recommended and in most cases, are presented in the order of construction. All proposed improvements are shown on Exhibit E in Appendix A.

4.1.1 Lift Station No. 4

The proposed 80-90 MGD lift station facility will provide reliable pumping capacity and will allow plant personnel flexibility in isolating the influent lift stations for maintenance purposes. In addition, it will allow the City remove the temporary emergency pumps currently on site. The facility will have an approximate footprint of 40' by 75' and will include the following:

- Bio-filter odor control facility or upgrades to existing system
- Wet well with eight (8) submersible pumps
- Lift Station Building
- Flow Meter

4.1.2 Headworks

Theproposed headworks must be constructed to reduce grit build-up in the aeration basins and will have an approximate footprint of 50' by 80'. The new facility will include the following:

- Four (4) bar screens andassociated washers/compactors
- Four (4) vortex grit chambers
- Grit pumps and classifiers
- Bio-filter odor control facilityor upgrades to existing system

4.1.3 Process Train No. 3 Aeration Basin

A third aeration basin will be constructed adjacent to one of the existing trains. This two pass basin will be located south of the east process train and will have a footprint of approximately 300' by 100'. The following will be included:

- 36" diameter influent piping to deliver screened/degritted sewage
- Splitter structure to divide flows equally between operating aeration basins
- 18" RAS piping to deliver RAS from the clarifiers to the head of the new basin
- Mixed liquor return pump and piping
- Fine bubble aeration diffusers and piping
- Process air piping
- Isolation Structures on RAS channel and clarifier influent

4.1.4 Existing Aeration Basin Retrofits

The existing aeration basins will be converted to 6 MGD trains for biological nutrient removal.This work would be performed one train at a time and includes the following:

- Extend the influent piping to the head of the re-configured basins
- Extend the RAS channel to deliver RAS where the influent enters the basins
- Demolishing the wall between the first two RAS re-aeration basins
- Installation of new walls and baffles to form anoxic zones
- Anoxic mixers
- Mixed liquor return pumps and piping
- Replace existing course bubble system with fine bubble piping/diffusers

4.1.5 Process Train No. 4 Aeration Basin

The fourth aeration basinwill provide a total plant capacity of 24 MGD (firm treatment capacity of 18 MGD). This two pass basin will be located south of the west train with a footprint of approximately 210' by 140' and will include the same features as the Process Train No. 3 aeration basins. Some quantities will differ based on theparticular location and routing of pipes.

4.1.6 Disinfection

Although major modifications to the disinfection system are currently under construction as a part of the Phase 1 improvements, further study will be performed during the preliminary design phase to determine whether the hypochlorite feed system should be modified and whether the existing chlorine contact chambers would benefit from the installation of baffles or the construction of new rectangular basins to prevent short circuiting. The existing chlorine contact chambers are converted circular clarifiers which are less reliable in providing a uniform contact time (i.e. flow pattern)thru the basin and can result in short circuiting.

4.2 RECOMMENDED PLAN COSTS

A preliminary cost estimate was developed to provide budgetary numbers for capital planning. Cost estimate accuracy is within 30% of the actual costs. The costs shown below include a 25% construction contingency, 22.8% administrative allowance, and are in 2013 dollars. The construction costs should be escalated approximately 3% per year to the midpoint of construction to account for inflation. The detailed cost estimates are included in Appendix B for more information.

Table 4-1Phase 2 Cost Estimate Summary

Item	Construction Cost ($)	Project Cost ($)
East Plant Retrofit	$5,585,000	$6,865,000
West Plant Retrofit	$5,585,000	$6,865,000
New East Process Train No. 3	$11,245,000	$13,815,000
New West Process Train No. 4	$10,545,000	$12,955,000
Influent Pump Station	$9,910,000	$12,180,000
Headworks	$9,734,000	$11,964,000
Maintenance Building	$1,158,000	$1,428,000
Disinfection System Modifications & Chlorine Contact Basin Mech Equip Replacement	$1,300,000	$1,560,000
Digester No. 2,3 & 4 Mech Equip Replacement	$975,000	$1,185,000
LMWWTP Decommissioning & Transfer	$24,932,000	$30,622,000
Total	**$80,969,000**	**$99,439,000**

4.3 PHASING OF CAPITAL IMPROVEMENTS

The improvements detailed in this masterplan are intended to be constructed in two phases (2A and 2B). However, if it is more economically feasible, the work may be completed inup to three phases as shown below.

Item	Phase 2A (Part 1)	Phase 2A (Part 2)	Phase 2B
Lift Station No. 4	Optional	Optional	X
Headworks	X		
Train No. 3 Aeration Basins	X		
Flow Splitter Structure	X		
Retrofit Existing East Train		X	
Retrofit Existing West Train		X	
New Blowers			X
Train No. 4 Aeration Basins			X

Phase 2A (Parts 1 and 2) will include the headworks, splitter structure, Train No. 3 aeration basins and the retrofit of the existing east and west trains. Although included in Phase 2A, the upgrades to the existing process trains must not be constructed until after the headworks and new process train No.3 are in operation. AllPhase 2A facilities will include I&C and SCADAupgrades with provisions for connectingto thePhase 2Bfacilities in the near future. Lift Station 4 should be constructed as soon as possible as it will provide reliable pumping capacity and will eliminate the need for the temporary Godwin pumps that have been installed for several years. However, it is not absolutely necessary until Phase 2B improvements. Phase 2B willalso include the Blower House No.3 upgrades to accommodate the fourth process train.

Appendix A

EXHIBITS

OSO WRP AERIAL

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801 NAVIGATION, SUITE 300
CORPUS CHRISTI, TEXAS 78408
TBPE FIRM NO. F-366
PH. (361) 883-1984
FAX (361) 883-1986
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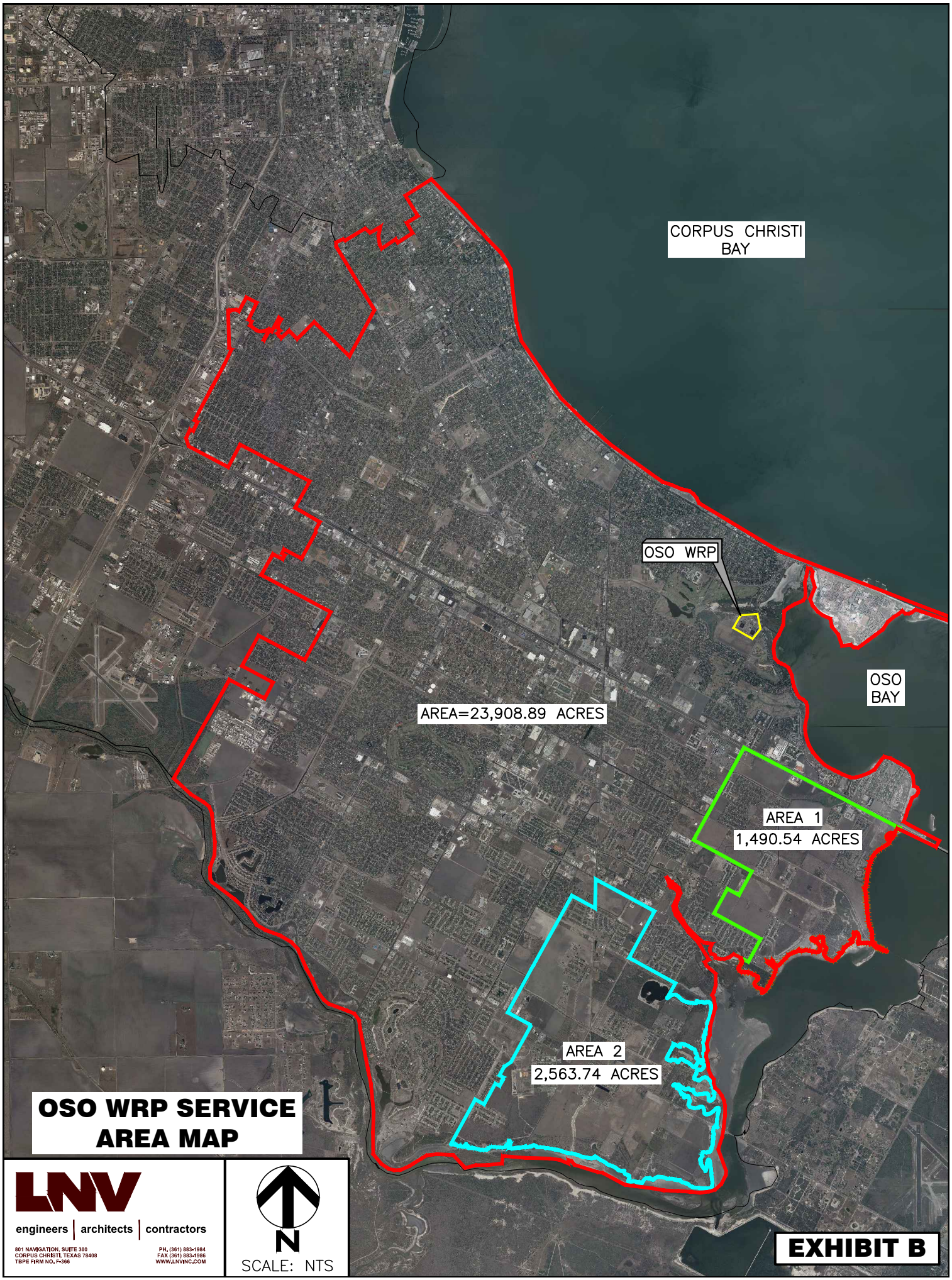
N

SCALE: NTS

EXHIBIT A



OSO WRP SERVICE AREA MAP

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SCALE: NTS

EXHIBIT B

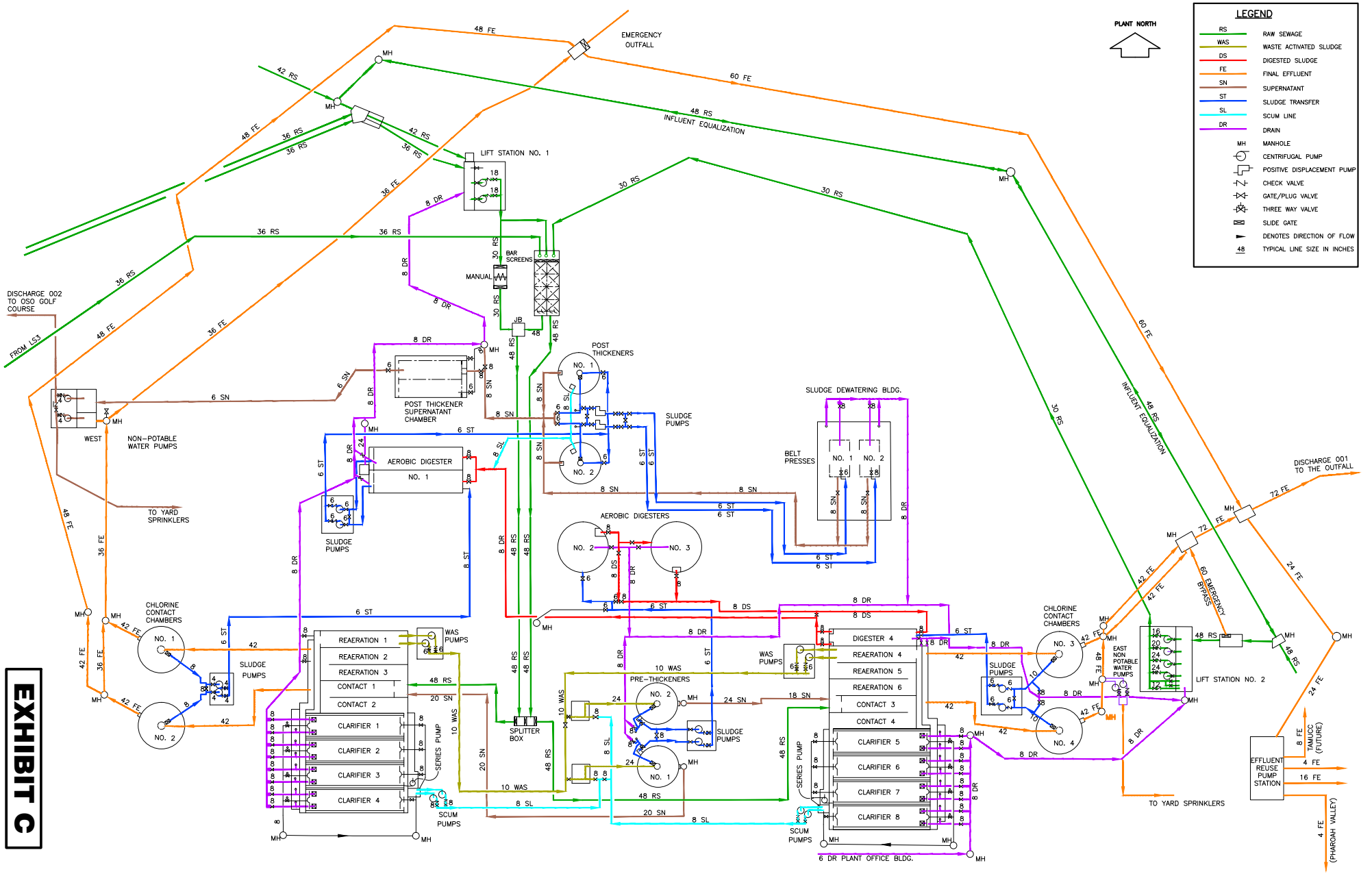

EXHIBIT C

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SCALE: NTS

EXISTING OSO WRP FLOW SCHEMATIC

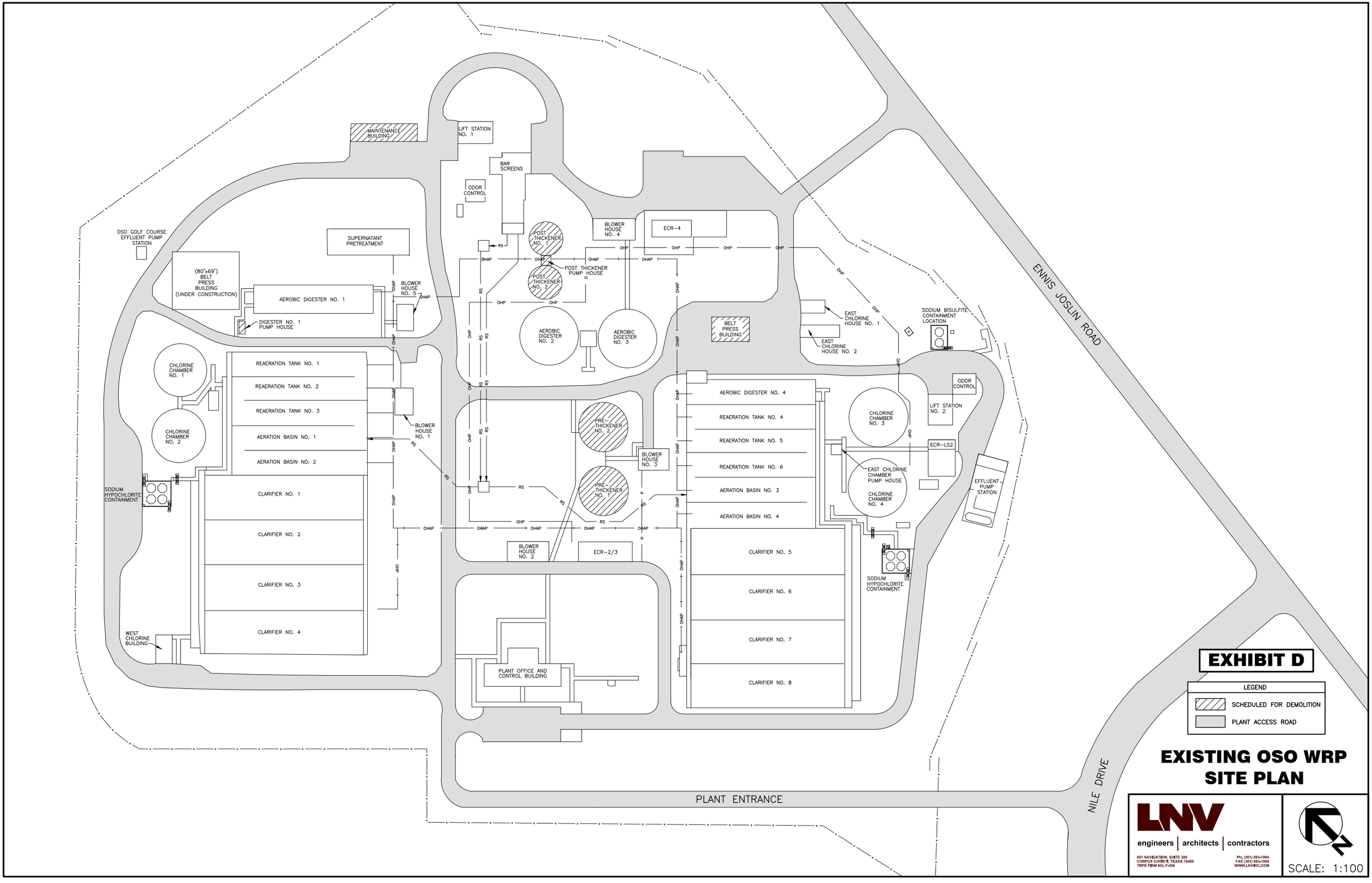

EXHIBIT D

LEGEND

- SCHEDULED FOR DEMOLITION
- PLANT ACCESS ROAD

EXISTING OSO WRP SITE PLAN

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SCALE: 1:100

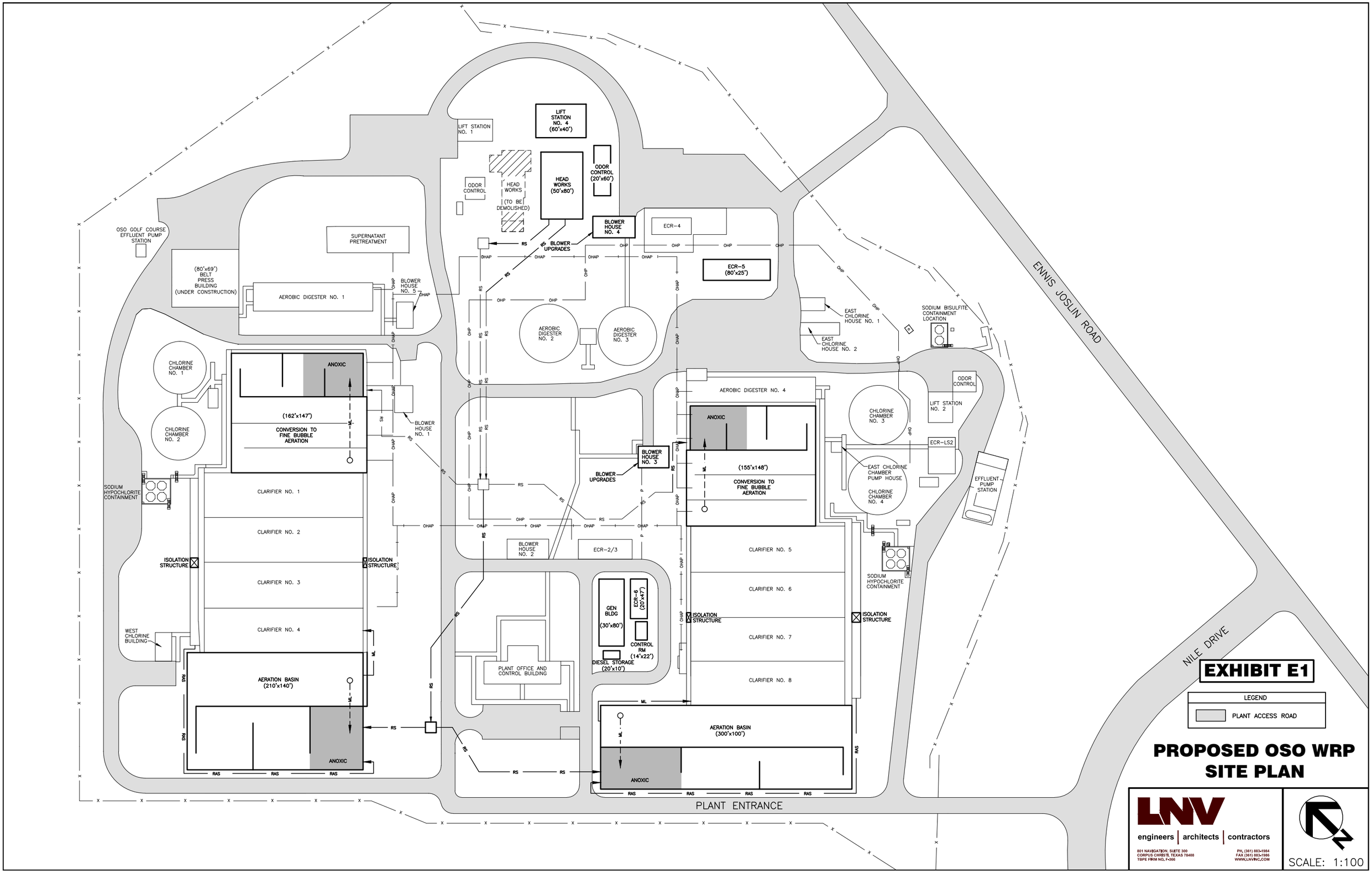

EXHIBIT E1

LEGEND

PLANT ACCESS ROAD

PROPOSED OSO WRP SITE PLAN

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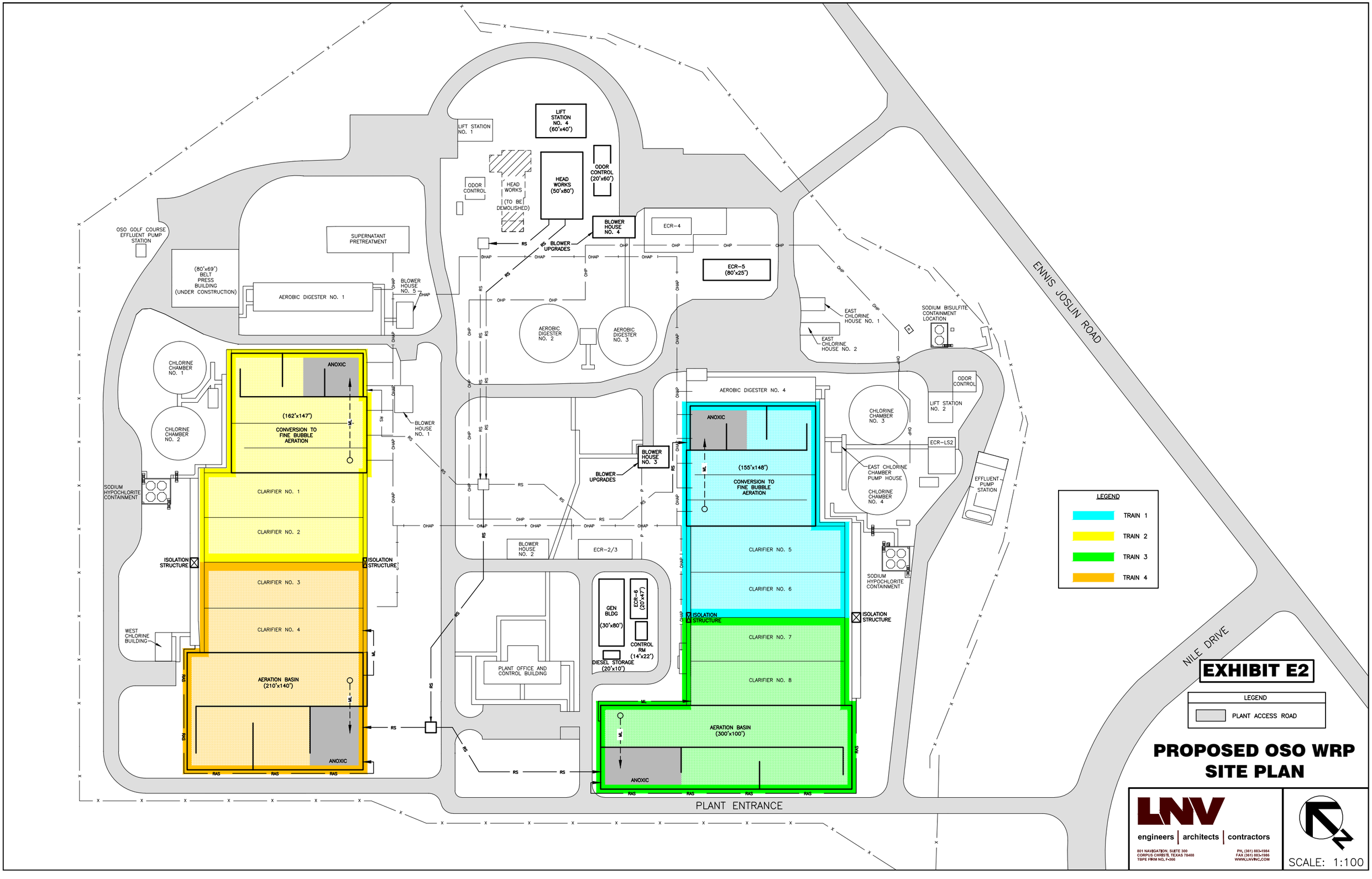
SCALE: 1:100


LIFT STATION NO. 1
LIFT STATION NO. 4 (60'x40')
HEAD WORKS (50'x80')
ODOR CONTROL (20'x60')
ODOR CONTROL
HEAD WORKS (TO BE DEMOLISHED)
OSO GOLF COURSE EFFLUENT PUMP STATION
SUPERNATANT PRETREATMENT
BLOWER HOUSE NO. 4
ECR-4
BLOWER UPGRADES
ECR-5 (80'x25')
(80'x69') BELT PRESS BUILDING (UNDER CONSTRUCTION)
AEROBIC DIGESTER NO. 1
BLOWER HOUSE NO. 5
AEROBIC DIGESTER NO. 2
AEROBIC DIGESTER NO. 3
EAST CHLORINE HOUSE NO. 1
EAST CHLORINE HOUSE NO. 2
SODIUM BISULFITE CONTAINMENT LOCATION
ENNIS JOSLIN ROAD
CHLORINE CHAMBER NO. 1
ANOXIC
(162'x147')
CONVERSION TO FINE BUBBLE AERATION
CHLORINE CHAMBER NO. 2
BLOWER HOUSE NO. 1
AEROBIC DIGESTER NO. 4
ODOR CONTROL
LIFT STATION NO. 2
CHLORINE CHAMBER NO. 3
ANOXIC
(155'x148')
CONVERSION TO FINE BUBBLE AERATION
ECR-LS2
BLOWER HOUSE NO. 3
BLOWER UPGRADES
EAST CHLORINE CHAMBER PUMP HOUSE
CHLORINE CHAMBER NO. 4
EFFLUENT PUMP STATION
SODIUM HYPOCHLORITE CONTAINMENT
CLARIFIER NO. 1
CLARIFIER NO. 2
CLARIFIER NO. 5
CLARIFIER NO. 6
ISOLATION STRUCTURE
ISOLATION STRUCTURE
ISOLATION STRUCTURE
CLARIFIER NO. 3
CLARIFIER NO. 4
CLARIFIER NO. 7
CLARIFIER NO. 8
WEST CHLORINE BUILDING
AERATION BASIN (210'x140')
ANOXIC
BLOWER HOUSE NO. 2
ECR-2/3
GEN BLDG (30'x80')
ECR-6 (20'x47')
CONTROL RM (14'x22')
DIESEL STORAGE (20'x10')
PLANT OFFICE AND CONTROL BUILDING
AERATION BASIN (300'x100')
ANOXIC
NILE DRIVE
PLANT ENTRANCE
LEGEND
TRAIN 1
TRAIN 2
TRAIN 3
TRAIN 4
EXHIBIT E2
LEGEND
PLANT ACCESS ROAD
PROPOSED OSO WRP SITE PLAN
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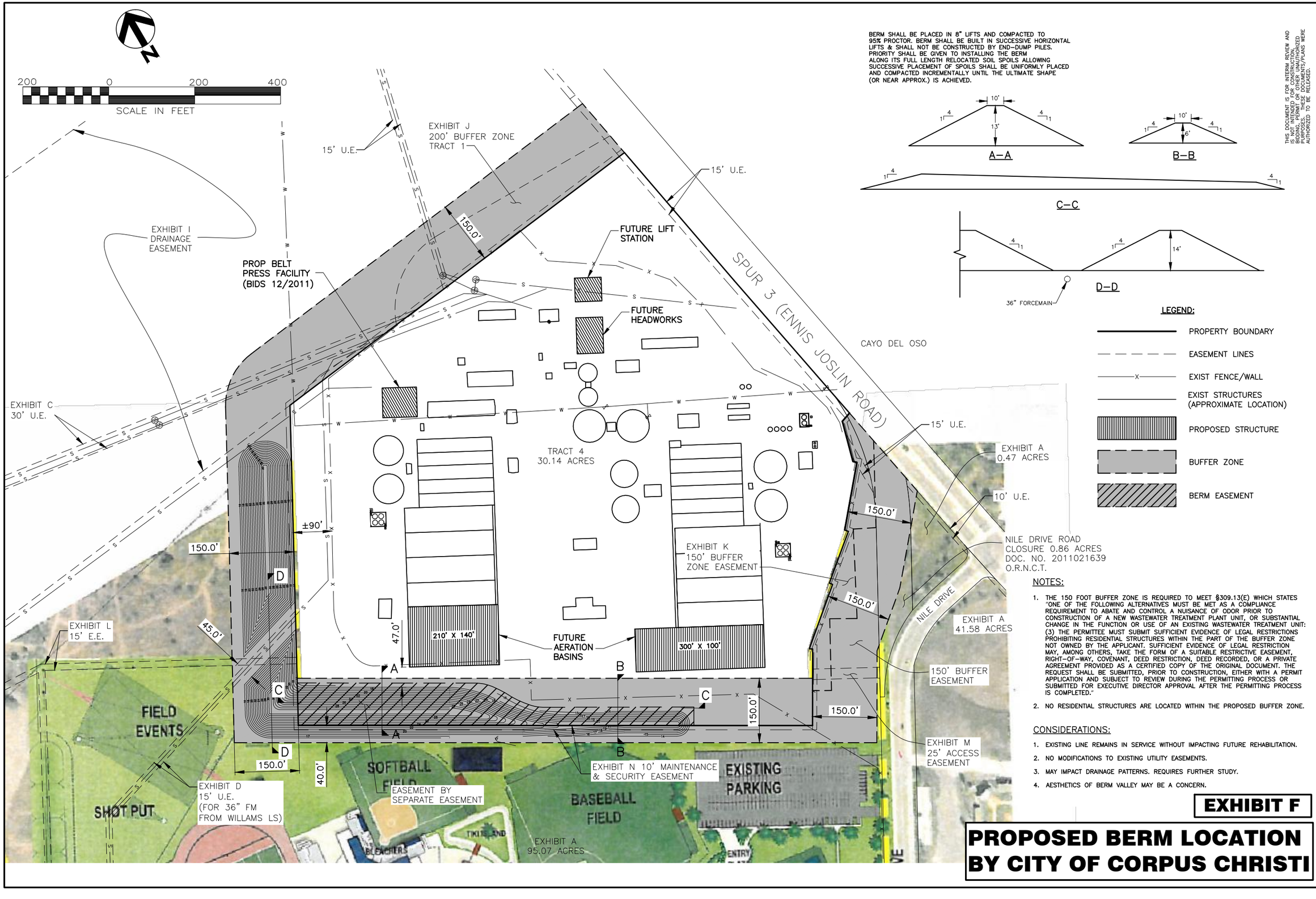

BERM SHALL BE PLACED IN 8" LIFTS AND COMPACTED TO 95% PROCTOR. BERM SHALL BE BUILT IN SUCCESSIVE HORIZONTAL LIFTS & SHALL NOT BE CONSTRUCTED BY END-DUMP PILES. PRIORITY SHALL BE GIVEN TO INSTALLING THE BERM ALONG ITS FULL LENGTH RELOCATED SOIL SPOILS ALLOWNG SUCCESSIVE PLACEMENT OF SPOILS SHALL BE UNIFORMLY PLACED AND COMPACTED INCREMENTALLY UNTIL THE ULTIMATE SHAPE (OR NEAR APPROX.) IS ACHIEVED.

LEGEND:

- PROPERTY BOUNDARY
- EASEMENT LINES
- EXIST FENCE/WALL
- EXIST STRUCTURES (APPROXIMATE LOCATION)
- PROPOSED STRUCTURE
- BUFFER ZONE
- BERM EASEMENT

NOTES:

1. THE 150 FOOT BUFFER ZONE IS REQUIRED TO MEET §309.13(E) WHICH STATES "ONE OF THE FOLLOWING ALTERNATIVES MUST BE MET AS A COMPLIANCE REQUIREMENT TO ABATE AND CONTROL A NUISANCE OF ODOR PRIOR TO CONSTRUCTION OF A NEW WASTEWATER TREATMENT PLANT UNIT, OR SUBSTANTIAL CHANGE IN THE FUNCTION OR USE OF AN EXISTING WASTEWATER TREATMENT UNIT: (3) THE PERMITTEE MUST SUBMIT SUFFICIENT EVIDENCE OF LEGAL RESTRICTIONS PROHIBITING RESIDENTIAL STRUCTURES WITHIN THE PART OF THE BUFFER ZONE NOT OWNED BY THE APPLICANT. SUFFICIENT EVIDENCE OF LEGAL RESTRICTION MAY, AMONG OTHERS, TAKE THE FORM OF A SUITABLE RESTRICTIVE EASEMENT, RIGHT-OF-WAY, COVENANT, DEED RESTRICTION, DEED RECORDED, OR A PRIVATE AGREEMENT PROVIDED AS A CERTIFIED COPY OF THE ORIGINAL DOCUMENT. THE REQUEST SHALL BE SUBMITTED, PRIOR TO CONSTRUCTION, EITHER WITH A PERMIT APPLICATION AND SUBJECT TO REVIEW DURING THE PERMITTING PROCESS OR SUBMITTED FOR EXECUTIVE DIRECTOR APPROVAL AFTER THE PERMITTING PROCESS IS COMPLETED."
2. NO RESIDENTIAL STRUCTURES ARE LOCATED WITHIN THE PROPOSED BUFFER ZONE.

CONSIDERATIONS:

1. EXISTING LINE REMAINS IN SERVICE WITHOUT IMPACTING FUTURE REHABILITATION.
2. NO MODIFICATIONS TO EXISTING UTILITY EASEMENTS.
3. MAY IMPACT DRAINAGE PATTERNS. REQUIRES FURTHER STUDY.
4. AESTHETICS OF BERM VALLEY MAY BE A CONCERN.

EXHIBIT F

PROPOSED BERM LOCATION BY CITY OF CORPUS CHRISTI

BY: WILLIAM LOGAN BURTON P.E.
LICENSE NO.: 99383 DATE: 1/11/13

NO.	DESCRIPTION	DATE	BY
	*** REVISION BLOCK ***		

DRAWN BY: ORB
CHECKED BY: LB
APPROVED BY: LB
SCALE: SHOWN
SEPTEMBER 2012

CORPUS CHRISTI, TX
OSO WATER RECLAMATION PLANT NUTRIENT REMOVAL

BUFFER ZONE & BERM EXHIBIT

LNV engineers | architects | contractors
801 NAVIGATION, SUITE 300
CORPUS CHRISTI, TEXAS 78408
(361) 883-1984
PH: (361) 883-1984
FAX: (361) 883-1988
WWW.LNVINC.COM

JOB NO: 100140.00
TAB NO.
SHEET NO: 1 OF 1

Appendix B

COST ESTIMATES

LNV engineers | architects | contractors

In association with:
Jacobs Engineering Group
Joshua Brown, P.E.

DATE: March 20, 2013
BY: JB & LB & JH

PROJECT: Oso WRP Nutrient Removal Project (Ammonia) - Phase 2 Improvements
PROJECT NO: E09007

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST

Item	Description	Qty	Unit	Unit Price	Total Price
1	East Plant Retrofit	1	LS	$ 5,585,000	$ 5,585,000
2	West Plant Retrofit	1	LS	$ 5,585,000	$ 5,585,000
3	New East Process Train No. 3	1	LS	$ 11,245,000	$ 11,245,000
4	New West Process Train No. 4	1	LS	$ 10,545,000	$ 10,545,000
5	Influent Pump Station	1	LS	$ 9,910,000	$ 9,910,000
6	Headworks	1	LS	$ 9,734,000	$ 9,734,000
7	Maintenance Building	1	LS	$ 1,158,000	$ 1,158,000
8	Disinfection System Modifications & Chlorine Contact Basin Mech Equip. Replacement	4	EA	$ 325,000	$ 1,300,000
9	Digester No 2,3 & 4 Mech Equip Replacement	3	EA	$ 325,000	$ 975,000
10	LMWWTP Decommissioning & Transfers	1	LS	$ 24,932,000	$ 24,932,000
				SUB TOTAL	**$ 80,969,000**
				CONSTRUCTION SUB TOTAL (2013 $)	**$ 80,969,000**
	DESIGN - BASIC SERVICE (8.0%)				$ 6,478,000
	ENGINEERING - ADDITIONAL SERVICES (2.0%)				$ 1,620,000
	TOPOGRAPHIC SURVEY (0.3%)				$ 243,000
	CONTRACT ADMINISTRATION (3.0%)				$ 2,430,000
	ENGINEERING SERVICES (3.5%)				$ 2,834,000
	CONSTRUCTION INSPECTION (3.5%)				$ 2,834,000
	TESTING (1.0%)				$ 810,000
	BOND INSURANCE (1.0%)				$ 810,000
	MISC. (PRINTING, ETC) (0.5%)				$ 405,000
				ADMINISTRATIVE SUB TOTAL	**$ 18,470,000**
				PROJECT TOTAL (2013 $)	**$ 99,439,000**

CONSTRUCTION TOTAL (2016 $)[Note 1] **$88,478,000**

PROJECT TOTAL (2016 $)[Note 1] **$106,948,000**

NOTES:

1. Preliminary construction prices are based on recent and historical data on local projects in Corpus Christi and costs should be escalated 3% per yr to the midpoint of construction in 2013 dollars.
2. Items not included in the estimate are any structures or equipment identified during the condition assessment as requiring upgrades, rehabilitation, or replacement including but not limited to the outfall facilities, administration building, belt press building, digesters, clarifiers and/or yard piping.

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In association with:
Jacobs Engineering Group
Joshua Brown, P.E.

DATE: March 20, 2013
BY: JB & LB & JH

PROJECT: Oso WRP Nutrient Removal Project (Ammonia) - Phase 2 Improvements
PROJECT NO: E09007
DESCRIPTION: East Plant Aeration Basin Retrofit

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST

Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization	1	LS	$ 210,000	$ 210,000
2	Sludge removal & disposal	1	LS	$ 250,000	$ 250,000
3	Utilty relocation (RS piping)	1	LS	$ 160,000	$ 160,000
4	Demolition (160' baffle wall)	1	LS	$ 100,000	$ 100,000
5	New baffle walls	1	LS	$ 250,000	$ 250,000
6	Yard piping modifications	1	LS	$ 500,000	$ 500,000
7	Mixers, MLR pump & pipe, WAS pump & pipe	1	LS	$ 750,000	$ 750,000
8	New fine bubble diffusers	1	LS	$ 525,000	$ 525,000
9	Upgrades to air piping (automated valves)	1	LS	$ 450,000	$ 450,000
10	Walkway retrofit due to new air pipe	1	LS	$ 250,000	$ 250,000
11	Electrical and Instrumentation	1	LS	$ 850,000	$ 850,000
				SUB TOTAL	**$ 4,295,000**
				CONTINGENCIES (30%)	**$ 1,290,000**
				CONSTRUCTION SUB TOTAL (2013 $)	**$ 5,585,000**
	DESIGN - BASIC SERVICE (8.0%)				$ 447,000
	ENGINEERING - ADDITIONAL SERVICES (2.0%)				$ 112,000
	TOPOGRAPHIC SURVEY (0.3%)				$ 17,000
	CONTRACT ADMINISTRATION (3.0%)				$ 168,000
	ENGINEERING SERVICES (3.5%)				$ 196,000
	CONSTRUCTION INSPECTION (3.5%)				$ 196,000
	TESTING (1.0%)				$ 56,000
	BOND INSURANCE (1.0%)				$ 56,000
	MISC. (PRINTING, ETC) (0.5%)				$ 28,000
				ADMINISTRATIVE SUB TOTAL	**$ 1,280,000**
				PROJECT TOTAL (2013 $)	**$ 6,865,000**

NOTES:

1. Preliminary construction prices are based on recent and historical data on local projects in Corpus Christi and costs should be escalated 3% per yr to the midpoint of construction in 2013 dollars.

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In association with:
Jacobs Engineering Group
Joshua Brown, P.E.

DATE: March 20, 2013
BY: JB & LB & JH

PROJECT: Oso WRP Nutrient Removal Project (Ammonia) - Phase 2 Improvements
PROJECT NO: E09007
DESCRIPTION: West Plant Aeration Basin Retrofit

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST

Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization	1	LS	$ 210,000	$ 210,000
2	Sludge removal & disposal	1	LS	$ 250,000	$ 250,000
3	Utilty relocation (RS piping)	1	LS	$ 160,000	$ 160,000
4	Demolition (160' baffle wall)	1	LS	$ 100,000	$ 100,000
5	New baffle walls	1	LS	$ 250,000	$ 250,000
6	Yard piping modifications	1	LS	$ 500,000	$ 500,000
7	Mixers, MLR pump & pipe, WAS pump & pipe	1	LS	$ 750,000	$ 750,000
8	New fine bubble diffusers	1	LS	$ 525,000	$ 525,000
9	Upgrades to air piping (automated valves)	1	LS	$ 450,000	$ 450,000
10	Walkway retrofit due to new air pipe	1	LS	$ 250,000	$ 250,000
11	Electrical and Instrumentation	1	LS	$ 850,000	$ 850,000
				SUB TOTAL	**$ 4,295,000**
				CONTINGENCIES (30%)	**$ 1,290,000**
				CONSTRUCTION SUB TOTAL (2013 $)	**$ 5,585,000**
	DESIGN - BASIC SERVICE (8.0%)				$ 447,000
	ENGINEERING - ADDITIONAL SERVICES (2.0%)				$ 112,000
	TOPOGRAPHIC SURVEY (0.3%)				$ 17,000
	CONTRACT ADMINISTRATION (3.0%)				$ 168,000
	ENGINEERING SERVICES (3.5%)				$ 196,000
	CONSTRUCTION INSPECTION (3.5%)				$ 196,000
	TESTING (1.0%)				$ 56,000
	BOND INSURANCE (1.0%)				$ 56,000
	MISC. (PRINTING, ETC) (0.5%)				$ 28,000
				ADMINISTRATIVE SUB TOTAL	**$ 1,280,000**
				PROJECT TOTAL (2013 $)	**$ 6,865,000**

NOTES:

1. Preliminary construction prices are based on recent and historical data on local projects in Corpus Christi and costs should be escalated 3% per yr to the midpoint of construction in 2013 dollars.

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In association with:
Jacobs Engineering Group
Joshua Brown, P.E.

DATE: March 20, 2013
BY: WLB & BHE & JH

PROJECT: Oso WRP Nutrient Removal Project (Ammonia) - Phase 2 Improvements
PROJECT NO: E09007
DESCRIPTION: Proposed East Aeration Basin (Train 3)

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST

Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization	1	LS	$ 420,000	$ 420,000
2	Utility relocation	1	LS	$ 200,000	$ 200,000
3	New splitter box with gates	1	LS	$ 350,000	$ 350,000
4	Isolation Structures (Clarifier & RAS)	2	EA	$ 100,000	$ 200,000
5	Excavation/ fill/ disposal	20000	CY	$ 30	$ 600,000
6	Dewatering	1	LS	$ 250,000	$ 250,000
7	New aeration basin concrete structure	1	LS	$ 1,600,000	$ 1,600,000
8	Yard & Air piping modifications	1	LS	$ 1,100,000	$ 1,100,000
9	Mixers, MLR pump, WAS pump	1	LS	$ 700,000	$ 700,000
10	Diffusers	1	LS	$ 525,000	$ 525,000
11	Air piping (automated valves)	1	LS	$ 450,000	$ 450,000
12	Blower Upgrades & Replacement	1	LS	$ 750,000	$ 750,000
13	Walkways, Safety Rails	1	LS	$ 250,000	$ 250,000
14	Electrical and Instrumentation	1	LS	$ 1,250,000	$ 1,250,000
				SUB TOTAL	**$ 8,645,000**
				CONTINGENCIES (30%)	**$ 2,600,000**
				CONSTRUCTION SUB TOTAL (2013 $)	**$ 11,245,000**
	DESIGN - BASIC SERVICE (8.0%)				$ 900,000
	ENGINEERING - ADDITIONAL SERVICES (2.0%)				$ 225,000
	TOPOGRAPHIC SURVEY (0.3%)				$ 34,000
	CONTRACT ADMINISTRATION (3.0%)				$ 338,000
	ENGINEERING SERVICES (3.5%)				$ 394,000
	CONSTRUCTION INSPECTION (3.5%)				$ 394,000
	TESTING (1.0%)				$ 113,000
	BOND INSURANCE (1.0%)				$ 113,000
	MISC. (PRINTING, ETC) (0.5%)				$ 57,000
				ADMINISTRATIVE SUB TOTAL	**$ 2,570,000**
				PROJECT TOTAL (2013 $)	**$ 13,815,000**

NOTES:

1. Preliminary construction prices are based on recent and historical data on local projects in Corpus Christi and costs should be escalated 3% per yr to the midpoint of construction in 2013 dollars.

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In association with:
Jacobs Engineering Group
Joshua Brown, P.E.

DATE: March 20, 2013
BY: WLB & BHE & JH

PROJECT: Oso WRP Nutrient Removal Project (Ammonia) - Phase 2 Improvements
PROJECT NO: E09007
DESCRIPTION: Proposed West Aeration Basin (Train 4)

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST

Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization	1	LS	$ 330,000	$ 330,000
2	Utility relocation	1	LS	$ 200,000	$ 200,000
3	Isolation Structures (Clarifier & RAS)	2	EA	$ 100,000	$ 200,000
4	Excavation/ fill /disposal	20000	CY	$ 30	$ 600,000
5	Dewatering	1	LS	$ 250,000	$ 250,000
6	New aeration basin concrete structure	1	LS	$ 1,600,000	$ 1,600,000
7	Yard & Air piping modifications	1	LS	$ 900,000	$ 900,000
8	Mixers, MLR pump, WAS pump	1	LS	$ 700,000	$ 700,000
9	Diffusers	1	LS	$ 525,000	$ 525,000
10	Air piping (automated valves)	1	LS	$ 450,000	$ 450,000
11	Blower Upgrades & Replacement	1	LS	$ 750,000	$ 750,000
12	Walkways & Safety Rails	1	LS	$ 250,000	$ 250,000
14	Electrical and Instrumentation	1	LS	$ 1,350,000	$ 1,350,000
				SUB TOTAL	**$ 8,105,000**
				CONTINGENCIES (30%)	**$ 2,440,000**
				CONSTRUCTION SUB TOTAL (2013 $)	**$ 10,545,000**
	DESIGN - BASIC SERVICE (8.0%)				$ 844,000
	ENGINEERING - ADDITIONAL SERVICES (2.0%)				$ 211,000
	TOPOGRAPHIC SURVEY (0.3%)				$ 32,000
	CONTRACT ADMINISTRATION (3.0%)				$ 317,000
	ENGINEERING SERVICES (3.5%)				$ 370,000
	CONSTRUCTION INSPECTION (3.5%)				$ 370,000
	TESTING (1.0%)				$ 106,000
	BOND INSURANCE (1.0%)				$ 106,000
	MISC. (PRINTING, ETC) (0.5%)				$ 53,000
				ADMINISTRATIVE SUB TOTAL	**$ 2,410,000**
				PROJECT TOTAL (2013 $)	**$ 12,955,000**

NOTES:

1. Preliminary construction prices are based on recent and historical data on local projects in Corpus Christi and costs should be escalated 3% per yr to the midpoint of construction in 2013 dollars.

LNV
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In association with:
Jacobs Engineering Group
Joshua Brown, P.E.

DATE: March 20, 2013
BY: WLB & BHE & JH

PROJECT: Oso WRP Nutrient Removal Project (Ammonia) - Phase 2 Improvements
PROJECT NO: E09007
DESCRIPTION: Proposed Influent Lift Station

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST

Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization	1	LS	$ 370,000	$ 370,000
2	Utility Relocation Allowance	1	LS	$ 300,000	$ 300,000
3	Excavation	1	LS	$ 500,000	$ 500,000
4	Dewatering	1	LS	$ 150,000	$ 150,000
5	New 60" Inlet Piping	500	LF	$ 1,000	$ 500,000
6	Lift Station Dual Wet Well	1	LS	$ 750,000	$ 750,000
7	Submersible Influent Pumps	8	EA	$ 150,000	$ 1,200,000
8	Lift Station Building	1500	SF	$ 300	$ 450,000
9	Yard piping & Fittings	1	LS	$ 500,000	$ 500,000
10	Flow Metering	1	EA	$ 200,000	$ 200,000
11	Pump Hoist & Lifting System	1	LS	$ 150,000	$ 150,000
12	Demolition & Decommissioning of LS1 & LS2	1	LS	$ 150,000	$ 150,000
13	Electrical, Instrumentation & Programming	1	LS	$ 2,400,000	$ 2,400,000
				SUB TOTAL	**$ 7,620,000**
				CONTINGENCIES (30%)	**$ 2,290,000**
				CONSTRUCTION SUB TOTAL (2013 $)	**$ 9,910,000**

	DESIGN - BASIC SERVICE (8.0%)	$ 793,000
	ENGINEERING - ADDITIONAL SERVICES (2.0%)	$ 199,000
	TOPOGRAPHIC SURVEY (0.3%)	$ 30,000
	CONTRACT ADMINISTRATION (3.0%)	$ 298,000
	ENGINEERING SERVICES (3.5%)	$ 347,000
	CONSTRUCTION INSPECTION (3.5%)	$ 347,000
	TESTING (1.0%)	$ 100,000
	BOND INSURANCE (1.0%)	$ 100,000
	MISC. (PRINTING, ETC) (0.5%)	$ 50,000
	ADMINISTRATIVE SUB TOTAL	**$ 2,270,000**
	PROJECT TOTAL (2013 $)	**$ 12,180,000**

NOTES:

1. Preliminary construction prices are based on recent and historical data on local projects in Corpus Christi and costs should be escalated 3% per yr to the midpoint of construction in 2013 dollars.

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In association with:
Jacobs Engineering Group
Joshua Brown, P.E.

DATE: March 20, 2013
BY: WLB & BHE & JH

PROJECT: Oso WRP Nutrient Removal Project (Ammonia) - Phase 2 Improvements
PROJECT NO: E09007
DESCRIPTION: Proposed Headworks Structure

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST

Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization	1	LS	$ 360,000	$ 360,000
2	Sludge removal and disposal	1	LS	$ 150,000	$ 150,000
3	Demolition (Removal of buried post thickeners and Existing Headworks facility)	1	LS	$ 350,000	$ 350,000
4	Pier Foundation - (54) 36" dia piers @ 50' Depth)	2700	VF	$ 120	$ 324,000
5	Utility Relocation	1	LS	$ 100,000	$ 100,000
6	Excavation	1	LS	$ 50,000	$ 50,000
7	Modifications to Existing Lift Station Force Mains	500	LF	$ 500	$ 250,000
8	Bar Screen Channel Concrete Structure	1	LS	$ 500,000	$ 500,000
9	Grit Basin Concrete Structure	1	LS	$ 750,000	$ 750,000
10	Bar screens, Compactors, Gates	1	LS	$ 1,500,000	$ 1,500,000
11	Vortex Grit Equipment	4	EA	$ 400,000	$ 1,600,000
12	Miscellaneous Piping	1	LS	$ 300,000	$ 300,000
13	Electrical and Instrumentation	1	LS	$ 500,000	$ 500,000
14	Odor Control Facility Improvements	1	LS	$ 750,000	$ 750,000
				SUB TOTAL	**$ 7,484,000**
				CONTINGENCIES (30%)	**$ 2,250,000**
				CONSTRUCTION SUB TOTAL (2013 $)	**$ 9,734,000**

	DESIGN - BASIC SERVICE (8.0%)	$ 779,000
	ENGINEERING - ADDITIONAL SERVICES (2.0%)	$ 195,000
	TOPOGRAPHIC SURVEY (0.3%)	$ 30,000
	CONTRACT ADMINISTRATION (3.0%)	$ 293,000
	ENGINEERING SERVICES (3.5%)	$ 341,000
	CONSTRUCTION INSPECTION (3.5%)	$ 341,000
	TESTING (1.0%)	$ 98,000
	BOND INSURANCE (1.0%)	$ 98,000
	MISC. (PRINTING, ETC) (0.5%)	$ 49,000
	ADMINISTRATIVE SUB TOTAL	**$ 2,230,000**
	PROJECT TOTAL (2013 $)	**$ 11,964,000**

NOTES:

1. Preliminary construction prices are based on recent and historical data on local projects in Corpus Christi and costs should be escalated 3% per yr to the midpoint of construction in 2013 dollars.

LNV
engineers | architects | contractors

In association with:
Jacobs Engineering Group
Joshua Brown, P.E.

DATE: March 20, 2013
BY: WLB & BHE & JH

PROJECT: Oso WRP Nutrient Removal Project (Ammonia) - Phase 2 Improvements
PROJECT NO: E09007
DESCRIPTION: Maintenance Building

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST

Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization	1	LS	$ 43,000	$ 43,000
2	Site Clearing & Preparation	1	LS	$ 20,000	$ 20,000
3	Metal Building & Foundation (3000 SF)	3000	SF	$ 200	$ 600,000
4	Utility Relocation	1	LS	$ 25,000	$ 25,000
5	Plumbing & HVAC	1	LS	$ 150,000	$ 150,000
6	Electrical Improvements	1	LS	$ 50,000	$ 50,000
				SUB TOTAL	**$ 888,000**
				CONTINGENCIES (30%)	**$ 270,000**
				CONSTRUCTION SUB TOTAL (2013 $)	**$ 1,158,000**
	DESIGN - BASIC SERVICE (8.0%)				$ 93,000
	ENGINEERING - ADDITIONAL SERVICES (2.0%)				$ 24,000
	TOPOGRAPHIC SURVEY (0.3%)				$ 4,000
	CONTRACT ADMINISTRATION (3.0%)				$ 35,000
	ENGINEERING SERVICES (3.5%)				$ 41,000
	CONSTRUCTION INSPECTION (3.5%)				$ 41,000
	TESTING (1.0%)				$ 12,000
	BOND INSURANCE (1.0%)				$ 12,000
	MISC. (PRINTING, ETC) (0.5%)				$ 6,000
				ADMINISTRATIVE SUB TOTAL	**$ 270,000**
				PROJECT TOTAL (2013 $)	**$ 1,428,000**

NOTES:

1. Preliminary construction prices are based on recent and historical data on local projects in Corpus Christi and costs should be escalated 3% per yr to the midpoint of construction in 2013 dollars.

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DATE: March 20, 2013
BY: WLB

PROJECT: Oso WRP Nutrient Removal Project (Ammonia) - Phase 2 Improvements
PROJECT NO: E09007
DESCRIPTION: Laguna Madre WWTP Decommissiong, Transfer Lift Station & Wastewater/Effluent Force Mains

PRELIMINARY ESTIMATE OF PROBABLE CONSTRUCTION COST

Item	Description	Qty	Unit	Unit Price	Total Price
1	Mobilization	1	LS	$ 920,000	$ 920,000
2	Utility Relocation Allowance	1	LS	$ 300,000	$ 300,000
3	Excavation for Wet Well	1	LS	$ 35,000	$ 35,000
4	Dewatering for Wet Well	1	LS	$ 40,000	$ 40,000
5	New 36" Inlet Piping	100	LF	$ 350	$ 35,000
6	Dual Concrete Wet Well	1	LS	$ 150,000	$ 150,000
7	135 HP Submersible Influent Pumps	6	EA	$ 80,000	$ 480,000
8	Lift Station Building	1000	SF	$ 300	$ 300,000
9	LS Yard piping Modifications	1	LS	$ 50,000	$ 50,000
10	Flow Metering	1	EA	$ 125,000	$ 125,000
11	Pump Hoist & Lifting System	1	LS	$ 125,000	$ 125,000
12	Demolition & Decommissioning of LMWWTP	1	LS	$ 750,000	$ 750,000
13	Electrical, Instrumentation & Programming	1	LS	$ 1,000,000	$ 1,000,000
14	Dual 20-in Wastewater Force Main to Oso WRP	29300	LF	$ 250	$ 7,325,000
15	Dual 20-in Wastewater FM Installed across Oso Bay via HDD	4750	LF	$ 490	$ 2,327,500
16	Dual 20-in Wastewater FM across Shoreline Bridge	1700	LF	$ 300	$ 510,000
17	12-in Effluent Force Main to LMWWTP	29300	LF	$ 85	$ 2,490,500
18	12-in Effluent FM installed across Oso Bay via HDD	4750	LF	$ 170	$ 807,500
19	12-in Effluent FM across Shoreline Bridge	1700	LF	$ 100	$ 170,000
21	Dewatering by Well Pointing for both FMs	29300	LF	$ 25	$ 732,500
22	HMACP Pavement Repair (3300 LF)	2567	SY	$ 60	$ 154,000
23	Air Release Valve Manholes & Assembly	20	EA	$ 9,000	$ 180,000
24	Gate Valves @ 4000' Spacing	30	EA	$ 5,500	$ 165,000
				SUB TOTAL	**$ 19,172,000**
				CONTINGENCIES (30%)	**$ 5,760,000**
				CONSTRUCTION SUB TOTAL (2013 $)	**$ 24,932,000**
	DESIGN - BASIC SERVICE (8.0%)				$ 1,995,000
	ENGINEERING - ADDITIONAL SERVICES (2.0%)				$ 499,000
	TOPOGRAPHIC SURVEY (0.3%)				$ 75,000
	CONTRACT ADMINISTRATION (3.0%)				$ 748,000
	ENGINEERING SERVICES (3.5%)				$ 873,000
	CONSTRUCTION INSPECTION (3.5%)				$ 873,000
	TESTING (1.0%)				$ 250,000
	BOND INSURANCE (1.0%)				$ 250,000
	MISC. (PRINTING, ETC) (0.5%)				$ 125,000
				ADMINISTRATIVE SUB TOTAL	**$ 5,690,000**
				PROJECT TOTAL (2013 $)	**$ 30,622,000**

NOTES:

1. Preliminary construction prices are based on recent and historical data on local projects in Corpus Christi and costs should be escalated 3% per yr to the midpoint of construction in 2013 dollars.

Appendix C

Buffer Zone Easement

12

BUFFER ZONE EASEMENT
CITY OF CORPUS CHRISTI
(OSO WASTEWATER TREATMENT PLANT)

1. Grant of Easement. The **BOARD OF REGENTS OF THE TEXAS A&M UNIVERSITY SYSTEM** (hereafter, "**TAMUS**"), on behalf of the State of Texas, acting by and through its duly authorized officer, under authority of Board Policy 41.01(6), and by virtue of authority granted to the Board by TEX. EDUC. CODE § 85.26, in consideration of the mutual benefits to be derived by both parties, GRANTS, SELLS AND CONVEYS to the **CITY OF CORPUS CHRISTI, TEXAS**, a Texas Home Rule municipal corporation, as grantee (hereafter, "**CITY**"), its successors and permitted assigns, a non-exclusive buffer zone easement (the "Easement") across certain property of **TAMUS** (hereafter "the Property") located in Nueces County, Texas, more particularly described as follows:

A plat of the Property showing the surface area affected by the Easement and the location of **CITY**'s buffer zone is depicted on Exhibit "A" attached hereto and incorporated for all purposes

2. Purpose and Location of Easement. The Easement is granted for the purpose of maintaining a buffer zone on the Property located around the Oso Wastewater Treatment Plant to abate and control odors in compliance with state law and regulations of the Texas Commission on Environmental Quality.

3. Right of Access. **CITY** has the right of ingress and egress across the Property for the purpose of maintaining a buffer zone. **CITY** agrees to occupy the surface of the Property only to the extent and for the length of time necessary for maintaining the buffer zone. Any gate or opening used by **CITY** for ingress or egress in the exercise of its rights must be kept in proper condition and closed at all times.

4. Duties. **CITY** is responsible for any damage to the Property, to the extent that it causes said damage to the Property, and to any other real or personal property of **TAMUS** adjacent to the Property. **CITY** must, within a reasonable period of time, repair or replace **TAMUS'** property to the extent it will, as nearly as practicable, be in like condition as before such damage or destruction. At the option of **TAMUS**, in lieu of repairing or replacing, money damages will be paid.

5. No Fee Interest Granted. This is a grant of a nonexclusive easement only, and does not grant any fee interest to the surface, subsurface, or any interest in the minerals on or under the Property. The conveyance is made subject to any and all outstanding restrictions, reservations, covenants, conditions, leases, easements and other encumbrances filed of record or apparent on the ground. **TAMUS** expressly retains all rights to grant, control and renew all restrictions, reservations, covenants, conditions, leases, easements and other encumbrances, of every kind and character, on, over or under the Property.

6. Duration of Easement. In accordance with TEX. EDUC. CODE ANN. §85.26(c), this grant is for a term of ten (10) years and may be renewed only at the election of **TAMUS**. **CITY** expressly understands that its continued possession of the Property under this Agreement after expiration of its term, without first obtaining a renewal from the Board of Regents of The Texas A&M University System, is a violation of state law that subjects **CITY** to a penalty of ONE HUNDRED DOLLARS ($100) for each day of such violation. **CITY** agrees to pay **TAMUS** such penalty within ten (10) business days after receipt of notice from **TAMUS** sent in compliance with Paragraph 20 of this Agreement. **TAMUS** and **CITY** acknowledge that at the time of execution of this Easement, it is **CITY**'s intent that it will seek a renewal of this Easement from the Board of Regents of The Texas A&M University System after the expiration of its 10-year term.

7. **CITY** will comply with the Antiquities Code of Texas, TEX. NAT. RES. CODE ANN. § 191 et seq., and **CITY** further agrees title to archaeological objects or artifacts, if any, in or on the Property remain with **TAMUS**.

8. Reservation of Use. **TAMUS** expressly reserves:

A. The right to use the Property for its own benefit or the benefit of any of its members including the right to construct and maintain a berm on the Property as depicted on Exhibit "B" attached hereto and incorporated for all purposes. The right, without limitation, to grant permits, licenses, and easement rights in the Property to other parties, so long as the use does not interfere with the use of the Property as a buffer zone. **TAMUS** agrees to contact the wastewater department of **CITY** at the address below at least five (5) days prior to any surface construction or subsurface excavation in order to avoid damage to existing utilities:

City of Corpus Christi
Wastewater Department
P.O. Box 9277
Corpus Christi, Texas 78469-9277

B. The right to grant permits, licenses and easements covering the Property to other parties for the benefit of third parties or the public, so long as (i) the third party or public use does not interfere with the use of the Property as a buffer zone.

9. Hold Harmless. **CITY AND TAMUS, TO THE EXTENT ALLOWED BY THE CONSTITUTION AND LAWS OF THE STATE OF TEXAS, EACH AGREE TO HOLD THE OTHER HARMLESS FROM ANY AND ALL CLAIMS, DEMANDS, LIABILITIES AND CAUSES OF ACTION FOR PERSONAL INJURY OR DEATH AND/OR DAMAGE TO OR DESTRUCTION OF PROPERTY OR IMPROVEMENTS CAUSED BY, ARISING OUT OF, OR RESULTING FROM THE EXERCISE OF EACH PARTIES RIGHTS AND OBLIGATIONS UNDER THIS AGREEMENT.**

10. Hazardous Waste. **CITY** will not commit or suffer to be committed waste upon the Property; will keep the Property and the improvements in good working order and repair and in a clean, safe and healthful condition; and comply with all state, federal and local laws, rules and regulations with regard to the use and condition of the improvements on the Property.

CITY will not use the Property or permit the Property to be used so as to cause, suffer, or allow any contamination of soils, ground water, surface water, or natural resources on or adjacent to the Property resulting from, but not limited to, spills or leaks of oil, gasoline, hazardous materials, hazardous wastes, or other chemical compounds. **CITY** is solely responsible for cleanup of any contamination resulting from violation of this provision.

IF THE PRESENCE OF HAZARDOUS MATERIALS ON THE PROPERTY IS CAUSED BY CITY AND SUCH MATERIALS RESULT IN CONTAMINATION OF THE PROPERTY THEN CITY, TO THE EXTENT ALLOWED BY THE CONSTITUTION AND LAWS OF THE STATE OF TEXAS, SHALL INDEMNIFY, DEFEND AND HOLD TAMUS HARMLESS FROM ANY AND ALL CLAIMS, JUDGMENTS, DAMAGES, PENALTIES, FINES, COSTS, LIABILITIES OR LOSSES (INCLUDING DIMINUTION IN VALUE OF THE PROPERTY, DAMAGES FOR THE LOSS OF OR RESTRICTION ON USE OF THE PROPERTY OR OF ANY AMENITY OF THE PROPERTY, AND SUMS PAID IN SETTLEMENT OF CLAIMS, ATTORNEYS' FEES, CONSULTANTS' FEES AND EXPERTS FEES) WHICH ARISE DURING OR AFTER THE EASEMENT TERM AS A RESULT OF SUCH CONTAMINATION. CITY'S HOLD HARMLESS INCLUDES COSTS INCURRED IN CONNECTION WITH ANY INVESTIGATION OF SITE CONDITIONS FOR ANY CLEANUP, AND REMEDIAL, REMOVAL OR RESTORATION WORK REQUIRED BY ANY FEDERAL, STATE OR LOCAL GOVERNMENTAL AGENCY OR POLITICAL SUBDIVISION BECAUSE OF HAZARDOUS MATERIAL PRESENT IN THE SOIL OR GROUND WATER ON OR UNDER THE PROPERTY.

11. Default and Termination. It is agreed upon default by **CITY** of any of these covenants, conditions and agreements, **TAMUS** has the right, and such right is expressly reserved, to declare the Easement forfeited, without prejudice to any claim **TAMUS** may have against **CITY**; provided, however, **TAMUS** will give **CITY** written notice of its intention to terminate the Easement and the reasons for termination, and **CITY** will have thirty (30) calendar days after receipt of notice to rectify the default or violation. Upon timely correction, the Easement will remain in full force and effect. Upon termination or abandonment of the Easement all rights granted in the Easement revert to **TAMUS** without the necessity of any further action or suit on the part of **TAMUS**, and **CITY** agrees to file a Release of Easement in the Deed Records of Nueces County, Texas. Abandonment will be deemed to have occurred when the Property is not used as a buffer zone for a continuous period of one calendar year.

12. Waiver. No waiver by **TAMUS** or **CITY** of any default or breach of any term, condition, or covenant of the Easement will be a waiver of any other breach of any other term, condition, or covenant.

13. Privileges and Immunities. **CITY** acknowledges **TAMUS** is an agency of the State of Texas and nothing in this agreement will be construed as a waiver or relinquishment by **TAMUS** of its right to claim exemptions, privileges, and immunities as may be provided by law.

14. Texas Law to Apply. This agreement is construed under and in accordance with the laws of the State of Texas and is performable in Nueces County, Texas; however, by statute, mandatory venue for all suits against **TAMUS** is to be in the county in which the principal office of the chief executive officer is located. At execution of this agreement, such county is Brazos County, Texas.

15. Grammatical Interpretation. When the singular number is used, it also includes the plural, and the masculine gender includes the feminine and neuter gender.

16. Headings. Headings are for reference and will not be construed to limit or alter the meaning of the provisions of this agreement.

17. Parties Bound. This agreement is binding upon and inures to the benefit of the parties and their respective heirs, executors, administrators, legal representatives, successors in interest or office, and assigns (but this Section does not constitute permission for an assignment).

18. Saving Clause. Should any clause in this agreement be found invalid by a court of law, the remainder of this agreement will not be affected and all other provisions in this agreement remain valid and enforceable to the fullest extent permitted by law.

19. Assignment. This agreement is personal to **CITY**. **CITY** may not sell, assign, encumber, or convey its interest in this agreement or the Easement without the prior written consent of **TAMUS**, and any attempt by **CITY** to sell, assign, encumber, or convey its interest in this agreement or the Easement without such consent will cause the Easement to terminate.

20. Notices. Any notice required or permitted under this Agreement must be in writing, and shall be deemed to be delivered (whether actually received or not) when deposited with the United States Postal Service, postage prepaid, certified mail, return receipt requested, and addressed to the intended recipient at the address set out below. Notice may also be given by regular mail, personal delivery, courier delivery, facsimile transmission, email, or other commercially reasonable means and will be effective when actually received. **TAMUS** and **CITY** may change their respective notice address by sending to the other party a notice of the new address. Notices should be addressed as follows:

If to **TAMUS**: The Texas A&M University System
Office of General Counsel
Attn: System Real Estate
301 Tarrow Street, 6th Floor
College Station, Texas 77840-7896

If to **CITY**: City of Corpus Christi, Texas
Engineering Services
Attn: Daniel Biles, P.E.
P. O. Box 9277
City Hall, 1201 Leopard, Third Floor
Corpus Christi, Texas 78469-9277

20. Entire Agreement. This agreement constitutes the entire agreement between **TAMUS** and **CITY** with respect to the subject matter hereof and will not be explained, modified, or contradicted by any prior or contemporaneous negotiations, representations, or agreements, either written or oral. This agreement may only be amended by a subsequent written instrument executed by both parties.

21. Effective Date. This agreement is deemed to be in force on the 1st day of September 2012.

BOARD OF REGENTS OF THE TEXAS A&M UNIVERSITY SYSTEM, an agency of the State of Texas

By: _____
JOHN SHARP
Chancellor
The Texas A&M University System

APPROVED AS TO FORM:

_____
EDDIE D. GOSE. J.D.
Assistant General Counsel
Office of General Counsel
The Texas A&M University System

TERMS AND CONDITIONS EXPRESSLY ACKNOWLEDGED AND ACCEPTED:

CITY OF CORPUS CHRISTI, TEXAS, Texas Home Rule municipal corporation

Approved as to Legal form: 12-20-12

Veronica Ocañas
Assistant City Attorney
For City Attorney

By: _____
DANIEL BILES, P.E.
Director, Department of Engineering Services

ACKNOWLEDGEMENTS

STATE OF TEXAS §
§
COUNTY OF BRAZOS §

BEFORE ME, the undersigned authority, a Notary Public in and for the State of Texas, on this day personally appeared **JOHN SHARP**, Chancellor of the Texas A&M University System, known to me to be the person whose name is subscribed to the foregoing instrument and acknowledged to me that he executed it as the act and deed of the Board of Regents, The Texas A&M University System for the purposes and consideration therein expressed, and in the capacity therein stated.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this _____ day of _____, A.D. 2012.

_____
Notary Public, State of Texas

Prepared by Office of General Counsel
City of Corpus Christi Buffer Zone Easement
Legal Files No. 2012-0030909
EDG-12/13/2012

ACKNOWLEDGEMENTS

STATE OF TEXAS §
§
COUNTY OF BRAZOS §

BEFORE ME, the undersigned authority, a Notary Public in and for the State of Texas, on this day personally appeared **JOHN SHARP**, Chancellor of the Texas A&M University System, known to me to be the person whose name is subscribed to the foregoing instrument and acknowledged to me that he executed it as the act and deed of the Board of Regents, The Texas A&M University System for the purposes and consideration therein expressed, and in the capacity therein stated.

GIVEN UNDER MY HAND AND SEAL OF OFFICE this 16 day of January, A.D. 2013.

KRISANN L. EVERETT
MY COMMISSION EXPIRES
AUGUST 11, 2013

Krisann L. Everett
Notary Public, State of Texas

STATE OF TEXAS §
§
COUNTY OF NUECES §

BEFORE ME, the undersigned authority, a Notary Public in and for the State of Texas, on this day personally appeared **DANIEL BILES, P.E.**, Director, Department of Engineering Services for the City of Corpus Christi, known to me to be the person whose name is subscribed to the foregoing instrument and acknowledged to me that he executed it for the purposes and consideration therein expressed, and in the capacity therein stated.

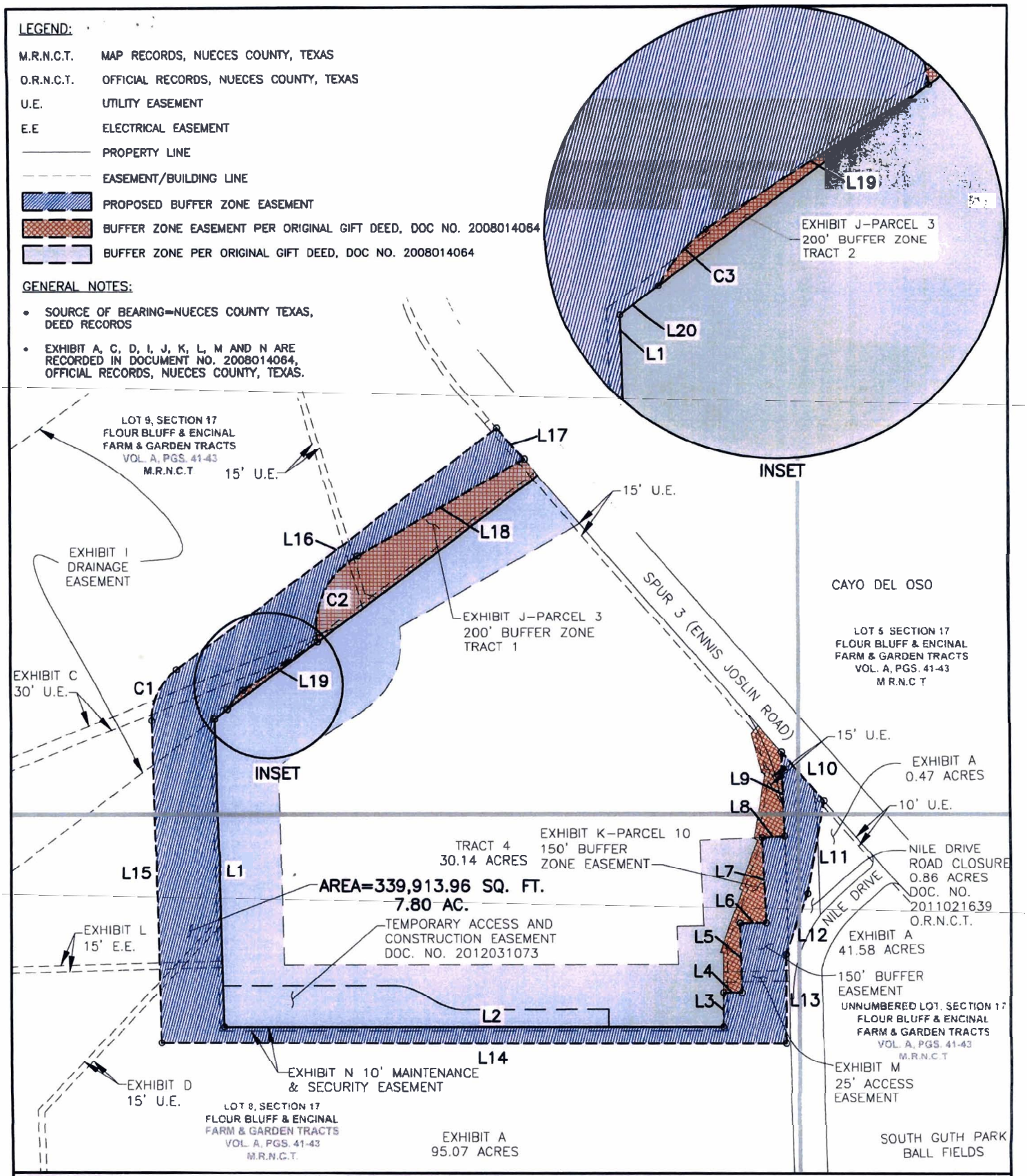
GIVEN UNDER MY HAND AND SEAL OF OFFICE this 20th day of December, A.D. 2012.

EUSEBIO GARZA, III
MY COMMISSION EXPIRES
February 14, 2013

Notary Public, State of Texas

Prepared by Office of General Counsel
City of Corpus Christi Buffer Zone Easement
Legal Files No. 2012-0030909
EDG-12/13/2012

Exhibit A
Page 1 of 2



LNV
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WWW.LNVINC.COM

CITY OF CORPUS CHRISTI, TX

BUFFER EASEMENT

11/9/12

SHEET 1 OF 2

SCALE: 1"=300'

LINE	BEARING	DISTANCE
L1	S 28°31'28" W	746.03'
L2	S 59°59'33" E	1196.81'
L3	N 30°09'46" E	81.41'
L4	S 60°22'00" E	44.02'
L5	N 28°33'52" E	166.93'
L6	S 60°37'27" E	63.76'
L7	N 27°36'11" E	208.44'
L8	S 63°41'07" E	52.83'
L9	N 28°26'49" E	202.40'
L10	S 11°00'46" E	155.01'
L11	S 40°13'37" W	229.89'
L12	S 49°54'16" W	154.96'
L13	S 30°09'46" W	214.36'
L14	N 59°59'33" W	1495.71'
L15	N 28°31'28" E	782.16'
L16	N 82°56'21" E	966.55'
L17	S 10°33'46" E	98.61'
L18	S 89°59'26" W	462.66'
L19	S 86°39'20" W	213.92'
L20	S 82°56'21" W	38.30'

(C1)
Δ=54°24'53"
R=150.00'
L=142.46'
CB=N55°43'54"E

(C2)
Δ=70°16'49"
R=200.00'
L=245.32'
CB=S54°51'35"W

(C3)
Δ=17°17'33"
R=200.00'
L=60.36'
CB=S69°36'27"W

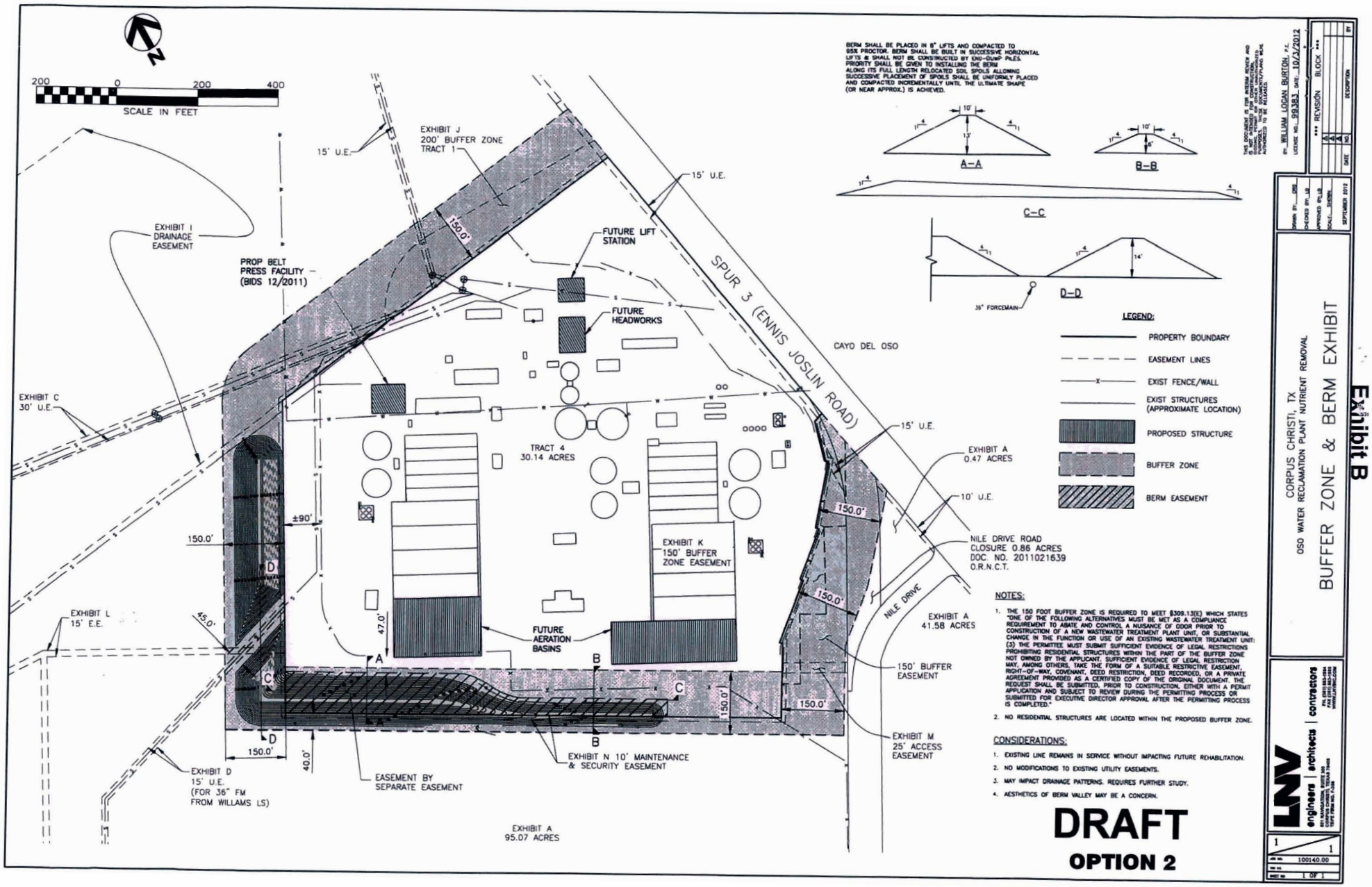
LNV
engineers | architects | contractors
801 NAVIGATION, SUITE 309
CORPUS CHRISTI, TEXAS 78408
TBPE FIRM NO. F-366
PH. (361) 883-1984
FAX (361) 883-1986
WWW.LNVINC.COM

CITY OF CORPUS CHRISTI, TX

BUFFER EASEMENT

11/9/12

SHEET 2 OF 2



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Pages 12
01/24/2013 9:49AM
Official Records of
NUECES COUNTY
DIANA T. BARRERA
COUNTY CLERK
Fees $59.00

Any provision herein which restricts the Sale, Rental or use of the described REAL PROPERTY because of Race, Color, Religion, Sex, Handicap, Familial Status, or National Origin is invalid and unenforceable under FEDERAL LAW, 3/12/89.

STATE OF TEXAS
COUNTY OF NUECES
I hereby certify that this instrument was FILED in file number sequence on the date and at the time stamped herein by me, and was duly RECORDED in the Official Public Records of
Nueces County, Texas
Diana T. Barrera

Diana T. Barrera

City of Corpus Christi
Dept. of Engineering Services
Property and Land Acquisition
P. O. Box 9277
Corpus Christi, TX 78469-9277