CITY OF TOMBALL
PHASE I – PRELIMINARY DESIGN
TOMBALL HILLS LIFT STATION
CITY OF TOMBALL E&P FILE NO. 2007-10006

PREPARED BY:
O'MALLEY ENGINEERS, L.L.P.
TBPE NO. F-3244
BRENHAM, TEXAS
OE JOB NO. 166.017-MD

SUMMARY OF TECHNICAL REVIEW COMMITTEE MEETING

&

PRELIMARY ENGINEERING REPORT

(FINAL & APPROVED DOCUMENTS)

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SUMMARY OF TECHNICAL REVIEW MEETING HELD APRIL 23, 2009

INTRODUCTION

The Technical Review Committee (TRC) met on April 23, 2009 to review and discuss the preliminary engineering report prepared by O'Malley Engineers pertaining to the replacement of Tomball Hills Lift Station. This document is a summary of the items discussed during the TRC meeting including the decisions made during the meeting.

DISCUSSION ITEMS AND RECORD OF DECISIONS

General
The TRC accepted the recommendation of O'Malley Engineers to replace the existing Tomball Hills Lift Station with a new lift station.

Land Acquisition and Location
City to acquire Lot 37 in Block 4 of the Tomball Hills Subdivision and the new lift station will be located on this lot outside the boundary of the 100-year floodplain.

Lift Station Design Parameters and Features
The new Tomball Hills Lift Station will be designed and constructed in accordance with the following:

- Duplex lift station with submersible pumps manufactured by ITT Flygt.
- Preliminary Duty Point and Motor Sizes for Pumps (To Be Confirmed During Final Design): 410 gpm at 143-ft Total Dynamic Head, 35 HP, 460 VAC, 3 Phase, 60 Hertz.
- Pumps to be controlled with float switches.
- Reinforced concrete wet well with Thane coat on interior.
- Remote monitoring using an auto-dialer (Verbatim auto-dialer by RACO).
- Ductile iron station discharge piping and valves to be above ground.

- Security for lift station to include lockable features/panels and a chain link fence around perimeter of lift station. Chain link fence to have privacy slats, PVC coated fabric (green), and a fabric height of 8-ft with a single strand of barbed wire at the top of the fence. Fence to be equipped with double swing gates for access by personnel and equipment.

- A metallic shelter will be constructed over the electrical/control panel rack for the new lift station.

- New lift station to be designed to allow portable generator to be connected to lift station to provide emergency power during power outages (i.e. Option A in preliminary engineering report). Portable generator to be acquired separately by the City of Tomball and excluded from the scope of work for the construction of the new lift station.

- Vehicular access to new lift station will be from the cul-de-sac on Chris Lane. Access drive from Chris Lane to be reinforced, concrete pavement with the appropriate area for a turn-around near the perimeter security fence at the lift station.

- Shrubs/vegetation to be planted around/near lift station to provide a visual barrier. Type of shrubs/vegetation to be determined during final design.

PROBABLE CONSTRUCTION COST
See attached opinion of probable construction cost. Probable Construction Cost = $299,750.00.

APPROVAL OF TECHNICAL REVIEW COMMITTEE

NAME & TITLE	*SIGNATURE*	*DATE*
Mark McClure, P.E. Director of Engineering & Planning		05/11/09
Lori Lakatos, P.E. Assistant City Engineer		5/7/09
Bobby Sanders Engineering Construction Inspector		5/6/09
David Kauffman Director of Public Works		5/6/09
John Escamilla Utilities Superintendent		5.6.09
Danny Hitchcock Utilities Foreman		5-6-09

CITY OF TOMBALL

PHASE I – PRELIMINARY DESIGN

PRELIMINARY ENGINEERING REPORT
FOR

TOMBALL HILLS LIFT STATION

CITY OF TOMBALL E&P FILE NO. 2007-10006
OE JOB NO. 166.017-MD

MAY 2009

STATE OF TEXAS
TIMOTHY W. ROBERTSON
85565
LICENSED
PROFESSIONAL ENGINEER
Timothy W. Robertson
5/4/09

Prepared by:
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PRELIMINARY ENGINEERING REPORT FOR TOMBALL HILLS LIFT STATION

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LIST OF EXHIBTS

EXECUTIVE SUMMARY

Project Location: The existing Tomball Hills Lift Station is located in the northern area of Tomball on the easterly side of Tomball Parkway (SH 249) near the bridge across Spring Creek and the westerly end of the Chris Lane cul-de-sac in the Tomball Hills Subdivision (See Exhibit A – Vicinity Map, Exhibit B – Location Map for Existing Lift Station and Force Main, and Exhibit C – Map of Existing Utilities Around Lift Station). The key map reference for the existing lift station is 248W.

Statement of Problem: The existing Tomball Hills Lift Station is a submersible pump type lift station that is in substandard condition, located in a floodplain area, and difficult to access by maintenance personnel. Access by maintenance vehicles is impossible during significant storm events and does not comply with current Texas Commission on Environmental Quality (TCEQ) regulations even when the area is not inundated with stormwater. Improvements on the tract of land adjacent to the lift station have caused fill dirt to be placed over the original lift station site and have also restricted access to the site along the platted access easements.

Project Base Solution: Construction of a new lift station that will not be inundated with stormwater and will be accessible to maintenance personnel and equipment during inclement weather conditions as prescribed in TCEQ regulations (TAC Chapter 217).

Evaluation of Alternative Solutions: It is evident that the Tomball Hills Lift Station needs to be replaced due to the condition and location of the existing facility. The primary items evaluated as alternatives in this report include the location of a new lift station, type of lift station pumps (submersible vs. self-priming), and options pertaining to emergency power.

Findings from Phase I Design Activities: Conflicts with existing utilities are not anticipated on this project. The recommended land acquisition for this project includes the City acquiring Lot 37 in Block 4 of the Tomball Hills Addition so the new lift station can be constructed outside the boundary of the 100-year floodplain. The Phase I – Environmental Site Assessment and Limited Wetlands Assessment did not recommend any additional environmental investigation or permitting on the property for the new lift station. The geotechnical investigation performed for this project did not find any abnormal soil conditions that would impact final design of the proposed lift station. However, groundwater could be encounter during construction due to the normal variations in precipitation even though it was not encountered while drilling during the field investigation.

Recommended Project: O'Malley Engineers, LLP recommends that the City of Tomball construct a new, duplex submersible pump type lift station with capacity of 410 gpm at 143-ft of total dynamic head (single pump running). We recommend a concrete wet well and have determined a preliminary depth of 26-ft for the wet well. A preliminary site plan for the proposed lift station is included with this report as Exhibit H. As mentioned above, we recommend the lift station be located outside the 100-year floodplain on Lot

37 in Block 4 of the Tomball Hills Addition. TCEQ regulations require emergency power for this lift station due to the power outage history at this site. The two recommended methods of providing emergency power to the new lift station include a portable generator or a permanent, onsite generator. The onsite generator can be powered by either natural gas or diesel. Descriptions and estimated construction costs for three (3) options on the new lift station and the emergency power for the lift station are included in the next paragraph.

Estimated Construction Cost: O'Malley Engineers, LLP has prepared three (3) opinions of probable construction cost for the new Tomball Hills Lift Station recommended in this report. The difference in the three (3) options pertains to the approach used to provide emergency power to the new lift station and the cost of the basic lift station does not change between each of the options.

Option A – New Lift Station Equipped to Connect Portable Generator
Estimated Construction Cost (Without Portable Generator) = $299,750.00

Option B – New Lift Station with Onsite Generator (Natural Gas)
Estimated Construction Cost = $426,250.00

Option C – New Lift Station with Onsite Generator (Diesel)
Estimated Construction Cost = $398,750.00

If Option A is selected, the City must meet TCEQ regulations for using a portable generator for emergency power (TAC Chapter 217, Paragraph 217.63). Detailed construction cost estimates for each of the above options are included with this report in Exhibit J.

INTRODUCTION

Project Location
The existing Tomball Hills Lift Station is located in the northern area of Tomball on the easterly side of Tomball Parkway (SH 249) near the bridge across Spring Creek and the westerly end of the Chris Lane cul-de-sac in the Tomball Hills Subdivision. The key map reference number where the existing lift station is located is 248W as published by Key Maps, Inc. of Houston, Texas. A general Vicinity Map for Tomball showing the location of the existing lift station is included with this report as Exhibit A. Exhibit B – Location Map for Existing Lift Station and Force Main and Exhibit C – Map of Existing Utilities Around Lift Station are more detailed maps that show the immediate area around the lift station and the force main including existing underground utilities.

Statement of Problem and Existing Condition Assessment
The existing Tomball Hills Lift Station has the following deficiencies:

1. The lift station is in substandard condition and is not configured in accordance with current design standards typically used for municipal utility infrastructure.
2. The lift station site is located in a floodplain area and it is not possible to access the station with typical maintenance vehicles and equipment during significant storm events. The access to the lift station site is also difficult when the area is not inundated with stormwater and does not comply with current TCEQ regulations in TAC Chapter 217. Improvements on an adjacent tract of land interfere with and restrict access to the lift station site through the platted access easements.

The following paragraphs include a more detailed review and history of the above deficiencies.

City Staff provided O'Malley Engineers, LLP with copies of several plan sheets from a 1987 project that included proposed improvements to the Tomball Hills Lift Station and some other utility line improvements. Based on a review of these plans, it appears there was an existing lift station at this site before 1987 and this is a reasonable conclusion because the Tomball Hills Subdivision was platted in 1978. The 1987 plans show an existing wet well and a new concrete wet well that were to be connected with an 8-inch diameter connector pipe, thereby increasing the overall wet well storage capacity. The new concrete wet well was to be installed on the south side of the existing wet well. As part of the 1987 project, the existing pumps were to be removed from the existing wet well and reinstalled in the new wet well with new discharge piping and valves from the relocated pumps in the new wet well to an existing 6-inch diameter force main immediately adjacent to the wet wells. The electrical and controls equipment were not to be replaced or upgraded as part of the 1987 project and were to be reused according to the plans. According to City Staff, the lift station improvements shown on the 1987 were not actually constructed by the contractor that was under the contract for the project. Instead, city personnel constructed the improvements to the lift station around the same

period of time and the improvements were not constructed exactly as shown on the 1987 plans. The new wet well installed by city personnel was a fiberglass wet well instead of a concrete wet well and the pumps remained in the old wet well on the northern side of the lift station site and were never moved to the new wet well. The old wet well on the northern side of the lift station site is also a fiberglass wet well.

Since 1987, it appears that a significant amount of fill has been added in the area of the lift station site and we estimate that the fill depth is between 3 and 5-ft at the station. The evidence of this fill can be seen by looking at the current height of the chain link fence around the station and the fact that a portion of the original fence is now below the current ground elevation in the area. The fill may have been added adjacent to the lift station, but erosion has caused the soil to migrate into the actual lift station site and raise the elevation of the ground within the perimeter of the station. Regardless of the cause of the fill, the fencing around the lift station site no longer conforms to current TCEQ regulations.

Another improvement at the lift station site since 1987 includes the addition of vertical fiberglass extensions to the existing wet wells. According to City Staff, the extensions were added to the top of each of the wet wells to help reduce stormwater inflow into the wet wells. When the extensions were installed, they were considered a temporary retrofit until a more permanent solution could be provided. The wet well extensions are visible at the lift station and the current elevation at the top of the wet wells is several feet above the surrounding ground. A wooden platform that was used to elevate the electrical and controls equipment above the ground was left in place after the addition of the new wet well on the southern side of the station site in the late 1980s. It appears that the wooden platform was expanded at some point so that maintenance personnel could have a deck to access the wet wells and the pumps after the vertical extensions were added. The overall arrangement at this lift station does not conform to current design standards for a typical lift station in a municipal utility setting. Also, current TCEQ regulations specifically require lift station wet wells to be watertight and gastight. City Staff has concerns that the wet wells are not watertight and we would agree with this assessment given the general arrangement of the existing wet wells.

According to City Staff, access to this lift station is not possible when there is a significant storm event and the 1987 plans also indicate that flooding was a concern because the vent pipe, electrical equipment and controls equipment were located at an unusual vertical distance above the ground elevation as it existed at that time. Specifically, the new vent pipe that was to be installed on the 1987 project was approximately 7.2 ft above the top of the wet wells and matched the 100-year water surface elevation stated on the plans for that project. Based on our field observations and comments from City Staff, it is difficult to access the lift station site even when the area is not inundated with stormwater. The original plat for the Tomball Hills Subdivision shows two (2) easements that could be used for access to the lift station site. One access easement is completely blocked with the improvements on an adjacent tract of land. The second access easement is at least partially blocked by improvements on an adjacent tract of land and cannot be accessed where it connects to the State Highway 249 right-of-way.

Basically, the platted access routes to this lift station are not usable in accordance with the original intent. TCEQ regulations require an all weather access road that is located in a dedicated right-of-way or permanent easement, has a minimum width of 12-ft, and is above the water level of a 25-year rainfall event. The access to the lift station site does not currently conform to TCEQ regulations.

Based on conversations with City Staff, there have been three (3) times in the past 20-years (+/-) that floodwater was deep enough in the area of the lift station that it had to be temporarily taken out of service. This type of occurrence can cause damage to private residences, businesses, and other private property and puts the City at risk for being fined for violating TCEQ regulations.

The existing Tomball Hills Lift Station has a contributing drainage area that primarily includes the residential subdivision called the Tomball Hills Addition on the easterly side of SH 249 and Lone Star College, which is located on the westerly side of SH 249. Two (2), existing 6-inch gravity sanitary sewer lines combine at the lift station site and carry the sewage that is contributed from the Tomball Hills Addition. The College is served by an 8-inch gravity sanitary sewer line. The existing force main from the lift station is a 6-inch diameter PVC pipe and a portion of it was re-routed during a 1996 project. The general route of the existing 6-inch force main is shown on a map in included with this report (See Exhibit B – Location Map for Existing Lift Station and Force Main). The approximate length of the existing 6-inch force main is 4,615 linear feet. Exhibit C – Map of Existing Utilities Around Lift Station shows the existing utilities in the immediate area of the lift station. Both Exhibit B and Exhibit C were prepared using City of Tomball utility maps.

According to City Staff, the two (2) submersible pumps at the lift station are 10 hp pumps with a design operating point of 225 gallons per minute. Historical records from City Staff indicate that the following for the pumps:

Manufacturer: ITT Flygt
Model No.: CP3127
Impeller No.: 481
Electrical: 230 Volt, 3 Phase, 60 Hertz
Design Duty Point: 225 gpm at 80 ft Total Dynamic Head (TDH)

Project Base Solution

Based on the above paragraphs regarding the problems at this existing lift station and condition of the existing facilities, the City of Tomball has correctly identified a need to construct a new lift station to replace the existing Tomball Hills Lift Station. Furthermore, it is necessary that the new lift station not be inundated with stormwater and is accessible to maintenance personnel and equipment during inclement weather conditions as prescribed in TCEQ regulations (TAC Chapter 217).

FINDINGS FROM PHASE I DESIGN ACTIVITIES

Utilities Research
City of Tomball utility maps were obtained and reviewed during the preparation of this report. Exhibit C - Map of Existing Utilities Around Lift Station shows the existing city utilities in the immediate area around the existing lift station. The existing utilities are primarily the sanitary sewer lines that are related to the existing lift station with the exception of a single, 2-inch diameter gas distribution line that is on the southerly side of Lot 37 as shown on the map in Exhibit C. The sanitary sewer lines in the area are connected to the existing lift station and consist of both gravity and force main lines that will need to be extended to the new lift station. Conflicts with city owned utilities that would increase costs are not anticipated on this project. Signs of other underground utilities, such as markers for petroleum pipelines, were not observed during field visits.

Proposed Real Estate Acquisition
Land acquisition will be necessary to construct a new lift station that is more accessible to maintenance personnel and not subject to stormwater inundation. O'Malley Engineers, LLP considered Lots 36 and 37 in the Tomball Hills Addition as two (2) options for the location to construct the new lift station recommended in this report. Lot 37 is currently vacant, has an appraised value of around $14,500.00, and has a total area of approximately 30,807-sq ft. Lot 36 is also vacant, has appraised value of around $20,000.00, and an approximate area of 183,610-sq ft. Both lots have more area than is typically necessary for a lift station. However, we feel it would be prudent to purchase an entire lot for the new lift station because constructing the new station on either lot would likely render the remaining portions of that lot unusable for the purpose of constructing a residential structure. Also, the City could create a buffer area around the lift station by purchasing an entire lot and this may help reduce any issues that could possibly develop with adjacent property owners.

To form our recommendation on the real acquisition for this project, our evaluation of Lots 36 and 37 included the following:

1. The appraised value for Lot 37 is less than the appraised value for Lot 36 per the Harris County Appraisal District (See Exhibit D – Harris County Appraisal District Account Information (Lots 36 and 37, Block 4, Tomball Hills Addition). Approximate savings using appraisal district values would be around $5,500.00
2. Extensions of sanitary sewer lines needed to connect the new lift station to existing gravity and force main lines will be shorter and less costly if the lift station is located on Lot 37 instead of Lot 36.
3. A larger portion of the land on Lot 37 is located outside the boundary of the 100-year flood plain when compared to Lot 36.
4. If the lift station were located on Lot 36, it would likely be in the normal path of any vehicle that is proceeding in a westerly direction along Chris Lane. Even though the volume of traffic on Chris Lane is very low, it is preferable to

locate the lift station out of the path of a vehicle would proceed should it leave the end of the road (i.e. brake failure, driver disability due to medical condition, etc).

Based on the above evaluation, O'Malley Engineers, LLP recommends that the City acquire Lot 37 and locate the new lift station recommended in this report on the lot in an area that is outside the boundary of the 100-year floodplain.

Phase I Environmental Site Assessment
O'Malley Engineers, LLP had a Phase 1 Environmental Site Assessment (ESA) prepared for the proposed lift station area by LFC, Inc. of Houston Texas. The ESA "revealed no evidence of recognized environmental conditions in connection with the property" and "no additional environmental investigation appears to be warranted at this time." (LFC, Inc., Phase 1 Environmental Site Assessment, Tomball Hills Lift Station Replacement, LFC Project No. 09-0100, February 2009). A copy of the ESA is being provided to the City of Tomball as a separate submittal and is not included with this report.

Limited Wetlands Assessment
O'Malley Engineers, LLP had a limited wetlands assessment prepared for the proposed lift station site by LFC, Inc. of Houston, Texas. In accordance with the assessment, "the vegetation, soil conditions, and hydrology of the subject property do not indicate that wetlands are likely to be present on the subject property. Therefore, permitting is not required prior to development of the subject property." (LFC, Inc., Limited Wetlands Assessment, Tomball Hills Lift Station Replacement, LFC Project No. 09-0100, February 2009). A copy of the limited wetlands assessment is being provided to the City of Tomball as a separate submittal and is not included with this report.

Geotechnical Investigation
O'Malley Engineers, LLP had geotechnical investigation performed for the proposed lift station site by LFC, Inc. of Houston, Texas. The report for the investigation is based on a single bore hole that was drilled to a depth of 40-ft. The report indicates that two (2) types of soil were encountered during drilling including a high plasticity clay in the top 4-ft of the bore and a silty sand in the remaining 36-ft below the top layer. Even though groundwater was not encountered during the field investigation, the report stated that the "groundwater level should be expected to fluctuate throughout the years with variations in precipitation." (LFC, Inc., Geotechnical Engineering Report – Tomball Hills Lift Station Replacement, LFC Project No. 09-0098). The geotechnical report also contains other typical parameters, analyses and recommendations needed for the design of the lift station in relation to the subsurface conditions in the area. The report did not reveal anything in the geology around the area that we feel would require an unusual approach during the detailed design of lift station. A copy of the geotechnical engineering report is being provided to the City of Tomball as a separate submittal and is not included with this report.

Inter-agency Coordination
There are no potential conflicts with other projects from other City departments or other agencies, therefore O'Malley Engineers, LLP does not anticipate any coordination efforts on this project.

Floodplain/Floodway Analysis
A floodplain map that was developed using a FEMA Flood Insurance Rate Map is included with this report as Exhibit E. The location of the existing lift station and the proposed lift station recommended in this report are shown on the map. The existing lift station is located inside the boundary of the area that is designated as the 100-year floodplain. The recommended location of the new lift station is outside the 100-year floodplain boundary. As mentioned in previous sections of this report, part of the problem with the existing lift station is that it is located in area that has been inundated with stormwater in the past. The recommended location for the new lift station will resolve this problem and make the lift station accessible during significant storm events. We also recommend that the top of all manholes that are located within the 100-year floodplain be raised above the 100-year flood elevation.

Permit and Licenses
Permits or licenses from governmental agencies, private or public utilities, wetlands, etc. will not be required for this project. We do not anticipate more than 1-acre of ground being disturbed during construction and, therefore, the project should be exempt from obtaining coverage under a general permit for storm water discharges from construction activities. As usual, the project will be subject to a possible plan review by the TCEQ and the appropriate submittal will need to be made to the TCEQ.

Tree/Landscaping Impacts
The only trees that will be potentially impacted by this project are those trees that are on Lot 37, which is the recommended location for the proposed lift station. Any trees that conflict with the proposed lift station and utility lines associated with the lift station will need to be removed prior to, or during, construction. Based on our observations, tree removal may not be necessary or will be very minimal. We recommend that the primary criteria for removing any tree will be if the tree conflicts with the proposed improvements or will create a conflict as the tree grows in the future. Obviously, it is also important to re-establish ground cover after a lift station is constructed to prevent issues with erosion and stormwater pollution.

EVALUATION AND RECOMMENDATIONS

Evaluation of Alternatives
Based on the information in the *Statement of Problem and Existing Condition Assessment* section of this report, it is evident that the Tomball Hill Lift Station needs to be replaced. If this recommendation is accepted, then the primary items that need to be evaluated for this project are: 1) lift station location, 2) type of lift station pumps(i.e. submersible vs.

self-priming), and 3) options pertaining to emergency power to lift station during power outage.

The evaluation on the location of the lift station is included in a previous section of this report where we evaluated and compared Lots 36 and 37 in Block 4 of the Tomball Hills Addition. In this section of the report, we concluded with a recommendation that the City acquire Lot 37 and locate the new lift station on this lot outside the boundary of the 100-year floodplain (See *Proposed Real Estate Acquisition* section).

There are two (2) types of pumps that are generally used for municipal lift stations; submersible pumps and self-priming pumps. Based on our observations in other municipalities in southeast and central Texas, lift stations with submersible pumps are a lot more common and desirable. Lift stations with submersible pumps have more equipment that that is below ground and not visible when compared to a lift station with self-priming pumps and this seems to make a submersible pump lift station more aesthetically pleasing to homeowners near the lift station. Submersible pump lift stations normally generate less noise and this is also something that adjacent homeowners find desirable. One major comment our firm has heard many times from city maintenance personnel in various municipalities pertains to the problems they encounter with self-priming pumps regularly losing their prime. Since a submersible pump resides below the water surface in a wet well, they do not lose their prime. We feel the choice between submersible pumps and self-priming pumps should be left with the owner of the lift station and a lift station design with either type of pump can be provided for this project. However, we usually recommend submersible pumps for municipal lift station unless the owner prefers otherwise.

The TCEQ requires that the power outage history for a lift station be reviewed to determine the need for emergency power. Included with this report in Exhibit F is a letter from Mr. Steve Stone with Centerpoint Energy that lists the power outages that occurred over the past 24-months at the Tomball Hills Lift Station. The longest power outage listed in the letter occurred during Hurricane Ike and was 85 hours, 55 minutes. Obviously, it would be virtually impossible to provide enough retention capacity in a lift station and collection system to meet TCEQ regulations for a power outage of this duration. Accordingly, provisions for emergency power at this lift station are necessary to meet TCEQ regulations. There are two (2) alternatives that the City may consider in regards to emergency power for this lift station. The first alternative is to construct the lift station with the appropriate equipment to connect it to a portable generator and demonstrate that the portable generator meets TCEQ regulations. To use a portable generator, the TCEQ requires the following:

1. Have documentation available for the TCEQ on the storage location of each generator,
2. Determine the amount of time that will be needed to transport the generator to the lift station,
3. Have documentation available for the TCEQ on the number of lift stations that the generator is dedicated to as a backup,

4. Have documentation available for the TCEQ pertaining to the routine maintenance and upkeep planned for each generator to insure they will be operational when needed, and
5. Have an operator that is knowledgeable in the operation of the generator on call 24-hours per day every day.

The collection system and new lift station will have the capacity to store the peak flow for approximately 53 minutes (See preliminary calculations in Exhibit G). Therefore, a portable generator will need to be transported and made operational within this amount of time if the portable generator option is selected. We consider the portable generator approach a viable option, but the City may elect to not to consider this option if the time constraints are too restrictive.

The second alternative is to install a permanent, onsite generator at the lift station site. The primary consideration under the second alternative is what type of fuel will be used to power the onsite generator; natural gas or diesel. In our opinion, natural gas is a more reliable fuel supply when compared to diesel because of the maintenance required to keep moisture out of diesel fuel. Generally, the main consideration for the options on a generator is the cost. Included in this report are estimated construction costs for the following three (3) options

Option A – New Lift Station Equipped to Connect Portable Generator
Option B – New Lift Station with Onsite Generator (Natural Gas)
Option C – New Lift Station with Onsite Generator (Diesel)

The basic lift station is the same under each of the above options and the cost for each option follows under report section ESTIMATED CONSTRUCTION COST. Typically, owner preference is the most important factor when selecting one of the above options. Alternate bids for each of the above options can be requested from contractors during the bidding process and O'Malley Engineers, LLP recommends that the City proceed accordingly. After bids are received, a final selection can be made on the option that is best suited to the City's budget, personnel and operations.

Recommended Project
O'Malley Engineers, LLP recommends that the existing Tomball Hills Lift Station be completely replaced with a new lift station. We recommend the City acquire Lot 37 in Block 4 of the Tomball Hills Addition and construct the lift station on this lot such that it is located outside the boundary of the 100-year floodplain with access to the lift station from the cul-de-sac on Chris Lane. The design of the lift station should conform to TCEQ regulations and the recommended design parameters and features are as follows:

1. Design Pumping Conditions: 410 gpm @ 143-ft TDH (Single Pump)
2. Number of Pumps: 2 each (35 hp, 460 v, 3 Phase, 60 Hertz)
3. Type of Pumps: Submersible
4. Control: Floats

5. Remote Monitoring: Required by TCEQ (Auto-Dialer, SCADA, or Web based)
6. Wet Well Size and Construction: 8-ft diameter X 26-ft depth, Reinforced Concrete
7. Station Piping: Ductile Iron
8. Below Ground Piping: PVC
9. Emergency Power Provisions: Required by TCEQ; 3 Options
10. Security: Fencing or Lockable Features
11. Access: 12-ft Wide Roadway Above 25-year Flood Level

In support of the recommendations contained in this report, a preliminary site plan for the new lift station is included in Exhibit H and lift station calculations, system curves and pump curves are included in Exhibit G (Note: All preliminary calculations and curves will need to be confirmed during final design). Also, Exhibit I includes photographs of the existing lift station, recommended lift station site on Lot 37, and an aerial photograph of the area

ESTIMATED CONSTRUCTION COST

O'Malley Engineers, LLP has prepared an opinion of the probable construction cost for each of the three (3) options on the new lift station included in this report. As noted previously, the basic lift station that is recommended in this report does not change between each of the three (3) options and the only variation pertains to the manner that the City will provide emergency power to the proposed facility.

Option A – New Lift Station Equipped to Connect Portable Generator

Estimated Construction Cost = $299,750.00

TCEQ regulations require, as a minimum, that this lift station be designed and constructed to connect to a portable generator. The new lift station would be constructed with the appropriate equipment to allow city personnel to connect a portable generator during a power outage. The above construction cost does not include the cost for a portable generator. As described in previous sections of this report, the City will be required to demonstrate that a portable generator is available to connect to the lift station during a power outage as stipulated in TCEQ regulations.

Option B – New Lift Station Equipped with Onsite Generator (Natural Gas)

Estimated Construction Cost = $426,250.00

Option B includes the lift station recommended in this report, but is equipped with a permanent, onsite generator that is powered by natural gas. The City's natural gas system is in close proximity to the new lift station site and we recommend that the City consider a natural gas generator as an option.

Option C – New Lift Station Equipment with Onsite Generator (Diesel)

Estimated Construction Cost = $398,750.00

Option C also includes the lift station recommended in this report, but is equipped with a permanent, onsite generator that is powered by diesel.

A detailed opinion of probable cost for each of the above options is included in Exhibit J at the end of this report. We recommend that the City request alternate bids for each of the three (3) options.

EXHIBITS

As mentioned throughout this document, there are several exhibits that are pertinent to this report. The following is a list of all exhibits that are included with this report:

Exhibit A – Vicinity Map

Exhibit B – Location Map for Existing Lift Station & Force Main

Exhibit C – Map of Existing Utilities Around Lift Station

Exhibit D – Harris County Appraisal District Account Information (Lots 36 and 37, Block 4, Tomball Hills Addition)

Exhibit E – Floodplain Map (Re: FEMA Flood Insurance Rate Map, Map No. 48201C0210L, Published June 18, 2007)

Exhibit F – Power Outage History

Exhibit G – Preliminary Lift Station Calculations, System Curves, and Pump Curves

Exhibit H – Preliminary Site Plan for New Lift Station

Exhibit I – Photographs (Existing Lift Station, New Lift Station Site & Aerial)

Exhibit J – Opinion of Probable Construction Cost (Options A, B and C)

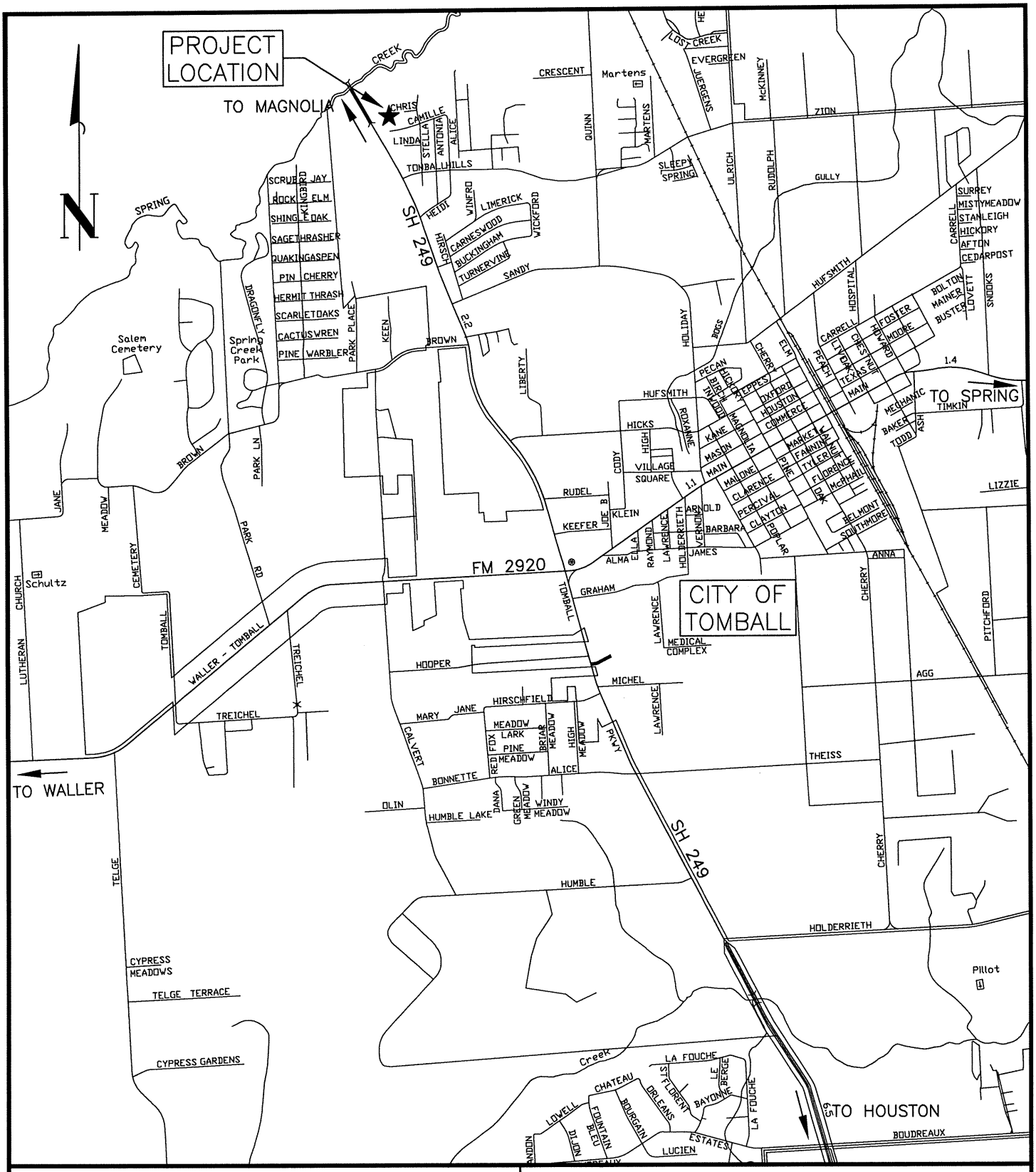
REPORT CLOSURE

All information in this report should be considered preliminary in nature and all calculations, system curves, and pump curves included herein should be confirmed during the final design phase of this project. As mentioned previously in this report, O'Malley Engineers, LLP has utilized several reports prepared by LFC, Inc. including a Phase I- Environmental Site Assessment, a Limited Wetlands Assessment, and Geotechnical Engineering Report. The reports prepared by LFC, Inc. will be provided to the City as a separate submittal and we appreciate their services on this project.

O'Malley Engineers, LLP stands ready to review the contents of this report with City Staff and we look forward to preparing the final design for this project.

Exhibit A

Vicinity Map



CITY OF TOMBALL
TOMBALL HILLS LIFT STATION
PRELIMINARY ENGINEERING REPORT

EXHIBIT A
VICINITY MAP

O'MALLEY ENGINEERS, LLP
TBPE NO. F-3244
BRENHAM, TEXAS

Scale: 1"=3000'	
Project Number: 166.017 MD	
Drawn By: JDG	Date: 3-4-09
Revised:	
Sheet Number: 1 of 1	

Exhibit B

Location Map for Existing Lift Station & Force Main

EXHIBIT B
LOCATION MAP FOR EXISTING LIFT STATION & FORCE MAIN

CITY OF TOMBALL
TOMBALL HILLS LIFT STATION
PRELIMINARY ENGINEERING REPORT

O'MALLEY ENGINEERS, LLP
TBPE NO. F-3244
BRENHAM, TEXAS

Scale: 1"=100'	
Project Number: 166.017 MD	
Drawn By: JDG	Date: 3-17-09
Revised:	
Sheet Number:	1 of 1

Exhibit C

Map of Existing Utilities Around Lift Station

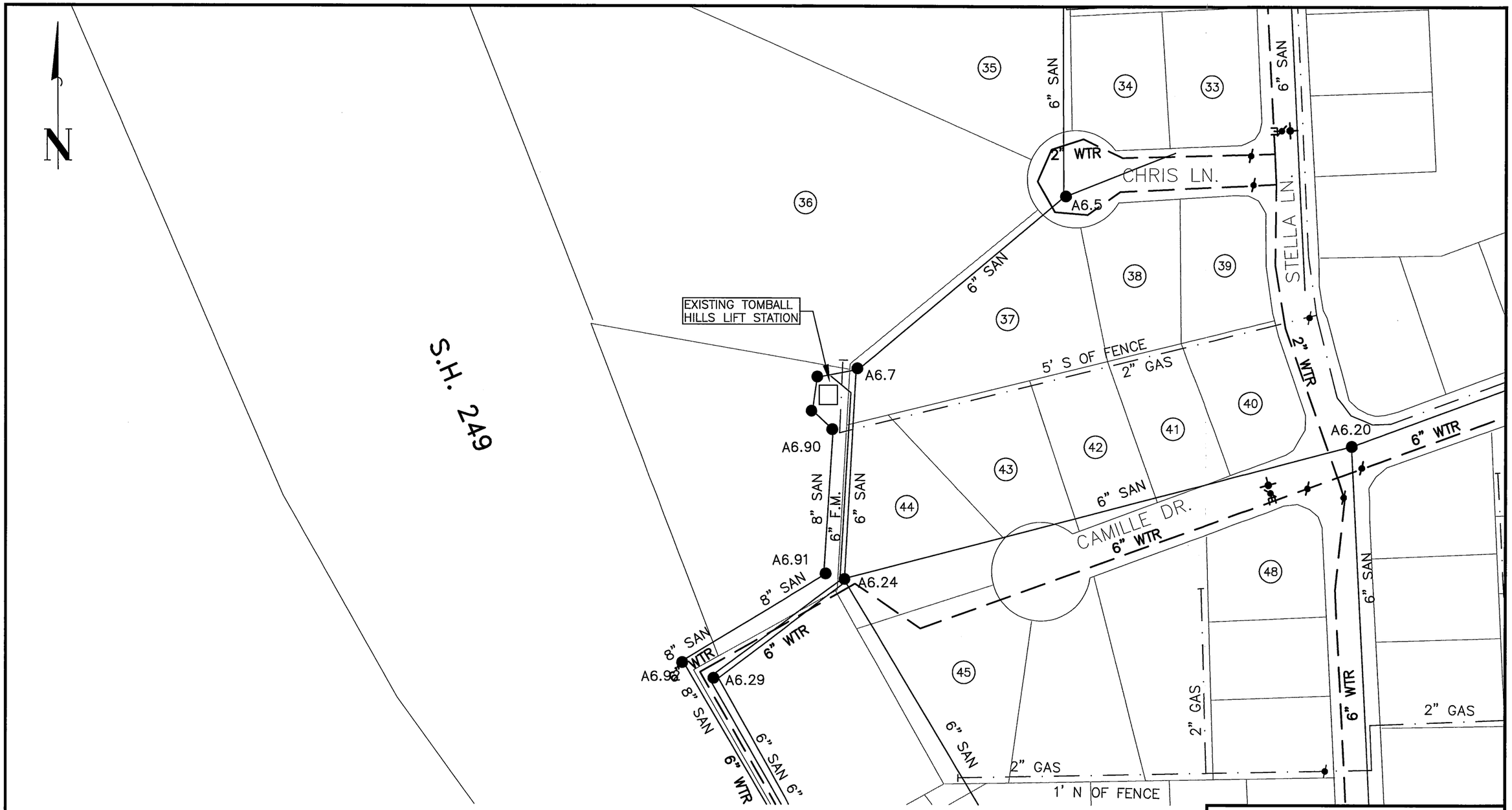


EXHIBIT C
MAP OF EXISTING UTILITIES
AROUND LIFT STATION

CITY OF TOMBALL
TOMBALL HILLS LIFT STATION
PRELIMINARY ENGINEERING REPORT

O'MALLEY ENGINEERS, LLP
TBPE NO. F-3244
BRENHAM, TEXAS

Scale: 1"=100'	
Project Number: 166.017 MD	
Drawn By: JDG	Date: 3-17-09
Revised:	
Sheet Number:	1 of 1

Exhibit D

Harris County Appraisal District Account Information (Lots 36 and 37, Block 4, Tomball Hills Addition)

HARRIS COUNTY APPRAISAL DISTRICT
REAL PROPERTY ACCOUNT INFORMATION
1129570000036

Tax Year: 2008

Owner and Property Information			
Owner Name & Mailing Address:	**HILDRETH SYLVIA L** **30702 S H 249** **TOMBALL TX 77375**	Legal Description: Property Address:	**TR 36 BLK 4** **TOMBALL HILLS** **0 CHRIS LN** **TOMBALL TX 77375**

State Class Code	Land Use Code	Land Area	Total Living Area	Neighborhood	Map Facet	Key Map®
C1 -- Real, Vacant Lots/Tracts (In City)	1000 -- Residential Vacant	183,610 SF	0 SF	2550	4772C	248X

Value Status Information

Capped Account	Value Status	Notice Date	Shared CAD
No	Noticed	4/28/2008	No

Exemptions and Jurisdictions

Exemption Type	Districts	Jurisdictions	ARB Status	2007 Rate	2008 Rate
None	026	TOMBALL ISD	Supplemental: 02/20/2009	1.275000	1.360000
	040	HARRIS COUNTY	Supplemental: 02/20/2009	0.392390	0.389230
	041	HARRIS CO FLOOD CNTRL	Supplemental: 02/20/2009	0.031060	0.030860
	042	PORT OF HOUSTON AUTHY	Supplemental: 02/20/2009	0.014370	0.017730
	043	HARRIS CO HOSP DIST	Supplemental: 02/20/2009	0.192160	0.192160
	044	HARRIS CO EDUC DEPT	Supplemental: 02/20/2009	0.005853	0.005840
	045	LONE STAR COLLEGE SYS	Supplemental: 02/20/2009	0.114400	0.110100
	083	CITY OF TOMBALL	Supplemental: 02/20/2009	0.251455	0.251455
	679	HC EMERG SERV DIST 8	Supplemental: 02/20/2009	0.030000	0.050000

Valuations

2007 Value			2008 Value		
	Market	Appraised		Market	Appraised
Land	21,600		Land	20,000	
Improvement	0		Improvement	0	
Total	21,600	21,600	Total	20,000	20,000

Land

Market Value Land

Line	Description	Site Code	Unit Type	Units	Size Factor	Site Factor	Appr O/R Factor	Appr O/R Reason	Total Adj	Unit Price	Adj Unit Price	Value
1	1000 -- Res Vacant Table Val	SF5	SF	10,000	1.00	1.00	1.00	--	1.00	1.20	1.20	12,000
2	1000 -- Res Vacant Table Val	SF3	SF	173,610	1.00	0.10	0.46	Frequent Flooding	0.05	1.20	0.06	10,417

Building

Vacant (No Building Data)

Appraised Value History: 1129570000036

Tax Year:	2008	2007	2006	2005	2004
Appraised Value:	$20,000	21,600	21,600	21,600	21,600

(The appraised value shown on this screen may be less than the property's January 1 market value if the property is a residence homestead and is subject to a cap on annual increases in appraised value.)

-close window-

HARRIS COUNTY APPRAISAL DISTRICT
REAL PROPERTY ACCOUNT INFORMATION
1129570000037

Tax Year: 2008

Owner and Property Information			
Owner Name & Mailing Address:	**HILDRETH PETER** **PO BOX 1030** **TOMBALL TX 77377-1030**	Legal Description: Property Address:	**LT 37 BLK 4** **TOMBALL HILLS** **0 CHRIS LN** **TOMBALL TX 77375**

State Class Code	Land Use Code	Land Area	Total Living Area	Neighborhood	Map Facet	Key Map®
C1 -- Real, Vacant Lots/Tracts (In City)	1000 -- Residential Vacant	30,807 SF	0 SF	2550	4772C	248X

Value Status Information

Capped Account	Value Status	Notice Date	Shared CAD
No	Noticed	4/28/2008	No

Exemptions and Jurisdictions

Exemption Type	Districts	Jurisdictions	ARB Status	2007 Rate	2008 Rate
None	026	TOMBALL ISD	Certified: 08/22/2008	1.275000	1.360000
	040	HARRIS COUNTY	Certified: 08/22/2008	0.392390	0.389230
	041	HARRIS CO FLOOD CNTRL	Certified: 08/22/2008	0.031060	0.030860
	042	PORT OF HOUSTON AUTHY	Certified: 08/22/2008	0.014370	0.017730
	043	HARRIS CO HOSP DIST	Certified: 08/22/2008	0.192160	0.192160
	044	HARRIS CO EDUC DEPT	Certified: 08/22/2008	0.005853	0.005840
	045	LONE STAR COLLEGE SYS	Certified: 08/22/2008	0.114400	0.110100
	083	CITY OF TOMBALL	Certified: 08/22/2008	0.251455	0.251455
	679	HC EMERG SERV DIST 8	Certified: 08/22/2008	0.030000	0.050000

Valuations

2007 Value			2008 Value		
	Market	Appraised		Market	Appraised
Land	14,500		Land	14,497	
Improvement	0		Improvement	0	
Total	14,500	14,500	Total	14,497	14,497

Land

Market Value Land												
Line	Description	Site Code	Unit Type	Units	Size Factor	Site Factor	Appr O/R Factor	Appr O/R Reason	Total Adj	Unit Price	Adj Unit Price	Value
1	1000 -- Res Vacant Table Val	SF5	SF	10,000	1.00	1.00	1.00	--	1.00	1.20	1.20	12,000
2	1000 -- Res Vacant Table Val	SF3	SF	20,807	1.00	0.10	1.00	--	0.10	1.20	0.12	2,497

Building

Vacant (No Building Data)

Appraised Value History: 1129570000037

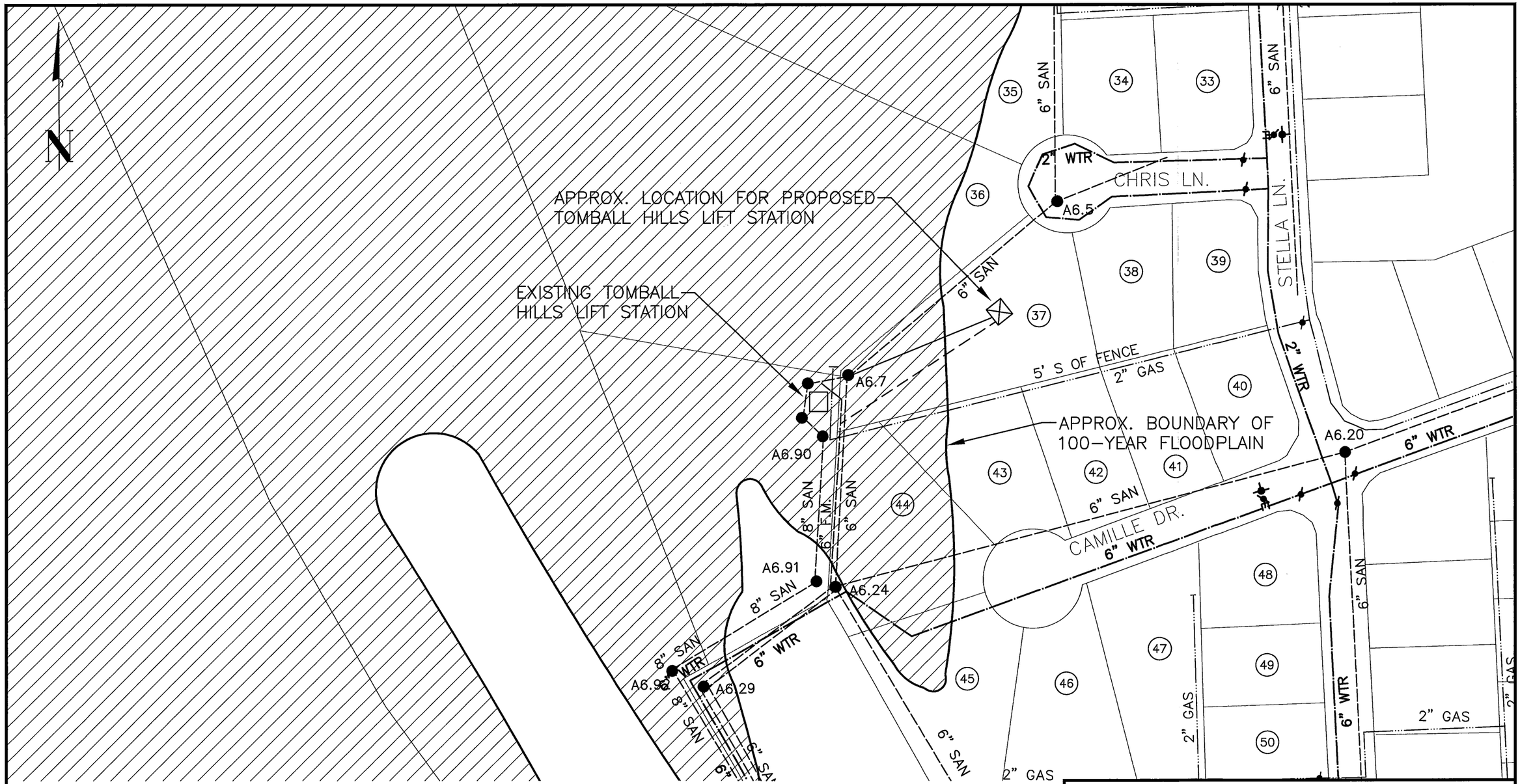
Tax Year:	2008	2007	2006	2005	2004
Appraised Value:	$14,497	14,500	14,500	14,500	14,500

(The appraised value shown on this screen may be less than the property's January 1 market value if the property is a residence homestead and is subject to a cap on annual increases in appraised value.)

-close window-

Exhibit E

Floodplain Map
(Re: FEMA Flood Insurance Rate Map, Map No. 48201C0210L, Published June 18, 2007)



100-YEAR FLOODPLAIN PER REFERENCED FEMA FLOOD INSURANCE RATE MAP (ZONE AE, BASE FLOOD ELEV.=161.70±)

EXHIBIT E
FLOODPLAIN MAP
(RE: FEMA FLOOD INSURANCE RATE MAP, MAP NO. 48201C0210L, PUBLISHED JUNE 18, 2007)

CITY OF TOMBALL
TOMBALL HILLS LIFT STATION
PRELIMINARY ENGINEERING REPORT

O'MALLEY ENGINEERS, LLP
TBPE NO. F-3244
BRENHAM, TEXAS

Scale: 1"=400'	
Project Number: 166.017 MD	
Drawn By: JDG	Date: 3-16-09
Revised:	
Sheet Number:	1 of 1

Exhibit F

Power Outage History

CenterPoint Energy
18018 Huffmeister Road
Cypress, TX 77429-6404

January 29, 2009

O'Malley Engineers L.L.P.
c/o: Tim Robertson
Tomball Hills Lift Station -Tomball, TX 77375

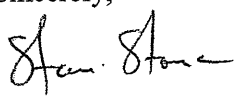
Per your request on January 29, 2009, I have reviewed the outage history for the referenced location listed below for the past twenty-four months.

30702 Tomball Pkwy.
Circuit –TB-44

Date	Time out	Duration	Outage Description
03/12/07	0548	11 minutes	lightning
03/12/07	0606	61 minutes	tree clear
03/14/07	1516	0 minutes	lightning
06/23/07	1611	0 minutes	substation
06/23/07	1807	6 minutes	substation
06/29/07	1450	0 minutes	operation (lightning)
08/24/07	0710	24 minutes	unknown
10/24/07	1340	27 minutes	wind
10/25/07	1014	11 minutes	unknown
10/31/07	1104	6 minutes	unknown
11/04/07	0913	21 minutes	pole top switch
11/15/07	0447	0 minutes	tree clear
11/15/07	0534	0 minutes	tree clear
11/20/07	1520	99 minutes	primary clamp

04/18/08	0455	0 minutes	lightning
06/25/08	1435	0 minutes	lightning
09/13/08	0322	85 hours,55 minutes	hurricane
09/14/08	0334	0 minutes	hurricane
09/17/08	1727	5 minutes	unknown
10/04/08	1114	0 minutes	unknown
10/23/08	1211	0 minutes	unknown
11/12/08	0030	0 minutes	lightning

Sincerely,



Steve Stone
Sr. Service Consultant
CenterPoint Energy
Cypress Service Center
18018 Huffmeister Rd.
Cypress, Texas 77429

Exhibit G

Preliminary Lift Station Calculations, System Curves, and Pump Curves

CITY OF TOMBALL

TOMBALL HILLS LIFT STATION

PRELIMINARY ENGINEERING REPORT

OE JOB NO. 166.017-MD

LIFT STATION CAPACITY CALCULATIONS

Estimate Daily Wastewater Flow From All Sources Except Lone Star College.

No. of Connections (Equivalent) =		180	each
No. of Person Per Connection =		2.7	persons/conn.
Flow Contribution Per Capita =		100	gpcd
Daily Average Flow =	Q_{AVG} =	48,600	gpd
	or Q_{AVG} =	33.75	gpm
	or Q_{AVG} =	0.075	cfs

Assume Peak Factor = 4

Peak Flow = Q_{PEAK} = (Daily Avg Flow) X (Peak Factor)

Q_{PEAK} =	194,400	gpd
Q_{PEAK} =	135	gpm
Q_{PEAK} =	0.301	cfs

Estimate Daily Wastewater Flow From Lone Star College.

The tables below show the historical water use data at Lone Star College for 2004 to 2008, inclusive. The water use data was provided by City Staff and includes Acct. Nos. 16-1520-00, 16-1501-01, and 16-1500-00. No water use data was included from irrigation meters.

Water Use For 2004

Month & Yr	Water Use (gallons)	Approx. Operating Days	Daily Avg (gpd)
Jan-04	161,000	10	16,100
Feb-04	520,000	21	24,762
Mar-04	341,000	16	21,313
Apr-04	498,000	21	23,714
May-04	447,000	21	21,286
Jun-04	773,000	21	36,810
Jul-04	1,179,000	21	56,143
Aug-04	723,000	21	34,429
Sep-04	1,006,000	21	47,905
Oct-04	617,000	21	29,381
Nov-04	789,000	19	41,526
Dec-04	198,000	12	16,500
Yearly Total	7,252,000 gallons		

Water Use In 2005

Month & Yr	Water Use (gallons)	Approx. Operating Days	Daily Avg (gpd)
Jan-05	285,000	10	28,500
Feb-05	531,000	21	25,286
Mar-05	357,000	16	22,313
Apr-05	473,000	21	22,524
May-05	544,000	21	25,905
Jun-05	733,000	21	34,905
Jul-05	626,000	21	29,810
Aug-05	558,000	21	26,571
Sep-05	766,000	21	36,476
Oct-05	754,000	21	35,905
Nov-05	444,000	19	23,368
Dec-05	336,000	12	28,000
Yearly Total	6,407,000 gallons		

Water Use In 2006

Month & Yr	Water Use (gallons)	Approx. Operating Days	Daily Avg (gpd)
Jan-06	270,000	10	27,000
Feb-06	615,000	21	29,286
Mar-06	472,000	16	29,500
Apr-06	659,000	21	31,381
May-06	568,000	21	27,048
Jun-06	509,000	21	24,238
Jul-06	604,000	21	28,762
Aug-06	669,000	21	31,857
Sep-06	639,000	21	30,429
Oct-06	734,000	21	34,952
Nov-06	513,000	19	27,000
Dec-06	326,000	12	27,167
Yearly Total	6,578,000 gallons		

Water Use In 2007

Month & Yr	Water Use (gallons)	Approx. Operating Days	Daily Avg (gpd)
Jan-07	239,000	10	23,900
Feb-07	449,000	21	21,381
Mar-07	451,000	16	28,188
Apr-07	761,000	21	36,238
May-07	634,000	21	30,190
Jun-07	585,000	21	27,857
Jul-07	651,000	21	31,000
Aug-07	570,000	21	27,143
Sep-07	441,000	21	21,000
Oct-07	483,000	21	23,000
Nov-07	298,000	19	15,684
Dec-07	252,000	12	21,000
Yearly Total	5,814,000 gallons		

Water Use In 2007

Month & Yr	Water Use (gallons)	Approx. Operating Days	Daily Avg (gpd)
Jan-08	176,000	10	17,600
Feb-08	333,000	21	15,857
Mar-08	412,000	16	25,750
Apr-08	456,000	21	21,714
May-08	625,000	21	29,762
Jun-08	543,000	21	25,857
Jul-08	743,000	21	35,381
Aug-08	614,000	21	29,238
Sep-08	553,000	21	26,333
Oct-08	585,000	21	27,857
Nov-08	320,000	19	16,842
Dec-08	713,000	12	59,417
Yearly Total	6,073,000 gallons		

Top 3 Months With Highest Daily Average for 2004 to 2008 are as follows:

Dec-08	59,417	gpd
Jul-04	56,143	gpd
Sep-04	47,905	gpd

Recommend using the Daily Average Flow from highest month during 2004 to 2008 time period & allow for additional 50% growth at Lone Star College.

Dec-08 Flow + 50% = Daily Average Flow

Daily Average Flow =		Q_{AVG} =	89,125	gpd
	or	Q_{AVG} =	62	gpm
	or	Q_{AVG} =	0.138	cfs

Assume Peak Factor = 4

Peak Flow = Q_{PEAK} = (Daily Avg Flow) X (Peak Factor)

Q_{PEAK} =	356,500	gpd
Q_{PEAK} =	248	gpm
Q_{PEAK} =	0.552	cfs

Estimated Wastewater Flow From All Sources

Daily Average Flow =		Q_{AVG} =	137,725	gpd
	or	Q_{AVG} =	96	gpm
	or	Q_{AVG} =	0.213	cfs

Peak Flow =		Q_{PEAK} =	550,900	gpd
	or	Q_{PEAK} =	383	gpm
	or	Q_{PEAK} =	0.852	cfs

TCEQ regulations (TAC Chapter 217 - Paragraph 217.61) require that the firm pumping capcity of a lift station be able to handle the expected peak flow. The firm pumping capacity is the pumping capacity of the lift station with the largest pump out of service.

RECOMMENDATIONS:

Based on the above calculations and TCEQ requirements, we recommend a duplex lift station with minimum 383 gpm pumps.

From a review of pump curves, the best pump available for this system will pump 410 gpm. Recommend 410 gpm pumps for this lift station.

Verify That Force Main Velocity Meets TCEQ requirements.

Existing Force Main: 6" ASTM D2241 SDR 26 PVC

Note: Size and type of pipe for force main was not field verified for this report and was obtained from the 1996 plans prepared by Cobourn, Linseisen & Ratcliff for rerouting the force main along Tomball Hills Drive.

I.D. of 6" ASTM 2241 SDR 26 Force Main = 6.115 in = 0.51 ft

Cross-Sectional Area of 6" Force Main = A = 0.204 sq ft

Pump Rate (One Pump) = Q_{PUMP} = 410 gpm = 0.913 cfs

Velocity = V = (Q_{PUMP}) / (A) = 4.5 fps (Exceeds TCEQ requirement of 3.0 fps)

CONCLUSION:

Size of existing 6" force main is acceptable for recommended pumping capacity (single pump) of 410 gpm.

CITY OF TOMBALL
TOMBALL HILLS LIFT STATION
PRELIMINARY ENGINEERING REPORT
OE JOB NO. 166.017-MD

WET WELL CALCULATIONS

Compute Minimum Wet Well Volume Per TCEQ Regulations.

$$V = (T \times Q) / (4 \times 7.48)$$

Where:

V =	Active Volume (cubic feet)
Q =	Pump Capacity (gallons per minute)
T =	Cycle Time (minutes)
7.48 =	Conversion Factor (gallons /cubic ft)

TCEQ Minimum Cycle Time = 6 minutes
(TCEQ Chapter 217, Paragraph 217.60, Pump Horsepower < 50 hp)

Pump Capacity = Q = 410 gpm

Using above equation, the minimum Active Volume can be computed as follows:

V = (6 min X 410 gpm) / (4 X 7.48) = 82.2 cu ft

Inside Diameter of Wet Well = 8 ft
Inside Area of Wet Well = 50.4 sq ft

Determine Active Water Depth.

Active Water Depth is the required vertical distance inside wet well from "pump off" liquid level to "pump on" liquid level to meet TCEQ minimum cycle time. Per TCEQ, the invert elevation of the influent pipe into a wet well must be above the liquid level of the "pump on" setting.

Active Water Depth = (Active Vol) / (Inside Area of Wet Well) = 1.6 ft

Determine Elevation at Bottom of Wet Well.

F.L. Elevation of Influent Pipe into Wet Well =	144	ft (Approximate)
Less Active Water Depth for Min. Cycle Time =	-1.6	ft
Less Water Level Above Bottom of Wet Well =	-2	ft
	140.4	ft

RECOMMENDATIONS (PRELIMINARY):

Elevation at Bottom of Wet Well =	*140*	*ft*
"Pump Off" Liquid Level =	*142*	*ft*
"Pump On" Liquid Level =	*143.6*	*ft*
F.L. Elev. of Influent Pipe =	*144*	*ft*
Top of Wet Well Elevation =	*166*	*ft*
Wet Well Depth =	*26*	*ft*

CITY OF TOMBALL
TOMBALL HILLS LIFT STATION
PRELIMINARY ENGINEERING REPORT
OE JOB NO. 166.017-MD

TRANSPORT TIME FOR PORTABLE GENERATOR

Determine approximate volume that can be stored in lift station & collection system.

Approximate Hydraulic Grade Line (HGL) = 162 ft (+/-)

Storage in Lift Station Wet Well:

Diameter of Wet Well =	8 ft		
Hydraulic Grade Line =	162 ft		
- "Pump Off" Elevation =	142 ft		
Storage In Wet Well =	20 vertical ft		
Storage In Wet Well =	1,005.3 cu ft =		7,520 gallons

Storage in Gravity Collection Lines:

8" Gravity Line

Approx. Length of 8" Gravity Line Below HGL =			1,410 ft (+/-)
X Cross-Sectional Area of 8" Gravity Line =			0.35 sq ft
Approx. Volume in 8" Gravity Lines =			493.5 cu ft
		or	3,691 gallons

6" Gravity Line

Approx. Length of 6" Gravity Line Below HGL =			1,890 ft (+/-)
X Cross-Sectional Area of 6" Gravity Line =			0.20 sq ft
Approx. Volume in 6" Gravity Lines =			378 cu ft
		or	2,827 gallons

Storage in Manholes:

No. of Manholes =	14	each
Approx. Storage Depth =	6	ft in each manhole (+/-)
X Cross-Sectional Area =	12.5	sq ft
Approx. Volume/Manhole =	75	cu ft (+/-)
X No. of Manholes =	14	each
Approx. Total Volume =	1,050	cu ft
or	7,854	gallons

Total Storage (Lines, Manholes & Lift Station):

Total Approx. Storage =	21,893	gallons

Estimate time allowed to transport portable generator.

Total Approx. Storage (All Sources) =	21,893	gallons
Estimated Influent Rate (Peak Flow) =	410	gpm
Approx. Time to Transport Generator =	*53*	*minutes*

SUMMARY:

If the City elects to use portable generator as emergency power for the Tomball Hills Lift Station, personnel will be required to transport the generator to the lift station and get it operational in approximately 53 minutes.

CITY OF TOMBALL

TOMBALL HILLS LIFT STATION

PRELIMINARY ENGINEERING REPORT

OE JOB NO. 166.017-MD

LIFT STATION HEAD CALCULATIONS

PIPE LOSSES:

From Cameron Hydraulic Data Book (p. 3-121), determine equivalent length of fittings & valves:

Station Piping:

Fitting	Equivalent Length (ft)
4" to 6" Englargement	10 ft
6" 90° Bend	16 ft
6" 90° Bend	16 ft
6" Check Valve	40 ft
6" Dresser Coupling (Use Run of Tee)	11 ft
6" Plug Valve	40 ft
6" 90° Bend	16 ft
6" Tee (In Side Outlet)	35 ft
6" 45° Bend	8 ft
6" 45° Bend	8 ft
Equivalent Length of Station Fittings =	200 ft
Plus Length of 6" Station Piping =	30 ft
Total Equivalent Length for Station Pipe & Fittings =	230 ft

Force Main Piping:

Fitting	Equivalent Length (ft)
6" 45° Bend	8 ft
6" 45° Bend	8 ft
6" 45° Bend	8 ft
6" 90° Bend	16 ft
6" 90° Bend	16 ft
6" 45° Bend	8 ft
6" 45° Bend	8 ft
6" 45° Bend	8 ft
Equivalent Length of Force Main Fittings =	80 ft
Plus Length of Force Main Piping	4850 ft
Total Equivalent Length for Force Main Pipe & Fittings =	4930 ft

ELEVATION (STATIC) HEAD:

Top of Lift Station Elevation =		166.00	ft
Lift Station Depth =	312 inches =	26.00	ft
Inside Bottom of Wet Well =		140.00	ft
Plus 2 ft Up to Water Surface =		2.00	ft
Approx. Water Surface Elev =		142.00	ft
High Point of Force Main =		207.00	ft
Approx. Water Surface Elev =		142.00	ft
Elevation (Static) Head =		65.00	ft

NOTE: All elevations. pipe lengths and fittings shown above are approximate and need to be verified during final design.

CITY OF TOMBALL

TOMBALL HILLS LIFT STATION

PRELIMINARY ENGINEERING REPORT
OE JOB NO. 166.017-MD

DESCRIPTION: PRELIMINARY SYSTEM CURVE CALCULATIONS FOR TOMBALL HILLS LIFT STATION

The system curve computations (below) that show the headloss per ft of pipe are based on the Hazen-Williams equation in the form shown on p. 556 of "Hydrology & Hydraulic Systems" by Ram S. Gupta. The general form of the Hazen-Williams equation used is as follows:

$$V = 1.318*C*R^{0.63}*S^{0.54}$$

Where:

V = Velocity in fps = Q/A
C = Hazen-Williams Coefficient
R = Hydraulic Radius in ft = A/P = d/4 for circular pipes
S = Slope of the hydraulic gradient = hf / L = Headloss due to friction per ft of pipe.
d = diameter of pipe (ft)

DATA FOR SYSTEM HEAD CURVE CALCULATION	
Value of C1	100
Value of C2	120
Value of C3	140
Pipe Diameter of Station Piping (in.)	6.115
Pipe Diameter of Force Main Piping (in.)	6.115
Equivalent Length of 6" Station Piping (ft)	230
Equivalent Length of 6" Force Main Piping (ft)	4930
Total Elevation (Static) Head (ft)	65.00

FLOW (GPM)	Total Elev. Head (ft)	6" Station Piping Velocity (fps)	6" FM Piping Velocity (fps)	Head Loss Per Ft of 6" Sta. Piping (C1=100)	Head Loss Per Ft of 6" FM Piping (C1=100)	TDH (ft) C1 = 100	Head Loss Per Ft of 6" Sta. Piping (C2=120)	Head Loss Per Ft of 6" FM Piping (C2=120)	TDH (ft) C2 = 120	Head Loss Per Ft of 6" Sta. Piping (C3=140)	Head Loss Per Ft of 6" FM Piping (C3=140)	TDH (ft) C3 = 140
0	65.00	**0.00**	**0.00**	0.0000	0.0000	**65.00**	0.0000	0.0000	**65.00**	0.0000	0.0000	**65.00**
10	65.00	**0.11**	**0.11**	0.0000	0.0000	**65.11**	0.0000	0.0000	**65.08**	0.0000	0.0000	**65.06**
20	65.00	**0.22**	**0.22**	0.0001	0.0001	**65.41**	0.0001	0.0001	**65.29**	0.0000	0.0000	**65.22**
30	65.00	**0.33**	**0.33**	0.0002	0.0002	**65.87**	0.0001	0.0001	**65.62**	0.0001	0.0001	**65.46**
40	65.00	**0.44**	**0.44**	0.0003	0.0003	**66.47**	0.0002	0.0002	**66.05**	0.0002	0.0002	**65.79**
50	65.00	**0.55**	**0.55**	0.0004	0.0004	**67.23**	0.0003	0.0003	**66.59**	0.0002	0.0002	**66.20**
60	65.00	**0.66**	**0.66**	0.0006	0.0006	**68.12**	0.0004	0.0004	**67.23**	0.0003	0.0003	**66.68**
70	65.00	**0.76**	**0.76**	0.0008	0.0008	**69.15**	0.0006	0.0006	**67.96**	0.0004	0.0004	**67.23**
80	65.00	**0.87**	**0.87**	0.0010	0.0010	**70.31**	0.0007	0.0007	**68.79**	0.0006	0.0006	**67.85**
90	65.00	**0.98**	**0.98**	0.0013	0.0013	**71.61**	0.0009	0.0009	**69.72**	0.0007	0.0007	**68.55**
100	65.00	**1.09**	**1.09**	0.0016	0.0016	**73.03**	0.0011	0.0011	**70.73**	0.0008	0.0008	**69.31**
110	65.00	**1.20**	**1.20**	0.0019	0.0019	**74.58**	0.0013	0.0013	**71.84**	0.0010	0.0010	**70.14**
120	65.00	**1.31**	**1.31**	0.0022	0.0022	**76.25**	0.0016	0.0016	**73.03**	0.0012	0.0012	**71.04**
130	65.00	**1.42**	**1.42**	0.0025	0.0025	**78.05**	0.0018	0.0018	**74.31**	0.0014	0.0014	**72.00**
140	65.00	**1.53**	**1.53**	0.0029	0.0029	**79.97**	0.0021	0.0021	**75.68**	0.0016	0.0016	**73.03**
150	65.00	**1.64**	**1.64**	0.0033	0.0033	**82.00**	0.0024	0.0024	**77.14**	0.0018	0.0018	**74.12**
160	65.00	**1.75**	**1.75**	0.0037	0.0037	**84.16**	0.0027	0.0027	**78.67**	0.0020	0.0020	**75.28**
170	65.00	**1.86**	**1.86**	0.0042	0.0042	**86.43**	0.0030	0.0030	**80.30**	0.0022	0.0022	**76.50**
180	65.00	**1.97**	**1.97**	0.0046	0.0046	**88.83**	0.0033	0.0033	**82.00**	0.0025	0.0025	**77.78**
190	65.00	**2.08**	**2.08**	0.0051	0.0051	**91.33**	0.0036	0.0036	**83.79**	0.0027	0.0027	**79.13**
200	65.00	**2.18**	**2.18**	0.0056	0.0056	**93.95**	0.0040	0.0040	**85.66**	0.0030	0.0030	**80.54**
210	65.00	**2.29**	**2.29**	0.0061	0.0061	**96.69**	0.0044	0.0044	**87.62**	0.0033	0.0033	**82.00**
220	65.00	**2.40**	**2.40**	0.0067	0.0067	**99.54**	0.0048	0.0048	**89.65**	0.0036	0.0036	**83.53**
230	65.00	**2.51**	**2.51**	0.0073	0.0073	**102.50**	0.0052	0.0052	**91.76**	0.0039	0.0039	**85.12**
240	65.00	**2.62**	**2.62**	0.0079	0.0079	**105.57**	0.0056	0.0056	**93.95**	0.0042	0.0042	**86.77**
250	65.00	**2.73**	**2.73**	0.0085	0.0085	**108.75**	0.0061	0.0061	**96.22**	0.0045	0.0045	**88.48**
260	65.00	**2.84**	**2.84**	0.0091	0.0091	**112.04**	0.0065	0.0065	**98.57**	0.0049	0.0049	**90.24**
270	65.00	**2.95**	**2.95**	0.0098	0.0098	**115.44**	0.0070	0.0070	**101.00**	0.0052	0.0052	**92.07**
280	65.00	**3.06**	**3.06**	0.0105	0.0105	**118.95**	0.0075	0.0075	**103.51**	0.0056	0.0056	**93.95**
290	65.00	**3.17**	**3.17**	0.0112	0.0112	**122.57**	0.0080	0.0080	**106.09**	0.0060	0.0060	**95.89**
300	65.00	**3.28**	**3.28**	0.0119	0.0119	**126.30**	0.0085	0.0085	**108.75**	0.0064	0.0064	**97.89**
310	65.00	**3.39**	**3.39**	0.0126	0.0126	**130.13**	0.0090	0.0090	**111.49**	0.0068	0.0068	**99.95**
320	65.00	**3.50**	**3.50**	0.0134	0.0134	**134.07**	0.0096	0.0096	**114.30**	0.0072	0.0072	**102.07**
330	65.00	**3.61**	**3.61**	0.0142	0.0142	**138.12**	0.0101	0.0101	**117.18**	0.0076	0.0076	**104.24**
340	65.00	**3.71**	**3.71**	0.0150	0.0150	**142.27**	0.0107	0.0107	**120.15**	0.0080	0.0080	**106.46**
350	65.00	**3.82**	**3.82**	0.0158	0.0158	**146.53**	0.0113	0.0113	**123.19**	0.0085	0.0085	**108.75**
360	65.00	**3.93**	**3.93**	0.0166	0.0166	**150.89**	0.0119	0.0119	**126.30**	0.0089	0.0089	**111.09**
370	65.00	**4.04**	**4.04**	0.0175	0.0175	**155.36**	0.0125	0.0125	**129.49**	0.0094	0.0094	**113.49**

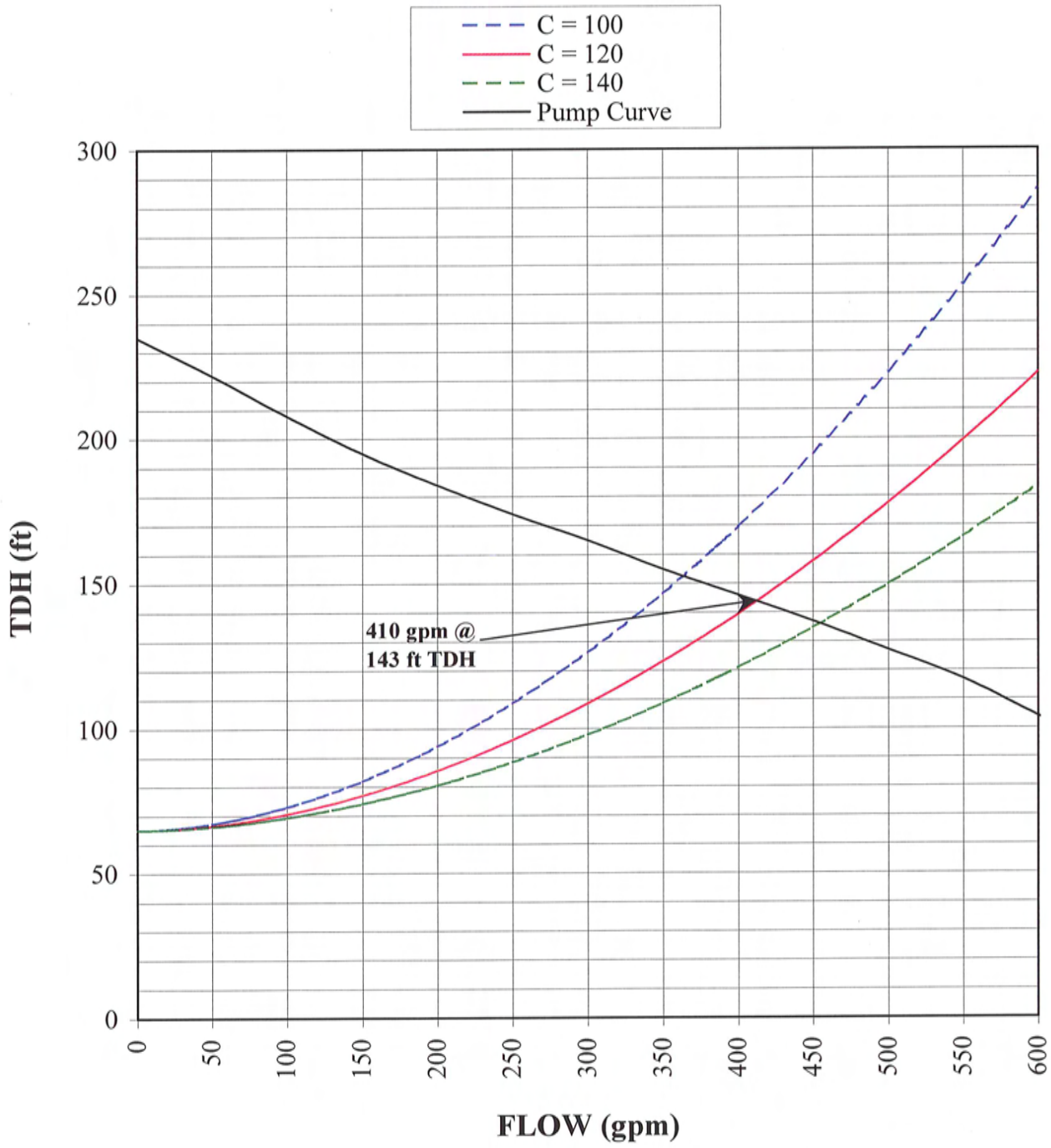
FLOW (GPM)	Total Elev. Head (ft)	6" Station Piping Velocity (fps)	6" FM Piping Velocity (fps)	Head Loss Per Ft of 6" Sta. Piping (C1=100)	Head Loss Per Ft of 6" FM Piping (C1=100)	TDH (ft) C1 = 100	Head Loss Per Ft of 6" Sta. Piping (C2=120)	Head Loss Per Ft of 6" FM Piping (C2=120)	TDH (ft) C2 = 120	Head Loss Per Ft of 6" Sta. Piping (C3=140)	Head Loss Per Ft of 6" FM Piping (C3=140)	TDH (ft) C3 = 140
380	65.00	**4.15**	**4.15**	0.0184	0.0184	**159.92**	0.0131	0.0131	**132.75**	0.0099	0.0099	**115.94**
385	65.00	**4.21**	**4.21**	0.0188	0.0188	**162.25**	0.0135	0.0135	**134.41**	0.0101	0.0101	**117.18**
390	65.00	**4.26**	**4.26**	0.0193	0.0193	**164.60**	0.0138	0.0138	**136.08**	0.0104	0.0104	**118.45**
400	65.00	**4.37**	**4.37**	0.0202	0.0202	**169.37**	0.0144	0.0144	**139.49**	0.0109	0.0109	**121.01**
410	65.00	**4.48**	**4.48**	0.0212	0.0212	**174.25**	0.0151	0.0151	**142.97**	0.0114	0.0114	**123.63**
420	65.00	**4.59**	**4.59**	0.0221	0.0221	**179.23**	0.0158	0.0158	**146.53**	0.0119	0.0119	**126.30**
430	65.00	**4.70**	**4.70**	0.0231	0.0231	**184.32**	0.0165	0.0165	**150.16**	0.0124	0.0124	**129.03**
440	65.00	**4.81**	**4.81**	0.0241	0.0241	**189.50**	0.0172	0.0172	**153.86**	0.0129	0.0129	**131.81**
450	65.00	**4.92**	**4.92**	0.0252	0.0252	**194.78**	0.0180	0.0180	**157.63**	0.0135	0.0135	**134.64**
460	65.00	**5.03**	**5.03**	0.0262	0.0262	**200.17**	0.0187	0.0187	**161.47**	0.0141	0.0141	**137.53**
470	65.00	**5.13**	**5.13**	0.0273	0.0273	**205.66**	0.0195	0.0195	**165.39**	0.0146	0.0146	**140.48**
480	65.00	**5.24**	**5.24**	0.0283	0.0283	**211.24**	0.0202	0.0202	**169.37**	0.0152	0.0152	**143.48**
490	65.00	**5.35**	**5.35**	0.0294	0.0294	**216.93**	0.0210	0.0210	**173.43**	0.0158	0.0158	**146.53**
500	65.00	**5.46**	**5.46**	0.0306	0.0306	**222.72**	0.0218	0.0218	**177.56**	0.0164	0.0164	**149.63**
510	65.00	**5.57**	**5.57**	0.0317	0.0317	**228.60**	0.0226	0.0226	**181.76**	0.0170	0.0170	**152.79**
520	65.00	**5.68**	**5.68**	0.0329	0.0329	**234.58**	0.0235	0.0235	**186.03**	0.0176	0.0176	**156.00**
530	65.00	**5.79**	**5.79**	0.0340	0.0340	**240.67**	0.0243	0.0243	**190.37**	0.0183	0.0183	**159.27**
540	65.00	**5.90**	**5.90**	0.0352	0.0352	**246.85**	0.0252	0.0252	**194.78**	0.0189	0.0189	**162.58**
550	65.00	**6.01**	**6.01**	0.0365	0.0365	**253.13**	0.0260	0.0260	**199.27**	0.0196	0.0196	**165.95**
560	65.00	**6.12**	**6.12**	0.0377	0.0377	**259.50**	0.0269	0.0269	**203.82**	0.0202	0.0202	**169.37**
570	65.00	**6.23**	**6.23**	0.0389	0.0389	**265.98**	0.0278	0.0278	**208.44**	0.0209	0.0209	**172.85**
580	65.00	**6.34**	**6.34**	0.0402	0.0402	**272.55**	0.0287	0.0287	**213.13**	0.0216	0.0216	**176.37**
590	65.00	**6.45**	**6.45**	0.0415	0.0415	**279.22**	0.0296	0.0296	**217.89**	0.0223	0.0223	**179.95**
600	65.00	**6.55**	**6.55**	0.0428	0.0428	**285.98**	0.0306	0.0306	**222.72**	0.0230	0.0230	**183.58**

PRELIMINARY DESIGN CONDITIONS FOR ONE PUMP RUNNING:

410 GPM @ 143-FT T.D.H. (C2 = 120)

Note: Graph of system curves for C1, C2 and C3 is shown on the next page with the pump performance curve superimposed on the graph.

PRELIMINARY SYSTEM & PUMP CURVES FOR TOMBALL HILLS LIFT STATION



PERFORMANCE CURVE

PRODUCT	TYPE
NP3171.185	SH

DATE	PROJECT	CURVE NO	ISSUE
2009-03-16		63-277-00-1070	1

	1/1-LOAD	3/4-LOAD	1/2-LOAD
POWER FACTOR	0.92	0.91	0.86
EFFICIENCY	90.5 %	91.5 %	92.0 %
MOTOR DATA	---	---	---

RATED POWER	35	hp
STARTING CURRENT ...	---	
RATED CURRENT ...	39	A
RATED SPEED	3520	rpm
TOT.MOM.OF INERTIA ...	0.071	kgm2
NO. OF BLADES	2	

IMPELLER DIAMETER: 180 mm

MOTOR #	STATOR	REV
25-18-2AA	01D	10

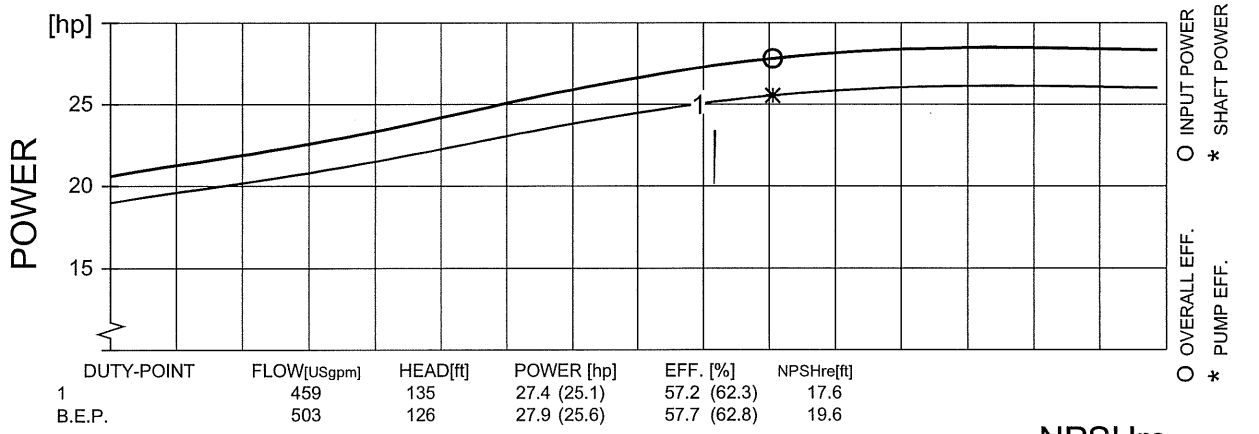
FREQ.	PHASES	VOLTAGE	POLES
60 Hz	3	460 V	2

GEARTYPE	RATIO
---	---

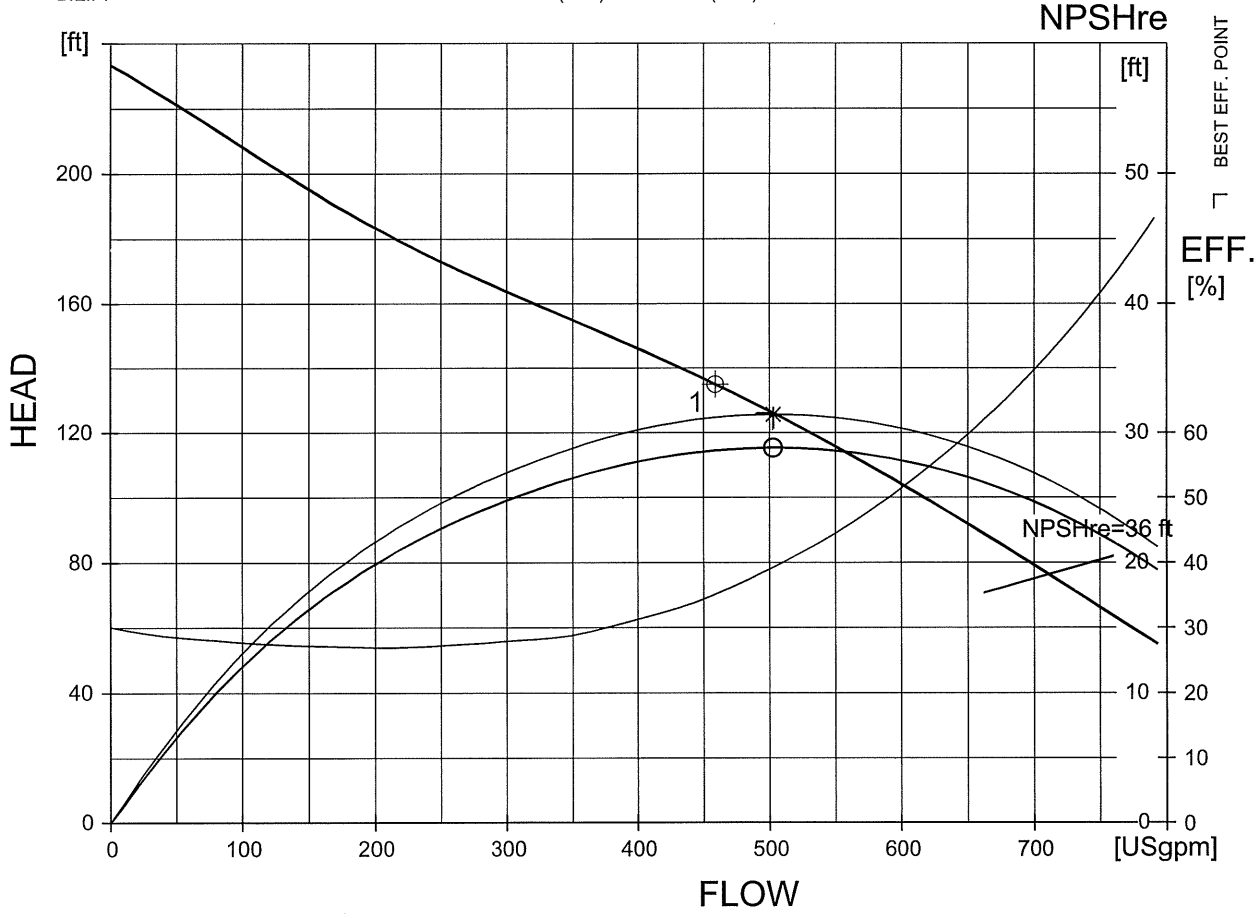
COMMENTS

INLET/OUTLET: -/ 4 inch

IMP. THROUGHLET: ---



DUTY-POINT	FLOW[USgpm]	HEAD[ft]	POWER [hp]	EFF. [%]	NPSHre[ft]
1	459	135	27.4 (25.1)	57.2 (62.3)	17.6
B.E.P.	503	126	27.9 (25.6)	57.7 (62.8)	19.6



NPSHre = NPSH3% + min. operational margin

Performance with clear water and ambient temp 40 °C

HI B Curve

FLYPS3.1.6.3 (20060531)

Exhibit H

Preliminary Site Plan for New Lift Station

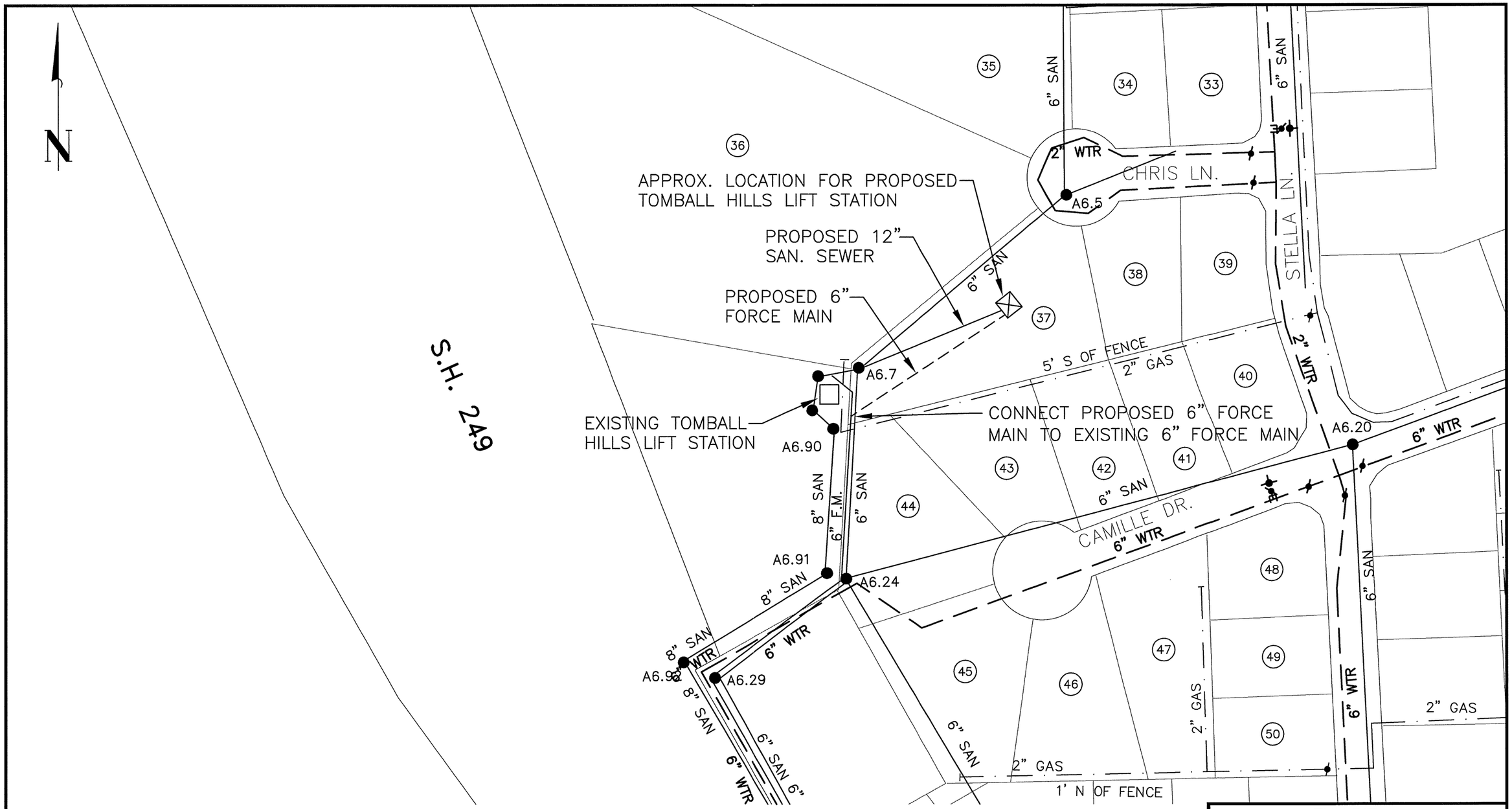


EXHIBIT H
PRELIMINARY SITE PLAN
FOR NEW LIFT STATION

CITY OF TOMBALL
TOMBALL HILLS LIFT STATION
PRELIMINARY ENGINEERING REPORT

O'MALLEY ENGINEERS, LLP
TBPE NO. F-3244
BRENHAM, TEXAS

Scale: 1"=100'	
Project Number: 166.017 MD	
Drawn By: JDG	Date: 3-17-09
Revised:	
Sheet Number:	1 of 1

Exhibit I

Photographs
(Existing Lift Station, New Lift Station Site & Aerial)

CITY OF TOMBALL
TOMBALL HILLS LIFT STATION
PRELIMINARY ENGINEERING REPORT

AERIAL PHOTOGRAPH

O'MALLEY ENGINEERS, LLP
TBPE NO. F-3244
BRENHAM, TEXAS

Scale: 1"=100'	
Project Number: 166.017 MD	
Drawn By: JDG	Date: 3-17-09
Revised:	
Sheet Number:	1 of 1

EXISTING TOMBALL HILLS LIFT STATION

EXISTING TOMBALL HILLS LIFT STATION

EXISTING TOMBALL HILLS LIFT STATION &
WESTERN PORTION OF LOT 37 IN TOMBALL HILLS ADDITION

FLOOPLAIN AREA NORTH OF EXISTING TOMBALL HILLS LIFT STATION

RECOMMENDED LOCATION FOR NEW LIFT STATION ON LOT 37, TOMBALL HILLS ADDITION

Exhibit J

Opinion of Probable Construction Cost
(Options A, B and C)

CITY OF TOMBALL

TOMBALL HILLS LIFT STATION

PRELIMINARY ENGINEERING REPORT

OE JOB NO. 166.017-MD

OPTION A - NEW LIFT STATION EQUIPPED TO CONNECT PORTABLE GENERATOR

PROBABLE CONSTRUCTION COST

Description	Probable Cost
New Lift Station (Features: 2 ea - 35 hp submersible pumps, concrete wet well, ductile iron station piping, valves, control panel, chain link fencing, concrete access drive, site grading and connection for portable generator)	$220,000.00
Force Main Piping to Connect New Lift Station to Existing 6" Force Main	$15,000.00
Raising Existing Manholes Above Floodplain and Installation of Gravity Sanitary Sewer Lines (Including New Manholes) to Connect Existing Collection System to New Lift Station	$25,000.00
Demolition of Existing Lift Station	$12,500.00
SUBTOTAL	$272,500.00
Plus Contingencies	$27,250.00
PROBABLE CONSTRUCTION COST	**$299,750.00**

*Note: If this option is selected, the City must meet TCEQ regulations for using a portable generator for emergency power (TAC Chapter 217, Paragraph 217.63). Preliminary size of portable generator required for this lift station is 100 kW.

CITY OF TOMBALL

TOMBALL HILLS LIFT STATION

PRELIMINARY ENGINEERING REPORT

OE JOB NO. 166.017-MD

OPTION B - NEW LIFT STATION WITH ONSITE GENERATOR (NATURAL GAS)

PROBABLE CONSTRUCTION COST

Description	Probable Cost
New Lift Station (Features: 2 ea - 35 hp submersible pumps, concrete wet well, ductile iron station piping, valves, control panel, chain link fencing, concrete access drive, and site grading)	$220,000.00
Force Main Piping to Connect New Lift Station to Existing 6" Force Main	$15,000.00
Raising Existing Manholes Above Floodplain and Installation of Gravity Sanitary Sewer Lines (Including New Manholes) to Connect Existing Collection System to New Lift Station	$25,000.00
Demolition of Existing Lift Station	$12,500.00
150 kW Emergency Generator (Natural Gas) with Sound Enclosure & 260 Amp Automatic Transfer Switch	$115,000.00
SUBTOTAL	$387,500.00
Plus Contingencies	$38,750.00
PROBABLE CONSTRUCTION COST	**$426,250.00**

CITY OF TOMBALL

TOMBALL HILLS LIFT STATION

PRELIMINARY ENGINEERING REPORT

OE JOB NO. 166.017-MD

OPTION C - NEW LIFT STATION WITH ONSITE GENERATOR (DIESEL)

PROBABLE CONSTRUCTION COST

Description	Probable Cost
New Lift Station (Features: 2 ea - 35 hp submersible pumps, concrete wet well, ductile iron station piping, valves, control panel, chain link fencing, concrete access drive, and site grading)	$220,000.00
Force Main Piping to Connect New Lift Station to Existing 6" Force Main	$15,000.00
Raising Existing Manholes Above Floodplain and Installation of Gravity Sanitary Sewer Lines (Including New Manholes) to Connect Existing Collection System to New Lift Station	$25,000.00
Demolition of Existing Lift Station	$12,500.00
100 kW Emergency Generator (Diesel) with Sound Enclosure, 24-Hour Fuel Tank & 225 Amp Automatic Transfer Switch	$90,000.00
SUBTOTAL	$362,500.00
Plus Contingencies	$36,250.00
PROBABLE CONSTRUCTION COST	**$398,750.00**